بسم الله الرحمن الرحيم

Sudan University of Science and Technology

College of Graduate Studies

Study of the Causes of Deforestation in kunduwa Forest at Nyala Locality, South Darfur State, Sudan

دراسة اسباب ازالة غابة كندوة محلية نيالا- ولاية جنوب دارفور- السودان

A Dissertation Submitted in Partial Fulfillment of the Requirements for the Degree of M.Sc. in Environmental Forestry

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الاستهلال

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قال تعالى:

الَّذِي جَعَلَ لَكُم مِّنَ الشَّجَرِ الْأَخْضَرِ نَارًا فَإِذَا أَنتُم مِّنْهُ تُوقِدُونَ ﴿٨٠﴾

صدق الله العظيم

سورة يس الآية ٨٠

Dedication

This work is dedicated to my parents and my husband who encourages me to continue my education during this life .Also I would like to dedicate it to Prof .Dr. Mohamed AbdoDesougiand to my son Mohamed.

Acknowledgement

Thanks to Allah the Greatest who helped me to do this work

I would also like to thank my supervisor Professor Dr. Mohamed AbdoDesougi for his continued attention, encouragement and advice throughout my work. I would also like to thank Dr .Mahgoup Suliman for his help and advice. I would also like to thank my colleagues and friends in FNC at Nyala office and library, for their help and cooperation. I would also like to extend my thanks to Miss FatheyaNorian and ZinabAdam who helped me, Last and not least I would also like to thank my dear husband who encouraged me and for his appreciation and respect.

Abstract:

This study was conducted at kunduwa forest, Nyala locality, South Darfur State during the year2017. The objective of this study was to know the causes of deforestation at kunduwa forest .Data were collected from previous studies, references a socio economic study using a questionnaire and official and unofficial meetings. This study showed that education level is low at the study area and also it is found that environmental awareness is low. The study also showed that income is mainly from agriculture.

Also the study showed that the types of trees found there were *Azadirachtaindica, Khayasenegalensisand Eucalyptusmicorotheca*. These were the most important timber species found at the study area. Leaves, roots and fruits are the main tree parts used in medicine or as fodderandalso in industry field. Kunduwa forest creates good environment for animal's and acts as a source of fodder for them .The study also revealed that the forest had been used for recreation. This study also showed that other activities at the study area were farming and grazing, and the main tree species consumed during summer were*Acacia Oerfota* and *Acacia mellifera*. Animals found at the study area were mainly cows, sheep and goats and the study showed that damage was caused by them .Also this study showed that income source was during drought and summer was through grass selling. The study revealed that there were conflicts between farmers and pasturalists. This study also showed that energy source was from firewood and charcoal. Kunduwa forest was well stocked before refugee's settlement. The study also showed that people participation in extension work was low. It also revealed that there was legislation for forest protection though they are

suitable for that purpose, but they were not applied effectively. The study recommended that adequate fund should be made available to rehabilitate the destructed forest .Kalma camp of refugees should be shifted far away from the forest. This is in addition to provision of security services so as to implement the extension and plantation programs.

خلاصة البحث:

أجريت هذه الدراسة فى غابة كندوة فى محلية نيالا ولاية جنوب دار فور في الفترة 2017م , هدفت الدراسة لمعرفة الأسباب التى أدت الي ازالة الأشجار في غابة كندوة. تم جمع البيانات في هدا البحث من الدراسات السابقة والمراجع وتم عمل استبيان للدراسة الاقتصادية الاجتماعية لسكان منطقة الدراسة و أجريت مقابلات رسمية وغير رسمية.

وأوضحت هذه الدراسة انخفاض فى مستوى التعليم و انخفاض الوعي البيئ في منطقة الدراسة . وأظهرت الدراسة ان الزراعة هي مصدر الدخل الأساسي في منطقة الدراسة, وأوضحت ايضا ان أكثر الانواع الشجرية الموجودة في منطقة الدراسة هي النيم والمهوقني والبان. كما أوضحت الدراسة ان أكثر الأجزاء الشجرية المستخدمة في الاستخدامات الطبية وكاعلاف في المنطقة هي الأوراق والجذور والثمار.كانت غابة كندوة مأوي للحيوانات ومصدر غدائها ومكان للاستجمام والترفيه لسكان المنطقة.وكما أوضحت الدراسة ان الأنشطة الأساسية الممارسة في منطقة الدراسة هي الزراعة والرعي .وأوضحت ايضا ان الأشجار الأساسية المستهلكة خلال فصل الصيف هي الكتر واللعوت والحيوانات الأليفةالموجودة في منطقة الدراسة هي الأبقار ثم الأغنام والماعز وأوضحت الدراسة ان تربية هذه الحيوانات داخل الغابة تسببت في الكثير من الدمار .كما كشفت الدراسة ان مصدر الدخل لسكان منطقة الدراسة خلال الجفاف والصيف هو بيع الحشائش . وكشفت الدراسة أيضا ان هنالك صراعات في منطقة الدراسة بين المزارعين والرعاة .

كشفت الدراسة أيضا ان مصدر الطاقة الأساسي في منطقة الدراسة هو حطب الحريق والفحم كما أوضحت أيضا ان غابة كندوة كانت كثيفة بالأشجار قبل استيطان النازحين بالقرب منها.كما أوضحت الدراسة ان مشاركة السكان في العمل الارشادي ضعيف وأوضحت ان هنالك تشريعات لحماية الغابة وهي مناسبة لهذا الغرض لكن لم يتم تطبيقها بفعالية.

أوصت الدراسة برفع المستوي التعليمي والوعي البيئ للسكان في منطقة الدراسة وأوصت الدراسة ايضا بتوفير الدعم المادي وتوفير الأمن في منطقة الدراسة وابعاد معسكر النازحين لمسافة بعيدة من الغابة.

Research contents

Abbreviations

FN C Forest National Corporation

FAOFoodand Agricultural Organization

UVUltraviolet

NASANational American Space Agency

EPAEnvironmental Protection Agency

WWFWorld WildlifeFund

Chapter One

1.1 Introduction:-

Our forests provide us with a range of benefits, many of which can be tapped by engaging in sustainable practices while protecting the natural existence of the forest environment. Forests are vital to the survival of biodiversity. The forests alone are home to millions of species; many of them have not yet been discovered and studied. Its rich variety of life forms offers humanity great value in terms of foods, medicine, research, knowledge and tourism. More than half of the world's estimated 10 million species of plants, animals and insects live in the rainforests. The main cause of forest degradation is selective logging of commercially valuable trees. This has caused severe damage to many forests, especially in South Darfur where the density of commercially valuable timber species is high such as *khayasenegalensis, Cordiaafricana*, *Sclerocaeryabirrea, Pseudocedrelakotschyii*. The deforestation of trees not only lessens the amount of carbon stored, it also releases carbon dioxide into the air. This is because when trees die, they release the stored carbon. According to the 2010 Global Forest Resources Assessment, deforestation releases nearly a billion tons of carbon into the atmosphere per year, though the numbers are not as high as the ones recorded in the previous decade. Deforestation is the second largest anthropogenic (human-caused) source of carbon dioxide to the atmosphere, ranging between 6 percent and 17 percent. (Werf, 2009)

Carbon isn't the only greenhouse gas that is affected by deforestation. Water vapor is also considered a greenhouse gas. "The impact of deforestation on the exchange of water vapor and carbon dioxide between the atmosphere and the terrestrial land surface is the biggest concern with

regard to the climate system. Changes in their atmospheric concentration will have a direct effect on climate.

Deforestation has decreased global vapor flows from land by 4 percent, according to a study published by the (National Academy of Sciences(,2017). Even this slight change in vapor flows can disrupt natural weather patterns and change current climate models.

New settlements, roads and farming springing up in many in forest area places surely add to the problem we face with deforestation today. As roads are constructed to access remote areas in these forests, they act as a magnet for new settlements.

Once people begin to settle too close to forests areas, they begin to rely on the resources of that forest to for their needs in their daily life. Another cause of deforestation may be the poorly implemented environmental regulations that encourage land owners to covert forest lands to agricultural farms, without any regard to authority and laws.

The adverse impact ofDeforestation permanently is the destroying valuable plant and wildlife species within a forest. Deforestation can impact heavily on small communities who are depending on forests as a source of emergency income and food during famine or economic hardship. Hundreds of millions of people in developing countries depend on forests for their livelihood. About 12 million hectares of natural forest are lost in the tropics every year, either through the permanent destruction of forests or through their degradation and deforestation .This study is aboud deforestation in kunduwa forest. It will be conducted at Nyala locality south Darfurstate. Excessive clearing or thinning of forests can destabilize the area climate by releasing into the atmosphere millions of tons of greenhouse gasses normally stored in wood in the form of carbon.

This can damage the atmosphere and lead to global warming and eventually climate change. By storing carbon, forests provide a major environmental benefit by reducing global warming.

Since 2005, about half of the forests have been destroyed in the area. Animals and living things have been endangered. Despite the improvements in education, information and general awareness of the importance of forests, deforestation has not been reduced much, and there are still many more communities and individuals who are to the still destroying forest land for personal gains. Other causes of contemporary deforestation may include corruption of government institution(-Burgonio 2008), the inequitable distribution of wealth, power, population growth,overpopulation, displacement andurbanization. Globalization is often viewed as another root cause of deforestation.

