

**Sudan University of Science and Technology**  
**College of Graduate Studies**

**The Role of Protection Forests In Land Conservation.**  
**Case Study Elain Forest (North Kordofan State)**

دور غابات الحماية في الحفاظ على الأرض  
دراسة حالة غابة العين (ولاية شمال كردفان)

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

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## *Dedication*

This work is dedicated to my father, mother, Prof. Dr. Mohamed Abdo Desougi, and to all of my sisters, and their sons.

## *Acknowledgement*

First Thanks to Allah the Greatest

I would like to thank my supervisor Prof. Dr. Mohamed AbdoDesougi for his continued attention encouragement and advice throughout my work.

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## الاستهلال

قال تعالى (الَّذِي جَعَلَ لَكُم مِّنَ الشَّجَرِ الْأَخْضَرِ نَارًا فَإِذَا أَنْتُمْ مِنْهُ تُوقِدُونَ )

صدق الله العظيم

سورة يس الاية 80

## Abstract

This Study was conducted at Elain forest which is characterized by good soil in year (2017). The objective of this study was to enhance the forest protection and soil conservation. Research methods used for collection data through a questionnaire and it also included official and unofficial meetings. Secondary data were collected from reports, previous studies, and internet. The questionnaire included 26 questions and was distributed to forty respondents. The official meeting was with the director of (FNC) at Elobeid. The unofficial meeting was with the an elder man at Aldibuba village who is the sheik of the village. The following results were obtained and revealed that education level is low at the study area. The study also showed that the forest is important for water resources protection. The study revealed that Elain forest is important for soil conservation, it is also important for wildlife protection since it is a home for wildlife and is a source of food. The study also showed that Elain forest is used as a place for recreation specially for people living near it. The study also revealed that people income at the study area is mainly from agriculture. This study also showed that the main aim of Elain forest is a protection one and that the main tree species at the study area were *Acacia mellifera*, *Acacia seyal* and *Acacia senegal*. This study revealed that the soil is in a good condition.

This study showed that there are laws for protection and they were enforced extension work is found at the study area and there is environmental awareness.

## الخلاصة

أجريت الدراسة في غابة العين المحجوزه بولاية شمال كردفان التي تتميز بخصوبة أراضيها خلال هذا العام 2017. هدفت الدراسة لمعرفة دور غابات الحماية في الحفاظ على الأرض والدور الذي تلعبه غابة العين في المحافظة على مصادر المياه. طرق البحث شملت المعلومات الأولية التي جمعت عن طريق الاستبيان والمقابلات الرسمية وغير الرسمية وكذلك تدوين الملاحظات من الحقل الميداني. المعلومات الثانوية جمعت من التقارير والدراسات السابقة والإنترنت.

الاستبيان تضمن 26 سؤال وتم توزيعه على 40 مستهدف ,المقابله الرسمية كانت مع مدير الهيئة القومية للغابات وموظفوا الغابات, و المقابله غير الرسمية كانت مع شيخ قرية الدببية والمواطنين. اوضحت الدراسة الانخفاض الملحوظ في المستوى التعليمي بينت الدراسة أن معظم مصدر الدخل هو الزراعة وخلصت الدراسة أن غابة العين تمثل مصدرا مهما لحماية موارد المياه وتوفير مياه الشرب لمدينة الأبيض وبينت الدراسة اهمية غابة العين للحفاظ على التربة وحماية الحياة البرية وتوفير الغذاء للحيوانات كما تعتبر مكاناً للترفية , اوضحت الدراسة ان تربة الغابة جيدة.الغرض الاساسي من الغابة هو الحماية و أن بعض الانواع الشجرية الموجوده تشمل الكثر و الطلح والهشاب. وخلصت الدراسة بأن المواطنين لديهم الوعي البيئي وان هنالك برامج ارشادية.

أوصت الدراسة باتباع الخطة الفنية للمحافظة على الغابة و بتكثيف العمل الإرشادي.

## List of the main acronyms and abbreviations

F N C	Forest National Corporation
F A O	Food Agriculture Organization Of United Nation
N F I	National Forest Inventorty
E P A	<i>Environmental Protection Agency</i>
U N E P	United Nations Environmental Programe
I U N C	International Union for Conservation of Nature
N P W S	National Parks and Wildlife Service.
I P C C	Intergovernmental Panel on Climate Change
W C M C	World Conservation Monitoring Centre
G D P	Gross Domestic Product
SPSS	Statistical Package for the Social Sciences
PCLG	Poverty and Conservation Learning Group

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# Chapter 1

## 1. Introduction

Sudan is located between latitudes 23°5' 8° 45' N and longitudes 38° 34' 21 ° 49' E, in the north eastern part of Africa with an area of 1,882,000 square kilometers (USAID, 2012). The vast longitudinal extension gives the Sudan unique ecological characters, from dry sandy desert in the northern central parts to high rainfall areas in the south. The country is also covered with desert shrubs and stunted bushes (Sudanet, 2013). The combination of rainfall and soil texture determines the distribution of vegetation cover in the Sudan. Over 80% of Sudan's employment takes place in the agricultural sub-sector. The majorities of the population are farmers and pastoralists living on subsistence farming and livestock herding in a nomadic way of life (USAID, 2012; Sudanet, 2013). Sudan embraces diverse biological resources which represent an important national asset and heritage. Based on the Africover, the Forests National Corporation (FNC, 1996) estimates that, after secession of South Sudan, forests cover constitutes about 11.60% of the total area, the agricultural land represents 13.70%, rangelands 26.40%, bare land 48.13% and water bodies 0.17%. The national forest inventory of latitude 10°N (NFI, 1996) concluded that the annual average growth of forests in Sudan was approximately 11.0 million cubic meters which was far below the national annual consumption rate of wood estimated by (FAO/FNC, 1994) to be about 16.0 million cubic meters. The annual deforestation in Sudan is estimated at 2.4%. Energy consumption is considered as a major driver of deforestation (firewood and charcoal), (Technical Report, March 2012).

Forests are considered among the most important natural features in the Sudan where they form,

with other varying intensities of plant cover, the base for the terrestrial ecosystems of the country. Their indirect role in supporting agriculture through ameliorating an otherwise harsh climate, combating soil erosion and conserving water is well recognized by both government circles and rural societies. (GFRA, 2005). Forests play an important role in the welfare of the Sudanese population and in conserving and protecting the environment and the development of the country's national economy. The most important tree types in the Sudan include *Acacia nilotica*, *Acacia seyal*, *Acacia senegal*, *Balanites aegyptiaca*, and *Acacia mellifera* (Harrison and Jackson, 1958; Geller, et.al., 2009).

Perhaps the most tangible benefit derived by the people of Sudan from their forests is fuel wood, building poles and sawn timber. According to the results of the Forest Products Demand Survey (1994), Sudan would have consumed in 2002 energy equivalent to eight million tons of oil, 70% of this in the way of wood, charcoal and other biomass. Other products derived by people of Sudan from their forests include protection of watershed, fodder for domestic and wildlife, the most important of which is Gum Arabic (GA). The annual exports of G A range between 20-35 thousand tons fetching some U\$S 20- 80 millions.

Concurrently the rest is lost because of horizontal expansion of agriculture, fires, drought and overgrazing. Between 1990 and 2005, Sudan lost an estimated 12% of its forests, 8.8 million hectares. Most of the deforestation has occurred in the traditional and mechanized rain fed agricultural areas in northern, eastern, and central regions of the country (UNEP 2007, FAO 1999).

Protection forests are either natural forests planted under strict safety against the exploitation of production purposes for their role in the prevention of mountain slopes against soil erosion or landslides and the protection of watersheds and

streams valleys, rivers and ,for soil conservation and other land exposed to the collapse of the environment caused by natural forests over-exploitation, or artificial forests specially created in those areas where wiped out .

The study area ( Elain Forest) is located at the North kordofan State. its about 26 kilometers South East of Elobeid city its area is about 444,5912 acres.

At the study area is found an important water basin which is used mainly to supply Elobeid city with drinking water.

