Impacts of Darfur War inDegradation of NaturalForests, Thur Forest, JabelMarraDarfur, *Sudan*

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Abstract:*The increased need for natural resources in the last three decades, with increase of human and animals population, and the degradation of natural resources, due to; haphazard agricultural, pastoral and irrational urban expansion, couple with the decline in rainfall, desert encroachment, as well as the political turmoil, have led to the violence and the current fighting.This status quo has resulted in exodus of significant numbers of the population to fertile rural areas, and to the most stable cities. The research aims to assess the war aftermath in Thur, JabelMarra Central Darfur State; and to review war impactions on forest deterioration as well as the impact on natural resources.The study adopted the descriptive analytical approach for the collection and analysis of data, using questionnaires, meetings, and inventory asa basic tool for data collection and analysis by the Statistical Package for the Social Sciences program (SPSS).The study concluded that, some species such as Cordia Africana (Gimbeel), Tamaraindusindica (Ardeb) has also disappeared from the study area. The study also indicated that, 96% of the studied community used firewood and charcoal to obtain their daily needs of energy for cooking/lighting, whereas 60% of the studied community has access to energy materials directly from the forest without obtaining authorization license.Finally, the inventory investigation determined that, tree density decreased from 400 trees per hectare in 1998 to 126 trees per hectare in 2003to 27 trees per hectare in 2016, which confirm that, the deforestation rate was significant during the conflict and preceding years, due to the absence of local government as well as forests management.The study recommended thatTaungya system can be applied on agricultural land to improve the density of tree-cover. In addition, the area should be protected in the future from environmental hazards such as soil erosion.Also range administration should pay more attention to rangeland in the study area and find solution for the degraded lands. Moreover, Comprehensive planning should be carried out to restock the depleted forest through a forestation program with consideration to the role of community participation.*
Key words:JabelMarra, Darfur, War, Impacts of war, Thur, Forests, Degradation.

I. Introduction:

Darfur region lies in the western Sudan, seven million Sudanese people called Darfur home, but at least half of them displaced because of war. Darfur has been affected by intermittent war. There have been many different approaches for analysing and understanding the war, some of them attributed it to what is called the inherent war of nature of tribalism and pastoralism. Others related to the pressure of ecological degradation, others considered this political war between government and groups of rebels highlight issues such as developments, authorities share and marginalization, this lead to war according to rebels Agenda.

In Jebel Marra particularly, the war is unbroken because of its strategic position in Darfur surrounded by mountains, flanks, drainages, natural and artificial forests, all these factors made the mountain to be the best place for clashes and battles. Many people were killed, injured and displaced to other areas, for instance, Internally Displaced People (IDPs) camps in several cities in Darfur, similarly many animals were looted in this war. Natural resources were seriously affected and deteriorated.

II. Study Area

Location:
Central Darfur State is located in the south western part of the Sudan. It is
Extending from 14.8° - 11.8° East and 24.5° - 22.5° North (Yousif, 2015).
The state is bordered by three states, North, South, and West Darfur and both republics of Chad and Central Republic of Africa (Ahmed, 2016).

Geographical location of Jabel Marra:

Jabel Marra is an isolated 3042, high volcanic massif. It is located mostly in Central Darfur State of Sudan republic near the border with Chad (fig.1) approximately between latitudes of 12 ° - 30 ° N and 13 ° – 30 ° N and longitudes of 24 E and 24 - 30. The most interesting feature of Jabel Marra is its island-like position amidst the lowlands of the Sahelo- Sudanian transition zone. It lies " in the very heart of African continent" (WICHENS 1976) at minimum 1500 km from the sea. The most peculiar feature of this location is that it is at least 1000 km away from any similarly high mountain (Adam, 2003). The present research is conducted in the western and southern flanks of JabelMarra (Thur area) it attempts to study impact of Darfur war on the natural resource as general and forest sector in particular.