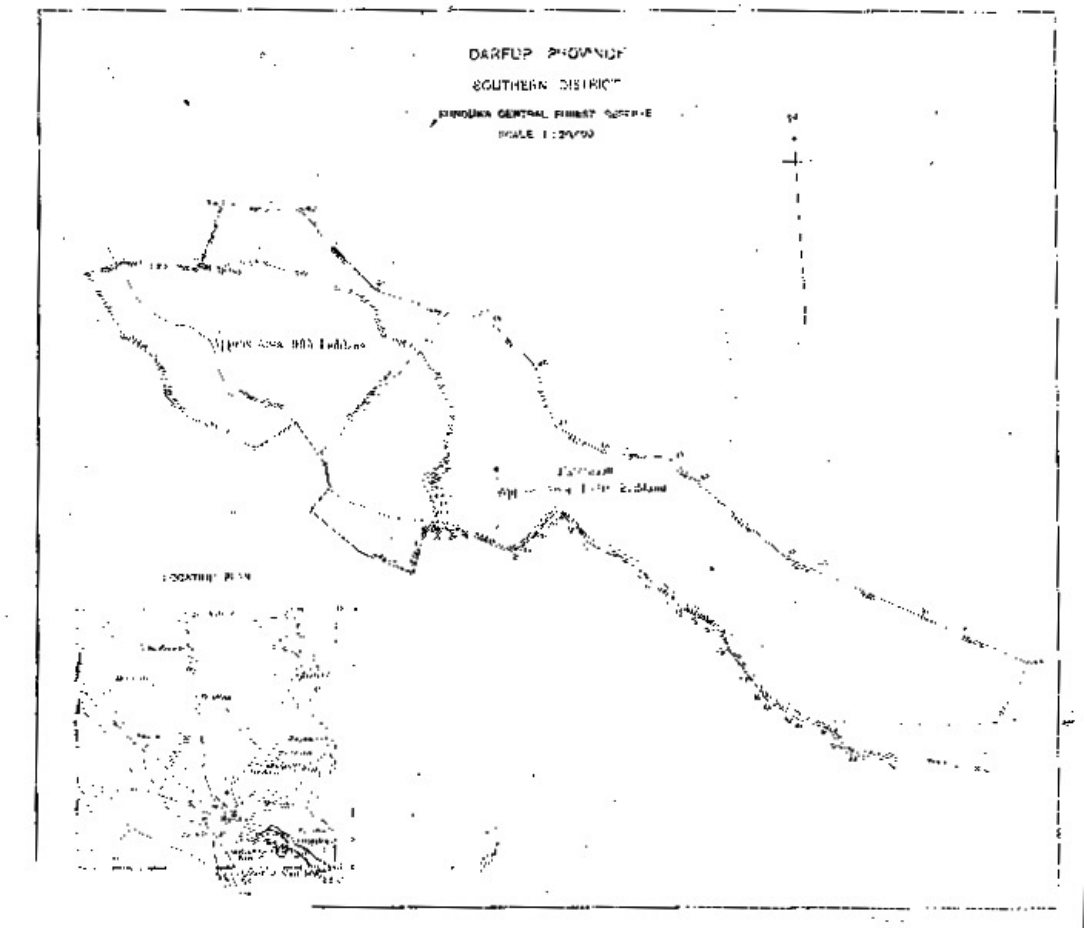
Deforestation is the permanent destruction of forests and woodlands. An issue high on the global environmental agenda for many years, deforestation remains a serious problem today. In the tropics and many other parts of the world, nations continue to lose their natural forests along with valuable biodiversity, soil and water conservation, and climate regulation these ecosystems provide.

Over the past 30 years, the world has lost fully a fifth of all tropical forest cover. While deforestation has stabilized in most developed countries, only a fraction of primary temperate forests still stand. A more pressing issue in these countries today is the condition of the remaining forests. Even though virtually none of their primary forests remain, developed nations continue to allow their commercial exploitation. Meanwhile, pollution and fragmentation endanger ecosystems throughout much of the developed world *(*Burgonio, 2008*)* . .

1.2 Location of the study area (Kunduwaforest)

Are Located in the southern direction east of the city of Nyala and onlfive kilometersaparts from it.

Kunduwa forest is bordered to the north by the railway and on the east by Blail locality , on the south by Al salam locality and in the middle of it is Burley valley, The forest area is 3299 acres



1.3 The Technical plan for Kunduwa forest:

Reforestation of kunduwa forest started in part of the forest in 2005,and it was stopped in the year 2014 because of removal of the recent plantation and then it was resumed in mid 2016 and continued until now. The annual program for reforestation was executed by farmers using taungya system .Also sporadic plantation was done .The previous year's plantation ages were about (2 to1 2 years). During the year 2017 fifty acres were planted with Mahogany trees. (FNC, Nyala, 2017).

1.4 The problem:-

Deforestation: Deforestation occurs for multiple reasons: trees are cut down to be used or sold as fuel (sometimes in the form of charcoal) or timber, while cleared land is used as pasture for livestock and as farms for grazing crops. The removal of trees without sufficient substitution has resulted in a severe damage environment, biodiversity loss and aridity. It has adverse impacts of atmospheric carbon dioxide.*(* Kauppi,2006).In spite of the improvements in education, information flow and general awareness of the importance of forests, deforestation has increased and there are still many more communities and individuals who are still destroying forest land for personal gain .One of the main causes of desertification is the selective felling of commercially valuable trees. This has resulted severe damage to many of South Darfur forests, especially in Nyala locality where the density of commercially valuable timber species is high, e.g.Kunduwa Forest. Deforestation can impact heavily on small communities who are dependent on forests as a source of emergency income and food during famine or economic hardship (.FNC, Nyala, 2017).

1.5 Objectives:

- To study some of the important causes of deforestation in Kunduwaforest.

-To investigate land degradation problems and ways of possible means of land reclamation.

-To study the means and ways of restoration ofKunduwaForest

Chapter Two

Literature Review

2.1 Definition Deforestation:

Deforestation: is when humans remove or clear large areas of forest lands and related ecosystems for non-forest use. These include clearing for farming purposes, ranching and urban use. In these cases, trees are never re-planted. SAFnetDictionary|Definition For [deforestation]. (2008-07-29).

Deforestation has thus many causes. Population pressures, profits, and internal social and political forces can also all push up the rate of forest loss. Generally the removal or destruction of significant areas of forest cover has resulted in a degraded environment with reduced biodiversity.

Deforestation includes not only the conversion to non-forest, but also degradation that reduces forest quality, the density and structure of the trees, the ecological services supplied, the biomass of plants and animals, the species diversity and the genetic diversity.

Deforestation results from removal of trees without sufficient reforestation and usually results in a significant loss of biodiversityGrubbler, 1990).(

2.2 Deforestation: Impact, Causes and Facts

2. 2.1 Benefits of forests

Earth without forests is a picture that most of humankind presently could not conceive. Forests cover much of the planet's land area. They are extremely important to humans and the natural world. For humans they have many aesthetic, recreational, economic, historical, cultural and religious values. Timber and other products of forests are important economically both locally and as exports. They provide employment for

those who harvest the wood or products of the living forest. Herbalists, rubber tappers, hunters and collectors of fungi, nuts, bamboo and berries are able to utilize such resources. Other non-wood forest products come in the form of medicinal compounds, dyes gums, fodder, food and fabrics. There are many people who are dependent on forestland for their livelihoods. One-third of the world's people depend on wood for fuel as a significant energy source (Dudley, 1995). Surveys in Cameroon, Cote d'Ivoire, Ghana and Liberia found that forest wildlife accounted for 70 to 90% of the total animal protein consumed (FAO, 1993). Some indigenous peoples are completely dependent on forests. As well as providing a home for some people, the forest environment provides a popular setting for eco-tourism, which includescamping, bird watching and other outdoor adventure or nature study activities.

2.2.3 Protection role from Natural Disasters

Trees protect the soil against erosion, and reduce the risk for landslides and avalanches. They may increase the rate that rainwater recharges groundwater, as well as control the rate that water is released in watersheds (FAO, 1993). They help to sustain freshwater supplies and therefore are an important factor in the availability of water, one of life's basic needs. When rain falls, some may sink to the ground, some may run off the surface of the land, and flow toward the rivers and some may evaporate. Running water is a major cause of soil erosion. During heavy rains, flooding may occurs, filling the waterways with eroded soil. The silt clogs these waterways, cutting off water sources for plants and animals during the dry season. Silt may also fill reservoirs created by dams, reducing its ability and future capacity to generate hydroelectricity and provide irrigation (McCroy, collen. 1997). The removal of forests causes nutrient loss in the soil especially if the period between harvests isn't long enough.

2.2.4 Purification of the Air

Forests affect the climate and are an important source of oxygen (O_2), although they play a lesser role than once thought. Rain forests serve as an important filter for carbon dioxide (CO_2), a greenhouse gas that contributes to global warming. The Amazon region alone stores at least 75 billion tons of carbon (C) in its trees. When stripped of its trees, rainforest land soon becomes useless and inhospitable because the soil lacks the nutrients to support any kind of agriculture. Regeneration of a tropical rainforest may not be possible or, when it can occur, it may take hundreds of years (Anderson, 1990).

Research continually reveals that trees benefit urban communities in a number of ways. First with respect to air quality, trees remove damaging pollutants from the atmosphere, and replenish it with O_2. Through the process of transpiration and photosynthesis, trees sequester grams of ozone (O_3), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and carbon monoxide (CO) every hour, amassing several tons of carbon storage each year. This carbon sequestration process in turn reduces the harmful effects of these noxious gases that cause global warming as well as lung-related ailments. Researchers have also been able to quantify the value of this carbon removal through the use of a carbon storage and sequestration model called UFORE-C. In fact utilizing the figures economists employ to estimate the effect pollutants cost society, one research ecologist was able to compute carbon sequestration into a tangible “dollar-value.” (Robinson,1994).

2.2.5 Modification of Climate

Researchers have found that trees help the urban ecosystem by decreasing air temperatures. Studies indicate that a 10 percent increase in tree canopy cover results in a one to two degree Fahrenheit reduction in air

temperature. In addition a one-degree decrease in temperature will reduce the possibility of smog by 6 percent. Furthermore, increased tree canopy coverage protects urban dwellers from harmful effects of ultraviolet (UV) radiation (Robinson, 1994).

Strategic planting of trees can also increase a city's energy efficiency. Research conducted since the mid 1980s has quantified the energy saving potential of urban forests. According to the Energy Information Administration, household heating and cooling cost consumers 180 billion US dollars in 1987. Studies have found that a 25 feet tall tree could save 10 to 25 US dollars annually on these energy costs alone. Because trees release cool vapor into the air during photosynthesis, the need for artificial cooling devices is reduced. In fact, according to one study, the air-conditioning savings from a deciduous tree near a well insulated home ranged from 10 to 15 percent, while an 8 to 10 percent savings was reported during peak cooling periods. Landscape vegetation around individual buildings can also result in heat savings of 5 to 15 percent savings, and cooling savings of 10 to 50 percent (Robinson, 1994).