Also Elain Forest protects the wildlife found at the study area and it is an important area for recreation for the people living near it .

## **1-2 Description of Study area**

Back ground :

Elain forest was established in 1912 for an area of 12000 feddans the main objective was supply fuel wood energy to operate steam locomotive (trains). in 1932 the forest was reserved as a provincial forest and the area was exceeded to 2400 feddans ,including the seasonal villages (Elneel and khor Bagra ).

In 1950 the forest was managed by forest Department for its unique biodiversity and to protect water reservoirs which were established at that time to supplying Elobied town with drinking .later an extension area added to the main forest and the total area of the forest is 44459.52 feddans (SOS the Red sahel 1989, ENFMP, 2001)..

### 1-2-1 Location and boundaries :

The forest lies between latitude  $12^{\circ} 52'$  and  $13^{\circ} 3'$  N . and longitude  $30^{\circ} 16'$  degree and  $30^{\circ} 21'$  E. is located about 26 km south degree wpst of Elobied. The forest served by an all weather roads ,Elobied Elrhad railway and Elobied Kosti highway as recorded in (F N C ,2002).

### 1-2-2 Constitution and legal position :

Elain forest was listed in colonial time a land acquisition dated 22.2.1951. At that time ,it was recommended that Elain and Al Bacha be combined to make one reserve. The total area of this reserve was estimated to be 26659 feddans (11196.78Ha). This forest was then finally gazetted on 15.4.1954,Gazette number 867,with four rights of way through the forest.

About a year later ,1850 feddans (777ha.) were allocated for a water reservoir from the original reserve and round about the same time ,a new extension for the forest was acquired totaling 18650 feddans(7896ha.)

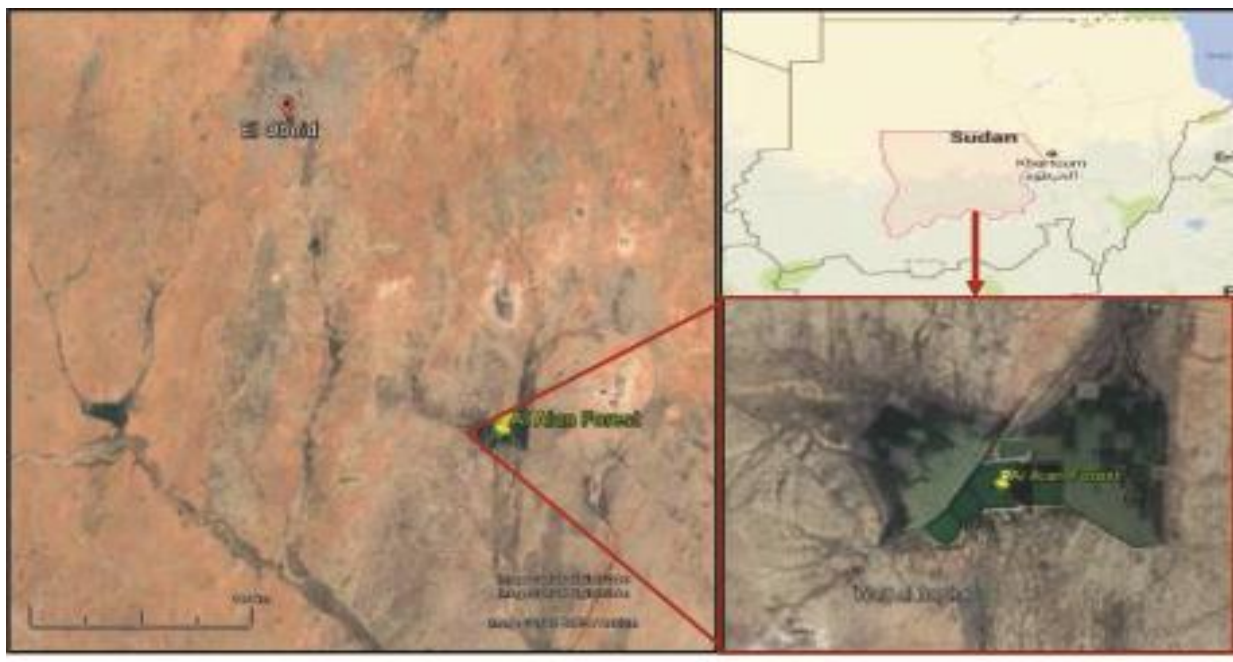


Fig. Study Area: Al Aian Forest-Modified from Google Earth and Google map

### 1-2-3 Forest Distribution :

The forest consists of three main parts , these are :

Central forest	24809.52 fed
Water reservoir	1850 fed
New extension	17800 fed
Total area of the forest reserve	44459.52 fed

### 1-2-4 Geology and soil :

Soil in the North Kordofan is generally a sandy soil barren sand dunes fixed and mobile site topography of the area has helped to protect it from sand dunes proportion to the presence of the mountains, as well as rain water has a great role to protect the area so it was transporting sand out of the area and the deposition away but nevertheless, the human intervention negatively in various ways helped in the incidence of major changes to the soil Fixed formed soils called Kapesol type which is a Garedud soil of the oldest soils in this region around the mountains there are cumulus affected soils in large sand and gravel and stones and called Alantesol (Hunting,1964)

### Types of Elain soil :

- a/ Brown Gardud cover most of the area of the forest .
- b/ Red Gardud .
- c/ Black Gardud a Good which is most productive soil within the forest .
- d / Craked clay soil a sedimentary soils which include Lands Elneel Khor and Khor bagar Nile .

### 1-2-5 Vegetation cover :

Climate and the amount of rainfall distribution in combination with soil and human activities determined the extent of the vegetation composition in the Elain Forest. The vegetation of the semi – desert is a varying mixture of grasses and

herbs, the major woody species in this arid zone are *Acacia mellifera* , *Acacia tortilis* and *Acacia seyal* .

### 1-3 **Research Problem**

Elain Forest is used as a protection forest and beside that part of Elain Forest is used for production purposes. But the study area is a marginal land, so this creates environmental problems and may lead to land degradation and change in the vegetation cover. Other problems at the study area is that some areas are used for agriculture and grazing Land this lead to soil degradation

### 1-4 **Objectives:-**

The main objective is to study the role of Elain Forest in Land conservation.

specific objectives :

1-To investigate the land use problems at the study area .

2- To investigate the best means and techniques for land reclamation .



## Chapter Two

### Literature Review

2-1 Protection forests are forests that mitigate or prevent the impact of a natural hazard, including a rock fall, avalanche, erosion, landslide, debris flow or flooding on people and their assets in mountainous areas. A protection forest generally covers the sloping area between a hazard potential (e.g. an unstable rock cliff or an avalanche release zone) and the endangered or exposed assets. In the Alps, protection forests are increasingly considered equal to engineered mitigation measures against natural hazards.(Brang, , et al. 2001)

#### **2-1-2The importance of conserving forests**

([www.japantimes.co.jp/opinion](http://www.japantimes.co.jp/opinion)29 Apr 2002 .)

Forests play a vital role in preventing global warming and building sustainable societies. So the need to protect and develop them can never be stressed enough. Japan's substantial forests make it a notable example. In brief, that is the message of the government report on forests and forestry released last week. The white paper, the first to be prepared under the Forest and Forestry Basic Law that took effect last July, points out various problems, including financial ones, that stand in the way of forest conservation.

Forests have a variety of functions, including land conservation, securing of water sources, control of climate change, and creation of natural environs essential to human existence. The law gives new value to these "multifunctional" forests with a view to achieving harmony between them and society.

There is a hard lesson to be learned from Japan's forestry administration in the postwar period. The government applied a rigid policy to developing forestry as an industry. As a result, domestic logs lost in the price competition with imported logs. The deficit has widened, pushing forest owners and forestry associations to brink of bankruptcy. They are so depressed, it is said, they cannot perform even the basic task of thinning out their stands of trees.

