

## Contribution of Forest Resources to Rural Development in Zalingei Area, Central Darfur State-Sudan

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### ABSTRACT

The main objective of the study is to clarify the contribution of forest resources to rural development in Zalingei locality-Central Darfur state in Sudan. The specific objectives included to identify quantities of fuelwood consumption by rural households, type of cooking stoves, housing, fences, and major causes of deforestation and desertification comforting the forest resources and trees in the study area, to know the types of fodder plants, tree parts use, who is collected the resources, source of products and prepare check list of the major different trees uses, to identify types and level of forest benefits for respondents and to identify y relationships between respondents benefits from forest resources and some socio-economic variables. A field study was conducted on the area of study in May, June and July 2015, where a random sample composed of 227 household heads were personally interviewed using questionnaire prepared for the purposes of the study. Based upon a relevant literature review and theatrical framework a number of hypotheses on relationships between level of benefit from forest resources and some socio-economic variables were proposed. Several statistical methods were used in the analysis of field data, including frequency distributions, percentages, averages and ranges to describe the study variables. Also Chi square test was used in testing the study hypotheses. Cramer's V coefficients also were used to indicate the strength of the relationships between the level of benefit from forest resources and social and economic variables. The results showed that the total fuel wood consumption was 333.6 hectare/year and the deforestation ratio was 0.30 hectare/year. The study findings indicated that statistically significant relationships (at level of .01) were found between level of benefits from forests resources and each of age, educational level, marital status, sex and family size. The study was concluded with a discussion of its major findings and a number of recommendations on how to increase the benefits from forest resources while achieving the sustainable development were introduced.

**Key words:** fuelwood, deforestation, consumption, households, socio-economic variables.

### INTRODUCTION

Forest products play an important role in supporting rural livelihoods and food security in many developing countries. Forests provide critical sources of many non-timber forest products to meet household needs for food, medicine for people and livestock, shelter, building materials, fuels, honey, wild coffee, social and cultural. More than 15 million people in Sub-Saharan Africa earn their income from forest-related enterprises such as firewood and charcoal which extracted for household consumption and for markets, small-scale saw-milling, commercial hunting, construction, agriculture tools, household equipments and handicraft production. Non-market benefits of tropical forest preservation have long been recognized to include carbon sequestration, biodiversity, endangered species habitat, watershed, protection, protective environmental functions such as the maintenance and restoration of soil fertility, soil improvement, erosion control, maintenance of biodiversity and climate regulation (Mullatu, 2010 and Brian *et al.* 2012).

### Problem statement

The natural forests constitute the main source of woody and non-woody products for the people living within the forest vicinity. The increasing population leads to increasing needs for forest products, high poverty, desertification and deforestation, low agricultural production, low natural range resources and no alternatives of fuel wood consumption. In addition importance of rural development was ignored by government as well as researchers. Therefore, the studies raise the following questions:- as well as researchers. Therefore, the studies raise the following questions:-

1. What are the variables which affects the level of benefits of forest resources?
2. How can increase the level of benefits of forest resources for rural households?
3. What is the annual percentage of deforestation in the study area?
4. What is the role of forest resources in rural development?
5. What is the nature of the relationship among forests, trees and rural households?

**Objectives of the study**

- 1- To identify quantities of fuelwood consumption by rural households, type of cooking stoves, housing, fences, and major causes of deforestation and desertification comforting the forest resources and trees in the study area. .
- 2- To know the types of fodder plants, trees parts use, who is collected the resources, source of products and prepare chick list of the major different trees uses.
- 3- To identify types and level of forest benefits for respondents.
- 4-To identify relationships between respondent's benefits from forest resources and some socio-economic variables.

**Literature review**

Forest trees provide fuel and other goods essential to meet basic needs at the rural household and community level. Forests and forest lands provide food and the environmental stability necessary for continued food production. Forests and forest products can generate income and employment in the rural community; people are dependent upon natural resources for meeting a large number of their basic necessities of life (FAO, 1992 and Imam, 2009).

The Sudan possesses for natural vegetation that varies in its diversity and density from north to south according to soil type and intensity of rainfall which increases towards the south. Global forest resource assessment estimated the total forests and other wood lands cover of the ex-Sudan at 50.2 million ha which constituted 27% of the total area. After the independence of the South Sudan, as a separate country, the retained forests constituted only 11.6% of the present Sudan's total area, while agricultural land, range and water constitute 13.70%, 26.40%, and 0.17%, respectively. The average annual increment of the growing stock volume was estimated to be 1.340 Million cubic meters (MCM) of which 5% was removed per hectare per year. The majority of the products were used for firewood and charcoal, while 9% is used for high quality timber processing (FNC, 1998, Kigenyi *et al.* 2002, Elnour, *et al.* 2014 and Ballal *et al.* 2014).

Many species of trees in the tropics are used for fodder either for browse or stall feeding, 75% of the tree species are used as browses. They make a significant contribution to domestic livestock production which in turn influence milk and meat supply. Animals depend on fodder trees for their food particularly during the dry season periods.