It has been observed that one of the largest energy fluxes at the earth's surface is that due to evaporation by trees. Heat is absorbed by trees for transpiration of fluid, and later released into the upper atmosphere. The fluid involved is groundwater flowing up the trunk of the tree. Increased annual runoffs from deforested areas in the Amazon support this attribution (Bruinzeel, 1996).

2.3. Deforestation Fact:

Forest, which is roughly the size of the country of Panama, are lost each year, according to the United Nations' Food and Agriculture Organization (FAO,1993)

-About half of the world's tropical forests have been cleared (FAO,1993) .
-Forests currently cover about 30 percent of the world's land mass (National Geographic,2017) .

-Forest loss contributes between 6 percent and 12 percent of annual global.

- carbondioxideemissions (Werf.2009).

-About 36 football fields worth of trees lost every minute World Wildlife Fund (WWF,2017).

2.4 **Examples of Deforestation and** Location:

Tropical countries are the most common victims of deforestation, but also destinations like Indonesia, Bangladesh, Sri Lanka, China, Liberia, Malaysia, Laos, and Ghana. All of the above have lost large amounts of their rainforest. Other examples include: Philippine Archipelago: 90% of the country's forests have been lost. Central America: Only 2/5 of the country's original forest remains. (National Geographic,2017). Madagascar: Madagascar is currently struggling to supply fresh water, food, and adequate sanitation for its rapidly increasing population. The country has lost 95% of its rainforests, which has led to soil loss, desertification, and degradation of water resource (National Geographic,2017)

Nigeria: Between 1990 and 2005 79% of Nigeria's old-growth forests are no more a direct result of logging, subsistence agriculture, and the gathering of fuel wood, (National Geographic,2017).

Ethiopia: In the past 50 years, 98% of the forested regions of the country are gone. 14% alone (the equivalent to 21,000 kmÂ²) were lost, (National Geographic,2017).

Brazil: The Brazilian government has reported in 2008 that a record rate of deforestation is taking place in the Amazon. The cause of deforestation in this country is also influenced by commodity prices, including recent developments in agriculture that has seen beef ranches and other crop farms move farther into the forest.National Emergencies: Several countries have deemed their deforestation a national emergency particularly Thailand, India, and the Philippines.Deforestation occurs around the world, though tropical rainforests are particularly targeted. NASA predicts that if current deforestation levels proceed, the world's rainforests may be completely in as little as 100 years. Countries with significant deforestation include Brazil, Indonesia, Thailand, the Democratic Republic of Congo and other parts of Africa, and parts of Eastern Europe, according to a United Nations Environment Program collaborating center. The country with the most deforestation is Indonesia. Since the last century, Indonesia has lost at least 15.79 million hectares of forest land, according to a study by US University of Maryland and the World Resource Institute.

Though deforestation has increased rapidly in the past 50 years, it has been practiced throughout history. For example, 90 percent of continental United States' indigenous forest has been removed since 1600. The World Resources Institute estimates that most of the world's remaining

indigenous forest is located in Canada, Alaska, Russia and the Northwestern Amazon basin.

2.5. Causes of Deforestation

There are many causes of deforestation however harmless they may seem. So much damage can be done by even a single chainsaw, because behind those chainsaws are huge companies that care only about demand and profit, and forests are needed to supply this.

2.5.1. Commercial Exploitation

The first and most important cause of deforestation is wood extraction. Wood has always been a primary forest product for human populations and industrial interests. Since wood is an important structural component of any forest, its removal has immediate implications on forest health. Intensive harvests can lead to severe degradation, even beyond a forest's capacity to recover. When the soil has been stripped of its nutrients, farmers move further into the forests in search of new land. Shifting cultivation is one of the most unproductive uses of farmland, and a major cause of degraded land where forests cannot regrow. In eastern India, this agricultural practice called "jhumming," has laid barren previously fertile tracts of the hillside (Bhasin, 1991).

Timber is one of our most precious as well as used resource. We use it to build our houses, furniture and stock our fireplaces. This heavy demand for is also one of the main factors that causes fuels the destruction of our forests at an unsustainable rate. For every tree that is logged, 27 are killed or damaged in the process (http://www.geocities.com).

In small doses logging isn't too bad, and over 30 or so years the forest will grow back. But with todays demand for wood the areas that are logged are too large, and this causes permanent destruction of the forests.

The impact of the timber trade is generally greater than has been claimed in the past. The North plays a key role in many of the factors leading to forest decline (Dudley, etal, 1995).

Commercial forestry is the leading cause of deforestation in the world's temperate regions. The forces of large global markets for wood and wood products drive the scale of logging activities such as clear cutting. The source of demand is increased consumption by North America and Europe, not population growth. Again, transportation routes have a role, opening up new areas for natural resource exploitation. Privatization of natural resource industries has led to decreased regulations regarding timber harvesting. Multinational corporations dominate trade in wood. Most of these companies were organized in the US (Dudley, etal, 1995). Multinational companies for whom improvement of forest practices is not a priority often export the timber in an unprocessed state out of the country of origin.

Mining for precious resources also plays a major role. There are many forests that hold fair amounts of Earth's resources, such as iron ore, copper, oil and other precious metals. Many mining methods such as strip-mining and strong-force hoses break down the earth and cause major erosion. The mining sites are large and many trees need to be demolished to make way for them. When nothing is left to be mined, there is little chance of the forest growing back because of erosion and the lack of nutrients in the soil, which was churned out during mining.

2.5.2. Cattle Ranching

Perhaps the worst culprit of deforestation, at least in the Brazilian Amazon, is cattle ranching, accounting for 38 percent of deforestation in this region. Cattle ranching involve hundreds and thousands of cattle

grazing on expansive areas in and near forests. Because the forest soil isn't adapted to these conditions, it isn't long before the area becomes unproductive. So cattle ranchers expand their grazing area, leading to more destruction. After the grazed land is left, the forest is very unlikely to growback due to the stripping of the soil. Cattle ranching each year in this manner destroy an estimated 5700 square miles of rainforest alone. The Brazilian government subsidizes some of the cattle ranches that exist on converted forestland. The land is unproductive. Much of the demand for the beef comes from the fast food hamburger market, which is more concerned with quantity, than quality farm raised meat. (http://www.davison.k12.mi.us ,2017).

2.5.3. Development

People destroy or degrade forests because, for them, the benefits seem to outweigh the costs. Underlying causes include such issues as poverty, unequal land ownership, women's status, education and to some extent, population. Immediate causes are often concerned with a search for land and resources, including both commercial timber and fuel wood. In many areas, rural households rely solely on fuel wood collected from the forest for their domestic energy supply (Wallma.jacobson,1998).The roads that are built into the rainforest encourage and provide access for settling activities. In north-east India road building is often wrecking havoc on the forests. A road is cut through a hill face and the first loss is of the trees along its trace. The debris is thrown down, destroying the trees below, leaving a trail of dead or wilting trees in its wake. This debris enters the valleys, pushing up the levels of streams and rivers, causing siltation and floods (Bhasin, 1991).

There are many government agencies with policies that are uncoordinated in nature. Long range planning is not undertaken; and the Amazon is

greatly affected by forces outside of the region. Some of the causes of migration to the tropical forests are population growth and political persecution. The settlers clearing and cultivating the land do not have the knowledge and experience of indigenous peoples of the forests and are unable to utilize the land effectively or sustainable. The process of shifting cultivation is accelerated and as a result the forest doesn't have enough time to recover. Tropical rainforests are truly under the assault by humans (Anderson, 1990).

2.5.4. Agriculture

In the tropical forests of the world, the clearing of land for agriculture and livestock are the primary activities resulting in deforestation. The main cause is unequal distribution of land (Anderson, 1990). 4.5 percent of Brazil's landowners own 81 percent of the country's farmland, and 70 percent of the rural households are landless (Anderson, 1990). It seems that these conditions cause people to encroach on, penetrate and modify the forests. Governments have an important role in these processes.

In many countries in Asia and Africa, where family farms are still prevalent, the breakdown of large joint-families is causing uneconomic divisions to existing farms. These inefficiencies, in turn, put pressure on farmers to sell their land for development, and it turns whole farming comminutes into new developments (Bhasin, 1991).

2.5.5. Poverty and Inequality:

Another cause of the ecological crisis of the present is social inequality. Gender inequality is one of the more powerful forces at work, which exists in virtually all of human cultures. The natural world is often portrayed as feminine, in terms such as "Mother Nature," "virgin forest," "exploitation" and "rape of the valley" that are used to describe elements and uses of nature and serve to perpetuate this harmful attitude. Human

society's attitude with regard to the status of women makes an important contribution to environmental degradation and deforestation .Although it is easy to assume a strong connection between population growth and deforestation (Preston, 1994)

2.5.6. Beliefs:

One of the underlying causes of human exploitation and consumption of forests and other natural resources is human tradition and beliefs. One source of such belief is Christianity, whose dominance in the Americas and Europe has important consequences for natural resources. Christian's attitudes are of anthropocentrism. The dominant power on the planet is humankind. The first human, Adam, gave the animals their names, shows this kind of dominance (Winton, 1997). Modern science and technological changes began in the name of Christianity. These beliefs created the attitudes, traditions and activities that enable us to be responsible for the destruction of nature that is occurring in the forests and the rest of the world (Attfield, 1994). It is then possible that if certain Christian beliefs were different, human attitude towards nature would be that of conservation not exploitation. Such contrasting beliefs could include a god or gods that exist on Earth or even in trees, or that humans are reincarnated as plants and animals (Winton, 1997).

2.6. Effects of deforestation

Rates of resource harvesting and waste generation deplete nature faster than it can regenerate…as the world becomes ecologically overloaded; conventional economic development actually becomes self-destructive and impoverishing. Many scholars believe that continuing on this path might put our very survival at risk. (Goulde, 1997).