According to the report, domestic log prices have dropped to one-third of their peak of 30 years ago. The average annual income from forestry was only 260,000 yen in fiscal 2000. Forests cover 70 percent of the land, one of the highest rates among the developed countries. But imported logs account for 80 percent of the domestic demand, making Japan the world's third-largest log importer.

Recent studies prove, scientifically and economically, how important forests are. Of their various functions, those that can be measured in monetary value are worth 70 trillion yen, the report estimates. Reducing the burden on the environment and building a recycling-oriented society requires a well-defined policy focus on the utilization of domestic forests.

The relationship between forest conservation and global warming deserves special attention, given forests' great role as an absorber of carbon dioxide. Under the Kyoto treaty on climate change Japan is committed to cut emissions by 6 percent from the 1990 level in the five years between 2008 and 2012. More than half that deduction, 3.9 percent, is to be achieved through forest absorption.

The Forestry Agency, however, believes the 3.9 percent target will be impossible to achieve even if forest development is promoted at the current pace. Actual figures, it says, will probably miss the mark by a wide margin. So the pace needs to

be accelerated. In the long run, it is probably also necessary to introduce a carbon tax or a water-source tax, for example, because large-scale government spending is considered unavoidable.

However, the tax approach to the global warming issue — an issue that requires many years of patient efforts — is taking a back seat to immediate concerns, such as tax cuts for economic recovery and tax increases for fiscal reform. This is evident from discussions at the Council on Economic and Fiscal Policy and the Tax Commission.

The report, referring to “tree culture,” raises new possibilities for the mountain villages that saw their populations dwindle during the economy’s rapid expansion. These depopulated areas, it says, “can set future models for efforts to create a recycling-capable society.” That is a promising prospect indeed.

The report rightly says that forestry should be seen as culture, not just as an industrial sector, and that forestlands should be treated as an integral part of human activity. This is a welcome attempt to rejuvenate these heretofore neglected regions through exchanges with cities.

Forest conservation is also essential to wildlife protection. The latest conference on the biodiversity treaty in The Hague urged governments to take protective measures by 2010. Japan needs to bolster domestic efforts under the forestry conservation program adopted by the conference.

The government should also improve the vertically divided administrative system so it can take an integrated approach to forestry development, environmental protection and tax reform. Another challenge is to set rules for the shared roles between the central and local governments, and between private companies and

volunteer groups. Reviving forests and villages is a grand undertaking that requires the long-term, broad-gauged participation of communities and people across the country.

## **2-3 Soil conservation**

**Soil conservation** is the preventing of soil loss from erosion or reduced fertility caused by over usage, acidification, salinization or other chemical soil contamination.

Slash-and-burn and other unsustainable methods of subsistence farming are practiced in some lesser developed areas. A sequel to the deforestation is typically large scale erosion, loss of soil nutrients and sometimes total desertification. (handbook no. 703 1997)

Techniques for improved soil conservation include crop rotation, cover crops, conservation tillage and planted windbreaks and affect both erosion and fertility. When plants, especially trees, die, they decay and become part of the soil. Code 330 defines standard methods recommended by the US Natural Resources Conservation Service.(Rosa, ,2002)

Farmers have practiced soil conservation for millennia. Conservation practices fall in multiple categories:

### **2-3-1 Contour ploughing**

Contour ploughing orients crop furrows following the contour lines of the farmed area. Furrows move left and right to maintain a constant altitude, which reduces runoff. Contour plowing was practiced by the ancient Phoenicians, and is effective

for slopes between two and ten percent.<sup>1</sup> Contour plowing can increase crop yields from 10 to 50 percent, partially as a result from greater soil retention.

### **2-3-2 Terracing or terrace farming**

Terracing is the practice of creating nearly level areas in a hillside area. The terraces form a series of steps, each at a higher level than the previous. Terraces are protected from erosion by other soil barriers.

Terraced farming is more common on small farms and in underdeveloped countries, since mechanized equipment is difficult to deploy in this setting. It protects the soil from its erosion. It is one of the way by which soil erosion can be stopped.

### **2-3-3 Perimeter runoff control**

Tree, shrubs and ground-cover are effective perimeter treatment for soil erosion prevention, by impeding surface flows. A special form of this perimeter or inter-row treatment is the use of a “grass way” that both channels and dissipates runoff through surface friction, impeding surface runoff and encouraging infiltration of the slowed surface water.

### **2-3-4 Windbreaks**

Windbreaks are sufficiently dense rows of trees at the windward exposure of an agricultural field subject to wind erosion. Evergreen species provide year-round protection; however, as long as foliage is present in the seasons of bare soil surfaces, the effect of deciduous trees may be adequate.

### **2-3-5 Soil-conservation farming**

Soil-conservation farming involves no-till farming, “green manures” and other soil-enhancing practices. Such farming methods attempt to mimic the biology of virgin land. They can revive damaged soil, minimize erosion, encourage plant growth, eliminate the use of nitrogen fertilizer or fungicide, produce above-average yields and protect crops during droughts or flooding. The result is less labor and lower costs that increase farmers’ profits. No-till farming and cover crops act as sinks for nitrogen and other nutrients. This increases the amount of soil organic matter.( Dan,1981)

Repeated plowing/tilling degrades soil, killing its beneficial fungi and earthworms. Once damaged, soil may take multiple seasons to fully recover, even in optimal circumstances.

Critics argue that no-till and related methods are impractical and too expensive for many growers, partly because it requires new equipment. They cite advantages for conventional tilling depending on the geography, crops and soil conditions. Some farmers claimed that no-till complicates weed control, delays planting and that post-harvest residues, especially for corn, are hard to manage. (Bill Mollison,December,1988)

### **2-3-6 Soil organisms**

When worms excrete egesta in the form of casts, a balanced selection of minerals and plant nutrients is made into a form accessible for root uptake. Earth worm casts are five times richer in available nitrogen, seven times richer in available phosphates and eleven times richer in available potash than the surrounding upper 150 milli metres (5.9 in) of soil. The weight of casts produced may be greater than 4.5 kg per worm per year. By burrowing, the earth worm improves soil porosity, creating channels that enhance the processes of aeration and drainage (Arthur ,2004)

Other important soil organisms include nematodes, mycorrhiza and bacteria.

Degraded soil requires synthetic fertilizer to produce high yields. Lacking structure increases erosion and carries nitrogen and other pollutants into rivers and streams (Erica, 2015)

Each one percent increase in soil organic matter helps soil hold **20,000** gallons more water per acre.

### **2-4 Water conservation**

**Water conservation** includes all the policies, strategies and activities made to sustainably manage the natural resource fresh water, to protect the water environment, and to meet the current and future human demand.(defra.gov.uk. 2013).Population, household size, and growth and affluence all affect how much water is used. Factors such as climate change have increased pressures on natural water resources especially in manufacturing and agricultural irrigation. Many US

cities have already implemented policies aimed at water conservation, with much success.

The goals of water conservation efforts include:

- Ensuring availability of water for future generations where the withdrawal of fresh water from an ecosystem does not exceed its natural replacement rate.
- Energy conservation as water pumping, delivery and waste water treatment facilities consume a significant amount of energy. In some regions of the world over 15% of total electricity consumption is devoted to water management.
- Habitat conservation where minimizing human water use helps to preserve freshwater habitats for local wildlife and migrating waterfowl, but also water quality.

### **2-4-1 Strategies**

The key activities that benefit water conservation are as follows (*Geerts, S.; Raes, 2009*) :----

1. Any beneficial reduction in water loss, use and waste of resources.
2. Avoiding any damage to water quality.
3. Improving water management practices that reduce the use or enhance the beneficial use of water.
4. One strategy in water conservation is rain water harvesting. Digging ponds, lakes, canals, expanding the water reservoir, and installing rain water catching ducts and filtration systems on homes are different methods of harvesting rain water. Harvested and filtered rain water could be used for toilets, home gardening, lawn irrigation, and small scale agriculture.