Fodder trees and shrubs have an important advantage over fodder grasses and herbaceous. Legumes; they can tap deep, underground moisture reserves when the upper soil layers have dried out (FAO, 1992 and Aju, 2014).

Forests in Sudan contribute to 82% of the total energy consumption in the country. Firewood and charcoal are the main sources of household energy for cooking and heating (FAO, 2003).

**The study hypothesis**

Based upon the literature reviewed a number of socio-economic variables were selected to study their relationships with the dependent variable of the study which is level of forest benefit. The expected relationships between each of these variables and the independent variable were hypothesized as follows:

There is a relationship between level of forest benefit and the following:-

- 1-Age of head of the households.
- 2-Households working status, all households are benefit at the same level because there is no alternative.
- 3-Head of household's education level, all households are benefit at the same level.
- 4-Marital status, married households are more benefit than non-married.
- 5-Sex type.
- 6-Household's size.
- 7-Households income, when households income decreased, increasing the level of forest benefit.
- 8-Sufficient of local agriculture product.

**MATERIALS AND METHODS****1. Study area**

Zalingei locality lies in the far west of Sudan to the South west of Jebel Marra, between latitudes of 12.30 and 13.30 North and attitudes of 23.30 and 23.45 East. Its area is about 11033 square kilometers 13.5% of which is mountain the rest being valleys and plain land. The locality is bounded from the north by northern Darfur state, from the east by southern Darfur state and Jebel Marra locality, bounded from the west by Geniana locality and from the south by Wadisalih locality (Bellal, 2015).

**2. Data collection**

The primary data for this study was collected through direct survey, while the secondary data was collected from institutional reports. The main survey was conducted in May, June and July, 2015 for the collection of data using a comprehensive questionnaire, comprising all information, required for satisfying the objective of the targeted.

**3. Population and sampling**

Population of the study consists of all rural households (4780 households) in 165 traditional villages in Traig administration in Zalingei locality. The sample unit is head of rural households in the

villages. The population is 33707 (CBSS, 2008 and MOHZ, 2015).

Sample size was determined according to the following formula:

$$n = \frac{N}{[1 + [N(e)^2]]} = \frac{4780}{[1 + [4780(.07)^2]]} = 196 \text{ household}$$

Where:

n = sample size 196

N= population size (total number of households which is 4780)

e = precision level (7%) (Elezaby, 2014).

The number of the selected sample members was 196 respondents and they were selected by Cluster Random Sampling, using systematic random sample technique in two stages, first stage selected 14 villages and the second stage selected 4 villages as study sample (Triaj, Dar Elsalam, Gouz Khazzal and Nour Elhuda) according to size and have a lot of rural households living near the forests.

#### 4. Data analysis

Some statistical techniques were used in the analysis of the study data including frequency tables and percentages, chi square test is used to test whether a statistically significant relationships was exist between the independent variables, and each of the dependent variables. Cramer's v coefficient was used to measure strength of the relationships between the study variables.

### RESULTS

The analysis of data has revealed that:

#### 1. Quantities of firewood consumption

The minority of households (6.2%) are consumed in average less than one cubic meter firewood per month (less than 4 donkey load), (72.2%) are consumed 1.5 cubic meter in average firewood per month (4-6 donkey load) and (21.6%) consumed above 2.1 cubic meter in average fire wood per month (above 6 donkey load).

**Table 1: Firewood consumption by households (donkey load per month)**

Firewood consumption donkey load/ month	No	Percentage
1-3	14	6.2
4-6	164	72.2
>6	49	2.6
Total	227	100

#### 2- Time spent for collection firewood

Majority of households spend about 4-6 hours, while (6.6%) of sample size spend more than 6 hours and (1.3%) spend of less than 4 hours for firewood collection by animals.

**Table 2: Distribution of respondents according to time spent in collection of firewood**

Time spent in collection	No	Percentage
<4 hour	3	1.3
4 - 6 hour	209	92.1
> 6 hour	15	6.6
Total	227	100

#### 3. Quantities of charcoal consumption

The minimal of rural household's depend on charcoal in cooking. Only 19.2% are using or consumed charcoal, 80.2% are not using charcoal. There are few households who work on charcoal production in the study area. The majority of them (19.2%), however, used the charcoal in cooking and very low consumers used about (1-2 sacks per month).

**Table 3: Distribution of the respondents according to quantities of charcoal**

Quantity of Charcoal(sacks)	No	%
Non- users of charcoal	Zero	182 80.2
Users of Charcoal	1 - 2	29 12.8
	3 - 4	16 7
Total	227	100

#### 4. Type of cooker stoves

Majority of households (80.2%) used only the traditional stoves in cooking and lighting while minority of them (19.8%) used enhanced stoves (clay and iron) beside the traditional in cooking and heating, because there is no gas.

**Table 4: Presents type of cooker stoves used by respondents in the study area**

Type of cooker stove	Frequency	%
Traditional (stones)	182	80.2
Traditional (stones) and enhanced stoves (clay)	6	2.6
Traditional (stones) and enhanced stoves (iron)	33	14.5
Traditional (stones) and enhanced stoves (clay and iron)	6	2.6
Total	227	100

#### 5. Numbers and types of housing

Majority of households (46.3%) have only one hut (Goitya), (64.3%) have one Rakuba, (63.4%) have one Dandnky and (2.6%) have one Room. Households have two and more Huts 32.2%, Rakubas 30% and two Dandnkys 7.1%

#### 6. Types of fence materials

Most of households (96%) have houses fence vs. (4%) haven't fence. There are different types of timber (wet or dry) are used as fences set up in patches around the houses to shelter them from wild animal and used also as a fire wood in some cases especially in fall season. A lot of households (70.5%) haven't animals fence vs. (29.5%) have animal fence, because the animals rest around the

houses at live night and in the morning they graze in the pasture.

### 7. The major causes of deforestation and desertification

The questionnaire results reveals that (90.7%) of forests degradation causes attributed to fire wood cutting, (68.7%) making charcoal, (46.3%) hyper grazing, (40.5%) over population, on the other hand, (30%) of householders claim that deforestation is attributed to building material, (13.7%) fence, (12.8%) wooden handicraft and (11.9%) others.

### 8. Numbers and types of animals

They are a lot of animals in the area and the range load capacity is limited, forests are considered as a main fodder source for vast livestock resources. Most of these forests are localized naturally in poor savannah in north of the area under study to rich savannah in the south.

### 9. Types of fodder trees and plants in the study area

Animal productivity is low as it still depends on the traditional animal husbandry and pastoral activities of Trans humane and nomadic and their limited aspirations and content in subsistence. Large numbers of animal's protection rose, due to culture and social reasons.

### 10. Tree parts uses in the study area by respondents

Majority of rural households (68.3%), depend on cutting wet lower branches and cutting tree stems (24.7%), and (7%) dead-dry trees, cutting tree stems and lower wet branches as building materials. About (67%) cutting tree stems, (18.5%) cutting lower wet branches and cutting tree stems, while (14.5%) dead-dry trees, cutting wet lower branches, cutting tree stems as making charcoal, and (97.8%) dead-dry trees and (2.2%) gathering dead-dry trees and cutting dry lower branches as firewood.

### 11. Household's member participation in tree products gathering

Most of women (99.6%) are involved in firewood collection vs. (0.4%) for men. Majority of women (54.6%) are collected building material vs. (33%) for men and (12.4%) for both. Majority of women (57.7%) are making charcoal, vs. (16.7%) of men and (25.6%) of both. Most of forest products consumers are women.

### 12. Source of forest and trees products

Majority of householders (96.9%), (97.8%), (97.4%) and (99.1%), obtained their fire wood, charcoal, building material and fodder, respectively from scatter trees in the farms.

### 13. List of medicinal trees

Many products come from forests, either trees or understory plants. Some trees used for traditional medicine. There are very important species used for rural people, because it's available, easy to get, worldwide and free. The most common tree parts used as medicinal are barks, leaves, roots, fruits, seeds, brush, branches and stems. It's different from place to place according to the cultural heritage and part used and framework used.

### 14. List of wooden handicrafts

Some trees species were used in making traditional beds, chairs, mortars, dishes (for preserving the food), agricultural tools, wood slabs, animal saddles, poles, house doors and windows, sculpted woods and house eating tools. All these handicrafts are made manually by men, owing to their physical nature, but the mandollas, reyaks, takzoo, ropes, barateel, breash, and some women handicrafts are made by women. These crafts are selling directly (real market) or marketed by mediators (whole market), in a bid for getting money to purchase the basic needs directly.

### 15. Types of forest benefits

The percentage of households has won at a higher level than the average of the forest products benefit. All the respondents (100%) are used firewood in cooking, lighting and heating. The majority of respondents (74.4%) did not use charcoal in cooking lighting and heating. The majority of respondents (74.4%) did not use charcoal in cooking heating, the charcoal using vs. (25.5%) are benefited. The minority of respondents (39.2%) used building materials from forests and trees, vs. (60.8%) not benefited. The majority of respondents (75.8%) used trees as fodder; vs. (24.2%) not benefited. The minority of respondents (37%) used tree fruits, (37%) vs. (63%) are not benefited. The majority of respondents (96.5%) used fencing; vs. (3.5%) are not benefited.

**Table 5: Present number and types of households housing in the study area**

No of House	Type of building							
	Huts( Gotiya)		Rakubas		Dandnkys		Rooms	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
0.0	49	21.6	13	5.7	67	29.5	221	97.4
1	105	46.3	146	64.3	144	63.4	6	2.6
2	51	22.5	61	26.9	16	7.1		
3	15	6.5	7	3.1				
4	7	3.1						
Total	227	100	227	100	227	100	227	100

**Table 6: Types of fence materials in the study area**

Fence type		Frequency	Percentage	
Un uses of House fence		9	4	
Users of house fence	Material type of fences	Firewood	167	73.6
		Thorns	51	22.4
Total		227	100	
Un uses of animal fence		160	70.5	
Users of animal fence	Material type of fences	Firewood	12	5.3
		Thorns	55	24.2
Total		227	100	

**Table 7: The major causes of deforestation and desertification comforting the forest resources and trees in the study area**

Causes	Number	Percentage
Firewood	206	90.7
Wooden handicrafts	29	12.8
Building materials	68	30
Over population	92	40.5
Hyper grazing	105	46.3
Charcoal making	156	68.7
Fence making	31	13.7
Others	27	11.9

**Table 8: Numbers and types of animals in the house in the study area**

Number of Animal	Animal type					
	Donkeys		Horses		Camels	
	Frequency	%	Frequency	%	Frequency	%
0.0	12	5.3	184	81.0	225	99.1
1	110	48.5	41	18.1	2	0.9
2	65	28.6	2	0.9		
3	23	10.1				
4	17	7.5				
Total	227	100	227	100	227	100

Number	Sheep		Goats		Cows	
	Frequency	%	Frequency	%	Frequency	%
0.0	205	90.3	64	28.3	45	19.8
1 – 4	10	4.4	118	52.0	129	56.8
5 – 8	5	2.2	20	8.8	30	13.2
9 – 12	2	0.9	11	4.8	10	4.5
13 – 16	1	0.4	8	3.5	7	3.1
17 – 20	4	1.8	6	2.6	6	2.6
Total	227	100	227	100	227	100

**Table 9: Types of fodder trees and plants in the study area**

Family	Scientific name	Arabic name
Anacardiaceae	<i>Sclerocarya birrea</i>	الحميض
Balanitiaceae	<i>Balanites aegyptiaca</i>	الهجليج
Combretaceae	<i>Anogeissus leiocarpus</i>	الصهيب
Combretaceae	<i>Combretium hartimannia</i>	الهبيل
Fabaceae	<i>Dichrostachyos cinerea</i>	الكداد
Fabaceae	<i>Dalbergia melanoxylon</i>	الأبنوس
Leguminasae	<i>Acacia nilotica</i>	السنط
Leguminasae	<i>Acacia senegal</i>	الهشاب
Leguminasae	<i>Acacia seyal</i>	الطلح
Leguminosae	<i>Tamarindus indica</i>	العرديب
Leguminosae	<i>Acacia albida</i>	الحراز
Mimosoideae	<i>Albizia amara</i>	العرد

Cont. Table 9:

Moraceae	<i>Ficus sycamorus</i>	الجميز
Rhamnaceae	<i>Zizyphus spina-christi</i>	السدس
Caesalpiniodeae	<i>Senna abpusifolia</i>	الكول
Poaceae	<i>Cenchnus ciliaris</i>	الحسكثيت الناعم
Poaceae	<i>Cenchnus biflorus</i>	الحسكثيت الخشن
Poaceae	<i>Cynoden dactylon</i>	النجيلة
Poaceae	<i>Eragrostie spp</i>	البنو
Poaceae	<i>Aristida sp</i>	القو
Poaceae	<i>Echinochloa colonum</i>	الدفرة
Poaceae	<i>Dactyloctenium aegyptium</i>	ابو اصابع
Solanaceae	<i>Solanum dubium</i>	الجيبين

Table 10: Percentage of the tree parts uses in the study area by respondents

Tree part type	Building materials		Charcoal		Firewood	
	Frequency	%	Frequency	%	Frequency	%
Dead-dry trees	1	0.4	9	4	222	97.8
Lower branches	155	68.3	13	5.7		
Tree stems (Trunk)	8	3.5	152	67		
Dead-dry trees and lower branches	3	1.3	6	2.6	5	2.2
Lower branches and tree stems	56	24.7	42	18.5		
Dead-dry trees and lower branches and tree stems	1	0.4	4	1.8		
Dead-dry trees and tree stems	3	1.3	1	0.4		
Total	227	100	227	100	227	100

Table 11: Percentage of the household's member participation in tree products gathering in the study area.

Collectors	Building materials		Making charcoal		Firewood	
	Frequency	%	Frequency	%	Frequency	%
Women	124	54.6	131	57.7	226	99.6
Men	75	33	38	16.7	1	0.4
Women and men	28	12.4	58	25.6	0	0
Total	227	100	227	100	227	100

Table 12: Source of forest and trees products

Products	Firewood		Charcoal		Building materials		Fodders	
	F	%	F	%	F	%	F	%
Forests	1	0.4	1	0.4	1	0.4	0	0
Scatters trees	220	96.9	222	97.8	221	97.4	225	99.1
Forest and scatters trees	6	2.7	4	1.8	5	2.2	2	.9
Total	227	100	227	100	227	100	227	100

Table 13: List of medicinal trees used for human health care in the study area and the used part

Tree name	Medicine use
<i>Combretum spp</i> (bark)	Treatment tumor
<i>Acacia nilotica</i> (seeds )	Treatment of wounds, and colds
<i>Acacia nilotica</i> (fruits)	Treatment of abdominal pain
<i>Acacia nilotica</i> (leaves)	Treatment headache
<i>Anogeissus leiocarpus</i> (bark)	Treatment stomachache
<i>Azadirachta indica</i> (leaves and seeds)	Treatment tumor, clamminess and malaria
<i>Balanites aegyptiaca</i> (bark)	Treatment measles
<i>Balanites aegyptiaca</i> (fruits)	Treatment stomachache
<i>Khaya senegalensis</i> (bark)	Treatment diarrhea, bone pain, pressure blood, hepatitis, sugar and wounds
<i>Zizyphus spina-christi</i> (bark)	Treatment of abdominal pain
<i>Sclerocarya birrea</i> (bark )	Treatment of malaria
<i>Adansonia digitata</i> (Bark and leaves)	Treatment of dysentery and malaria
<i>Ficus sycamorus</i> (leaves)	Treatment of snakebites and jaundice
<i>Ficus sycamorus</i> (bark)	Treatment coughs, throat infections and chest pains

**Table 14: List of wooden handicrafts making in study area (unit)/week**

Forest product	unit/ week	Trees species used
Donkey saddle	7	<i>Boswellia papyrifera</i> , <i>Commiphora africana</i> and <i>Sclerocarya birrea</i>
Hours saddle	4	<i>Commiphora africana</i>
Camel saddle	5	<i>Balanites aegyptiaca</i> , <i>Combretum</i> spp, <i>Diospyr mespiliformis</i> and <i>Sclerocarya birrea</i>
Camel saddle(makhlofa)	2	<i>Diospyros mespiliformis</i>
wood slab (Luoh)	8	<i>Balanites aegyptiaca</i>
Mortar(Fundak)	6	<i>Sclerocarya birrea</i> and <i>Acacia albida</i>
Traditional bed (Angreeb)	4	<i>Balanites aegyptiaca</i> , <i>Cordia africana</i> , <i>Combretum</i> spp and <i>Diospyros mespiliformis</i> .
Mortar pole	10	<i>Acacia albida</i> , <i>Balanites aegyptiaca</i> and <i>Zizyphus spina-christi</i>
Traditional dish (Gadah)	6	<i>Sclerocarya birrea</i>
Wooden small chair	6	All tree species
Agricultural tools	-	<i>Albizia amara</i> , <i>Balanites aegyptiaca</i> and <i>Zizyphus spina-christi</i>
Furniture	-	<i>Acacia albida</i> , <i>Acacia nilotica</i> , <i>Balanites aegyptiaca</i> , <i>Dalbergia melanoxylon</i> and <i>Sclerocarya birrea</i> .
Trees bark	-	<i>Acacia senegal</i> , <i>Acacia nilotica</i> , <i>Acacia mellifera</i> , <i>Ficus sycamorus</i> and <i>Acacia seyal</i> .

#### 16. List of tree species contributed to rural households

All of respondents are in agreement that there are heavy cutting of trees and shrubs in the rural areas, for fuel cooking, constructing buildings and fodder. As a result, people living in rural areas are forced to find timber and fuel wood in the surrounding area. Most edible fruits are harvested seasonally and their availability and abundance varies all round the year. The fruit amounts harvested for consumption on the household and for sale make substantial contribution to economic situation of rural households and communities. Edible fruits used for additional local foods and sources of income, access of these products and used or stored in the time of production to be available all round the year to get sustainable income. Households are depending on a little fruits due to high prices of crops, and decrease of production with exceeded the consumption.

#### 17. Level of forest benefited

All of respondents are used firewood, majority of them 60.4 % over average. The majority of respondents (25.6%) are used charcoal in cooking and heating, most of them using (19.4%) over average. The minority of respondents (39.2%) used building materials from forests and trees, a lot of them using (32.6%) over average. The majority of respondents (75.8%) used trees as fodder, (56.9%) over average. The minority of respondents (37%) used tree fruits.

#### 18. Level of benefits according to the Socio-economic variables

The majority of the households (77.4%) were within the age category of less than 50 years, about (56.4%) of households are workers and the rest having no alternatives. A lot of the households (79.3%) regarded as un-educated (literacy and khalwa), majority of households (87.2%) were married. The majority of households were female (64.3%), some of household's size 5-8 members are (53.7%), household size above 9 is (20.3%) and 1-4 members are (26%). Majority monthly income of the households less than 1000SDG is (67.8%) while month income above the 1000SDG is (32.2%). Some of households (55.5.1%) were suffering from the decrease of local agriculture production (insecurity food), while (44.5%) had sufficient production.

#### 19. The relationships between respondent benefits from forest resources and some socio-economic variables, as measured by Values of Chi-square, and Cramer's V coefficient.

Correlations between level of forest benefits and each of the five variables as indicated by Cramer's V coefficients indicate that the strongest correlation was between respondent age (0.58) followed by working status (0.304), sex type (0.284), marital status (0.148) and finally family size (0.081).

The hypothesized relationships between level of benefits and each of the working status, family income, and sufficiency of agricultural production were not confirmed by Chi-square test at the probability level of 0.05.

### DISCUSSION

Fuel wood consumption is not different from place to place, access, because it's easy to get and its available in all times, useful and well cooking, one donkey load firewood equivalent 0,3 cubic meter ( $m^3$ ), one cubic meter of firewood outcomes one sack of charcoal 50kg. One hectare produced  $14m^3$  of firewood, however, i.e. 14 sacks of charcoal. All tree types are used as firewood, but there are different in lower smoke, long time of burning and calorific value. The common trees which used are *Albizia amara*, *Balanites aegyptiaca*, *Acacia nilotica* and *Anogeissus leiocarpus*, however, they have high calorific value respectively than the other trees in the area. See the appendix.

The consumption (light, burn and fence) increased in fall season; this put more pressure on forest-tree cover, also lead to land degradation. Increased the consumption ratio of charcoal used by households with increased the income, while firewood consumption and building materials is increase with decreasing households income.

Type of stoves and type of cooking houses have an effect on fuel usage. The traditional stove is very dispels the fire wood compare with the other stoves and not store heat and not efficient use of charcoal. Medium houses fence (80 meter length), four meters of fence equal one cubic meter of firewood, i.e. one house needs equivalent  $20m^3$  of firewood, which produced from an area of 1.4 hectars. Total houses fence needs timber of total length 13360m ( $3340m^3$ ) produced from an area of 238.6 hectare. The most

common trees used as a fence thorns trees, are *Acacia* spp.

Products are classified as seasonal if they are gathered from the wood lands only during some months of the year, e.g. wild fruits and thatching, while perennial products are those that are gathered through the year e.g. fuel wood and medicinal. The use of indigenous trees for medicine is wide spread probably due to poor health services in their area, which are often not supported with drugs the artificial.

Traditional medicinal is preferred as the local people consider it to be effective (The knowledge about the medicinal uses passed through the successive generations). Tannins are extracted from the bark and young wood, certain fruits and leaves. Dyes obtained from the bark, wood, and in some cases from the roots, of many trees and other plants, the oil is extracted from seeds of some tree species.

The Huts (Gotyia) and rooms building refer to stabilization mode, it takes 3-5years to renew, whereas, Dandnky building most refers to nomadic mode and Rakuba refers to both, it takes 2-3 years to renew. One Hut in average required to 20 poles, 10 forked support (sheaba) and 10 patches of branches (Matareg) (1 patch= 20 pieces). One Rakuba in average require to 12 poles and 6 forked support. One Dandnky in average require to 10 forked support and 2 patches of branches, and one Room in average require to 5 poles. These all building materials are free without any cost which is taken direct from scatter tree and forests.

**Table 15: Distribution of respondents according to types of benefits obtained from forest resources**

Type of benefited		Number	%
Fire wood	Benefited	227	100
	Not benefited	0.0	0.0
Total		227	100
Charcoal	Benefited	58	25.6
	Not benefited	169	74.4
Total		227	100
Building material	Benefited	89	39.2
	Not benefited	138	60.8
Total		227	100
Fodder	Benefited	172	75.8
	Not benefited	55	24.2
Total		227	100
Fruit	Benefited	84	37
	Not benefited	143	63
Total		227	100
Fence	Benefited	219	96.5
	Not benefited	8	3.5
Total		227	100





**Table 17: Distribution of benefited respondents by type and level according to level of benefit forest resources.**

Type of benefit	Level of forest benefit					
	NO			%		
	Over average	Less average	Total	Over average	Less average	Total
Firewood	137	90	227	60.4	39.6	100
Charcoal	44	14	58	19.4	6.2	25.6
Building material	74	15	89	32.6	6.6	39.2
Fodder	129	43	172	56.9	18.9	75.8
Fruit	67	17	84	29.6	7.4	37
Fence	134	85	219	59.1	37.4	96.5
Total	585	264	849	68.9	31.1	100

**Table 18: Distribution percentage of respondents by socio-economic variables and level of benefit. (n=227)**

Independent variables	Level of benefit %			
	Over average	Less average	Total	
Age	> 30 years	23.5	14.9	38.4
	31-50 years	25.1	14.9	40.0
	< 51 years	11.9	9.7	21.6
Total		60.4	39.6	100
Working status	Work	41.4	14.9	56.4
	Don't work	18.9	24.7	43.6
Total		60.4	39.6	100
Education level	Illiteracy	46.7	23.6	79.3
	Educated	13.7	7	20.7
Total		60.4	39.6	100
Marital status	Married	55.1	32.1	87.2
	Un married	5.3	7.5	12.8
Total		60.4	39.6	100
Sex type	Male	28.2	7.5	35.7
	Female	32.1	32.1	64.3
Total		60.4	39.6	100
Family size	1-4 members	14.9	11.1	26
	5-8 members	31.7	22	53.7
	< 9 members	13.7	6.6	20.3
Total		60.4	39.6	100
Family income / month	> 750	22	14.1	36.1
	751-1000	18	13.7	31.7
	< 1001	20.3	11.9	32.2
Total		60.4	39.6	100
Local agricultural production	Sufficient	26.4	18.1	44.5
	Not sufficient	33.9	21.6	55.5
Total		60.4	39.6	100

**Table 19: The relationships between respondent benefits from forest resources and some socio-economic variables as measured by values of Chi-square, and Cramer's v coefficient.**

Independent variables	Chi-square value	Df	Asymp. Sig.	Cramer's V Value
Age of respondents	14.203	2	.001	.058
Working status	3.705	1	.054	.304
Education level	77.925	1	.000	.059
Marital status	125.819	1	.000	.148
Sex type	18.612	1	.000	.284
Family size	41.692	2	.000	.081
Family income / month	.802	2	.670	.050
Local agricultural production	2.753	1	.097	.017

Range productivity is 2.5 ton/ feddan. The total range production is 237300 ton in Zalingei Locality, which comprised about (60%) of animals fodder vs. (40%) shortage ratio it balanced 158200 ton which produced from 63280 feddan. This means that trees can continue to produce fodder when grasses and annual crops have ceased to grow in dry seasons. The animals: cows, sheep, camels and goats used for lamp production, while donkey and hours to carry things such as woods and charcoal and as transportation mean. Nomads move within these range land from massif (Summer resting places) to makharef (rain season resting places) through old traditional passages towards the valley in their North and South travelling, searching for water, fodder as well as escaping from harmful of mud's and insects.

The forests degradation degree is different from place to place according to relationships between human activities and ecological nature. As the agricultural and animals production systems being degraded the people and animals are shifting to the natural forest and depleted. The increase demand for fuelwood by the growing population will outstrip sustainable supply, and lead to more deforestation. It's clearly the main causes of forest degradation in behalf of production of charcoal, that the people cut the whole trees and this prevented succession of trees, eventually led to forest degradation. Furthermore, the hyper grazing specially on leguminous trees alien with increasing of population led also to degradation of the forests. There are other several causes of forests degradation, that the rural peoples are relied on wood products to satisfy their needs for traditional building, furniture, agricultural tools, fences, handicrafts and others.

Women are always engaged to forest resources (firewood, charcoal, fence, building material, fruit and etc) to satisfying their daily needs because no alternatives in present time and the questionnaire was conducted in a random way, while the population were similar in their characteristic and male migration to urban areas and collecting of crude gold, large scale farms in search of paid employment has left women in duty of the management of small farming activities. Resources that can be utilized based on experience and social status and economic situation and the time. Many rural households depend on crafts making to satisfying own basic needs and to enhance their economics status, mainly in low agricultural production situation.

The scatters trees are most contributed products in the study area especially in scarcity time before the fall season when the fodder trees, range plants in land and mountain are finished, and few members obtained the products from forests.

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Finding indicated that elder respondents benefited more than younger respondents. They may have less access to regular jobs than younger respondents and depend totally on the available forests resources. Also they may have larger family size and their family members assist them in the utilization from the forest resources. Married respondents were joined to be benefited more than non-married respondents. On one hand, married people, because of the family responsibilities need more resources and are highly motivated to gain benefits from the available resources, on the other hand married people might have larger family labour forces who can contribute to the utilization of the forest resources. Female respondents benefited more than male respondents. This may due to the fact that females tend to be more involved instrumental and agricultural activities than males. Level of education was found to be positively associated with level of benefit from forest resources. Factor that may account for this positive relationship may deal with the skills and capacities needed for the utilization from the environment resources such as knowledge about procedures and means, acquaintance with the latent social structure, technical skills and access to the leadership structure.

The economical variables including income, sufficient of agricultural production and even working status were not associated significantly with level of forest benefit.

In the light of these results it can be said that regardless of differences in economical positions, the vast majority of respondents are still in need for the forests resources, and depending on the benefits they obtain from the utilization of these resources at least in the present time.

### CONCLUSION

Socio-economic benefits from forests are the basic rural household's needs and improvements in quality of life that are satisfied by the consumption of goods from forests and trees getting their income

directly from the forest. Forests are known to provide a wide range of environmental services that may indirectly benefit many people and their existence, may also provide benefits for current and future generations.

Respondent's benefits from forests resources was hypothesized to be associated with head of the households age, working status, educational level, marital status, sex type, family income, family size and sufficiency of agricultural production. Among these eight proposed relationships, five were confirmed by Chi-square test. Statistically significant relationships (at level of .01) were found between level of benefits from forest resources and each of age, educational level, marital status, sex and family size. Based upon the results, distribution of the respondents according to these five variables and level of benefit from forest resources, it can be concluded that relationships between each of these five variables and level of benefits are positive. These results mean that elder, higher educational, married, male and smaller family size respondents benefited more than younger, less educated, non-married, female and bigger family sizes.