2.6.1. Loss of Topsoil

Deforestation results in rapid degradation of nutrient rich topsoil. Heavy rainfall and high sunlight quickly damage the topsoil in clearings of tropical rainforests. When these rainforests are cut-and-burnt, nutrients are released in the form of ash. This allows for a year or two of good crop on the newly cleared "virgin" land, but eventually the nutrients will be washed away by the heavy tropical rain. Uncovered soil erodes 15000 times faster than soil that retains some plant cover as the trees anchor the soil (http://www.geocites.com , 2017). The precious mineral and salts are literally drained out of the ecosystem, into the streams and rivers, leaving vast areas of unusable land and causing a rise in the water level where it lands. During this time, rain is left free to erode the bare soil that is no longer protected by the roots of trees causing much of the topsoil to be washed away. The soil left behind is barren. The clearing of forestland results in increased erosion and landslides. Soil from areas of reduced forest cover can fill reservoirs created by dams causing a dam's ability and future capacity to generate hydroelectricity and provide irrigation to be significantly reduced (Bhasin, 1991). Surviving under these conditions is difficult at best. After a while it may become impossible for the forest to regenerate and the land will not be suitable for agricultural use for quite some time. A rise in water level may cause flooding which may further lead to loss of biodiversity.

2.6.2. Loss of biodiversity

Why does biodiversity matter? Because it contributes to resiliency. We are losing species whose benefits to humankind are unknown. An estimated 75,000 plants have edible parts; many thousands of others have medicinal benefits, like the rosy periwinkle of Madagascar, which is the basis of an effective Hodgkin's disease treatment. The birth control pill

has its origins in the Mexican yam. of the Smithsonian Institute sees preserving biodiversity as a critical issue in the next decades. “Much of this century has been dominated by the physics and information revolutions, the next and those to follow will be the centuries of biology,” he writes. “To reap the benefits, and for a healthy and productive society, we will need biodiversity.” The new Hall of Biodiversity at the American Museum of Natural History in New York is a testament to the growing importance and awareness of biodiversity. The range of tree species could shift with respect to altitude and latitude as a result of global warming. Furthermore, the stress of such environmental change may make some species more susceptible to the effects of insects, pollution, disease and fire (FAO, 1993). When forests are replanted, their replacement can mean a loss of quality and diversity. Genetic diversity may decrease and areas of trees may be lost. Rising sea levels brought on by global warming have the potential to threaten the locations of many major cities, much fertile agricultural land, the purity of fresh water supplies and the survival of some nations. Forests play a crucial role in the management of fisheries. Logging has directly and indirectly damaged spawning grounds, blocked river channels, raised water temperatures and caused water levels in streams to fluctuate dangerously. Therefore, the removal of trees can reduce the viability of fish stocks in their watershed and downstream environments. With all the present and predicted problems, it was estimated that one acre of Canadian forest was logged every 12.9 seconds in 1995 (McCroy, 1997).

Deforestation affects biological diversity by the destruction of natural habitats, which forces species out of their native areas. Isolation and/or fragmentation restrict their range, forcing them into unnatural and restrictive habitats, which may lead to their extinction. Temperature

changes caused by loss of the protective canopy of the forest also contribute to this. Deforestation through clear-cutting creates a patched look to the landscape. Not only is this unpleasant to the eye, but it is terrible to the local wildlife. The absence of forested corridors within a landscape hinders movement for some species, while the altered shape and size of forest patches influence both, biotic and abiotic processes (Van Dorp and Opdam, 1987). For other species, fragmented landscapes become population sinks that are sustained by immigration from nearby forest tracts (Robinson and Wilcove, 1994).

2.6.3. Loss of Potential Discoveries

There is the possibility that the basic elements of potential medical treatments, cures and vaccines may lie undiscovered within these environments. The key active ingredient in one-fourth of the world's prescription and non-prescription drugs come from plants growing in tropical rain forests. Fewer trees translate into an insecure future for forest workers. Some indigenous peoples' way of life and survival are threatened by the loss of forests. Among these groups are the Waorani of the Amazon's tropical rainforest, the Sami of Lapland's taiga and the Kyuquot of Vancouver Island's temperate rainforest (Dudley, etal,1995). Often, the stakeholders associated with forest areas are not always consulted before clear cutting occurs. This has sometimes lead to non-violent and violent confrontation and fueled bitter rivalries between area residents, the forest sector and environmentalists. Consequently anti-environmentalism has intensified and environmental activism can be dangerous.

2.7. Other effects of deforestation

Forests are complex ecosystems that affect almost every species on the planet. When they are degraded, it can set off a devastating chain of events both locally and around the world.

2.7.1. Loss of species:Seventy percent of the world's plants and animals live in forests and are losing their habitats to deforestation, according to(National Geographic,2017). Loss of habitat can lead to species extinction. It also has negative consequences for medicinal research and local populations who rely on the animals and plants in the forests for hunting and medicine.

2.7.2. Water cycle:Trees are important to the water cycle. They absorb rain fall and produce water vapor that is released into the atmosphere. Trees also lessen the pollution in water, according to the North Carolina State University, by stopping polluted runoff. In the Amazon, more than half the water in the ecosystem is held within the plants, according to the (National Geographic,2017) Society.

2.7.3. Soil Erosion:Tree roots anchor the soil. Without trees, the soil is free to wash or blow away, which can lead to vegetation growth problems. The WWF states that scientists estimate that a third of the world's arable land has been lost to deforestation since 1960. After a clear cutting, cash crops like coffee, soy and palm oil are planted. Planting these types of trees can cause further soil erosion because their roots cannot hold onto the soil. "The situation in Haiti compared to the Dominican Republic is a great example of the important role forests play in the water cycle. Both countries share the same island, but Haiti has

much less forest cover than the Dominican Republic. As a result, Haiti has endured more extreme soil erosion, flooding and landslide issues.

2.7.4. Life quality:Soil erosion can also lead to silt entering the lakes, streams and other water sources. This can decrease local water quality and contribute to poor health in populations in the area.

2.8. Deforestation and climate change:

Deforestation is considered to be one of the contributing factors to global climate change. According to, associate professor of Environmental science at LaSalle College in Newton, Massachusetts, the No. 1 problem caused by deforestation is the impact on the global carbon cycle. Gas molecules that absorb thermal infrared radiation are called greenhouse gases. If greenhouse gases are in large enough quantity, they can force climate change, according to. While oxygen (O_2) is the second most abundant gas in our atmosphere, it does not absorb thermal infrared radiation, as greenhouse gases do. Carbon dioxide (CO_2) is the most prevalent greenhouse gas. In 2012, CO_2 accounted for about 82 percent of all U.S. greenhouse gas, according to the Environmental Protection Agency (EPA, 1997). Trees can help, though. 300 billion tons of carbon, 40 times the annual greenhouse gas emissions from fossil fuels, is stored in trees, according to Greenpeace. (U.S. Environmental protection Agenecy, 1997)

The deforestation of trees not only lessens the amount of carbon stored, it also releases carbon dioxide into the air. This is because when trees die, they release the stored carbon. According to the 2010 Global Forest Resources Assessment, deforestation releases nearly a billion tons of carbon into the atmosphere per year, though the numbers are not as high

as the ones recorded in the previous decade. Deforestation is the second largest anthropogenic (human-caused) source of carbon dioxide to the atmosphere, ranging between 6 percent and 17 percent. (Werf,2009).

Carbon isn't the only greenhouse gas that is affected by deforestation. Water vapor is also considered a greenhouse gas. "The impact of deforestation on the exchange of water vapor and carbon dioxide between the atmosphere and the terrestrial land surface is the biggest concern with regard to the climate system. Changes in their atmospheric concentration will have a direct effect on climate.

Deforestation has decreased global vapor flows from land by 4 percent, according to a study published by the (National Academy of Sciences,(2017). Even this slight change in vapor flows can disrupt natural weather patterns and change current climate models.

Deforestation is one of the main causes of climate change. It is the second largest anthropogenic source of carbon dioxide to the atmosphere, after fossil fuel combustion. Deforestation and forest degradation contribute to atmospheric greenhouse gas emissions through combustion of forest biomass and decomposition of remaining plant material and soil carbon. It used to account for more than 20% of carbon dioxide emissions, but it's currently somewhere around the 10% mark. By 2008, deforestation was

12% of total CO_2, or 15% ifpeatlands are included. These proportions are likely to have fallen since given the continued rise of fossil fuel use.

Averaged over all land and ocean surfaces, temperatures warmed roughly 1.53 °F (0.85 °C)between 1880 and 2012, according to theIntergovernmental Panel on Climate Change. In the Northern

Hemisphere, 1983 to 2012 were the warmest 30-year period of the last 1400 years.Werf, (2009*).*

For the purpose of providing green spots industrial forests must choose the right plant for the conditions of the environment that will show them; trees and plants can be divided as follows:

Trees and plants tolerant to high temperatures.

Trees and plants tolerant to low temperatures.

Trees and plants tolerant to the vagaries of weather and wind. Trees and plants tolerant marine winds and salinity near the coast of the sea.

Trees and plants resistant to fumes and dust.

Trees and plants resistant to drought and thirst.

2.8.1. Counteracting climate change:

Reforesation: Reforestation is the natural or intentional restocking of existing forests and woodlands that have been depleted, usually through deforestation. It is the reestablishment of forest cover either naturally or artificially. Similar to the other methods of forestation, reforestation can be very effective because a single tree can absorb as much as 48 pounds of carbon dioxide per year and can sequester 1 ton of carbon dioxide by the time it reaches 40 years old.-SAFnet Dictionary of Forestry,2008.)

2. 8.2. Counteracting deforestation:

Many believe that to counter deforestation, people simply need to plant more trees. Though a massive replanting effort would help to alleviate the problems deforestation caused, it would not solve them all.

2.9. Reforestation would facilitate:

-Restoring the ecosystem services provided by forests including carbon storage, water cycling and wildlife habitat.

-Reducing the buildup of carbon dioxide in the atmosphere.

-Rebuilding wildlife habitats.

Reforestation won't completely fix the damage. points out that forest cannot sequester all of the carbon dioxide humans are emitting to the atmosphere through the burning of fossil fuels and a reduction in fossil fuel emissions. It is still necessary to avoid buildup in the atmosphere. Reforestation will not help with extinction due to deforestation, either. "Unfortunately, we have already diminished the population of many species to such an extreme that they might not recover, even with a massive reforestation effort. **(** National Geographic , 2017).

