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Assessment of Woody Vegetation in Zalingei Locality, Central Darfur State, Sudan

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Abstract.

This study was conducted at Zalingei area, in the period from May 2013 to April 2015. The objectives of this study are to assess woody species of forest trees in the study area. A reconnaissance survey was conducted on the basis of which the study area was stratified into seven ecological zones namely, contemporary flood plains, lower terraces, upper terraces, clay plains, sedentary plains, lower hill slopes and stony hill slopes. The total surveyed area was 278 ha of natural forests of Zalingei area. Field surveys were conducted. At the various ecological zones, all trees per plot with dbh equal to or greater than seven centimeters were enumerated, the number of trees per ha were calculated, tree height, diameter, crown diameter and volume measurements were calculated four times recurrently, twice in each season. The Statistical Analysis System (SAS) was also used for data analysis. Results showed that: Twenty nine trees species occur at the surveyed area. The average number of trees per hectare is was 70 trees. The average wood volume at the study area is 14.87m^3/ha and annual deforestation is 1.9 m^3/h whereas, the vegetation covers is about 17.96% .Government efforts for the conservation of natural forests would only be materialized if local people have been involved; hence community participation in management of these natural forests is very important. Government may consider the developing of forest regulations, policies and laws that are enforced in local communities.

Keywords: **, Woody Vegetation , Assessment , trees, species**

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الملخص.

أجريت هذه الدراسة بمنطقة زالنجي في الفترة من شهر مايو 2013م إلي شهر ابريل 2015 م، بهدف تقيم الغطاء النباتي الشجري في منطقة الدراسة. لقد تم إجراء مسح إستطلاعي وعلي اساسه قسمت منطقة الدراسة الي سبع مناطق بيئية وهي السهول الفيضية المعاصرة و التضاريس السفلي والتضاريس العليا والسهول الطينية والسهول المستقرة و منحدرات التلال والتلال الصخرية ، بلغت جملة المساحة 278 هكتار من مناطق الغطاء النباتي الغابي بمنطقة زالنجي. اجريت مسوحات ميدانية للغطاء النباتي. في مختلف المناطق البيئية تم حصر جميع الأشجار التي قطرها عند مستوي الصدر أكبر من أو يساوي سبعة سنتيمترات. وقد تم حساب عدد الأشجار في الهكتار و دونت إرتفاعاتها وأقطارها وأقطار تيجانها و تم حساب المخزون الخشبي. وأجريت هذه القياسات أربع مرات متكررة، مرتين في كل موسم. استخدم نظام التحليل الإحصائي (SAS) لتحليل البيانات. أظهرت النتائج أن هنالك تسعة وعشرون نوع من الأنواع الشجرية تم تحديدها وتسجيلها في منطقة الدراسة . كذلك اظهرت النتائج أن هنالك 70 شجرة/هكتار. حجم المخزون الخشبي 14.8م^3 /هكتار بمعدل فقد سنوي 1.9 م^3/هكتار، ونسبة الغطاء النباتي للمنطقة هو 17.96٪. يصعب تحقيق جهود الحكومه في الحفاظ على الغابات الطبيعيه دون مشاركة المجتمعات المحلية، وبالتالي المشاركه المجتمعية في إدارة هذه الغابات الطبيعيه مهم للغايه. يوصي بان تضع الحكومه في الاعتبار تطوير وتنظيم السياسات و القوانين التي طبقت علي السكان المحليين في القطر.

الكلمات المفتاحية:الغطاء النباتي الشجري، تقيم، اشجار، انواع.

I. Introduction

Sudan is the third largest country in Africa. It had been the largest until the secession of South Sudan in 2011(UNDP, 2013). Forests play an important role in the Sudanese welfare, in conserving the environment and the contribution to the country's national economy. The forests and woodlands covered 17.68% of the total land area of Sudan (FAO, 2000). Forests in the Sudan covered about 10 % of the total area of the country after separation (FNC, 2015). The forests in semi-arid Africa are disappearing at a rapid rate, because of many factors, among which is the need for new agricultural land and, to some extent, also for fuel wood. The greater Darfur region which was once an independent sultanate underwent a series of divisions and segmentation, as a result of which it is now composed of five states. Central Darfur is one of the recently established states with headquarters at Zalingei town. Anthropogenic factors and natural disasters have collectively impacted the natural resources of the region over the years. The current Darfur conflict had its direct and visible impacts on the natural resources and in particular forests and woodlands of the whole region and Zalingei area in particular. Different people view the status of woody vegetation in the area differently, some people think that the fleeing of communities to IDPs camps gave chance to the natural regeneration to establish at alarming rate and there are some areas that became closed forest as a result, others think that the long and vast empty areas left chance for wood traders to fell large areas. Compared to previous studies that have been conducted in the region such as (Smith, 1949), Lebon (1965), (Wickens 1976), (Maydell, 1986), (Badi, *etal* 1989), (El Amin, 1990) and (Adam, 2003**),** it has been noted that there is a change in the tree species composition in Sudan. The aim of this study is to assess woody vegetation species at the study area in central Darfur state in general and Zalingei area in particular. And determine the condition of the growing stock and densities of woody species in the Zalingei area. According to the modified version of Harrison and Jakson's map by (Wickens, 1976), Zalingei area lies in the thorn Savanna and scrub on clay soils and deciduous savanna wood land on latosols. For the first zone, the average rainfall range from 400 to 800 mm, pure stands of *Acacia mellifera* scrub occur between 400 and 500 mm with *Acacia seyal* and *Balanites aegyptiaca* dominant in the higher rainfall areas. Whereas for the second zone, the average rainfall ranges from 450 to 1300 mm annually. Here, *Combertum glutinsum, Anogeissus leiocarpus ,Terminalia brownii, Albizia amara* subsp. *sericoaphala, Khaya senegalensis* and *Isoberlinia doka* are the major trees. Recently (DRC and U of Z, 2009) reported that there is only twenty trees species at Wadi Salih and Azum locality which reflected low biodiversity, the number of trees per unit area were found to be 42trees/ ha and the natural regeneration was found to be 8598 seedlings/ha, the average wood volume per tree was calculated as 3.4 m^3 while the overall crown coverage was calculated as 5.1%,. The same study revealed that, the dominant tree species are *Albizia amara* and *Balanites aegyptiaca* . Remarkable forest change was reported by (DRC and U of Z, 2009) whose indicated that *Anogeissus leiocarpus*, which was a dominant species at the study area since long time ago is disappearing, and is being replaced by *Albizia amara*. *Faidherbia albida* at Wadies especially at Wadi Salih area where only 7 and 4 trees per hectare were recorded at Wadi Jiddo and Taringa respectively, but at Zalingei 9 trees/ ha were recorded (DRC and U of Z, 2009). Goda (2005) indicated 11 *Faidherbia albida trees /ha* at Zalingei area. Earlier publications cited by (DRC and U of Z, 2008) and Goda (2005), showed declining trend of *Faidherbia albida* from 72 trees/ha in 1966 to 51 trees/ha in 1968, then to 20 trees/ha in 1977, and lastly 16trees /ha in 1985.

II. MATERIAL AND METHODS

The area lies on the semi-arid Savannah zone, which affected by the elevation of Jabel Marra Massif. The study attempted to analyze the woody vegetation and the natural regeneration at the study area. A reconnaissance survey was carried out at the study area, during May and July 2013, to assess the general environmental conditions and woody plant community types. The study area was stratified into seven ecological zones according to soil type, slope and distance from Wadi system previously classified and described by (Wickens, 1976). These ecological zones are

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namely, contemporary flood plains, lower terraces, upper terraces, clay plains, sedentary plains, lower hill slopes and stony hill slopes as shown in Figure below.