Figure (1) shows the study area:

Source: FAO 2010

III.   Methodology:

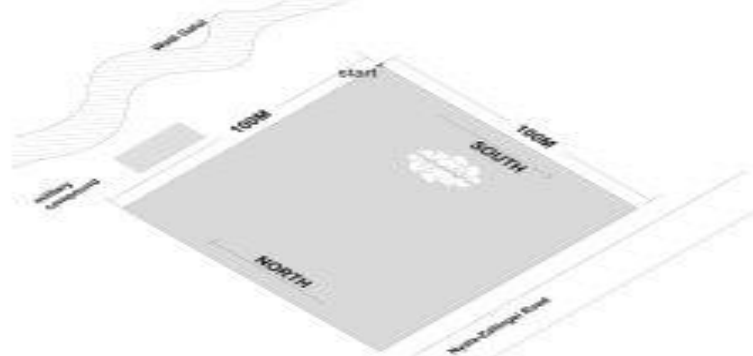Theoverall objective of the study is to assess the impacts of war on the natural forest, analyses the current condition of the natural forests, sources of deterioration of vegetation and to identify tree species that going to be extinct according to the impact of the war in the study area.

Informal interviews with elder's villagers, official staff of administration units, and both Forest National Corporation (FNC), Range and Pasture Administration (RPA), group discussions were organized. A questionnaire was prepared for collection data, it composed of 34 different questions, while 50 respondents were interviewed; target groups were local village leaders, teacher, farmers, herders and forests. Moreover; Inventory was taken for Thur natural forest to investigate the direct effect of war on the natural forest, in approximately an area of (2.84 ha). A 100% enumeration was done to find the density of tree-cover in the study area, while three sites were selected separately, the selection of sites were done according to two factors:

❖ The area is considered as a natural forest lands.
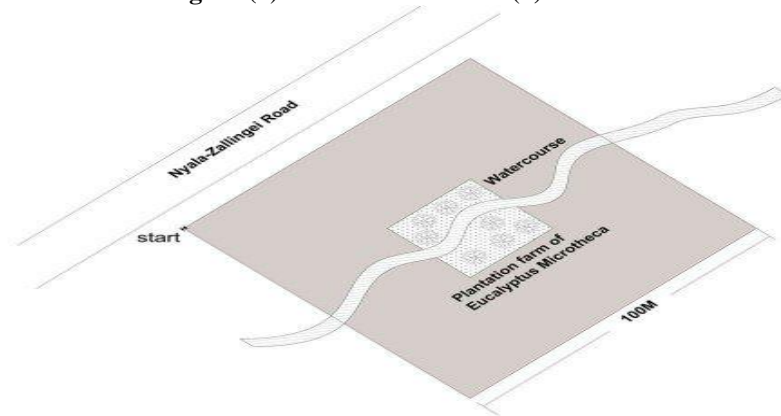❖ Some studies were done by researchers in last 20 years.

IV. Description of the Sites:

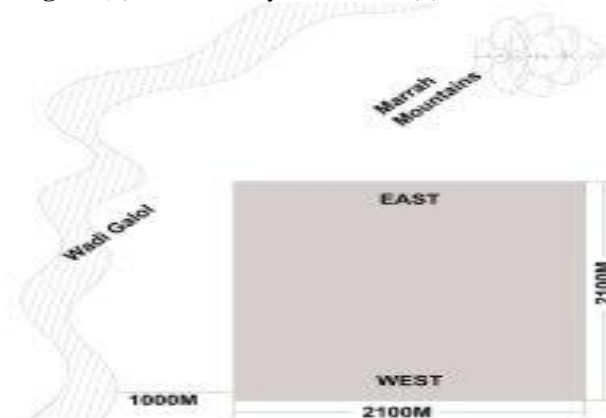**Figure (1)** the area of inventory in site one:

Sites (1) location lies on southern-east of (Thur) village on the east of Nyala – Zallingei Road 1000 m from the road, the total area of locationone is '1' ha (10.000m²) figure (1). The site was divided into three equal sections used the tape-meter to make the enumeration more easy.