In addition to reforestation, some other tactics are being taken to counteract or slow deforestation. Some of them include shifting the human population to a plant-based diet. This would lower the need for land to be cleared for raising livestock.

Global Forest Watch has also initiated a project to counteract deforestation through awareness. The organization uses satellite technology, open data and crowd sourcing to detect and alert others of

deforestation. Their online community is also encouraged to share their personal experiences and the negative effects of deforestation. **(** National Geographic , 2017).

2.10. Phenomenal ways to stop deforestation and protect our planet:

According to the United Nation's Food and Agriculture Organization (FAO,2001), the 33 million acres of forestland that are lost annually around the globe are responsible for 20% of human-caused greenhouse gas emissions. The main causes for deforestation include wood and paper products, mining and oil exploitation, urbanization, acid rain and wildfires. Other reasons include supplying wood timber for wood and paper products and clear land for crops, cattle and housing.

Trees are being destroyed at an alarming rate. More and more businessman is pushing through forests to gain land for industrial or commercial purposes. Environment is being sacrificed for the sake of profit. Deforestation can have serious effects on air and water pollution, climate change, soil erosion, loss of biodiversity as mentioned before.

As an individual or part of the global community, you can at-least plant a tree to combat deforestation. You can take one step further by the choices you make throughout the day when we're shopping, eating, or even driving. One small step by you, leads to twenty or more giant leaps towards a global campaign against deforestation.

Here are 12+ phenomenal ways that you can do to stop or prevent deforestation.

1. **Begin by hugging a tree**. It's that easy. This is the quickest way to appreciate the important part it plays in your life.

2. And **start planting trees**. That's the sum of the domestic campaign so far. Soon, all the neighbors will be carbon copying each other.

3. Also **stop printing and go paperless.** Whether at home or at work, many of us still have that nasty , lazy habit of not learning to utilize computer files and folders properly. So instead, we print. And, you know what; many of us do this when we think others are not looking. So, there you go. You know it's wrong.

4. **When shopping, move towards buying** recycled productsmainly. Most recycled items do not derive from areas that have been cleared of natural and rainforests.

5. When at home, **recycle as much as possible.** By extension, you are continuing with your proactive exercise in diverting the demand for clearing land.

6. In the kitchen, **cut down on your meat intake and eat as many vegetarian meals as possible.** It's a best practice and a healthy one on top of it too. Because it remains problematic and time-consuming trying to source meat products that are entirely devoid of being harvested on land that once brimmed with trees.

7. Speaking of meat**, donot buy meat products sourced from land where forests have been cleared.** At this stage, if you're prepared to go the whole hog, if you will, you'll need to spend extra care and time perusing the product's labels. Also, you're going to need to extend your

knowledge on the multinational companies that produce these pre-packaged supermarket items.

8. To get these things right, your shopping for recycled and sustainable products and your meat products, vigorously check the labels of each item you pick up. A much safer alternative and time-saving effort entails **simply buying organic products instead**. But avoid the multinationals that have pretentiously jumped onto the organic bandwagon, mainly to drive sales.

9. Palm oil is a type of edible vegetable oil that is derived from the palm fruit, grown on the African oil palm tree. According to the World Wildlife Fund, an area of the equivalent size of 300 football fields of rainforest is cleared each hour to make way for palm oil production. About 85% of all palm oil globally produced and exported from Indonesia and Malaysia; but most of the time not using sustainable measures**. Unless there's concrete proof that it's been sustainably produced, do not buy palm oil at all.**

10. Do not use firewood to heat up your fireplaces. It takes few hours to burn the firewood but takes years to grow a single tree. Live in such a way that your activities cause minimum impact on the environment.

11**. Encourage people to live in a way that doesn't hurt environment.** Try to bring in more people in your community and let them know about how trees are being destroyed at an alarming rate and what steps we need to take to minimize our carbon footprint on the environment.

12. Returning to the meat and grocery shopping list, **do not buy anything from large, multinationals that are actively or indirectly involved or**

responsible for the clearing of forest land. Shortly we'll be emphasizing the importance of broadening your knowledge on which companies are guilty. You will be surprised to learn that within a matter of minutes, you'll unmask them. Globally, active campaigners and NGO's have already published on the internet which companies are still responsible for clearing forests. They'll also enlighten you on the progress being made to reverse this. (FAO, 2007)

2.11. Deforestation and soil erosion:

Deforestation causes some of the worst soil erosion.

Forests keep soil where it is. The root structures of trees and other plants hold it in place; the natural mulch of leaves prevents soil from being exposed to the erosive forces of wind and rain. The canopy helps soften the impact of heavy rains. The soil of the forest floor is alive and rich, and can absorb large rainfalls without swelling rivers. Water is sponged into the soil itself and is slowed from running off the land by the physical barriers of roots and downed trees.

When a forest is cut down, nothing is left to protect the soil. Wind blows it away. Rain quickly washes away what healthy soil was there, and compacts the rest. A compacted soil absorbs much less water, making it run off more quickly. No spongy soil or plant roots to absorb the water mean that rain forms gullies and washouts. Often time's land that is forested (as opposed to agricultural land) is found on steep hillsides; once these forests are cut down, the erosive effects are much worse than on flat land. Erosion and rainfall in such places can cause large mudslides beyond just washouts.

On a local scale, this can cause serious land degradation. On a landscape scale (as with slash and burn agriculture and in most places where industrial logging is common place), it is catastrophic for soil integrity and surface water quality. Once cut down, a piece of land might take 100 years or more to regain its former forest cover and capacity to hold water, and rivers without rehabilitation efforts might take decades or more to recover (if they do) their former habitat and quality, vegetation plays several roles in erosion processes. Off the top of my head, the major ones are:

-In rainfall the force of water drops (i.e. “splash” erosion) can dislodge a soil particle from the surface. Water then transport the particle(s) along

Preferential pathways, causing further dislodging and transport of more particles (“gully” and “rill” erosion). Forest canopies can intercept and store rainfall, either reducing the velocity of the drain drop (and energy) or attenuating the volume of water that can become runoff.

-Roots anchor soil and provide the subsurface with structure. On hill sides or at higher gradient/slope zones, the force (and mass) of water acting on this surface can be absorbed by vegetation. Absent vegetation and trees, water saturates the soil and can initiate subsurface movement, leading to landslides and other “mass wasting” events. Generally, the greater the slope, the more risk to sliding. However, the risk does depend on the soil type and what the dominant substrate is (e.g. solid bedrock could be less prone to landslide—but trees are unlikely to grow on such a substrate). For old growth forests, the subsurface structure can be substantial and after cutting the trees, the roots decay over time, leaving the subsurface highly vulnerable to mass wasting as pores formerly occupied by roots collapse.

-Similarly, erosion by wind can be mitigated from vegetation. Instead of particles being dislodged by water, you have air. Under strong winds and in dry conditions (which can be worsened if trees and their roots are not present to store water or provide anchoring), soil particles may be swept away in dust or sandstorms. The particles carried by the wind provide additional force that acts to dislodge, potentially carrying more energy than rain drops.

Trees' roots, leaves and canopy keep the soil in place, cover it with a protective layer of mulch, soften the impact of rain and reduce run off by water. It also keeps the soil from heating up and drying out. Take trees away and soil erosion by water and wind will set in, (Jason , 2016)

2.12. How does deforestation affect biodiversity?

A forest is more than just a bunch of trees. It is a community of organisms including all types of animals, plants, fungi, and myriad microbial life. Each organism depends on others for food and shelter, and collectively, all depend on the integrity of the forest whole for survival. Further, forests vary by soil type, climate, location, elevation, aspect, latitude, and countless other factors. Different forest communities have different species of macro and micro organism of flora and funa and different genetic composition.

Quite simply, when a forest is cut down, there is no place left for the creatures that once lived there, and they die off. Biodiversity is decreased accordingly. The more forests that are cut down, the more associated organisms have no place to live, the more biodiversity decreases. Multiply this by worldwide deforestation in every climate, country and habitat, and the general trend of biodiversity is a significant reduction.

Deforestation depletes biodiversity by destroying habitat, by separating contiguous areas of rainforest from each other, by interfering with plant reproduction, and by exposing organisms of deep forest to “edge” effects. Logging does not simply remove a few trees from the forest.Deforestation affects biodiversity in a number of ways. Trees may be removed from particular areas in order to make various wood products, to clear land for new buildings or roads, or for creating new farming or grazing land. (Julie C Mattern , Aug 5, 2016) .

Deforestation can also occur as a result of natural disasters or accidental fires. When trees are removed or destroyed in masses, the species living in that forest lose their natural habitats, and some are not able to survive the change. When animals or plants die as a result of deforestation, the biodiversity of that area decreases. Fewer species in an area means a less biologically diverse environment.

Forests may grow back after being cleared out, but they don't always experience regrowth. Reportedly, only one-fourth of tropical forests that have been cleared are used as land for crops. The other three-fourths of the land is abandoned.(Justin Wilson, 2016) .

While the loss of forests is clearly visible, a decline in biodiversity has a less apparent effect. The subtle loss of biodiversity fails to indicate the significance that fewer species in the ecosystem increases the fragility of life for all species. Despite the negative effects of deforestation and the consequential decline of biodiversity, trees are cut down for an economic and consumer benefit. Members of society need to determine how much economic cost they are willing to spend in order to preserve plant and animal species. (Barbara C Case , Aug 6, 2016) .