5. Another strategy in water conservation is protecting ground water resources. When precipitation occurs, some infiltrates the soil and goes under ground. Water in this saturation zone is called ground water. Contamination of ground water causes the water supply to not be able to be used as resource of fresh drinking water and the natural regeneration of contaminated ground water can take years to replenish. Some examples of potential sources of ground water contamination include storage tanks, septic systems, uncontrolled hazardous waste, landfills, atmospheric contaminants, chemicals, and road salts. Contamination of ground water decreases the replenishment of available fresh water so taking preventative measures by protecting ground water resources from contamination is an important aspect of water conservation.

6. An additional strategy to water conservation is practicing sustainable methods of utilizing ground water resources. Ground water flows due to gravity and eventually discharges into streams. Excess pumping of ground water leads to a decrease in ground water levels and if continued it can exhaust the resource. Ground and surface waters are connected and overuse of groundwater can reduce and, in extreme examples, diminish the water supply of lakes, rivers, and streams. In coastal regions, over pumping ground water can increase saltwater intrusion which results in the contamination of groundwater water supply. Sustainable use of groundwater is essential in water conservation.

7. A fundamental component to water conservation strategy is communication and education outreach of different water programs. Developing communication that educates science to land managers, policy makers, farmers, and the general public is another important strategy utilized in water conservation. Communication of the science of how water systems work is an important aspect when creating a management plan to conserve that system and is often used for ensuring the right management plan to be put into action.

## **2-4-2 Social solutions**

Water conservation programs involved in social solutions are typically initiated at the local level, by either municipal water utilities or regional governments. Common strategies include public outreach campaigns, tiered water rates (charging progressively higher prices as water use increases), or restrictions on outdoor water use such as lawn watering and car washing. Cities in dry climates often require or encourage the installation of xeriscaping or natural landscaping in new homes to reduce outdoor water usage. (PDF) (US. EPA. 2002) Most urban outdoor water use in California is residential, illustrating a reason for outreach to households as well as businesses.

One fundamental conservation goal is universal metering. The prevalence of residential water metering varies significantly worldwide. Recent studies have estimated that water supplies are metered in less than 30% of UK households, and about 61% of urban Canadian homes (as of 2001). Although individual water meters have often been considered impractical in homes with private wells or in multifamily buildings, the U.S. Environmental Protection Agency estimates that metering alone can reduce consumption by 20 to 40 percent. In addition to raising consumer awareness of their water use, metering is also an important way to identify and localize water leakage. Water metering would benefit society in the long run it is proven that water metering increases the efficiency of the entire water system, as well as help unnecessary expenses for individuals for years to come. One would be unable to waste water unless they are willing to pay the extra charges, this way the water department would be able to monitor water usage by public, domestic and manufacturing services.

Some researchers have suggested that water conservation efforts should be primarily directed at farmers, in light of the fact that crop irrigation accounts for 70% of the world's fresh water use. The agricultural sector of most countries is important both economically and politically, and water subsidies are common. Conservation advocates have urged removal of all subsidies to force farmers to grow more water-efficient crops and adopt less wasteful irrigation techniques.

New technology poses a few new options for consumers. Elimelech, Menachem, features such as full flush and half flush when using a toilet are trying to make a difference in water consumption and waste. Also available are modern shower heads that help reduce wasting water: Old shower heads are said to use 5-10 gallons per minute, while new fixtures available are said to use 2.5 gallons per minute and offer equal water coverage.

### **2-4 -3 Household applications**

The Home Water Works website contains useful information on household water conservation. Contrary to popular view, experts suggest the most efficient way is replacing toilets and retrofitting washers.

Water-saving technology for the home includes (EPA) *Partnership Program. US:*

1. Low-flow shower heads sometimes called energy-efficient shower heads as they also use less energy
2. Low-flush toilets and composting toilets. These have a dramatic impact in the developed world, as conventional Western toilets use large volumes of water
3. Dual flush toilets created by Caroma includes two buttons or handles to flush different levels of water. Dual flush toilets use up to 67% less water than conventional toilets

4. Faucet aerators, which break water flow into fine droplets to maintain "wetting effectiveness" while using less water. An additional benefit is that they reduce splashing while washing hands and dishes
5. Raw water flushing where toilets use sea water or non-purified water
6. Waste water reuse or recycling systems, allowing:
  - Reuse of gray water for flushing toilets or watering gardens
  - Recycling of wastewater through purification at a water treatment plant. *See also Wastewater - Reuse*
7. Rainwater harvesting
8. High-efficiency clothes washers
9. Weather-based irrigation controllers
10. Garden hosenozzles that shut off water when it is not being used, instead of letting a hose run.
11. Low flow taps in wash basins
12. Swimming pool covers that reduce evaporation and can warm pool water to reduce water, energy and chemical costs.
13. Automatic faucet is a water conservation faucet that eliminates water waste at the faucet. It automates the use of faucets without the use of hands.

#### **2-4-4 Commercial applications**

Many water-saving devices (such as low-flush toilets) that are useful in homes can also be useful for business water saving. Other water-saving technology for businesses includes:

- Waterless urinals
- Waterless car washes

- Infrared or foot-operated taps, which can save water by using short bursts of water for rinsing in a kitchen or bathroom
- Pressurized water brooms, which can be used instead of a hose to clean sidewalks
- X-ray film processor re-circulation systems
- Cooling tower conductivity controllers
- Water-saving steam sterilizers, for use in hospitals and health care facilities
- Rain water harvesting
- Water to Water heat exchangers.

#### **2-4-5 Agricultural applications**

For crop irrigation, optimal water efficiency means minimizing losses due to evaporation, runoff or subsurface drainage while maximizing production. An evaporation pan in combination with specific crop correction factors can be used to determine how much water is needed to satisfy plant requirements. Flood irrigation, the oldest and most common type, is often very uneven in distribution, as parts of a field may receive excess water in order to deliver sufficient quantities to other parts. Overhead irrigation, using center-pivot or lateral-moving sprinklers, has the potential for a much more equal and controlled distribution pattern. Drip irrigation is the most expensive and least-used type, but offers the ability to deliver water to plant roots with minimal losses. However, drip irrigation is increasingly affordable, especially for the home gardener and in light of rising water rates. Using drip irrigation methods can save up to 30,000 gallons of water per year when replacing irrigation systems that spray in all directions. There are also cheap effective methods similar to drip irrigation such as the use of soaking hoses that can even be submerged in the growing medium to eliminate evaporation.

As changing irrigation systems can be a costly undertaking, conservation efforts often concentrate on maximizing the efficiency of the existing system. This may include chiseling compacted soils, creating furrow dikes to prevent runoff, and using soil moisture and rainfall sensors to optimize irrigation schedules. Usually large gains in efficiency are possible through measurement and more effective management of the existing irrigation system. The 2011 UNEP Green Economy Report notes that improved soil organic matter from the use of green manures, mulching, and recycling of crop residues and animal manure increases the water holding capacity of soils and their ability to absorb water during torrential rains", which is a way to optimize the use of rainfall and irrigation during dry periods in the season.

#### **2-4-6 Water Reuse**

Water shortage has become an increasingly difficult problem to manage. More than 40% of the world's population live in a region where the demand for water exceeds its supply. The imbalance between supply and demand, along with persisting issues such as climate change and exponential population growth, has made water reuse a necessary method for conserving water. There are a variety of methods used in the treatment of waste water to ensure that it safe to use for irrigation of food crops and/or drinking water.

Seawater desalination requires more energy than the desalination of fresh water. Despite this, many seawater desalination plants have been built in response to water shortages around the world .. This makes it necessary to evaluate the impacts of seawater desalination and to find ways to improve desalination technology. Current research involves the use of experiments to determine the most effective and least energy intensive methods of desalination.

Sand filtration is another method used to treat water. Recent studies show that sand filtration needs further improvements, but it is approaching optimization with its effectiveness at removing pathogens from water. Sand filtration is very effective at removing protozoa and bacteria, but struggles with removing viruses. (*Han, 2017*) Large-scale sand filtration facilities also require large surface areas to accommodate them.