Figure (2) show the area of site (2)

Site '2' was located in the southern – west of (Thur) village and on the west direction of Nyala – Zallingei Road about "3" km from thur village with total area of "1" ha (10.000 m²), then each site was divided into 3 equal sections to make the enumeration more easy, The average number of trees was found out from the three sites and tree per hectare was obtained by the following formula;

Figure (3) the inventory area of site (3):

Site (3) was located in the southern-east of (Thur) village, about "5" km on the west ofNyala – Zallingei Road with total area of (0.84 ha) it's far with 1000m from WadiGalol, with the same direction of JabelMarra.

The average number of trees was found out from the three sites and tree per hectare was obtained by the following formula

$$\text{The density of trees} = \frac{\text{number of trees counted}}{\text{Total area (m}^2)}$$

$$\text{Density of tree/ha} = \frac{\text{number of trees counted} \times 1000}{\text{Total area (m}^2)}$$

Computer and software SPSS was used to analyse the numerical data collected. Results obtained from the analysis were presented in the forms of frequency tables.

V.   Results And Discussions:

The results study of this composed of two parts (Questionnaire and Inventory) with comparisons of the results found with other relevant previous findings,

Questionnaire discussion;

Table (1) Rangeland Degradation**:**

Rangeland	Frequency	Percentage
Yes	41	82
No	9	18
Total	50	100

Table (1) shows that, the majority of respondents 82% agree that, rangeland were seriously degraded, the reasons behind rangeland degradation were the high level of insecurity, over-grazing and seasonal fires which represent the main causes of rangeland degradation, in addition to loss of management and desirable grasses, or maybe referred to highly concentration of grazing in the forest and this make pressure on the forest lands.

Table (2) Building materials in the study area:

Building materials	Frequency	Percentage	frequency	Percentage
Hey	44	88	6	12
Wood	31	62	19	38
Building poles	30	60	20	40
Bricks	7	14	43	86
Steel	1	2	49	98

According to the result in table (2) the majority of respondents 88% said that, they used forest materials and hey (straw) in building. While 62% and 60% were used wood and building poles. The result assured that the respondents in the study are depending on forests in buildings materials and this is considered as one of the factors which led to the degradation of forests, while 14% of respondents mentioned that, they use bricks to build their houses. This may be referred to their culture and traditional ways of building or limitation of their economic status.

Table (3) Disappearance of some plant species and forest components**:**

Disappear of some trees species	Affected Forest Component									
	Trees		Soil		Environment		All of them		Total	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%		
Yes	22	44	1	6	5	10	21	42	49	98
No	1	2	0	52	0	0	0	0	1	2
Total	23	46	1	58	5	10	21	42	50	100

Table (3) explains the relation between the plant species disappeared and the forest component mostly affected. 98 % of the respondents shows that, there are some species had been disappeared from the area and they mentioned some trees such (*Cordia Africanlum*,(Gembel) *Ficussycomorus(Gemiz)*, *Tamarindusindica*,(Ardeeb) *Accia Senegal*(talih) these species are mostly used for furniture, while 46 % of the respondents mentioned that, the trees were mostly affected by war factors, and 10 % of the respondents mentioned that, the environment was affected by over exploitation , 2 % of the respondents showed that soil are affected, and 42 % of the respondents shows that all of them are affected by war, this may be referred to people whom use the forest intensively and products by illegal ways.