2.13. The effect of deforestation on water quality:

Deforestation has an impact on the quality of water flowing through the watershed and alters the discharge, chemical and physical properties of water. This pare presents the effect of deforestation on water quality, in particular on physical and chemical characteristics of water and evaluates the community based watershed management schemes in Buy hang micro watershed. The quality of water is assessed on the basis of laboratory analysis of various parameters by using weekly grab sampling technique from three alternative land uses and in depth assessment of farmers' needs, priorities, and conservation practices. The farmers' primary concerns are food security and sustained productivity the perception and appreciation of people towards the function of forest ecosystems is limited. People are continuously changing the forest area for tobacco plantations, rice fields, and other agricultural crops in very steep slopes. There is only 0.97 ha of reforestation activity in the watershed. Most people judge the quality of water by its aesthetic properties of color, taste, odor and turbidity. Except the agricultural water samples, the other two samples appeared colorless through visual observations. The water from undisturbed forest area is palatable and all are free of odor. The pH values of the water samples ranged within standard values. Total hardness was trace except one sample from agricultural land. Turbidity was found to be less and ranging from 5 to 22 FTU. Sediment is recorded from agricultural water samples and higher during peak flow. The highest concentrations of PO_4^- were measured from the forest water samples. The mean Ca^{++} concentrations ranged from 10 to 11.6 mg/L. There is no significant difference between the three water samples in Mg^{++} concentration. Total K^+ was also found below 6.6 mg/L. Na concentrations were ranging from 6.5 to 8.7 mg/L. Generally, the results

from this study show no significant difference between waters from forest and deforested area in terms of chemical analysis but clear contrast in physical properties. The nutrient concentration of water from the forested site is relatively higher and untypical in the case of nitrate concentrations than deforested and agricultural water samples. Neal, colin,(2003)

Forests and water are highly important resources which provide many socioeconomic functions and services to human societies and the environment. However, the occurrence of disturbance on forests modifies and alters the discharge, chemical quality and physical properties of water. Due to its nature as a solvent, all water contains organic and inorganic matter and dissolved gases derived from its environment or the activity of living organisms. According to, the concentrations of substances and their biological, physical and chemical effects are the basic criteria in the determination of water quality.

Forest in upstream watersheds is the best land cover to maximize water quality and support constant yield for agricultural and domestic uses, preventing floods in downstream areas, regulate seasonal flows and ensure high water quality. Some common assumptions on the other hand have revealed that forests are not the best land cover to increase downstream water yield in arid and semi arid ecosystems. The reason is that forest ecosystems are a major user of water. Neal, colin,(2003)

Chapter Three

3.1. Methodology

Different kinds of research methods were used and different techniques of data collection were applied. This study was conducted at Kunduwa Forest reserve (South Darfur State) . The methods are:

3.1.1. Secondary data:

Secondary data were collected from recent references, annual reports and from the internet,

3.1.2. Primary data:

Primary data were collected by using a questionnaire, meetings and interviews and remote sensing photos.

3.1.2.1. Socio-economic study:

A socio-economic study was conducted A questionnaire was distributed to farmers in Kunduwa village and to some refugees in Kalma Camp. The questionnaire contained 29 questions and 60 respondents who were chosen randomly.

3.1.2.2. Official Meeting and interviews:

A meeting was held with the director of technical department of FNCSouth Darfur at Nyalalocality. Forestinspector, sayed Ahmad Omar Hamuda. An interview was conducted with them about the plan for this forest and its purpose.

3.1.2.3. Unofficial meeting:

I went to kunduwa village and I met sheikh Habib and interviewe him aboutkunduwa forest in terms of forest activities.

3.1.2.4. Observations:

A visit was paid to kunduwa forest and some observations about the state of the forest were noticed.

3.1.2.5. Remote sensing

A modern photo was obtained using remote sensing for kunduwa Forest to show the present condition.

Chapter Four

Results and Discussions

Table number (1) Gender

Gender	Frequency	Percentage
Male	43	71.7
Female	17	28.3
Total	60	100

Table No (1) showed that number of males is greater than number of females by 71.7%.

Table Number (2) Age Category

Age	Frequency	Percentage
1-30	37	61.7
More than30	23	38.3
Total	60	100

The table (2) showed that number of young people is more (61.7 %%).

Table number (3) marital status

Marital status	Frequency	Percentage
Married	39	65.0
Single	8	13.3
Divorced	13	21.7
Total	60	100

Table (3) showed that married larger (65%) from single and divorced

Table number (4) Educational level

Educational level	Frequency	Percentage
Illiterate	6	10
Khalwa	31	51.7
Primary	13	21.7
Secondary	8	13.3
University level	2	3.3
Total	60	100

Table (4) showed the low level of educational the study area, illiterte10%, khalwa(51.7 %).

Table number (5) Sources of income

Sources of income	Frequency	Percentage
Agriculture	58	96.7
Grazing	1	1.7
Trade	1	1.7
Total	60	100

Table (5) showed that the people in the study area depend on agriculture in their sources of income (96.7%).

Table Number (6) Types of trees at the study area

Types of trees	Frequency	Percentage
Mahogany	21	35.0
Neem	33	55.0
Ban	4	6.7
Siso	2	3.3
Total	60	100

Table No (6) showed that most dense trees are Neem(55%) then mahogany (35%)

Table number (7) the most important trees at the study area

Most importace trees	Frequency	Percentage
Mahogany	27	45.0
Neem	29	48.3
Ban	4	6.7
Total	60	100

Table No (7) showed the most important trees at the study area Neem (48.3 %) and mahogany (45%)

Table number (8) uses of tree parts

Parts of tree	Frequency	Percentage
Leaves	28	46.7
Ruits	13	21.7
Root	19	31.7
Total	60	100

Table No (8) showed the use of parts in the study area and shows that the most use is leaves (46.7%) and roots (31.7%).

Table number (9) Types Tree of Uses

Types of trees uses	Frequency	Percentage
Industry	1	1.7
Fodder	29	48.3
Medicinal	30	50
Total	60	100

Table (9) showed the use of trees and explained from the analysis of the sample that most uses are medical (50%).

Table number (10) Forests Benefits

Forests benefits	Frequency	Percentage
Source of income	1	1.7
Feeding and habitat place for animals	50	83.3
Recreation	9	15
Total	60	100

Table No (10) showed the benefits of trees and note that the most important benefits at the study area are feeding and habitat place for animals (83.3%).

Table number (11) the main activities

The main activities	Frequency	Percentage
Farming	58	96.7
Grazing	2	3.3
Total	60	100

Table No (11) showed the main activities at the study area, explain through the analysis of the sample that main activity is agriculture (96.7%).

Table number (12) what are the main trees species used during summer season

Trees consumed during summer	Frequency	Percentage
Laaut	31	51.7
Citer	12	20.0
Other	17	28.3
Total	60	100

Table No (12) showed that the main trees used during summer season, is fount laaut (51.7%).

Total number (13) Kind of animals raised at the study area

Kind of animals raised	Frequency	Percentage
Sheep	29	48.3
Goat	1	1.7
Cows	29	48.3
Other	1	1.7
Total	60	100

Table (13) showed kind of animals raised at the study area, the most common animals at the study area are sheep and cows (48.3%).

Is the any damage caused by animals at the study areaTable number (14)

Damage caused by animals	Frequency	Percentage
Yes	43	71.7
No	17	28.3
Total	60	100

Table No (14) showed that animals cause damage of the study area; (71.7%).

Table number (15) Trees used as forage at the study area

Trees used as forage	Frequency	Percentage
Gudiem	8	13.3
Sider	15	25.0
Haraz	37	61.7
Total	60	100

Table No (15) showed that Haraz is mainly used as forage of at the study area(61.7%).

Table number (16) Income source during drought and summer

Income resources during summer	Frequency	Percentage
Wood materials selling	1	1.7
Grasses selling	44	73.3
Trading	15	25.0
Total	60	100

Table No (16) showed income source during drought and summer, most people is mainly selling grasses (73.3%).

Table number (17)Materials Used for Houses building

Building materials	Frequency	Percentage
Poles	27	45.0
Mud and bricks	31	51.7
Grasses	2	3.3
Total	60	100

Table (17) showed materials used in houses building are mainly mud and bricks (51.7%).

Table number (18) Building Material Source

Building material source	Frequency	Percentage
Forest	2	3.3
Farm	28	46.7
Market	30	50.0
Total	60	100

Table No (18) showed building material source is mainly from market and farm (50%).

Table number (19) Conflicts at the study area

Conflicts at the study area	Frequency	Percentage
Yes	44	73.3
No	16	26.7
Total	60	100

Table No (19) showed there are conflicts at the study area (73.3%).

Table number (20) Do you consider that the study area had been affected by deforestation?

Effected by deforestation	Frequency	Percentage
Yes	59	98.3
No	1	1.7
Total	60	100

Table No (20) showed that the study area had been affected by deforestation (98.3%).

Table number (21) Types of Energy Used at The Study Area

Types of energy	Frequency	Percentage
Firewood	32	53.3
Charcoal	27	45.0
Gas	1	1.7
Total	60	100

Table No (21) showed types of energy used at the study area is mainly firewood (53.3%).

Table number (22) Source of Energy Used atStudy AreaThe

Source of energy	Frequency	Percentage
Forest	4	6.7
Around the study area	17	28.3
Market	39	65.0
Total	60	100

Table No (22) showed that source of energy used at the study area was mainly from market (65%).

Table number (23) Kunduwa Forest Status Before refugee's settlements

Kunduwa forest status	Frequency	Percentage
Dense	53	88.3
Moderate density	7	11.7
Total	60	100

Table (23) showed Kunduwa forest was dense before refugee's settlements (88.3%).

Table number (24) is there any sawn timber inside the Kalma comp

Sawn timber inside the comp	Frequency	Percentage
Yes	26	43.3
No	34	56.7
Total	60	100

Table (24) showed presence unlicensed sawn timber inside the Kalma camp by(56.7%).

Table number (25) Are The People Awareness of Forest importance

People awareness of forest importance	Frequency	Percentage
Yes	9	15.0
No	51	85.0
Total	60	100

Table No (25) showed that people were not awareness of forest importance (58%).

Table number (26) People Participation in Forest Extension Programs

.People participation	Frequency	Percentage
Yes	11	18.3
No	49	81.7
Total	60	100

Table No (26) showed that people participation in forest extension programs is low (18.3%).

Table number (27) is there any laws against Deforestation at the Study Area

Presence of a laws against deforestation	Frequency	Percentage
Yes	56	93.3
No	4	6.7
Total	60	100

Table No (28) showed that there are laws against deforestation at the study area (93.3%).

Table No (28) Do you think that Forest laws are Suitable for Protection

Laws are suitable to protect the forest	Frequency	Percentage
Yes	50	83.3
No	10	16.7
Total	60	100

Table No (28) showed that laws are suitable to protect the forest (83.3%).