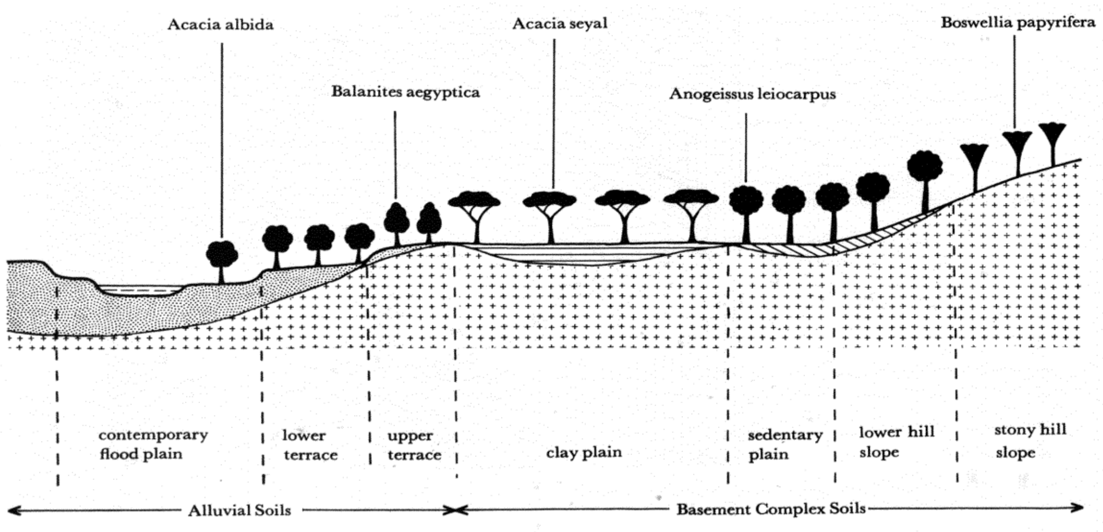

Fig. Schematic diagram of Zalingei area showing the relationship between geomorphology, soil and vegetation as cited in Wickens (1976).

According to the reconnaissance survey the selected sites for investigation, represented 278 ha of Zalingei woody vegetation area distributed as follows: 96 ha at Zalingei administrative unit, 108 ha at Abata administrative unit and 74 ha at rural Teraje administrative unit. The total size of sample plots was 13.9 ha representing 5 % of the total survey area. Sites selection for investigations was primarily based on its geographical position to the Wadi system, i.e. lying perpendicular to the wadies system, and this included Wadi Gallabat Traje, Wadi Aribo Zalingei, Wadi Dahab sharo Zalingei, Wadi Azum Zalingei and Wadi Uyer Abata, other factors dictated site selection were the existence of woody vegetation, the distribution of trees species in the area, and altitude for the stony hill slope sites. Eleven sites were selected for this study. Site 1 is a contemporary flood plain on Wadi Gallabat Teraje with altitude of 999 meter abve see level (m..a.s.l). Sites 2 and 3 represent lower terraces at Wadi Uyer in Abata with altitude of 960 m.a.s.l and Wadi Aribo in Zalingei with altitude of 902 m.a.s.l. Sites 4 and 5 are upper terraces at Wadi Dahab Sharo in Zalingei with altitude 922.2m.a.s.l and Wadi Gallabat Teraje with altitude of 1002 m.a.s.l. Site 6 is clay plain at Wadi Uyer in Abata with of altitude 973 m.a.s.l. Site 7 is sedentary plain at Wadi Uyer Abata with altitude of 980 m.a.s.l. Sites 8 and 9 are lower hill slope at Wadi Uyer in Abata with altitude of 993m.a.s.l and Wadi Gallabat Teraje with altitude of 1016 m.a.s.l. Sites 10 and 11 are Stony hill slope at Wadi Gallabat Teraje with altitude of 1112 m.a.s.l and Wadi Azum in Zalingei with altitude of 944.4 m.a.s.l (figure 1. and table 1)

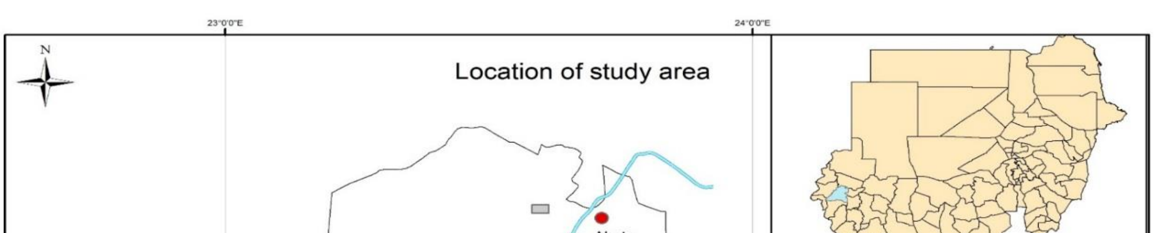

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Fig.1. the study sites at Zalingei area modified from Land sat (2015).

Table 1. Description of the area surveyed and direction of the sites relative to Zalingei town.

No	Description	Abbreviation	Total survey area in ha	Sample plot area in ha	Distance and direction from Zalingei Km
1	Contemporary flood plain- Teraje	CFT	10	0.5	26.5 S
2	Lower terraces – Abata	LTA	12	0.6	31 NE
3	Lower terraces – Zalingei	LTZ	12	0.6	1.5 S
4	Upper terraces- Zalingei	UTZ	42	2.1	11.5 E
5	Upper terraces – Teraje	UTT	12	0.6	22 SW
6	Clay plain - Abata	CPA	12	0.6	36 NNE
7	Sedentary plain -Abata	SPA	42	2.1	34 NE
8	Lower hill slope - Abata	LHA	42	2.1	37 NE
9	Lower hill slope – Teraje	LHT	42	2.1	24.5 SSW
10	Stony hill slope- Teraje	SHT	10	0.5	25 SSW
11	Stony hill slope- Zalingei	SHZ	42	2.1	4 .3 N
			278	13.9	

The systematic circular line-plot sampling design and systematic strip sampling after Wiley and Sons, (1982) was used for this survey. Using the Global Positioning System (GPS), measuring tape (100 m) , a compass, a caliper, and hypsometer, four inventories were carried out in the two seasons of 2013 and 2014. In the sites described above, sample plots were established as follows: Site 4,7,8,9 and 11 consisted of 42 hectare (600 m × 700 m) with 21 sample plots for each one. The sample plots were circular in shape with a radius of 17.84 m (0.1 ha in area). In addition, the survey lines were drawn with seven sample plots per line. The distance between survey lines is 200 m and the distance between successive sample plots is 100 m. The distance from the outer survey lines to the borderlines is 100 m. each sample plot represents 2.1 hectares. In site 2, 3,5and 6 the area occupied by trees was laid on strip and they were relatively smaller, therefore, strip sample plot were used each of them consisted of 12 hectare (200 m × 600 m) with 2 strip (5m× 600m) along the site and the distance between each strip is 100 m, each strip divided into two sample plots, the size of each sample plot was (5m×300m). Also strip sample plot were used in site 1 and 10, because the areas of trees was laid on narrow strip at site 1 and steep slope at site 10, they were relatively smaller, each of them consists of 10 ha (200 m × 500m) with 2 strip (5m× 500m) along the site and the distance between each strip is 100 m, each strip divided into two sample plots, Size of each sample plot (5m× 250 m). In the eleven sites, the tree species were identified and recorded, and all trees per plot with dbh equal to or greater than seven centimeters were enumerated. The number of trees per ha were calculated. Height, diameter and crown diameter were recorded. The species composition, the relative dominance, relative abundance, relative frequency and importance value indexes were calculated. Woody plant diversity, Similarity between sites and the change in the biomass of woody vegetation between the season 2013 and season 2014 were calculated. Simpson diversity index was used to measure the woody plant diversity. The value of this index ranges between 0 and 1. Within this index, 0 represents infinite diversity and 1, no diversity. Where: Simpson diversity index

$$D = \sum n(n-1)/N(N-1)$$

Where:

D = Simpson Diversity index.

n = the total number of individuals.