The removal of pathogens from recycled water is of high priority because wastewater always contains pathogens capable of infecting humans. The levels of pathogenic viruses have to be reduced to a certain level in order for recycled water to not pose a threat to human populations. Further research is necessary to determine more accurate methods of assessing the level of pathogenic viruses in treated wastewater.

## **2-5 Wildlife conservation**

**Conservation** is the practice of protecting wild plant and animal species and their habitats. The goal of wildlife conservation is to ensure that nature will be around for future generations to enjoy and also to recognize the importance of wildlife and wilderness for humans and other species alike. Many nations have government agencies and NGO's dedicated to wildlife conservation, (*Meyer,1993*).which help to implement policies designed to protect wildlife. Numerous independent non-profit organizations also promote various wildlife conservation causes.

According to the National Wildlife Federation, wildlife in the United States gets a majority of their funding through appropriations from the federal budget, annual federal and state grants, and financial efforts from programs such as the Conservation Reserve Program, Wetlands Reserve Program and Wildlife Habitat Incentives Program. Furthermore, a substantial amount of funding comes from the state through

the sale of hunting, fishing licenses, game tags, stamps, and excise taxes from the purchase of hunting equipment and ammunition, which collects around \$200 million annually.

Wildlife conservation has become an increasingly important practice due to the negative effects of human activity on wildlife (*"Wildlife Conservation" June 2012.*). An endangered species is defined as a population of a living species that is in the danger of becoming extinct because of several reasons. Some of the reasons can be, that 1. the species have a very low population, or 2. they are threatened by the varying environmental or prepositional parameters.

### **2-5-1 Major dangers to wildlife**

Fewer natural wildlife habitat areas remain each year. Moreover, the habitat that remains has often been degraded to bear little resemblance to the wild areas which existed in the past. Habitat loss—due to destruction, fragmentation and degradation of habitat—is the primary threat to the survival of wildlife in the United States. When an ecosystem has an ecosystem are some of the ways habitats can become so degraded that they no longer support native wildlife. ([www.nwf.org](http://www.nwf.org). 2016).

- Climate change: Global warming is making hot days hotter, rainfall and flooding heavier, hurricanes stronger and droughts more severe. This intensification of weather and climate extremes will be the most visible impact of global warming in our everyday lives. It is also causing dangerous changes to the landscape of our world, adding stress to wildlife species and their habitat. Since many types of plants and animals have specific habitat requirements, climate change could cause disastrous loss of wildlife species • (^McCallum 2009.). A slight drop or rise in average rainfall will translate into large seasonal changes. Hibernating mammals,



reptiles, amphibians and insects are harmed and disturbed. Plants and wildlife are sensitive to moisture change so, they will be harmed by any change in moisture level. Natural phenomena like floods, earthquakes, volcanoes, lightning, forest fires.

- Unregulated Hunting and poaching: Unregulated hunting and poaching causes a major threat to wildlife. Along with this, mismanagement of forest department and forest guards triggers this problem.
- Pollution: Pollutants released into the environment are ingested by a wide variety of organisms. Pesticides and toxic chemical being widely used, making the environment toxic to certain plants, insects, and rodents.
- Perhaps the largest threat is the extreme growing indifference of the public to wildlife, conservation and environmental issues in general. Over-exploitation of resources, i.e., exploitation of wild populations for food has resulted in population crashes (over-fishing and over-grazing for example).
- Over exploitation is the over use of wildlife and plant species by people for food, clothing, pets, medicine, sport and many other purposes. People have always depended on wildlife and plants for food, clothing, medicine, shelter and many other needs. But today we are taking more than the natural world can supply. The danger is that if we take too many individuals of a species from their natural environment, the species may no longer be able to survive. The loss of one species can affect many other species in an ecosystem. The hunting, trapping, collecting and fishing of wildlife at unsustainable levels is not something new. The passenger pigeon was hunted to extinction, early in the last century, and over-hunting nearly caused the extinction of the American bison and several species of whales.
- Deforestation: Humans are continually expanding and developing, leading to an invasion of wildlife habitats. As humans continue to grow they clear forested land to create more space. This stresses wildlife populations as there are fewer homes and food sources to survive off .

Population: The increasing population of human beings is the most major threat to wildlife. More people on the globe means more consumption of food, water and fuel. Therefore, more waste is generated. Every major threat to wildlife as seen above, is directly related to increasing population of human beings. If the population is altered so is the amount of risk to wildlife. The less is the population, less is the disturbance to wildlife.

Today, the Endangered Species Act protects some U.S. species that were in danger from over exploitation, and the Convention on International Trade in Endangered Species of Fauna and Flora (CITES) works to prevent the global trade of wildlife. But there are many species that are not protected from being illegally traded or over-harvested

### **2-5-2 Wildlife conservation as a government involvement**

In 1972, the Government of India enacted a law called the Wild Life (Protection) Act. The World Conservation Strategy was developed in **1980** by the "International Union for Conservation of Nature and Natural Resources" (IUCN) with advice, cooperation and financial assistance of the United Nations Environment Programme (UNEP) and the World Wildlife Fund and in collaboration with the Food and Agriculture Organization of the United Nations (FAO) and the United Nations Educational, Scientific and Cultural Organization (Unesco). The strategy aims to "provide an intellectual framework and practical guidance for conservation actions. This thorough guidebook covers everything from the intended "users" of the strategy to its very priorities. It even includes a map section containing areas that have large seafood consumption and are therefore endangered by over fishing. The main sections are as follows ([www.fws.gov](http://www.fws.gov) Retrieved 2016)

## **2-6-1 Recreation**

Traditionally the main function of forests in Europe has been wood production. Over the last few decades, in many countries, management for nature and ecological functions of forests has become an important secondary objective, sometimes surpassing wood production as the primary function. The social functions of forests, e.g.

Increasing urbanisation and the health benefits of an active lifestyle have created a demand for outdoor recreation. Forests provide an environment where it is possible to escape from the stresses of modern life, to connect with nature and the countryside and experience tranquil and scenic places. Forests also provide wild areas where activities such as mountain biking, orienteering and other active and challenging sports can be pursued. The development of forests for recreation is seen as an important aspect of sustainable forestry and there is an increasing recognition of the wide ranging benefits that forests provide to society. Today, recreation is perhaps the most important non-timber service provided by forests.

Since the early 1970s there has been an active programme of providing recreational facilities in Irish state forests. To date, some 150 recreational sites and 11 forest parks have been established in forests throughout the country. Most of these facilities were established by the Forest Service which today are being maintained and expanded by Coillte. In addition to the provision of recreational sites – picnic areas, trails etc., Coillte also has an Open Forest Policy that allows free public access to all parts of its 445,000ha forest estate

While Coillte is the main provider of forest recreation in Ireland the National Parks and Wildlife Service (NPWS) also provide open access to native woodland areas in

their national parks and nature reserves. Urban forests owned by County Councils and local communities are public forests primarily established and managed for recreation. These are relatively small in size but being located near population centres are popular and frequently used. Recreation in private/farm forests is limited at present, but there is willingness by many owners to develop facilities which will provide income from the forest in addition to timber.

Forests are a very valuable recreation resource attracting millions of visitors each year (estimated at 18 million visits to Coillte forests by Fitzpatrick Associates in 2005). Forests as tourism infrastructure contribute significantly to the economic output of the country. The public good benefits are also extremely valuable in supporting the forest industry by increasing the return on investment and gaining support for improved investment in forest-related activities.(PFEU 2003-2008) This programme was funded by the European Union

## **RECREATION SITES**

### **2-6-2 Coillte Forests**

Forest recreational areas are located in all counties in Ireland. The Coillte Outdoors website is the main online source of forest recreation facilities in Ireland which provides comprehensive information on recreation in Coillte forests. Recreation areas can be easily located by county and descriptions of the location of the site and facilities together with maps and description of trails etc are available to download.

### **2-6-3 National Parks**

Communication recreation facilities in the national parks and nature reserves. Many of these areas contain native woodlands that are important for biodiversity and nature conservation. Walking trails are provided with interpretive signage giving descriptions of the native flora and fauna to be found in the locality. The national parks and nature reserves in Counties Kerry and Wicklow are of particular interest for woodland walks in scenic areas. National Parks and Wildlife Service – Personal Communication(NPWS) also provide

### **2-7 The role of forest protected areas in adaptation to climate change**

Protected areas are even more important for biodiversity conservation and human livelihoods in a world with a changing climate.

The relationship between forests and climate change is intricate. On the one hand forests can mitigate climate change by absorbing carbon, while on the other they can contribute to climate change if they are degraded or destroyed. In turn climatic changes may lead to forest degradation or loss – which exacerbates climate change further.

A protected area is defined as: “A clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values” (Dudley, 2008). Forest protected areas help conserve ecosystems that provide habitat, shelter, food, raw materials, genetic materials, a barrier against disasters, a stable source of resources and many other ecosystem goods and services – and thus can have an important role in helping species, people and countries adapt to climate change. By virtue of their protective status, these forests should remain free from

destructive human intervention. They can thus continue to serve as a natural storehouse of goods and services into the future.

Today climate change is one of the main emerging threats facing biodiversity. Up to a quarter of mammal species (about 1 125) (IPCC, 2002) and about 20 percent of bird species (about 1 800) (IPCC, 2007) are at risk of global extinction because of climate change.

Protected areas that were set up to safeguard biodiversity and ecological processes are likely to be affected by climate change in a number of ways. Climate change is expected to cause species to migrate to areas with more favourable temperature and precipitation. There is a high probability that competing, sometimes invasive species, more adapted to a new climate, will move in. Such movements could leave some protected areas with a different habitat and species assemblage than they were initially designed to protect. For example, Scott (2005) found that a stated objective of Prince Albert National Park in Saskatchewan, Canada, to protect ecological integrity “for all time”, is unrealistic, as all possible climate scenarios project the eventual loss of boreal forests and their related biodiversity in that area. Climate change is expected to lead to disease outbreaks as pest species may become more resistant or survive longer and new pest species may invade protected areas. For instance, Pounds *et al.* (2006) have traced the much publicized extinction of the Monteverde harlequin frog (*Atelopus* sp.) and the golden toad (*Bufo periglenes*) in the Monteverde forest of Costa Rica nearly two decades ago to warming in the American tropics which is thought to have favoured a particular fungus that infected the amphibians. Climate change is also likely to lead to a higher incidence of fire in some situations and floods in others (IPCC, 2007).

In many cases, the negative effects of climate change on protected areas will be compounded by other stresses, notably those caused by humans, for example through over consumption, pollution or encroaching urbanization. Biodiversity in protected areas that may already be vulnerable because of these human threats may be more quickly or more severely affected by climate change.

With these and other likely changes, the management of existing protected areas will need to be modified if they are to fulfil their biodiversity conservation role as well as support adaptation to climate change. In a changing climate, protected areas will take on added importance as safe havens for biodiversity by offering good-quality habitats less vulnerable to climate extremes (African buffalo, *Synceruscaffer* – a species susceptible to drought conditions – in Ngorongoro Conservation Area, United Republic of Tanzania)

### **2-7-1 IMPORTANCE OF FOREST PROTECTED AREAS IN THE FACE OF CLIMATE CHANGE**

Protected areas have been recognized for several decades as an essential tool for conserving biodiversity. The impacts of climate change now give them a renewed role as adaptation tools for a changing climate. Their importance in this respect is threefold:

- in supporting species to adapt to changing climate patterns and sudden climate events by providing refuges and migration corridors;
- in protecting people from sudden climatic events and reducing vulnerability to floods, droughts and other weather-induced problems;
- indirectly, in supporting economies to adapt to climate change by reducing the costs of climate-related negative impacts.

### **2-7-2 Ecological role**

The world now has over 100 000 protected areas, of which the terrestrial ones cover 12.2 percent of the earth's surface (UNEP-WCMC, 2008). Protected areas can be among the most effective tools for protecting species from extinction and from the impact of human-induced threats. If well planned and managed, they can contribute to biodiversity conservation by:

- representing distinct natural communities within conservation landscapes and protected areas networks;
- maintaining ecological and evolutionary processes that create and sustain biodiversity;
- maintaining viable populations of species;
- conserving blocks of natural habitat large enough to be resilient to large-scale disturbances and long-term changes (Noss, 1992).

In the creation of most protected areas and in the identification of sites that achieve targets for habitat and species representation to date, a relatively constant climate has been assumed (Hannah *et al.*, 2007). However, as the climate changes, plans and assumptions about protected areas need to be reconsidered (McCarty, 2001). Areas for future conservation efforts need to be assessed in the face of different climate change scenarios, and the current protected area network needs to be reviewed to ensure that it can deliver intended conservation results and help mitigate negative climate change impacts.

In a changing climate, protected areas will take on added importance as safe havens for biodiversity by offering good-quality habitats less vulnerable to climate extremes, by providing refuges for threatened species and by conserving important gene pools.



It will also become more important to protect reference landscapes – ecosystems on which restoration planning is based, and which provide a basis for evaluating the success of restoration (Sayer, 2005).

Networks of protected areas within large-scale landscapes will help accomplish the fourth point above, providing resilience to climate change. Landscape planners can help biodiversity adapt to changing conditions by carefully defining and managing connections or corridors between protected areas, removing or preventing barriers such as roads or monoculture plantations of trees or agricultural crops and creating “stepping stones” for particular species .

To ensure the survival of priority plant and animal species targeted for conservation, it will be important to obtain new information on their:

- sensitivity to disruptions (e.g. by roads, agriculture, settlements);
- sensitivity to edge effect, i.e. the ratio between perimeter and area (generally the greater the ratio, the greater the sensitivity to disturbances from outside the perimeter);
- food specialization and availability;
- habitat quality required (e.g. primary or secondary forest);
- movements, particularly when under stress;
- migration habits and routes;
- relationship to local human communities and to other species (Mansourian, 2006).

### **2-7-3 Social role**

Protected areas may provide ecosystem services such as drinking water, carbon storage and soil stabilization; harbour sacred sites for different faith groups; and hold

important gene reservoirs of value in medicine, agriculture and forestry. In the face of climate change these roles all become more critical to enhance the adaptive capacity of local people to cope with climate change (Simms, 2006).

Protected areas, by helping to maintain natural ecosystems, can contribute to physical protection against major disasters, which are predicted to be on the rise with climate change (Scheuren *et al.*, 2007). Although the scale of disasters generally depends on an aggregation of factors (e.g. building regulations, land use), in many cases ecosystem maintenance and forest protection can greatly reduce their impacts. Coastal mangroves, coral reefs, flood plains and forests may buffer land, communities and infrastructure against natural hazards. For example, during the Indian Ocean tsunami in 2004, vegetation-covered coastal sand dunes at Yala and Bundala National Parks in Sri Lanka completely stopped the waves and protected the land behind them (Caldecott and Wickremasinghe, 2005). Some protected areas also provide an opportunity for active or passive restoration of traditional land use practices such as agroforestry and crop terracing, which may help mitigate the impacts of extreme weather events in arid lands, for example by reducing the risk of erosion and by maintaining soil structure (Stolton, Dudley and Randall, 2008).

In addition, protected area management can help empower marginalized human populations or community groups. Alternative forms of protected area governance such as community conservation or joint management, for example, are being implemented to reduce conflicts over land and to promote long-term maintenance of protected areas for provision of benefits to stakeholders. A case in point is the “Parks with People” policy developed in Bolivia in 2005 to engage indigenous communities in management of protected areas (Peredo-Videa, 2008).

#### **2-7-4 Economic role**

If a country's natural habitat is destroyed by climate change impacts, its economy will suffer. A recent study (Dasgupta *et al.*, 2007) found that the gross domestic product (**GDP**) of a number of countries, led by Viet Nam, could be negatively affected by sea level rise, saltwater intrusion and natural disasters attributed to climate change. In helping to protect natural habitat, protected areas indirectly help to protect the national economy.

In addition, protected areas can provide a direct means of enhancing revenue, notably through tourism, but also through the valuable products they harbour and the services they provide. For example, Guatemala's Mayan Biosphere Reserve provides employment for over 7 000 people and generates an annual income of approximately US\$47 million (PCLG, 2002). In Madagascar, a study of 41 reserves found that the economic rate of return of the protected area system was 54 percent, essentially from watershed protection and to a lesser extent from ecotourism (Naughton-Treves, Buck Holland and Brandon, 2005). Thus, protected areas provide a safety net which can be valuable in times of stress, such as extreme climate events.

The loss of protected areas may lead to significant costs, for example infrastructure damage and human tragedy caused by desertification or tsunamis, or to loss of revenue, from tourism for instance. Furthermore, deforestation of major forest blocks, such as the Amazon, is thought to have an impact on global rainfall, which in turn affects agriculture and therefore the livelihoods of millions of people (Nepstad, 2007). Protected areas therefore not only help protect biodiversity, but also indirectly contribute to the planet's food security.

### **2-7-5 Managing protected areas in landscapes**

Effective management is essential to climate adaptation. Protected area management to ensure adaptation to climate change may include restoration, focusing on resilient habitats, managing specifically for anticipated threats such as fire and pests, and addressing other threats (which can be exacerbated by climate change). Restoration will be important both within protected areas and around them in targeted locations within the wider landscape. WWF adopts a forest landscape restoration approach in which key elements of the landscape are identified for restoration to achieve multiple objectives and make the whole landscape more functional in meeting environmental, social and economic objectives (Mansourian, Vallauri and Dudley, 2005). In the lower Danube basin in Bulgaria, for example, WWF and partners have focused on restoring floodplain forests to ensure that this biological corridor, important for spawning fish as well as nesting and migratory birds, can withstand climate change (WWF, 2002). Since ancient habitats that have withstood variations in climate to date may be more likely to endure future changes, WWF is also working with local authorities in Chile to ensure protection of the resistant Valdivian forest which has trees over 3 000 years old.

Future protected area management strategies and plans should also include options for carbon storage as well as reducing emissions from deforestation and degradation. Regular assessments of management must be a priority so that interventions can be adjusted if necessary.

## **Chapter Three**

### **Material and methods**

This study was conducted at a Elain forest North Kordofan Primary data were collected from questionnaire , meetings , observations and remote sensing. Secondary data were collected from suitable references ,annual reports and from Net

#### 3-1.Socio –economic study

A socio – economic study was conducted at Eldibaba , Eljabel and

Al Gibna villages .

The questionnaire was included twenty six questions and forty respondents were chosen randomly .

#### 3-2. Official Meeting

The director of the National Forestry Corporation of North Kordofan Sayed Mohamedain Alamin (2017) I asked from the plan of the Elain forest and the purposes of the forest .

#### 3-3.Unofficial meeting

Sheikh Yaqub (2017)of Aljabal village were asked about Elain forest in relation to the activities in which they are involved .

### **3-4 Observation**

Elain Forest was seen the technique of harvesting water in Elain forest called dolphin

### 3-5. Remote sensing : google Earth

A modern photos were obtained using remote sensing for Elain Forest which showed the condition of Elain forest during the period (2002) (2009) and present condition (2017)

### 3-6. Data analysis (SPSS)

The data analyzed statistically by using package of scientific system

## Chapter four

### Results and Discussion

#### 4-1 Socio-economic study

Asocio-economic study was conducted at Eldibaba, Eljabel and Al Gibna villages

The questionnaire include twenty six questions and forty respondents were chosen randomly.

Table (1) sex of respondents

Type	Frequency	percentage
Male	25	62.5
Female	15	37.5
Total	40	100

Table (1) Showed that most of the respondents.were male which is equal (62.5%)of the respondents. and female were (37.5%)

Table (2) Agegroup Respondents

Age group	Frequency	percentage
20----40	19	47.5
40-----60	12	30.0
>60	9	22.5
total	40	100

Table (2) Showed that most of the respondent were of age group range between (20-40) which is equal 47.5%

Table (3) Social Status

Social status	frequency	Percentage
Married	29	72.5
Single	11	27.5
Total	40	100

Table (3) Showed that 72.5% of the respondent were married while (27.5)% were single .

Table (4) Education level

Education	frequency	Percentage
illiterate	11	27.5
khalawi	6	15.0
primary	10	25.0
Secondary	7	17.5
Unversitiy	6	15.0
Total	40	100

Table (4) Showed that most of the respondent were illiterate (27.5%) and primary (25.0%) this because their children work in the forest and there is no school in the village other hand there is school far from the village

Table (5) Sources of income

Answer	Farmer		Trade		Header		Employee	
	frequency	Percentage	frequency	Prcentage	Frequency	Percent age	frequency	Percentage
Yes	33	82.5	8	20	3	7.5	4	10.0
No	7	17.5	32	80	37	92.5	36	90.0
Total	40	100	40	100	40	100	40	100

Table showed that (82.5%) the respondents were farmers cultivate the land for crops



Table(6) Main Tribes

Main tribes	Bedearia		Gawama		Flata		Shnabla		Dajo	
Yes No	Freq uenc y	Perc enta ge	Freq uenc y	Perce ntage	Freq uenc y	Perce ntage	Freq uenc y	Per cent age	Freq uenc y	Perce ntage
	30	75.0	30	75.0	27	67.5	15	37.5	4	10.0
	10	25.0	10	25.0	13	32.5	25	62.5	36	90.0
Total	40	100	40	100	40	100	40	100	40	100

Table (6) Showed that main tribes were Bedearia by(75.0%) and Gawama(75.0%) Flata(67.5%) Shnabla (37.5%) Dajo (10.0%)

Table (7) Tribes Conditions

Resident		Semi nomdic		Nomdic	
Frequency	Percent%	Frequency	Percent%	Frequency	Percent%
37	92.5%	2	5.0	1	2.5
40	100	40	100	40	100

Table (7) showed that at the study area tribes were resident by 92.5% and semi nomdic5.0% nomdic2.5%

Table (8) List of Common Trees in the study area

Botanical name	Local name
<i>Acacia mellifera</i>	الكتز
<i>Acacia seyal</i>	الطلح
<i>Acacia senegal</i>	الهشاب
<i>Acaica nubica</i>	اللغوت
<i>ZiZiphus spina Christi</i>	السدر
<i>Acacia trotilis</i>	السيال
<i>Acacia nilotica</i>	السنت
<i>Balanites aegyptiaca</i>	الهجليج
<i>Adansonia digitata</i>	التبلدي
<i>Khaya senegalensis</i>	المهوقني
<i>Grewia tenax</i>	القضيم
<i>Combretum spp</i>	الصباغ
<i>Albizia amara</i>	العرد
<i>Tamrindus indica</i>	العرديب
<i>Combretumcordofanaum</i>	الهبيل

Table (9) Condition of vegetation Cover

Vegetation condition	frequency	percentage
Good	32	80
Medium	8	20
Poor	0.0	0.0
Total	40	100

equals to 80% of the total respondents. This result which is agreed with what said by the director of the forest (2017) the vegetation cover in the forest is good.

Table (10) Main Purpose of the Forest

Answer	protection		production	
	frequency	percentage	frequency	percentage
Yes	35	87.5	15	37.5
No	5	12.5	25	62.5
total	40	100	40	100

Table (10) showed that the main purpose of the forest is to protection (87.5%) and production (37.5)

Table (11) the forest benefits

Benefits from forest	Protection water source		Protection wildlife		Recreation		Source of income	
	frequency	Percentage	frequency	percentage	frequency	percentage	frequency	percentage
Yes	32	80	7	17.5	5	12.5	19	47.5
No	8	20	33	82.5	35	87.5	21	52.5
Total	40	100	40	100	40	100	40	100

Table (11) showed that respondents benefits from the forest according to the percentages such : forest protection water 80% , source of income 47.5% ,protection wildlife 17.5% , Recreation 12.5%

Table (12) show Soil condition

Soil condition	frequency	Percentage
Good condition	34	85.0
Medium condition	6	15.0
Poor	0	0.0
Total	40	100

85% of respondents answered that Elain forest soil is good condition Because of good protection from cutting trees that will be eroded by water this is the same as reported by (Rosa.2002).she said the farmers have practiced soil conservation in from contour ploughing terracing ,runoff roll ,and wind break.

Table (13) Activities in the ElainForest

Active in the forest	Trees cutting		planting		Grazing	
	frequency	Percentage	frequency	Percentage	frequency	Percentage
Yes	16	40.0	20	50.0	14	35.0
No	24	60.0	20	50.0	26	65.0
Total	40	100	40	100	40	100

Table No (13) showed that the most activities in the forest is as follows planting (50.0%) then trees cutting (40.0%) Grazing (35.0%)

Table (14) Forest condition

Forest Condition	frequency	Percentage
Good	35	87.5
Medium	5	12.5
Total	40	100

Table (14) showed that the forest condition is good (87.5%)



Figure (1) condition of Alain forest 2017 Source: googleearth(2017)



Figure (2): condition of Alain forest 2009 Source :google earth (2017)



Figure (3): Status of Alain forest 2002 Source: google earth (2017)

Table (15) Cause of Damage

Cause of damage	Illegal cutting		overgrazing		Agriculture Activities		Fire	
	frequency	percentage	frequency	percentage	frequency	percentage	Frequency	percentage
Yes								
No	21	52.5	19	47.5	4	10	3	7.5
	19	47.5	21	52.5	36	90.0	37	92.5
total	40	100	40	100	40	100	40	100



Table (15) showed that cause of damage Was as follows:-1-Illegalcutting(52.5%) then2- Overgrazing(47.5%) 3-Agriculture(10%) 4- Fire (7.5).



Figure (4): illegal cutting down of trees inside the forest



Figure (5) Animals were grazing in the forest.

Table (16) Agriculture Programs

Program agriculture	frequency	percentage
Yes	38	95.0
No	2	5.0
Total	40	100

Table(16 ) showed that these are agriculture program ( 95.0%)

Table (17) Environment awareness at the study area

Awareness	Frequency	percentage
Yes	39	97.5
No	1	2.5
Total	40	100

Table (17) showed that these are environmental awareness (97.5%)

Table (18) Protection laws

Laws	Frequency	Percentage
Yes	40	100
No	0	0
Total	40	100

In table (18),100% of the respondents answered yes ,the laws that there are laws are effective for protection the forest.this in the same as what said by Alsheik (2017),that forest is protected from the grazing and cutting.

Table (19)Are their extension programs

extension	frequency	Percentage
Yes	40	100
No	0	0
Total	40	100

Table (19) Showed that there are extension programs equals to 100% of the total respondents.

Table (20) People Participation in extension

participation	Frequency	Percent
Large	32	80.0
Medium	7	17.5
Little	1	2.5

Table No (21) showed that People at the study area participate in extension work (80.0%)

Table (21) Recommendation for Protection

Recommendation	Trees planting		Prevention over Grazing		Prevention of trees cutting	
	Frequency	Percent %	Frequency	Percent %	Frequency	Percent %
Yes						
No	23	57.5	9	22.5	18	45.0
	17	42.5	31	77.5	22	55.0
Total	40	100	40	100	40	100

Table No(22) showed that the recommendation for forest Protection were as follows 1- trees planting (57.5%) then Prevention trees cutting (45.0%) Prevention over grazing (22.5%)

## **Official meeting**

This official meeting was conducted with sayed Mohamedain Elamin director of (FNC) of North Kordofan at Elobeid .,He said that the importants of Elain forest is for protection water source,and for wood protection .He added that the soil at Elain forest is in a good condition and that vegetation cover is dense He mentioned that the species found at Elain forest are a mainly acaica like Acaicamellifera,Acacia nilotica,and Acacia seyal besids those there are Azadirochtainitdica and Khayasenegalensis.He also said that people benefit a lot from Elain forest specially in protection of water resource and soil conservation .it helped a lot to reduce soil erosion also Elain forest is a source of income for people living near the study area and it is also a place for recreation for people living at Elobeid city.Damage caused of Elain forest is from cutting down of trees,overgrazing and dieback disease.Laws for forest protection are found . he also said that there is a need to follow the technical plan,establishment of observation towers and more extension work. and people participation to protect the forest.

## **Un official meeting:-**

This meeting was conducted with sheik yagoub who is the sheik of Aldibubavillage. He said that the main tribes at the study are Bederia and Gwamoa and that their main income is from agriculture and forest products, hesaid thatthe main objective of the forest is to protect water resource and the provide the people of the study area with their need from of fuel wood and building material. He explained that the main damage at Elain forest from tree cutting, overgrazing and fire.He also said that the main tree species found there Are A acaciamellifera, Acacia seyal and A cacia nilotica.He mentinoned that in the past the main animals were deers and monkeys.

At the present time cows, sheep and camels are found at Elain forest

He also mentioned that there are laws and that they are enforced.

## Chapter Five

### Conclusion and Recommendations

#### 5-1 Conclusion

This study was conducted at Elian Forest near Elobeid North Kordofan during the year 2017 to know the role of the forest as a protection and conservation forest . This study showed that the level of education at the study area was low .The study also revealed that sources of income was mainly from agriculture .The study also showed that Elain forest is important for protection of water resources which is needed for drinking and other uses at Elobeid city. This study also showed that Elain forest is also important for conservation.Its also important for wildlife since it's a source of food and a habitat for animals .The study also revealed that Elain forest is a place of recreation for people living at Elobeid and neighboring areas. The study also showed that the aim of the forest is mainly as protection one more than a production one and that the trees found at the study area were mainly *Acacia mellifera*, *Acacia seyal* and *Acacia senegal*. This study showed that the soil is a good condition and this is mainly due to presence of a good vegetation cover.

The study also revealed that there are laws for the protection of the forest and they are enforced .Extension work is found at the study area and environmental awareness is good .

## **5-2 Recommendations**

This study recommended the following :-

- The technical plan for Elain Forest should be executed as planned .
- increasing the number of guards to intensify protection .
- Extension work should be done to increase people environmental awareness .



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## Appendix

### The Role of Protection Forests in land Conservation

1- Gender :- Male  Female

2- Age Category :- a- 20\_40  b- 40\_60  <60

3- Marital status :- a- Married  b- Single  c- Divorced

4- Education level :- a- Illiterate  b- khalwa  c- primary   
d-Secondary  e- University level

5- Source of income

a- Agriculture  b- grazing  c- Trade

6- the most important tribes in the region?

(A)

(b)

(c)

7:-Tribes Condtions :- a- Resident  b- Semi nomdic  c- Nomodic

8- the dominant trees Species in the Elain forest?

a-

b-

c-

9- :-Status of vegetation cover:-a- good  b- Modrate  c- poor

10- Forest benefits :- a- Protection of water sources  b- Protection of wildlife  c- Recreation  d- Sources of income

11- The main purpose of the forest :- a- Protection  b-Habitat for animals  c- Recreation  d- Protuctive

12 – Soil condition:- a- Good  b- Modreate  c- Poor

13- Activities of Elain forest :- a- Tree cutting  b-Agriculture  c- Grazing

14- The conditions of Elain forest :- a- Good  b- Modreate  c- Poor

15- Cause of damage to the Elain forest :- a- Tree cutting  b- overgrazing  c- other



16- Is there Any planting program to meet the objective of Elain forest:- a- Yes   
b- No

17- Do the people at the Study have environmental awareness about the importance of forest and its conservation:- a- Yes  b- No

18- Are there any laws for forest protection:- a- Yes  b- No

19- Are laws effective? A- Yes  b- No

20- Do people participate in forest extension programe? a- Yes  b- No

21-The extent of people participation extenssion programs:- 1- large   
2-moderate  3- little

22- What are you suggestion for soil conservation:- a- planting trees   
b-prevention of grazing  c- prevention of cutting