4-1- Socio-economic study:

The results of the study indicated that the level of education of the people in the study area was low (Table No 4) either for their poverty condition or for displacement due to the civil war in that part of the country. The low level of education in addition to displacement made people totally rely on forest products without any care to what will happen in the future. At the sametime table No 5 showed that people depend on agricultural crops as a source of income to 96.7% of them. Income generated from agricultural crops is very limited and at the sametime it is seasonal. This can be considered as another reason which leads people to rely on the forest products. Tables No 6 and 7 showed that the types of species dominating the forest are *Khayasenegalensis*(Mahogany*)*, *Azadirchtaindica* (Neem), *Eucalyptus spp* (Ban) and *Dalbergiasissoo*(sissoo) . These species are considered valuable timber trees which encouraged people to cut them down for their domestic uses and for selling their products in Nyala market which quite adjacent to the forest as a source for generating addition income. It was also found that people in Kunduwa area use all parts of the tree such as leaves, roots, and fruits especially for medicinal purposes. Besides these wood and non-wood forest products Kunduwa forest is considered as a good source for fodder for animals and shelter in the dry and hot season. Besides that the forest is a good recreational place as indicated in table No 10. The main species used for fodder are *Ziziphusspina- christi*(Sidir), *Faidherbiaalbida*(Haraz) and *Grewiutenax*(Gudeim), Table No 13. It was also found that the kind of animals kept in the study area are sheep49%, cows48% and limited number of goats, table No 13. Actually these animals cause severe damage to trees in the forest as well as to the soil beneath them. Selling grasses is one of the sources of income. Kunduwa

forest acts as one of the main sources of grass in the area. The civil war and conflicts between farmers and pastoralists lead to displacement of people and this in turn imposes great pressure on the limited resources in Kunduwa forest and the adjacent places. A large number of citizens keep using forests products and grasses as building material as shown in table No 17 and the main source of these material is the forest , farms and from the market, table No 18. The status of kunduwa forest before refugees' settlement was well stocked. 88.3% of the total area of the forest was dense and 11.7% was moderately dense as indicated in table 23 but as people settled near the forest and started to cut down trees for timber, as mentioned before, a great damage of the forest was experienced and consequently leads to completedeforestation of the forest as indicated in table No 23 and 24. Awareness of people about the importance of the forest is very low. They were no programs to raise the awareness of people, this is in addition to that people did not participate in the management of the forest. Forest legislations to inhibit illegal cutting of the forest, though they are available, but they wore not applied in an effective way or activated. Table No 25 showed that 85% of the citizens are not aware about the importance of the forest while 81.7% of them did not participate in the forest management and extension programs. This can be added to the previous factors responsible for the destruction of the forest under study.

4-2-Official and Unofficial Meeting:-

Official and unofficial meeting were conducted at Kunduwa forest. Official meeting was held with forest inspector sayed ,Ahmed Omer of NFC Nyala office The unofficial meeting was conducted with sheikh Habib(Kunduwavellage).

4-2-1-Official Meeting:

Official meeting was conducted with Inspector of forest sayed, Ahmed Omer Hamuda, He gave A general idea about Kunduwa forest and the beginning of forest deterioration and its causes, which had happened. Kunduwa forest is located at the northof the city Nyala and just adjacent to it.

It is bordered by the railway and on the east by Blail locality, on the south by Al salam locality and in the middle of it is by Burley valley .Also at the north-east of the forest exist Kalmacamp. This location of the forest make it very accessible to people.

Kunduwa is a reserve forest and its area is about 3299 acres. This area includes a kreb area which is suitable for the planting trees and the area is generally suitable for Acacia.

Since the forest is very close to the village and the it was severely attacked as a result of tribal conflicts and displacement camp, in the early 2000s that led to complete disappearance of trees; this had affected the environment and caused soil degradation and water depletion.

The forest was an outlet for the city and its purpose is to protect the city, It is a windbreaker, a place for recreation and provide livelihoods for poor families. The forest can provide rail way sleeper and creates good environment, for animals, and also acts as a recreation area for people.

The primary role FNC is protection and restoration of the destroyed forest. The beginning of Kunduwa forest reforestation is through seeds and planting of seedlings on the eastern part of the forest, but this did not succeed .due to agriculture activities by farmers. After this failure the forest administration adopted taungya system to participate people in the management of forest. The restoration of the Kunduwa forest had started by farmers since 2005 using taungya system. Trees were planted at different distances depending on the type of trees, such as 8-10m for

mahogany,6-8m, for neem and sesoo, ban trees were used as windbreakers. There were a number of guards for forest protection, against illegal cutting of trees.

4-2-2-Unofficial Meeting:

Unofficial Meeting was conducted with SheikhHabibAbdallahI asked him aboutthe benefits of the forest. He said that Kunduwa forest was very dense during the period (1969-2000) but it began to deteriorate after attacks by the refugees. Main benefits of Kunduwa forest are to protect Nyala city from natural disasters, wind erosion, maintain soil fertility and combat desertification. Other benefits include firewood and fuel such as *Faidherbiaalbida ,Ziziphusspinachristi*. Before deforestation the forest as a range land for animal feeding inside it, but after deforestation this sources fodder was lost due to harmful activities by refugees.

Chapter Five

Conclusion and Recommendations

5.1 Conclusion:

From the results of the study it is apparent that deforestation is increasing year after on other in the study area because of the settlement of the displaced people due to civil war and conflicts between the different land users. The study revealed that Kunduwa forest was well stocked before settlement of the refugees. The main species which are existing at that time were *Khayasengalensis*, *Azadrichtaindica* and *Eucalyptus spp*. These species are considered valuable commercial timer species which attract people for felling them. Besides timber people also use other parts of the trees e.g. leaves, roots and fruits for medicinal and other purposes. The study also showed that the forest besides it provides people with forest products, it is a source of fodder and shelter for their domestic animals and it also create good environment for people themselves as a recreational place. The main activities there are farming and grazing and due to low income earns from these activities as well as the low level of awareness about the adverse impact of the forest clearance and the environmental problems resulting from forest clearance, in addition to low level of education all these factors collectively make people start felling the trees for domestic uses and for selling the forest products in the market. Above all the study indicated that though there are forest legislations but they are not well applied in an effective way.

5-2 Recommendations:

The following recommendations are recommended for better management of the forest so as to implement the plantation program and work plan in a better way to improve the present situation.

-There is need to raise the awareness of people about the importance of the forest through education and extension programs.

-Adequate fund should be made available to implement the plantation program in Kunduwa forest.

-Kalma camp of refugees should be shifted to another place far away from the forest.

-Good security services are badly needed for implementing the plantation and extension programs in a secured environment.

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Appendix.1. the questionnaire

Title: Study of the causes of Deforestation in Kunduwa Forest at Nyala Locality

A Questionnaire:

(1) Gender: a- male ☐ b-female ☐

(2) Age category: a- 1-30 ☐ more than 30 ☐

(3) Marital status: a- Married ☐ b-Single ☐ c-Divorced ☐

(4) Education level: a- Illiterate ☐ b-Khalwa ☐

c- Primary ☐ d-Secondary ☐ e- University level ☐

(5) Sources of income: a-Agriculture ☐ b-Grazing ☐

c-Trade ☐

(6) Types of trees at the study area: a-Mahogany ☐

b-Neem ☐ Cisoo c- ☐ ☐

e-Other ☐

(7) The most important trees removed at the study area:

a- Mahogany ☐ b- Neem ☐ c- Ban ☐ d-Other ☐

(8) Parts of trees used:

a-Timber ☐ b- Leaves ☐ c-Fruit ☐ d-Root ☐

e- Other ☐

(9)Types of trees use s: a- Industry ☐ b-Fodder ☐

c- Medicinal ☐ d-Other ☐

(10)Forests benefits: a- Source of income ☐

b-Feedingand habitat Place for animal ☐

c- Recreation ☐

(11) The main activities

a- Farming ☐ b- Grazing ☐ c- Other ☐

(12) What are the main tree species consumed during summer season?

a- ☐ b- ☐ c- ☐

(13) Kind of animals raised at the study area

a- Sheep ☐ b- Goat ☐ C- Cows ☐ D- Other ☐

(14) Is the any damage caused by animals at the study area?

a-Yes ☐ b-No ☐

(15)Trees used as forage at the study area?

a- Gudiem ☐ b-Sidr ☐ c- Oshar ☐ -Other ☐

(16) Income resources during drought and summer?

a-Selling wood materials ☐ b- Selling grasses ☐ Trading ☐

(17) Materials used for houses building?

a- poles ☐ b-Grasses ☐ e-mud and brick ☐

(18)Building material source:

a-Forest ☐ b- Farm ☐ c- Market ☐

(19)Are there any conflicts at the study area:

a- Yes ☐ b- No ☐

(20) Do you consider that study area was affected by deforestation?

b-No ☐ a-Nes ☐

(21)- Types of energy used at the study area

A-Firewood ☐ b- Charcoal ☐ c- Gas ☐

(22) Source of energy used at the study area:

a- Forest ☐ b-Around the study area ☐ c- Market ☐

(23) Kunduwa forest status before refugee's settlements?

a- Dense ☐ b- Moderate density ☐ c-Low density ☐

(24)Is there any sawn timber inside the camp?

a-Yes ☐ b- No ☐

(25) Are the people aware of forest importance?

1- Yes ☐ 2- No ☐

(26) Do people participate in forest extension programs?

1- Yes ☐ 2- No ☐

(27) Are there any laws against deforestation at the study area?