N= the total number of species (Mahmoud, 2009).

The T Distribution (Paired - T-Test) was used to study the change in the biomass of woody vegetation between the season 2013 and season 2014 in all eleven sites. T Distribution (Paired - T-Test) can be calculated by the following formula:

$$\boldsymbol{T = \frac{D}{SD\sqrt{N}}}$$

Where:

T= T Value

N= number of Paired

SD = standard deviation.

D = The difference between the Paired means

The Statistical Analysis System (SAS) was used for data analysis.

III. Results and discussion

The results show that there is a great variation in woody vegetation stock at different locations. The greatest vegetation stock was recorded for lower terraces in Zalingei (38.9 m^3/ha), contemporary flood plain Teraje (35.68 m^3/ha) and lower terraces Abata (20.28 m^3/ha). The lowest was for clay plain in Abata (3.64 m^3/ha), upper terraces Teraje (7.17 m^3/ha) and lower hill slope Abata (7.23 m^3/ha). The mean volume is 14.87m^3/ha in the area with 1.9 m^3/h annual loss as shown in Table 2. This results slightly differs with (FAO 2001) who reported wood volume for Sudan at 9 m^3/ha, this variation is attributed to the fact that, FAO study was for all the country but the result of this study are only for Zalingei. Also differs with (DRC and U of Z, 2008) whose reported wood volume for Zalingei area at 17.9 m^3/ha. This variation is attributed to adverse human activities such as over cutting, overgrazing and agricultural expansions. The vegetation stock volume is below the average of the world which is equal to about 131 m3/ha (FAO, 2010). This is obviously because Sudan is mostly covered with dessert. The total vegetation stock volume m^3/ha was found to be decreasing from 16.2 m^3/ha to 14.9 m^3/ha in the first year and from 14.1 m^3/ha to 13.2 m^3/ha in the second year between the seasons. This degradation of vegetation in the area results from dependency of people livelihoods on forest resources. The most affected sites by human activities are upper terraces at Zalingei and lower terraces at Abata, for the first one, it is considered as the main area of charcoal making for Zalingei Town , where as for the second site is overgrazing by camel breeders whose fell down all the branches of the dominant *Faidherbia albida species* during summer period.

Table 2. Woody vegetation stock in the different sites.

Site	Y1W	Y1D	Y2W	Y2D	Annual loss m^3/ h	Volume m^3/ha
Contemporary flood plain- Teraje	17.84	17.84	17.84	17.84	0.0	35.68
Lower terraces – Abata	15.94	10.46	10.57	11.7	-2.1	20.28
Lower terraces – Zalingei	23.34	23.34	23.34	23.34	0.0	38.9
Upper terraces- Zalingei	26.2	20.41	16.53	11.94	-9.1	8.94
Upper terraces – Teraje	4.3	4.3	4.3	4.3	0.0	7.17
Clay plain - Abata	2.74	2.37	1.97	1.65	-0.7	3.64
Sedentary plain -Abata	22.97	22.56	21.05	18.86	-2.8	10.17
Lower hill slope - Abata	16.74	15.59	14.98	13.43	-2.0	7.23
Lower hill slope – Teraje	19.8	19.34	17.16	16.09	-2.9	8.62
Stony hill slope- Teraje	6.61	6.48	6.39	6.23	-0.2	12.86
Stony hill slope- Zalingei	22.18	21.62	20.96	20.02	-1.4	10.1
average	16.2	14.9	14.1	13.2	-1.9	14.87
Total	178.66	164.31	155.09	145.4	-23.1	163.59

Were:
Y1W = survey in the rainy seasons of first year Y2W = survey in the rainy seasons of second year
Y1D = survey in the dry seasons of first year Y2D = survey in the dry seasons of second year

The results of Crown cover showed that there is variation in the vegetation crown cover at different sites. The highest percentage of crown cover was the stony hill slope in Teraje (31.02%) followed by clay plain in Abata (28.72%), lower hill slope Abata (23.57%) and upper terraces in Zalingei (22.01%). The lowest was for the lower terraces in Abata (3.38%), upper terraces in Teraje (4.31%) and contemporary flood plain in Teraje (4.9%).The percentage of the vegetation cover of the area was17.96% (Table 3). This result showed that there were variations in the vegetation cover at different sites. And the percentage of the vegetation covers of the study area is less than that of (FAO, 2006), that worldwide vegetation cover was estimated at 21.4 % of the total land area. Half of this area was located in Russia, Canada and Brazil. FNC, (2004) reported that Forests cover of Sudan was 29.64 %. FAO, (2000) reported that the forests and woodlands covered 17.68% of the Sudan. FAO (2005) reported that the estimated forest cover was 28% of that study area, UNEP (2007) report that the vegetation degradation of Jebel Marra, Western Darfur shifted from 50.7% in the year 1973 to 35.8% in the year 2001. AFF, (2011), reported that the total area of Sudan and the area of vegetation cover of Sudan are reduced after separation of the two countries to 11.6%, which shows that most of the forest went with the Southern Sudan. Results of statistical analysis showed that there is a great deterioration in the woody vegetation stock through the seasons namely; survey in the rainy seasons of first year (Y1W), survey in the rainy seasons of second year (Y2W), survey in the dry seasons of first year (Y1D) and survey in the dry seasons of second year (Y2D). Also there is a great deterioration in the woody vegetation stock in the sites studied

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especially at upper terraces Zalingei and lower hill slope Abata. And there was little change in the clay plain of Abata , stony hill slope of Zalingei and lower hill slope of Teraje but there was no change at the other sites (Table 4).

Table 3. Crown cover and percentage of woody vegetation at different Sites.

Site	Y1W	Y1D	Y2W	Y2D	Average /ha	Sample plot / ha	Crown cover %
Contemporary flood plain-Teraje	245	245	245	245	0.025	0.5	4.9 %
Lower terraces – Abata	258.7	177.02	181	194.4	0.020	0.6	3.38%
Lower terraces – Zalingei	583.4	583.4	583.4	583.4	0.058	0.6	9.72%
Upper terraces- Zalingei	6811.3	5010.7	3669.7	2993.1	0.462	2.1	22.01%
Upper terraces – Teraje	258.7	258.7	258.7	258.7	0.026	0.6	4.31%
Clay plain - Abata	2048.6	1810.6	1618.9	1414.1	0.172	0.6	28.72%
Sedentary plain -Abata	4797.1	4469.3	4005.8	3641.4	0.423	2.1	20.14%
Lower hill slope - Abata	5523.1	5246.1	4723.7	4306.2	0.495	2.1	23.57%
Lower hill slope – Teraje	3770.8	3605.2	3173.5	3021.6	0.339	2.1	16.16%
Stony hill slope- Teraje	1594.5	1561.5	1540.5	1507.9	0.155	0.5	31.02%
Stony hill slope- Zalingei	3363.2	3209.4	3155.6	3136.2	0.322	2.1	15.31%
Total	29254.4	26176.9	23155.8	21302	2.497	13.9	17.96%

Were:
Y1W = survey in the rainy seasons of first year Y2W = survey in the rainy seasons of second year
Y1D = survey in the dry seasons of first year Y2D = survey in the dry seasons of second year

Results in table 4 and 5 showed that the vegetation stock has changed completely with the seasons especially in upper terraces of Zalingei and lower hill slope Abata in due to adverse human activities such as charcoal making and wood cutting at these sites and this confirmed the result by (FAO, 2001) who reported that a decrease of 959,000 ha/year; 90% of which is for fuel and charcoal making (ADB and FAO, 2003). And this result agreed with (UNEP, 2007) who reported that the annual linear deforestation rate (period loss) in Jebel Marra and Western Darfur are 1.04 % and 29.4 % respectively. Similar findings by FAO (2001) estimate the total forest cover of Sudan is 61,630,000 ha and constitutes 26 percent of the country's land area of 237,600,000 ha. The forest cover area in the Sudan decreased from 71,220,000 ha in 1990 to 61,630,000 ha in 2000. The results showed that there was variation in the crown vegetation cover between seasons namely; survey in the rainy seasons of first year (Y1W), survey in the rainy seasons of second year (Y2W), survey in the dry seasons of first year (Y1D) and survey in the dry seasons of second year (Y2D). Also there is a great decrease in crown vegetation cover in the different sites especially upper terraces Zalingei, lower hill slope Abata and sedentary plain Abata. There was a little change at the clay plain Abata , sedentary plain Abata and stony hill slope Zalingei, but there was no change in the rest of the sites (Table 5).

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Table 4. Woody vegetation stock volume (m^3) during different seasons.

Site	Comparison	T – value	Std Error	P	Level of significant
Lower terraces – Abata	Y1W **vs** Y2D	1.51	0.704	0.2292	**NS**
Upper terraces- Zalingei	Y1W **vs** Y2D	7.57	0.0897	0.000001	***
	Y1W **vs** Y1D	4.98	0.0554	0.0001	***
	Y2W **vs** Y2D	3.08	0.0709	0.0059	**
	Y1D **vs** Y2W	4.06	0.0455	0.0006	***
Clay plain - Abata	Y1W **vs** Y2D	3.35	0.0813	0.044	*
	Y1W **vs** Y2D	0.83	0.1115	0.4677	**NS**
	Y2W **vs** Y2D	4.62	0.0173	0.0191	*
	Y1D **vs** Y2W	1.39	0.0719	0.2584	**NS**
Sedentary plain -Abata	Y1W **vs** Y2D	2.10	0.0931	0.0483	*
	Y1W **vs** Y2D	1.96	0.0099	0.0636	**NS**
	Y2W **vs** Y2D	1.42	0.0735	0.1713	**NS**
	Y1D **vs** Y2W	2.90	0.0248	0.0089	**
Lower hill slope - Abata	Y1W **vs** Y2D	4.40	0.0358	0.0003	**
	Y1W **vs** Y2D	1.58	0.0346	0.1289	**NS**
	Y2W **vs** Y2D	2.40	0.0308	0.0264	*
	Y1D **vs** Y2W	2.08	0.0139	0.050	*
Lower hill slope – Teraje	Y1W **vs** Y2D	2.52	0.0701	0.0203	*
	Y1W **vs** Y2D	1.56	0.0141	0.1356	**NS**
	Y2W **vs** Y2D	1.68	0.0303	0.1077	**NS**
	Y1D **vs** Y2W	1.65	0.0630	0.1151	**NS**
Stony hill slope- Teraje	Y1W **vs** Y2D	1.38	0.0689	0.2616	**NS**
Stony hill slope- Zalingei	Y1W **vs** Y2D	3.11	0.0331	0.0056	**
	Y1W **vs** Y2D	1.62	0.0164	0.1201	**NS**
	Y2W **vs** Y2D	1.70	0.0264	0.1049	**NS**
	Y1D **vs** Y2W	**1.81**	**0.0174**	**0.0856**	**NS**

Were:
NS= Not Significant * = Significant at 0.05 ** = Significant at 0.01 *** = Significant at 0.001
Y1W = survey in the rainy seasons of first year Y2W = survey in the rainy seasons of second year
Y1D = survey in the dry seasons of first year Y2D = survey in the dry seasons of second year

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Table 5. Crown vegetation cover (m^2) in the wet and dry seasons

Site	Comparison	T – value	Std Error	P	Level of significant
Lower terraces – Abata	Y1W **vs** Y2D	1.64	9.7789	0.1988	**NS**
Upper terraces- Zalingei	Y1W **vs** Y2D	5.66	32.135	0.00001	***
	Y1W **vs** Y1D	3.16	27.148	0.0049	**
	Y2W **vs** Y2D	2.40	13.417	0.0262	*
	Y1D **vs** Y2W	4.18	15.270	0.0005	***
Clay plain - Abata	Y1W **vs** Y2D	5.64	28.106	0.0110	*
	Y1W **vs** Y2D	9.79	6.0765	0.0023	**
	Y2W **vs** Y2D	2.26	22.646	0.1088	**NS**
	Y1D **vs** Y2W	1.44	33.250	0.2451	**NS**
Sedentary plain -Abata	Y1W **vs** Y2D	4.39	12.542	0.0003	***
	Y1W **vs** Y2D	2.86	5.4538	0.0096	**
	Y2W **vs** Y2D	2.60	6.6848	0.0173	*
	Y1D **vs** Y2W	3.37	6.5401	0.003	**
Lower hill slope - Abata	Y1W **vs** Y2D	4.31	13.429	0.0003	***
	Y1W **vs** Y2D	2.38	5.5442	0.0274	*
	Y2W **vs** Y2D	2.79	7.1336	0.0114	*
	Y1D **vs** Y2W	3.69	6.7489	0.0015	**
Lower hill slope – Teraje	Y1W **vs** Y2D	3.15	11.340	0.0051	**
	Y1W **vs** Y2D	1.85	4.2550	0.0787	**NS**
	Y2W **vs** Y2D	1.92	3.7766	0.0699	**NS**
	Y1D **vs** Y2W	2.4	8.5831	0.0256	*
Stony hill slope- Teraje	Y1W **vs** Y2D	2.68	8.0782	0.0750	**NS**
Stony hill slope- Zalingei	Y1W **vs** Y2D	2.53	4.2789	0.0201	*
	Y1W **vs** Y2D	2.02	3.6301	0.0573	**NS**
	Y2W **vs** Y2D	0.1214	0.5710	0.1214	**NS**
	Y1D vs Y2W	**0.0677**	**1.3265**	**0.0677**	**NS**

Were:
NS= Not Significant * = Significant at 0.05 ** = Significant at 0.01 *** = Significant at 0.001
Y1W = survey in the rainy seasons of first year Y2W = survey in the rainy seasons of second year
Y1D = survey in the dry seasons of first year Y2D = survey in the dry seasons of second year

IV. Conclusion

The present research attempted to study the status of woody plant in selected areas of Zalingei locality, Central Darfur State, Sudan. This study is the first one conducted after the study of Wickens (1976), which had shown the importance of the various ecological zones in the area. Samples were distributed based on the ecological zones namely, contemporary flood plains, lower terraces, upper terraces, clay plains, sedentary plains, lower hill slopes and stony hill slopes. The number of trees per hectare was 70 trees. The diversity index for the ecological zones ranged between 0.15 - 1. The highest diversity was at the lower terraces (0.15) and the lowest diversity (1) was at the contemporary flood plain. Similarity coefficient between the areas Zalingei, Traje and Abata for the similar site such as Upper terraces, lower terraces and stony hill slope is less than 39%. The wood volume is 14.87 m^3/ha at the area, and the percentage of the vegetation cover in the area is 17.96%. There is variation in the deterioration of crown vegetation cover between the seasons due to continuous tree removal. There is a great deterioration in crown vegetation cover at the sites especially the upper terraces in Zalingei which is more close to IDPs stetting, lower hill slope Abata and sedentary plain Abata due to overgrazing .The main factors behind forest degradation are the adverse human activities pushed by livelihoods demands and climatic variations. Government efforts for the conservation of natural forests would only materialized if local people have been involved; hence community participation in management of these natural forests is very important. The main factors behind forest degradation are the adverse human activities pushed by livelihoods demands and climatic variations therefore; government needs to consider developing forest regulations, policies and laws that are enforced in local communities.

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