#### RECOMMENDATIONS

Based upon the study findings the following are some recommendations:

- 1-The Forest National Corporation Office (FNC) need to draw a scientific policy for forest management and pays more awareness about forest protection through building capacity of stakeholders and a forestation and reforestation in an integrative system with the rural people.
- 2-Pay more attention about using improved cement stoves instead of stove stone (traditional) to minimize fuel wood consumed.  
The range administration need also to, pay attention to range management must strew the range seeds in big areas to increase the range productivity; improvement the natural range lands to capable animal's density, increase fodder area and protect the farms from animals during the farming seasons to grantee the production and stability.
- 3- Zalingei Government should enforcement of the legislations pertaining forest management and protection and consolidation of the security situation.
- 4-Zalingei government is asked to establish more schools and provide teachers to educate local residents and improve their awareness and behavior about environmental protection and sustainability. Priority is given to eradicate illiteracy especially of females, through the adoption of mechanisms that take measures to ensure compulsory education, adult education and support systems.
- 5-Poverty alleviation to give priority to the problem of poverty, and work to reduce the incidence of poverty and reduce the effects on women, particularly in the rural sector, through the provision of employment opportunities and appropriate training for women. And expansion in the establishment of small businesses and family programs produced.
- 6-The involvement of rural women in development programs as the primary beneficiary of the natural resources in their daily lives, and also increase women's awareness of environmental risks, and their impact on the health of family members, and on-discrimination in the socialization according to sex.
- 7-It is suggested also to recycle agricultural residues and animal dung's to minimize the pressure on natural people. It is important to improve the management of agricultural systems and to enhance technology of production.

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### الملخص العربي

#### مساهمة موارد الغابات في التنمية الريفية في منطقة زالنجي، ولاية وسط دارفو - السودان

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كان الهدف العام من الدراسة توضيح مساهمة موارد الغابات في التنمية الريفية في منطقة زالنجي ولاية وسط دارفور في السودان، وقد استهدفت الدراسة لعينة محددة لتحقيق الأهداف التالية: التعرف على كميات خشب الوقود (حطب وفحم) المستخدمة بواسطة أرباب الأسر، أنواع الموافد المستخدمة في الطبخ، أنواع المساكن، أنواع السياج، والأسباب الرئيسية للتدهور والتصحر التي تواجه الموارد الغابية والأشجار في منطقة الدراسة. التعرف على أنواع الحيوانات، النباتات الرعوية، الأجزاء المستخدمة من الأشجار، الذين يجمعون الموارد، مصادر المنتجات وقائمة من الإستخدامات المختلفة للأشجار. التعرف على أنواع ومستوى الاستفادة للمبوهين. التعرف على العلاقات بين مستوى إستقادات المبوهين من موارد الغابات وبعض المتغيرات الإقتصادية والإجتماعية.

إجريت الدراسة الميدانية في مايو ويونيو ويوليو عام ٢٠١٥، حيث أخذت عينة عشوائية مكونة من ٢٢٧ من أرباب الأسر تمت مقابلتهم شخصياً باستخدام إستبيان أعد لغرض الدراسة. وبناء على مراجعة الأدبيات ذات الصلة والإطار النظري اقترحت عددا من الفرضيات ذات العلاقات بين مستوى الاستفادة من موارد الغابات وبعض المتغيرات الإجتماعية والإقتصادية. تم إستخدام العديد من الطرق الإحصائية في تحليل البيانات الميدانية من بينها التوزيع التكراري

والنسب المئوية والمتوسطات لوصف متغيرات الدراسة. كما تم استخدام إختبار مربع كاي في إختبار فروض الدراسة. واستخدمت معامل كيرمر أيضا للدلالة على قوة العلاقات بين مستوى الإستفادة من موارد الغابات والمتغيرات الإجتماعية والإقتصادية.

أظهرت النتائج أن إجمالي إستهلاك الخشب كان ٣٣٣.٦ هكتار/سنة، وكان معدل إزالة الغابات ٠.٣٠ هكتار/سنة. وأوضحت نتائج الدراسة وجود علاقات معنوية إحصائية (عند المستوى الإحتمالي ٠.٠١) بين مستوى الإستفادة من موارد الغابات وكل من العمر، المستوى التعليمي، الحالة الإجتماعية، الجنس وحجم الأسرة. وقد خلصت الدراسة بمناقشة النتائج الرئيسية وعدد من التوصيات حول كيفية زيادة الإستفادة من موارد الغابات في ظل تحقيق التنمية المستدامة في منطقة زالنجي، ولاية وسط دارفور - السودان.

### Appendix

#### Tree species used as fuelwood and fodder for animals in the study area

Scientific name	الاسم العربي	Crude protein (%)	Crude fiber (%)	Calorific value Kcal/Kg
<i>Acacia albida</i>	الحراز	20.8	51.2	4700
<i>Acacia nilotica</i>	السنط	14-20	25-33	4950
<i>Acacia senegal</i>	الهشاب	23.8	24.5	4600
<i>Acacia seyal</i>	الطلح	11-15	10-20	4800
<i>Albizia amara</i>	العرذ	26	-	4300
<i>Anogeissus leiocarpus</i>	الصهب	17.3	9.6	4900
<i>Balanites aegyptiaca</i>	الهجليج	14.2	34	4600
<i>Combretium hartmannia</i>	الهبيل	7.9	7.8	4600
<i>Dalbergia melanoxylon</i>	الأبنوس	-	-	5030
<i>Dichrostachys cinerea</i>	الكداد	11-15	-	5000
<i>Ficus sycomorus</i>	الجميز	9	31.5	5244
<i>Sclerocarya birrea</i>	الحميض	30.9	2.5	611
<i>Tamarindus indica</i>	العرديب	14	14.7	4950
<i>Zizyphus spina-christi</i>	السدر	5	31	4400

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