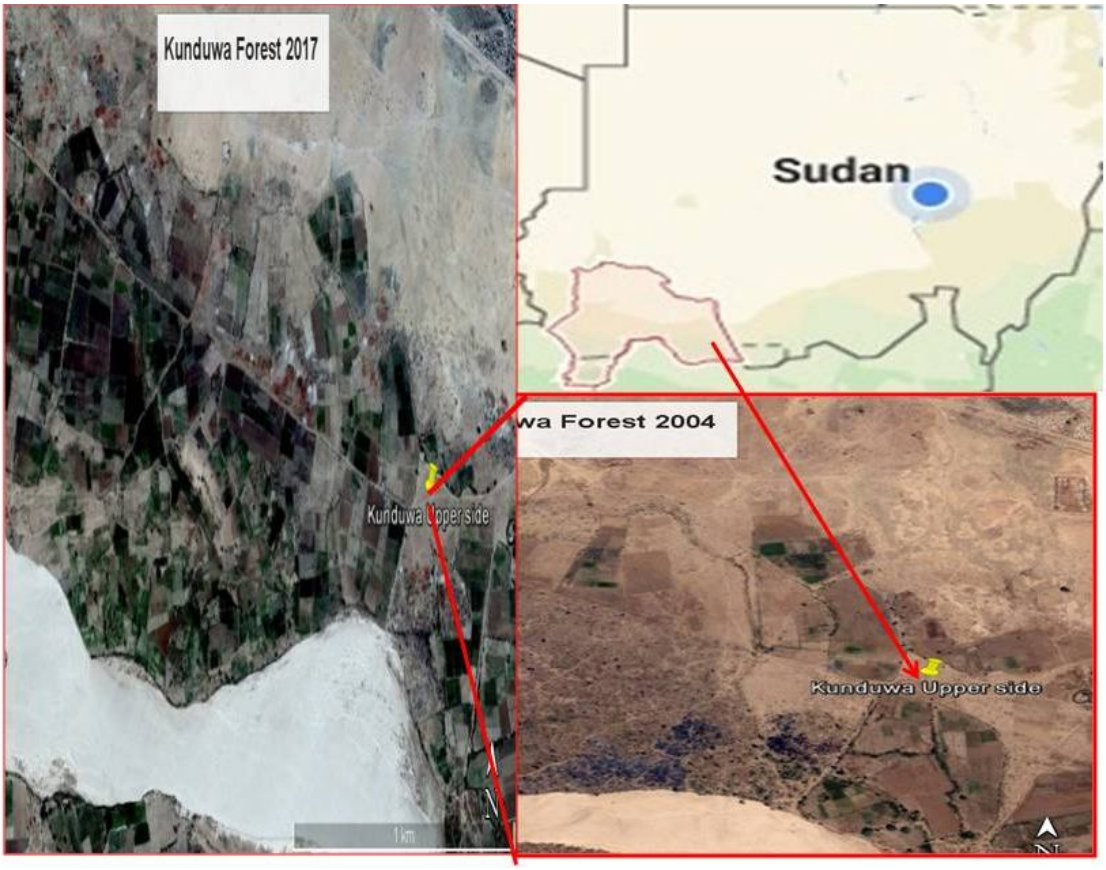
a- Yes ☐ b- No ☐

(28) Do you think that forest laws are suitable to protect the forest?

a-Yes ☐ b-No ☐

Appendix.2. photo

Photo No1 Showing Kunduwa Forest (2004-2017)Photo No2



Showing Kunduwa Forest 2004

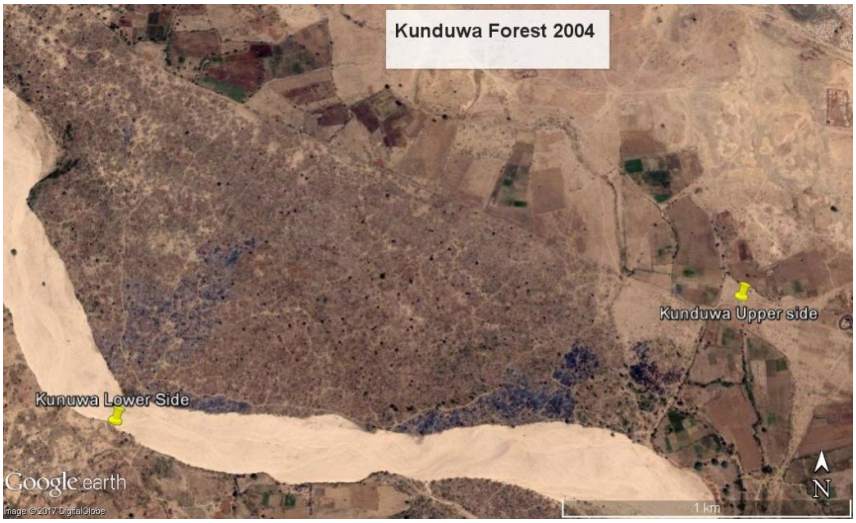


Photo No3 Showing Kunduwa Forest 2010

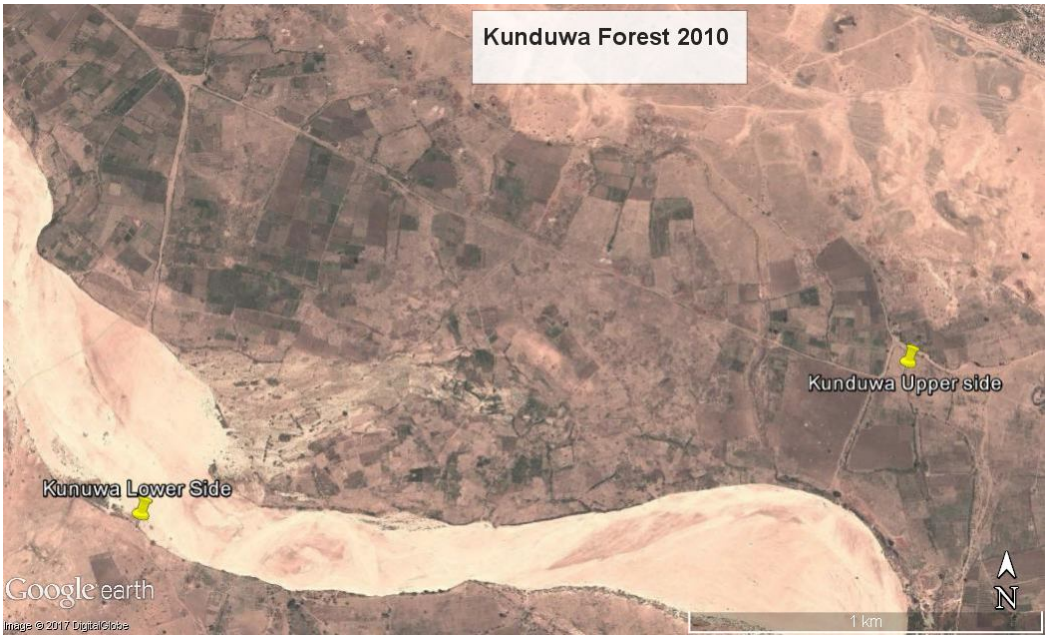


Photo No4 Showing Kunduwa Forest 2017

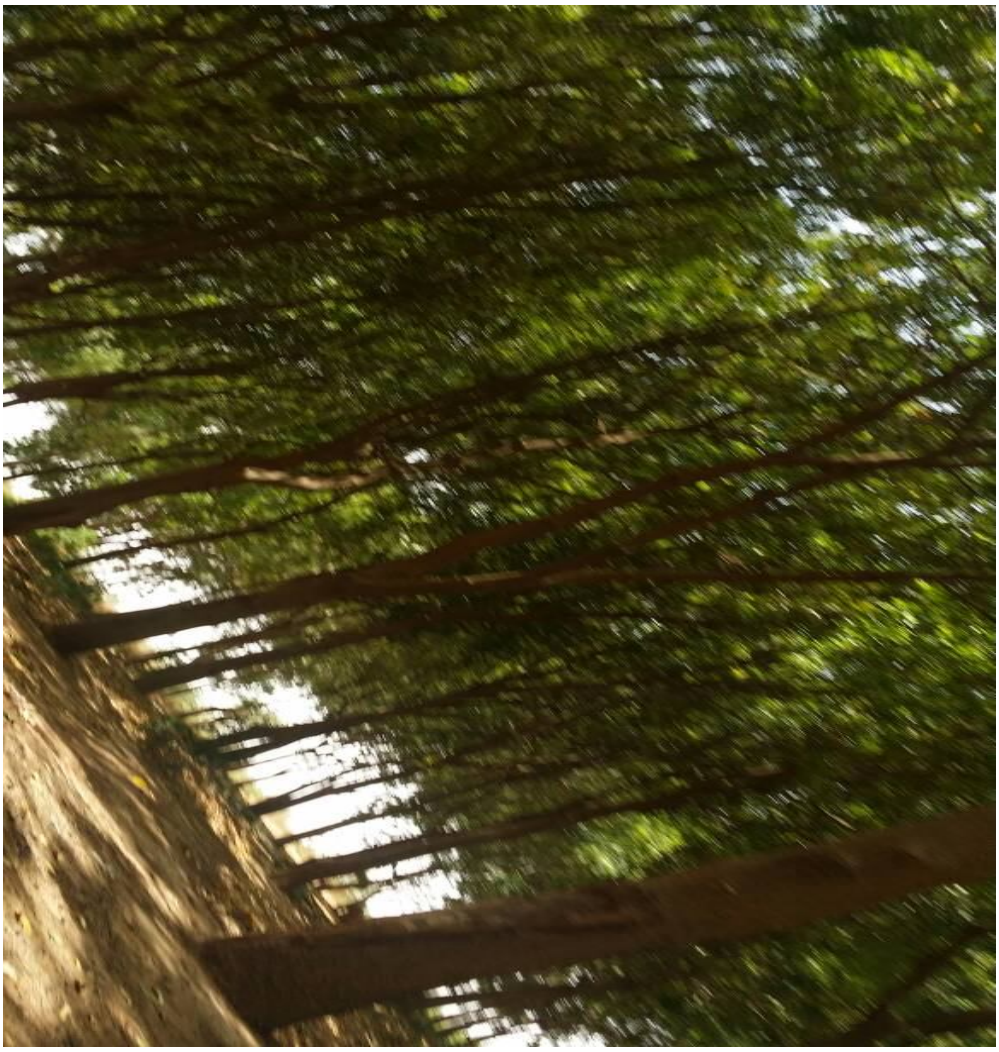


Photo No 5 showingKunduwaforest before deforestation

Photo 6 showing damage caused totrese at Kunduwa forest

Photo No 7 showing taungya system

Photo No 8 showing Trees planted during 2005

Photo No 9 showing cattle grazing inside Kundwa forest

Photo No 10 showing cattle ranching inside Kunduwaforest

Photo No 11 showing trees planting during 2007

Photo No 12 showing trees planting during 2017

Photo No 13 showing fodder of *Faidiherbiaalbida*as fodder