

## Impacts of Climate Change on Forest Resources in South Sudan: A Case Study of Rejaf County, Jubek State

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### **Abstract**

*This study focused on the Impacts of Climate Change on Forest Resources in South Sudan: A case study of Rejaf County, Jubek State. The paper aim to find out the impacts of climate change on forest resources in Rejaf County, and identifying some of the natural impacts on the forest resources and the biodiversity which can be affected by climate change in the area. The paper also wanted to examine the methods of forest conservation and afforestation in Rejaf County. The study the findings stated: root causes of climate change in the area constituted the expansion of population settlement in the area which caused the impacts to the forest lands due to overpopulation in the area, imbalance of rainfall (precipitation) due to climate change in the area.*

*In this study a personal interview and questionnaire method was used for the aim of data collection. Also, the secondary source was employed. In data analysis the descriptive statistical method was used for the purposes of collecting information on the impacts of climate change in Rejaf County. In analysis of data presented in the paper, the frequencies, percentages as well as tables employed. The study recommended that government should provide alternative suitable energy resources for the community in the areas, to improve the livelihood of people of Rejaf County instead of concentrating on the forest for building charcoal, and firewood in the area. Also the government should offer job opportunities for the citizens in the County through Vocational Training Centers in the area. The government should empower the youths, elders through the capacity building and awareness programs to avoid the attitudes of deforestation which contributed to the climate change in the area.*

**Key words:**-*Impact of Climate Change, Rejaf County, Jubek State, South Sudan.*

### **1. Introduction**

In general, climate change affects the forest conditions, area, health, and vitality and biodiversity in the area. The impacts of climate change, may allow increases in growth of forests while endangering the survival of some forest species and forest communities on the other hand (FAO, 2012).

The temperature rises, unavailability of water and changes in seasonality may all become of limiting factor for forests depending on original climatic, conditions biodiversity and human causes of activities. The most common impacts of climate changes will affect frequencies and intensity of wild fires and insect pests and diseases as well as damages done by extreme weather conditions such as drought during dry season and floods during rainy season for current forest composition and structure at Rejaf County is a result of past changes in climatic conditions and shows that forest and their species have inherent capacity to adapt to changes. The main differences are the increased rate of these changes and the degradation of fragmented remaining forests while reduces the capacity of the species and ecosystems to adapt (NOSS, 2001).

The definition of climate change: is when the average long-term weather patterns of a region are altered for extended period of time, typically decades or longer. For examples include shifts in wind patterns, average temperature or the amount of precipitation (WETO, 2013).

These changes can affect one region, many regions or the whole planet. The climate change is caused by the changes in the total amount of energy that is kept within the earth's atmosphere. This change in energy is then spread out around the globe mainly by ocean currents as well as wind and weather patterns to affect climate of different regions (FAO, 2015). Climate changes are caused by natural process such as volcanic eruptions, variations in Earth's orbits or changes in the sun's intensity are the possible causes. However, human activities also cause changes to the climate by the concept of production of greenhouse gases or cutting down of forest trees. Human activities such as burning of fossil fuels, industrial pollution etc. increased greenhouse gases levels or their accumulation in atmosphere. This trap more heat in the atmosphere, while drives global warming or realistic climate changes. The earth's climate is mostly, affected by latitude, the tilt of the earth's axis, and the movements of the Earth's wind belts. The differences in temperatures on forest land resources distribution, of sea, and topographies on the earth surface).

Also (FAO in 1945) defined forest as renewable resources which play a crucial role for the livelihoods of local communities. The forest is a very important renewable resource for entire human livelihoods; protect communities which are vulnerable to climate change (IPCC, 2013). South Sudan is losing forests and other wooded land greater than 0.5 ha, 10% of which is occupied by trees or referring to land which is covered with forest (Bateman. H, Curtis. St, McAdam. K, 2006).

The area covered by forest in South Sudan is 277,630 hectares. The rate of deforestation is determined by the national government, while deforestation accelerates high at rate of approximately 40% by 2006, or 20% of natural forests reserves. The Central Equatoria annually deforestation rate range from 1.53% to 35.2% of closed forest and wooded grassland (UNEP, 2007).