Table (4) Environmental problem**:**

Environmental problem	Yes		No	
	Frequency	Percentage	Frequency	Percentage
Disease	43	86	7	14
Rainfall fluctuation	37	74	13	26
Fires	26	52	24	48
Drought	25	50	25	50

According to the result in table (4), the majority of respondents 86% mentioned that, disease has occurred in the study area. These diseases related to usage of weapons and other factors of deforestation, followed by 74% of respondents show that rainfall fluctuation. Abdel nor,(1992) stated that forests played an important role in the formation of cloud, while UNEP. (2007) states that cultivation reduces the albedo by up to 30% all over the Sudan belt, deforestation process also has a big role in the climate change that what both Badi,(1989) states that clearing of tropical forest causes a change in albedo that could influence both local and regional climate, while 52% and 50% of respondents mention that, fires and drought were occurred in the area due the time of war, while the rate of fires has been increased.

VI.   The Inventory Results:
The results of the inventory work.

Table (5) the inventory in site "1"

Number	Tree species	Frequency	Percentage
1	*Anogeissaeleiocarpus*	8	21.5
2	*Balaniteseagyptiaca*	11	28.9
3	*Azanazgarkeana*	3	7.8
4	*zizphusspinachristi*	2	5.2
5	*Abiziasercocephela*	10	26.3
6	*Colotropisprocera*	4	10.5
	Total	38	100

Inventory in site (1) shows that, *Balaniteseagyptiaca (Lalob) was* 11 tree/ha and represent 29.9% of trees counted, this might be that, this species was dominant, while 5.2% was *Zizphusspina-christi*, (cidir) this may be referred to the high consumption of this tree species for different reasons, and this could be one of the factors behind the decreased number of tree. The richness of the species in this site because it lay in insecurity location, while the appearance of *Colotropisprocera (usher)* in the area of tropical forests reflected the vegetation changes**,** Ismail (2012) statedthat the vegetation of Darfur has changed first from twelve to six and presently to one species, this due to the depletion of the seed bank and overuse of land.
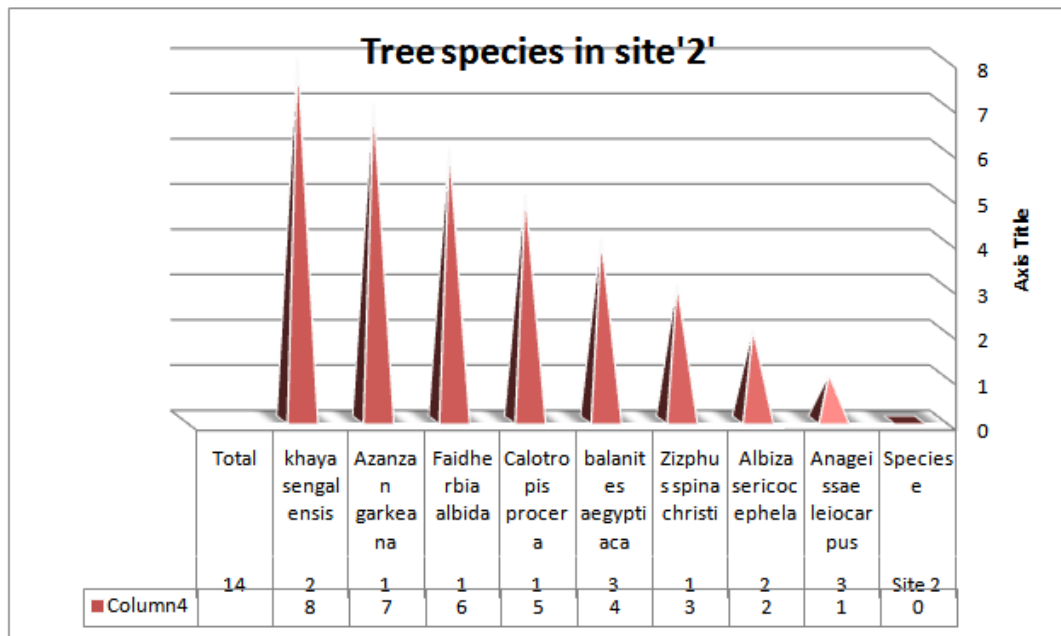
Figure (4) Inventory work in site '2'

Figure (4) shows that 3 tree/ha, *Balanitesaegyptiaca, Anageissaeleiocarpus*, represent 21.4% of the trees counted, this percentage indicting that, these species were dominant in Thur natural forest, but they had decreased due the over-use of this species, therefore the density of the trees was calculated for *Balanitesaegyptiaca, Anageissaeleiocarpus* ignoring the other species.