The human activity impacts on climate change on forest resources are related to the actions of deforestation. The disappearance of forests on large scales and the increase of CO<sub>2</sub> as the matter of fact, thus lead to the depletion of the ozone layer. The atmosphere is in dynamic of climate change on forests land surface, the soil degradation, reduction of moistures, snow, ice melting, oceans and other bodies of water. The forest resources as well as biodiversity ecosystem are affected by both natural and anthropogenic aspects. The natural world and technological environment even cultural and social contexts that shape human lives. It includes all factors living and nonliving that affect an individual organism or population expansion at any point in the life cycle, set of circumstances surrounding a particular forests occurrence and all the things that surrounds us. Forests support ecosystem services which, in turn, support mankind, providing food, material for shelter building and medicine. Forests currently absorb billions of tons of CO<sub>2</sub> globally every year, which worth hundreds of billions of dollars (UNEP, 2007).

**2. Statement of the problem**

The study concentrated on the background of climate change, causes of climate change on the forest resources in Rejaf County. The paper was conducted to answer the following questions:

- 2.1. What is climate change?
- 2.2. Examine the impacts of climate change on forest resources in Rejaf County?
- 2.3. Determine the appropriate solutions to the factors of climate change in Rejaf County?

**3. Objectives of the study**

The objectives of the study include the following:

- 3.1. To discuss the background of climate change.
- 3.2. To examine the causes of climate change as well as impacts in Rejaf County.
- 3.3. To explore the solutions to the impacts and factors contributing to climate change in Rejaf County, Jubek State.

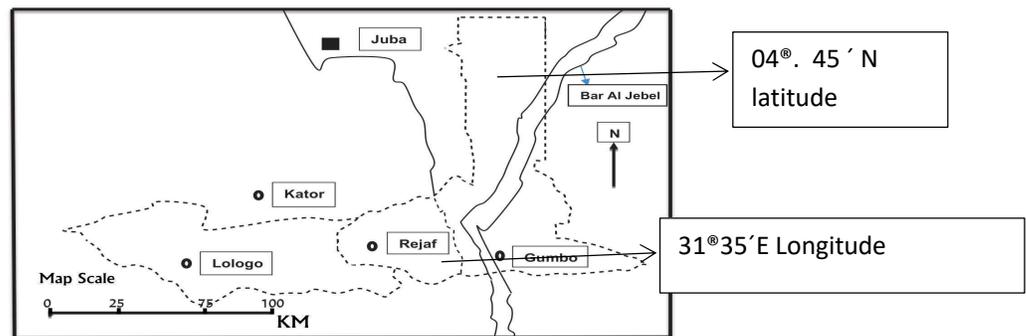
**4. Area of the Study**

The Rejaf or Rageef originated from Arabic word which means shaking of the earth due to Rejaf mountain volcanic shock. The Rejaf County in Jubek State lies on the west and East banks of Bahr Al Jebel River. The Lado was an enclave of the Congo Free State that existed from 1894 to 1910. Rejaf was the terminal for boats on the river Nile and the seat of European Commander during colonial period. There had been fierce battle in Rejaf on 17 February 1897 under Belgian commander Louis-Napoléon Chaltin (Ploch. L.B, 2016).

Rejaf was populated since British period; the administration was taken from Gondokoro Island to Rejaf 20,000 Km<sup>2</sup>. The distance taken via Juba is 15.5km and 14.7km via Gudele. The Rejaf County Comprised of east and west Payams on both sides of the Bahr Al Jebel River. The Rejaf County has been named as, County, on August 9 /2016 when 28 states system were introduced in South Sudan by the President of the country. Then during the period of British administration Rejaf was recognized as the Headquarter of Juba district in 1949 with the population of about 26,359 people (Martin. E. and Mosel. I, 2011).

The Rejaf County’s astronomical location is at latitude of 04° 45’N and longitude of 31° 35’E, lies on the eastern and western bank of Bahr Al Jebel River in Jubek state, with Rejaf mountain approximate elevation of 700 m above the sea level (Lokosang. L.L, 2010).

**4. Materials**



Source (Adapted from map of Jubek state, 2015).

Key	
	River
	Town And Residence Area
	Juba Capital Cities
	Road
	Rejaf Boundary Line

Map of Re

jaf County

## 5. Physical features of the Area

Physical features of Rejaf County include:

### 5.1. Climate

The climate of Rejaf County is similar to Jubek State climate which is in the tropical region. The annual temperature ranges from 24.7°C to 34.5°C, with a long rainy season from April – November. Rejaf has a tropical wet and dry climate (W. Koppen, 1918 AW). The climate is close to the Equatorial zone. The temperatures are hot all the year-round. However, no rainfalls from November to March, which is also the time of the year with the hottest maximum temperatures, reaching (100° F) in February. From April to October there are more than 3.9 inches of rain falls is rich in variety of wildlife as well as beautiful scenery. This can offer huge investment opportunities in the tourism sector in Jubek State (CWI Summit, 2012)

The precipitation is the droplets of water from clouds towards the ground in form of rain, snow, hail and sleet. The rainy season usually starts in May and lasts to October. The average precipitation level is around 1,000 mm. However, occasionally, precipitation levels of more than 1,200mm may be recorded. Most rainfall during the year concentrates in the rainy season, with almost no rainfall observed in the dry season; the flooding water affects an area covering almost 50% of the alluvial plain prompting the emergence of the temporal and seasonal rivers flowing into the river Nile. The area has abundant groundwater in the shallow aquifers (Martin. 2011).

The area has humidity of about 17-85g/m<sup>3</sup> according to Rejaf County and Payams administration of Forestry and Agriculture. The minimum temperature of the area ranges from 25-30°C during rainy seasons and maximum from 28-35°C mostly during dry seasons according to South Sudan Meteorology reported (SSMR, 2017).

### 5.2. Soils

The soils are sandy and permeable in Rejaf County with better drainage on alluvial banks of rivers (Williamson and Payne, 1999).

### 1.6. Vegetation

Natural Vegetation areas like biologist, ecologists “forest” as, Land with tree crown cover or equivalent stocking level of more than 10 percent and area of more than 0.5 hectares (ha) (FAO, 2005).

## 6. Economic Activities:

Economic activities in Rejaf County are as follows:

**6.1. Farming** farmers, grow varieties of crops such as maize, cassava, sweet potatoes, sorghum, groundnuts and beans. Farmers have two harvests every year, the first in June or July and the second harvest in November or December. Women often cultivate small home gardens with a variety of crops such as Sesame (okra (*Abelmoschus esculentus*), tomatoes, groundnuts (*Arachis hypogea*) and cassava (*Manihot tesculenta*) for home consumption. The community are also engaged in fishing for consumption and local market (WETOA, 2013).

### 6.2. Livestock

Livestock defined as dealing with agricultural practice of breeding and raising livestock in order to provide food for human consumption and to provide power (draught) and manure for crops. They also keep cattle and goats for milk and meat, as a kind of insurance in case of dowry (bride wealth) or any other social or economic needs. The meat and milk are sold for cash. Sometimes, cheese is produced from milk and sold for cash. Animals are sold when money is needed, and may also be slaughtered on special social occasions (WETOA, 2013).

## 7. Methods

Different methods and techniques were used during the data collection these include:

**7.1. Primary Data Collection** (Socio-Economic Studies) Socio- economic studies (primary data), the socio-economic studies in the area were carried out as the structural interview. These represent the primary data. The questionnaires were designed to collect information. The respondents were asked about their knowledge of impacts of climate change on forest resource, all aspects related to the impacts of climate on forest questions covering the age of the respondents, root cause of impacts of climate change on forest resources of Rejaf County and deforestation etc. Also, the method of observation was used in this research to establish solution to the research problem and meeting inclusive.

### 7.2. Secondary Data Collection

This consist of the views of the available literature related to the research topic, no specific methods of secondary data collection resources used although sources of secondary data vary and includes, the information from references, public records, organizational records, census data, previous studies, publications, journal, newsletters and websites as well as Electronic media, government and NGOs reports and internet services.

### 7.3. Data Collection Instruments

The main instrument which was used in this study to obtain relevant data from respondents is the questionnaire; which were administered to the selected sample population.

### 7.4. Ethical Considerations

In order to protect the anonymity and confidentiality of the information regarding respondents, names and house numbers were not identified in the Questionnaires and in the data set.

### 7.5. Data Analysis Methods

The primary data was carefully reviewed; questionnaires were transferred into a coding sheet and entered into SPSS software for analysis. And also of sets, Microsoft excel was employed for the purpose of getting the background characteristics of households in Rejaf County using frequencies, percentages distributions were calculated as a tool of analysis for interpretations of quantitative information calculated from the respondents. Then the data was tabulated, sorted out and proceed Also the data were displayed by using histograms or pie charts, and tables.

## 8. DISCUSSION AND RESULTS

**Table 1: ROOT CAUSES OF CLIMATE CHANGE IN REJAF COUNTY**

Response	Number of respondents	Percentage
Human expansion of settlement on forest land	100	20%
Charcoal burning	100	20%
Chopping down of tress	200	40%
All of the above	100	20%
<b>Total</b>	<b>500</b>	<b>100%</b>

**Table 1.** Showed that, 20% of respondents admitted that expansion of population settlement in the County since 2005 affected the forest lands due to the overpopulation in the area. Meanwhile, 20% of respondents engaged in charcoal burning as the source of income in the County, due to high demands for cooking in the area. Moreover, 40% of respondents were engaged in the chopping down trees as the source of economic livelihood to the people of the area which have negatively impacts on the forest. Also about, 20% of respondents admitted that all of the above activities caused negative effect on the forest which contributed the climate change in Rejaf County. The impacts of burning charcoal on population and environment in Rejaf County include the depletion of woodlands such as Acacia tree species for charcoal, and this due to high demand for charcoal. The cutting down of forest or trees harvesting may lead to the loss of a huge volume of woodlands in area from 15-30%. The deforestation can seriously affect biodiversity and ecosystem and soil degradation or soil erosion and increase of CO<sub>2</sub> in the atmosphere. And in long term will lead to migration and disturbance of wildlife, imbalanced rainfall ranges between 150 and 300 mm annually, increase of wildfire. The impacts on population, households cooking and heating, create eyes diseases respiratory, headache problems and sometimes vomiting, due to the gases released when cooking. Also the same aspects might happen to charcoal makers in the county.

**Table 2: LACK OF PRECIPITATION AND IMBALANCE OF RAINFALL IN REJAF COUNTY**

Response	Number of respondents	Percentage
Strongly agree	100	20%
Agree	100	20%
Strongly disagree	200	40%
Disagree	100	20%
<b>Total</b>	<b>500</b>	<b>100%</b>

**Table 2.** Indicated exactly that 20% of respondents accepted that there is imbalance of rainfall in County due to climate change. Meanwhile, 20% of them affirmed that the present lack of precipitation and imbalance of rainy seasons affect the forests in Rejaf County. On the other hand, 40% of respondents strongly disagree, for lack of precipitation and imbalance of rainfall in the County due to closeness of Rejaf to humid climate of equatorial region. Also, 20% respondents disagree for the variability of rainfall in the area due to the nearness of area to the Equator rain region and astronomical location of the county that located at latitude of 4°. 45' N and longitude of 31°. 35' E north of equator. The Rejaf County is close to the humid climate of Equatorial region, where temperature is minimum at least 18-27 c° annually, that with be slight deforestation in the County due to the presence of humidity and moistures. In terms of disagreement at the area which is close to equator region

with high humidity cannot be completely affected by the process of climate change, while, strongly disagree will match with the above explanations.

**TABLE 3.USE OF CHARCOAL AND FIREWOOD IN REJAF COUNTY**

Response	Number of respondents	percentage
Energy	100	20%
Cooking	300	60%
Ironing	100	20%
<b>Total</b>	<b>500</b>	<b>100%</b>

**Table 3.** The table displayed that 20% of respondents used charcoal and firewood as their main source energy in the County. While, 60% of respondents used charcoal and firewood in the county for cooking as the alternative energy used in the County, whereas, 20% of respondents used charcoal for ironing process due to lack electricity in Rejaf County. The principle source of energy could include biomass energy, natural gases energy, wind energy, thermal energy and solar energy could be used instead of fuel wood which generated depletion of Acacia tree species. Thus result of deforestation affected both eco-system and socio-economic and razed the forest, caused soil erosion and decline of forest cover, loss of bio-diversity in flora and fauna and livestock size in area.

**10. Conclusion**

In conclusion, the factors influencing population chopping down trees were economic purposes, deciding on how to make their livelihood in the County or rural to urban areas have complex demand of fuel woods. The variability of rainfall in the area is due to the nearness to the Equatorial region and astronomical location of the County. The mass of population who migrated to Jubek State since conflicts occurred contributed to the huge demand of energy and lands for settlement these have great impacts on the forest land as in Rejaf County. The displacement of the people caused overgrazing by livestock in the area. Whereas, lack of job opportunities turns some of the people to cut down trees due to the economic needs as well as education and health services in the area. Therefore, in reality, much of the literature has actually tended to urge the distinction between the positive and negative impacts and consequences of climate change on the forest resources in the county. The solution will be when peace is prevailing that will stop migration people with the huge herds including overpopulation of both people and animals on forest carrying capacity. Then government and NGOs will reconstruct various infrastructures, in order to minimize people’s ambitions turning on forest resources for economic livelihoods. Since South Sudan is now oil exploiting there will be alternative energy such as natural gas, electricity, and biomass energy and intensity use of solar system in remote areas. The government and NGOs should provide vocational training Centers for youth, job creation.

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