Table (6) Inventory work in site "3" tow fad (.84, ha)

No	Species'	Frequency	Percentage
1	*Azanzagarkeana*	2	8
2	*Albiziasericocephela*	6	24
3	*Ficussycomorus*	1	4
4	*Boswelliapapyrifear*	2	8
5	*Dichrostachyscinerea*	2	8
6	*Khayasengalensis*	1	4
7	*Ziziphusabyssinica*	1	4
8	*Combrutummolle*	3	12
9	*Balanitesaegyptiaca*	4	16
10	*zizphusspina Christi*	3	12
	Total	25	100

The result in table (6) site "3" shows 6 trees/ha*Albiziasericocephela* that represented 24 %, of trees counted, while *Ficussycomorus*, *khayasengalensis* and*Ziziphusabyssinica* were represented 4% this reflected that these species were semi-dominant but the high rate of consumption led to decreased of trees density. Therefore the densities of the trees were calculated for three sites.

The density of trees = $\frac{77}{2.84}$ = 27.11 per/ha

When we compared the degradation in Thur natural forest with other findings, it is realized that the tree density was 400 tree/ha in Adam (1997) and 126 tree/ha also in Adam (2003), the degree of degradation is 400 - 126 = 274 trees/ha. On the other hand, the density of trees in this study 2016 was 27 tree/ ha. Then the degree of degradation from 2003 to 2016 is 126 – 27 = 99 tree/ha. This explained that the degree of degradation between the periods of 2003 to 2016 is 99 tree/ha/year.

The loss of trees from 2003 to 2016 = $\frac{99}{13}$ = 7.6 tree/ha/year

From the results, the degradation in the study area from 1997 – 2003 has caused the removal of a lot of trees, but the degradation of the natural forests was increased from 2003 – 2016 during the period of war in the study area

for different reasons, such as collection of fuel wood, building materials, extension of agriculture lands, in addition to clearing of tree-cover for fights.

VII.   Conclusion:

Based on the results obtained and the findings of other authors, regardingthe impact of warfare on natural forest and range resources in the studyarea it can be concluded that:

Rangeland had been seriously degraded, as a result of over-grazing, while Continuation of gathering wood from the forest by unlawful ways,this led to deforestation. Furthermore the inventory indicated that, the density of tree-cover was decreased, from 400 tree/per/ha in (1997) to 126 tree/per/ha in (2003) to 26 tree/ per/ha in (2016)

VIII.   Recommendations:

Taungya system can be applied on agricultural land to improve the density of tree-cover. In addition, the area should be protected in the future from environmental hazards such as soil erosion.Also range administration should pay more attention to rangeland in the study area and find solution for the degraded lands. Moreover, Comprehensive planning should be carried out to restock the depleted forest through a forestation program with consideration to the role of community participation.

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Annex; 1Table (1) Plant species disappeared from the forest:

	Trees		Grasses / shrubs
1	*Cordiaafricana(Gimbeel)*	1	*Echinochloacolona(DanabAlnaga)*
2	*Acacia senegal(Hashab)*	2	*Indigoferaoblogifolia (Sharaya)*
3	*Ficussycomorus(Gumaiz)*	3	
4	*Tamarindusindica(Aradaib)*	4	
5	*Boswelliapapyrifera (TaragTarag)*	5	

Photos
Photo (1) wooden blocks in Saw**:**

Photo (2) blocks of *Khayasengalensis* in the saw: