



Evaluation the Current Range Condition in the Semi – arid areas at Eldebeibat area (South Kordofan State) – Sudan

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Abstract

The study was conducted at Eldebeibat area in South Kordofan State, which is considered the important part of Semi – arid grazing land in Sudan that used for grazing activity especially during the rainy season. The rangeland were divided into three sites according to soil types namely Clay, sandy and gardud soil. This study aims to evaluate the current Condition of rangelands in the semi – arid areas. For vegetation measurements the Parker loop method (Parker and Hiris, 1959) were used to measure relative plants composition and ground cover of the rangeland using transect 100 meter tape and a $\frac{3}{4}$ loop placed at ground level at one meter intervals. In addition to the quadrat method (Wilm *et al*, 1944) were used to determine plants frequency%. The questionnaires were designed for the two targeted group (mobile pastoralists and sedentary groups). The standard equations of vegetation measurements were used for plant attribute data analyzes, and the statistical Package for Social Sciences (SPSS) was used to analyze socio-economic data. The results show different plant attributes at the three sites, the sandy site recorded highest plant composition followed by clay soil while the lowest plant compositions was recorded at gardud soil in two grazing seasons. Clay site was dominated by *Schoenfeldia gracilis*, sandy site was dominated by *Zornia glochidiata*, while gardud site was dominated by *Vossia cuspidata* in the two seasons. Plant cover percentage at the three sites was low for the two rainy seasons; gardud site scored the highest percentage of bare soil for two seasons. The pastoralists confirmed that some species were found in all sites in the grazing areas such as *Dactyloctenium aegyptium*, *Echinochloa colona* and *Ipomea spp*, also sedentary people stated that some species were found around their villages such as *Dactyloctenium aegyptium*, *Zornia glochidiata*, *Cenchrus spp*, *Sida cordofolia* and *Eragrostis spp*. some species

disappeared at the grazing areas, while some plant species appeared according to the investigation of two groups. The results also showed that the new species invaded the area, most of them were consider unpalatable for livestock grazing. The phenomenon of range land deterioration was very clear since the invader plants species were represented in three soil types.

Keywords: plant composition, Plant cover, Litters, Bare soil, appeared, and disappeared

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Introduction

The rangelands in Sudan are varied from poor to rich according to the ecological zones, especially in South Kordofan State in Western and central regions, including Nuba Mountains area. (Bashir and El Tahir, 2006). Most of the rural areas of the Sudan are dominated by a population of pastoralists and agro-pastoralists who are totally dependent on land and its natural resources for support of their livelihoods. The traditional natural resource tenure system used to be effective for meeting the demands of herders and farmers without harming the overall environment. However, the increase in human and animal population, horizontal expansion in mechanized farming, and the series of droughts inflicting fragile ecosystem, e.g. those of the northern parts of northern states of Sudan, are leading to the breakdown of the tenure system (UNDP, 2006: Ahmed,. and Abu Sabah, M, 1993). According to (IFRPI and IFAD, 2006) South Kordofan State covers an area of approximately 158,355 km², most of which has been affected by insecurity due to the civil war. The region is rich in its natural resources; among them is vast rangeland which used both for livestock and crops production. It plays a vital role in economy and welfare of rural people. The insecurity situation resulted to population increase in southern Kordofan associated with

increasing demand for food production in rangeland, resulting in more pressure on the rangeland resources (IFAD, 2006). Several factors are responsible of range plant degradation, but the most significant ones are the increasing number of livestock population in open grazing system and the cropping in marginal lands (Fashir, 2012). extensive grazing is the other factor of range plant degradation, the most palatable species are not given enough rest to survive and invader plants are developing only a plants like *senna*, *obtusifolia* *Calotropis procera* and *Acanthospermum hispidum*,, in addition to other invader are left over because they contain poison and not eaten by livestock (Fashir,2014). Extensive grazing specially when combined with frequent drought leads also to the decrease of perennial species (Nefzaoui, 2004). All these phenomena are exacerbated by the changes leave way in pastoral system into settled around town as in Eldebeibat town. Grazing by domestic livestock has been considered as a major degrading factor because it changes vegetation structure and composition as a result of which some species increase in abundance and others decrease (Yates *et al.*, 2000). Besides, it is the most pervasive cause of soil degradation (IFAD, 2003), which in turn, results in decline of herbaceous biomass production. However, extensive livestock grazing in open grazing

land in savannah leads to the disappearance of the most palatable grass species where they replaced by other unpalatable plants.

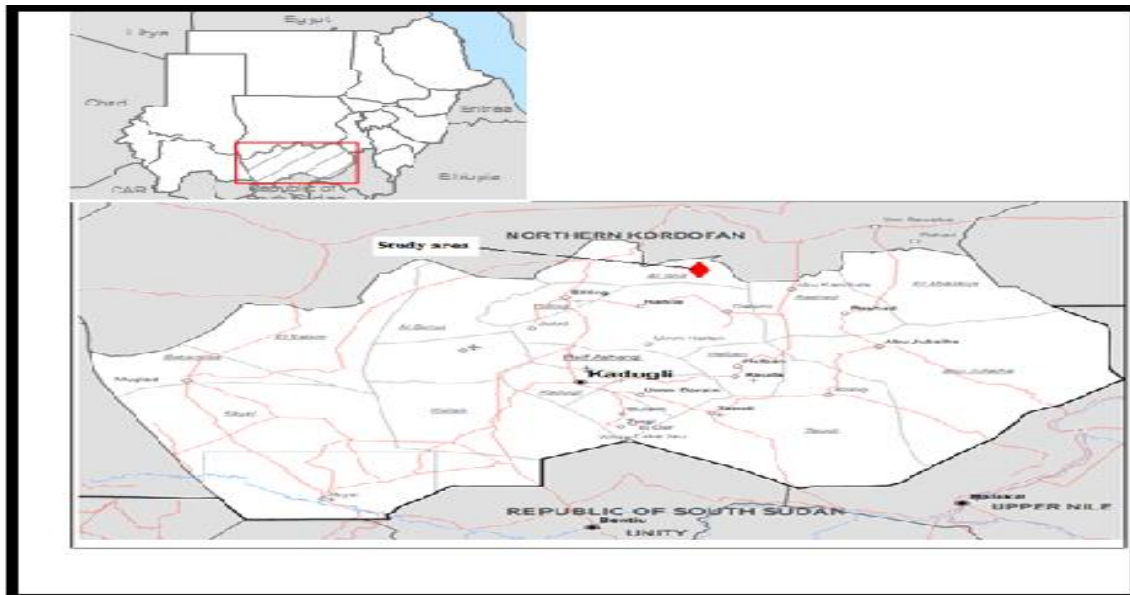
Material & Methods

Study area and location

The study area is considered the important part of grazing land in South Kordofan State

particularly in rainy season, it lies between latitude $11^{\circ} 45' - 12^{\circ} 49' N$ and longitude $25^{\circ} 29' - 30^{\circ} 0' E$. The area is about 5700Km^2 and constitute 7.3% of the total area that belong to El Dilling locality, (Musa, 2001).

Figure (2.1) Map of Sudan and South Kordofan State illustrates the study area



Source: (OCHA, 2012)

Methodology

Data collection

Primary Data: primary data were collected through vegetation attribute measurements, which were taken for two rainy seasons and two questionnaires for mobile pastoralists and sedentary groups at the study area. The Secondary data were taken from books papers and reports.

Vegetation attributes measurements

Sampling

The rangeland were divided into three sites according to soil types namely clay, sandy

and gardud soil. For vegetation measurements the Parker loop method (Parker and Hiris, 1959) was used to measure relative plants composition and ground cover of the rangeland using transect 100 meter tape and a $\frac{3}{4}$ loop placed at ground level at one meter intervals. A total of 24 transects were taken, 8 transects in each site were then distributed of the species, litter, bare soil and rocks along each transect were identified, then total hits of each parameter were calculated. The following equations were used to calculate

percent of certain plant attribute such as Plants composition%, relative plants species composition, and others parameters (litter%, bare soil% and rocks %) were calculated. A total of 100 hits per transect were taken, then distribution of the species, litter, bare soil and rocks along each transect were recorded,

the total hits of each parameter were calculated. The following equations were used to calculate percent of certain plants attributes such as Plants composition%, relative plants species composition; in addition to others parameters (litter%, bare soil% and rocks %).

$$\text{Plant composition\%} = \frac{\text{Total hits on plants}}{\text{Total hits/transect}} \times 100 \dots\dots\dots (1)$$

$$\text{Relative plant composition} = \frac{\text{Total hits on each species}}{\text{Total hits on all plants species}} \times 100 \dots\dots\dots (2)$$

$$\begin{aligned} &\text{Percent of others parameter (litters or bare soil or rocks)} \\ &= \frac{\text{Total hits on parameter (Litters, Bare soil or Rocks)}}{\text{Total hits}} \times 100 \dots\dots (3) \end{aligned}$$

In addition to the quadrat method (Wilm et al, 1944) were used to determine relative plants density, Frequency, atonal of 240 quadrates with size 1×1m² were taken, 80 quadrates per each site, ten quadrates per transect at ten meters interval . Then Plant

frequency was calculated by counting species which occur within each quadrat and recorded their names only not their number. The following equation was used to calculate frequency%: (Daubenmire, 1968).

$$\text{Frequency} = \frac{\text{Number of quadrats with plants species occurrence}}{\text{Total number of all quadrats}} \times 100 \dots\dots\dots (4)$$

Socio – economic aspects

The questionnaires were designed for the two targeted group (mobile pastoralists and sedentary groups), who used the rangelands at the study area in both seasons dry and wet season. The questions of these questionnaires included disappearance and appearance of plant species at the grazing areas and around villages and their preference of these species for livestock in the area, plants species exist in rangelands as native species, general health of livestock and their number compared with number in the past andetc.

Data analysis

The vegetation attributes data were analyzed by using the standard equations of range

vegetation measurements and statistical Package for Social Sciences (SPSS) were used to analyze Socio – economic aspects all results were presented in form of tables and figures.

Results and Discussion

Vegetation attributes measurements

Plants composition

Table (3.1) illustrates the plant composition percentage at different range sites through two seasons respectively, clay site recorded the lowest plant composition for two seasons (66% and 67%), when compared with sandy

site and gardud site scored (95% and 87%) and (76% and 44%) respectively. This variation in plant composition may be attributed to different soil types, grazing level and rainfall (amount, timing and distribution). All of these factors play important role of variation of plant composition at the three sites. Herlocker, (1999) declared “That the degree of grazing strongly affects the structure of plants, composition, quality and productivity of rangeland vegetation, Continuous intensive grazing leads to vegetation changes such as the replacement of palatable plants by less palatable plant species, replacement of perennial grasses by annuals one, bush

encroachment, lower standing biomass and reduced basal cover. The sandy site was recorded the highest percentage of plant composition (95% and 87%) for two seasons respectively. This may be due to availability of seeds into soil, and variation of species which structured the plants community, most species which covered the sandy site were not preferred by livestock such as *Zornia glochidiata* which was a dominant species at sandy site, but less preferred, therefore this reason gave chance for it to grow freely to tolerate grazing and develop their self quickly when compared with other species at other sites, are preferred by most classes of livestock.

Table (3.1) Average plants composition% of the three sites for the two rainy seasons

Parameters	Sites					
	Clay		Sandy		Gardud	
	2013	2014	2013	2014	2013	2014
Plants composition	66	67	95	87	76	44

Table (3.2) Average percentage of relative plants species composition in the three different sites for the two rainy seasons

Scientific name	Habit	Clay		Sandy		Gardud	
		2013	2014	2013	2014	2013	2014
<i>Schoenfeldia gracilis</i>	Grass	53	53	1	0.0	38	15
<i>Dactyloctenium aegyptium</i>	Grass	10	2	9	0.0	4	5
<i>Zornia glochidiata</i>	Forbs	12	7	27	75	0.0	16
<i>Solanum dubium</i>	Forbs	0.0	3	0.0	0.0	0.0	0.0
<i>Echinochloa colona</i>	Grass	8	3	25	5	5	3
<i>Chloris gayana</i>	Grass	2	15	0.0	0.0	1	7
<i>Chloris preiurii</i>	Grass	11	1	0.0	0.0	2	5
<i>Ipomea spp</i>	Forbs	0.0	0.0	1	0.0	0.0	0.0
<i>Eragrostis spp</i>	Grass	4	13	22	9	1	1
<i>Sida cordofolia</i>	Forbs	0.0	0.0	1	2	0.0	0.0
<i>Pennisetum pedicellatum</i>	Grass	0.0	0.0	0.0	1	0.0	0.0
<i>Oldenlandia senegalensis</i>	Forbs	0.0	1	5	3	0.0	0.0
<i>Waltheria indica</i>	Forbs	0.0	1	0.0	0.0	0.0	0.0
<i>Aristida spp</i>	Grass	4	2	7	4	4	0.0
<i>Cenchrus biflorus</i>	Grass	0.0	0.0	0.0	1	0.0	0.0

<i>Alysicarpus vaginalis</i>	Forbs	0.0	0.0	0.0	0.0	0.0	0.0
<i>Fimbristylis dicotomo</i>	grass	0.0	0.0	0.0	1	0.0	0.0
<i>Vossia cuspidata</i>	Grass	0.0	0.0	0.0	0.0	44	46
<i>Digitaria gayana</i>	Grass	0.0	0.0	0.0	0.0	0.0	0.0
<i>Acanthospermum hispidum</i>	Forbs	0.0	0.0	0.0	0.0	0.0	0.0
<i>Senna obtusifolia</i>	Forbs	4	1	0.0	0.0	2	4
<i>Cenchrus ciliaris</i>	Grass	0.0	0.0	0.0	0.0	0.0	4

Plant cover

Table (3.3) demonstrates percentage of plant cover at the three sites for two seasons; the three sites scored low plant cover percentage in the two seasons, clay site scored (11% and 16%), sandy site recorded (16% and 27%) and gardud site (11% and 16%) respectively. This may be due to soil types that sandy soil can keep plant seeds for long period or other factors such as rainfall characterizing, intensive grazing, expansion of agricultural land, and deforestation and compaction soil surface by animal’s hoofs. All of these lead to loss of vegetation cover for both (tree cover and understory) at the study area. Cayrol *et al*, (2000) and Loeser *et al*, (2007) reported that both natural (floods, fires, droughts, volcanoes, etc.) and human activities such as (deforestation, overgrazing, urbanization and pollution) influences are known to cause massive changes in vegetation cover and dynamics. Over-grazing was considered as the main biotic factor responsible for the low vegetation cover. Beside over grazing or uncontrolled grazing, trampling by domestic

livestock in semi-arid regions always reduces plant cover that protects the soil and generally results in soil erosion and compaction (Branson *et al*, 1981 and Oztas *et al*., 2003). All sites not reach in standard percentage of plant cover to protect soil and reduce the erosion ratio in the area, the percentage of plant cover ranging from 10.7 – 27%. Connolly *et al*, (1997) reported that when the percent of vegetation cover is less than 30–40%, runoff and soil loss dramatically increase. In vegetation cover improvement practices need to maintain more than 40% vegetation cover to decrease runoff and soil loss. Rangeland management practices should be included grazing management with the purpose of increasing the vegetation cover such as seeds broadcasting and decreasing the grazing pressure on the natural vegetation, controlling kinds and numbers of animals (Proper stocking), when they utilize the rangeland is absolutely essential in regulating the effects of grazing on vegetation cover.

Table (3.3) Average plant cover/m2 percentage at three sites for two seasons

Parameter	Sites					
	Clay		Sandy		Gardud	
	2013	2014	2013	2014	2013	2014
Plant cover%	11	16	16	27	11	16

Plant litters percentage

Plant litters that all dead parts of plants covered the land surface, that stated by (Whitford, 1988 and 1996). “Litter is any dead plant material that is in contact with the soil surface.” Litter provides a major source of the soil organic material and the raw materials for nutrient cycling. Table (3.4) illustrates percentage of plant litters at three sites for two seasons (2013 – 2014) the clay site was scored (6 and 7%) followed by sandy site (0.8 and 3%), while gardud scored (2.3 and 5%), where the results showed the percentage of plant litters were very low at all sites, this may be due to heavy grazing, shortage of rainfall particularly at last decade, early grazing, and low vegetation cover contribute of plant litters reduction. (Naeth *et al*, 1991) and (Jensen and Gutekunst, 2003) reported “that the standing and fallen litter mass generally decrease with increased grazing intensity.”

Bare soil percentage

Table (3.4) shows percentage of bare soil at three sites in the two seasons, the results of bare soil was different among three sites, gardud site recorded the highest percentage of bare soil, when compared with other sites for two seasons (23% and 52%) respectively and followed by clay site (30% and 29%) respectively, while sandy site scored the lowest bare soil% for two seasons (6% and

6%) respectively, this may be due to species which structure the plant community were different in their palatability for animals and tolerate grazing. Highest percentage of bare soil at gardud site may be attributed to high ratio of runoff, topography, continues intensive grazing, low ground cover, and compact soil surface layer by repetition of animal’s movement and the site close to pastoralist’s tents and their livestock routes. All these reasons increased erosion hazards whether by both water or wind and finally lead to create bare soil in the site. (FAO, 1987). The spatial variation in bare soil percentages may be caused by variable topographic features, overgrazing and agricultural practices. The results of Zhaoa *et al.*, (2005) showed that the contribution of grazing and trampling to bare ground formation was 47.4% and that of wind erosion was 52.6%. Heavy grazing can also cause soil erosion, loss of soil structure, and deterioration of soil environment (Scholl and Kinucan, 1996). Once heavy grazing created bare spots, wind would impose further severe erosive impacts on the soil, which causes small bare spots to merge together, resulting in enlargement of continuous bare patches. Wind impact was more severe than that of heavy grazing (Zhaoa *et al.*, 2005).

Table (3.4) Plant litters and Bare soil percentage at three soil types for two seasons

Parameter	Sites					
	Clay		Sandy		Gardud	
	2013	2014	2013	2014	2013	2014
Litters	6	7	0.8	3	2.3	5
Bare soil	30	29	6	6	23	52

Frequency%

The species *Schoenfeldia gracilis* recorded the highest frequency (62% and 59%) in the clay for the two rainy seasons respectively, *Zornia glochidiata* scored the highest frequency% (91% and 88%) in the sandy site for the two rainy seasons respectively but this species is not preferred by most animals in the area, this site needs a

replacement of the less palatable species with other more palatable one to avoid gathering animals at one site which lead to overgrazing and causes deterioration on rangelands and *Vossia cuspidata* recorded the highest frequency (71% and 46%) in the gardud site for the two rainy seasons respectively.

Table (3.5) Dominant species of the three soil types for two rainy seasons

Site	Species	Frequency%		Reducing
		2013	2014	
Sandy	<i>Zornia glochidiata</i>	91%	88%	3%
Clay	<i>Schoenfeldia gracilis</i>	62%	59	3%
Gardud	<i>Vossia cuspidata</i>	71%	46	25%

Socio – economic aspects

1Plants Species Occurrence at the three soil types during two Rainy Seasons

When respondents among pastoralists were asked about plants species, which occur at the three sites such as (clay, sandy and gardud) respectively 33% of them said *Dactyloctenium aegyptium*, 28% *Chloris gayana*, followed by 19% *Echicochloa colona* and other species in simple percentages illustrated in table (3.5). In sandy site 33% of them said *Zornia glochidiata*, 28% *Cenchrus spp*, followed by 19% *Eragrostis spp*, other species shown in table (3.5). While in gardud site the species

were different such as *Chloris preiurii* (48%), *Dactyloctenium aegyptium* (12.4), followed by *Ipomea spp* (9%) table (3.5). The respondents confirmed that three sites were dominated by different plants species, this could be attributed to variation in soil types, topography and level of utilization. when sedentary people in the area asked about plants species occurrence around their villages in the rainy season 47% of them said *Eragrostis spp*, 17% *Zornia glochidiata*, followed by 15% *Cenchrus spp* and other species showed simple ratios are mentioned in the table (3.6).

Table (3.6) Plants species occurrence at the three sites during rainy season according to mobile pastoralists' interview

Species	Sites/ Percentage					
	Clay	%	Sandy	%	Gardud	%
<i>Dactyloctenium aegyptium</i>		33		9		12
<i>Chloris gayana</i>		28	X	-		1
<i>Echicochloa colona</i>		19		2		9
<i>Chloris proreurii</i>		50	X	-		48
<i>Ipomea cordofana</i>		4	X	-	X	-
<i>Blepharis linariifolia</i>		3		1.0	X	-
<i>Andropogon gayanus</i>	X	-		2.0	X	-
<i>Aristita spp</i>		7	X	-		6
<i>Ipomea spp</i>		1		1.0		9
<i>Eragrostis spp</i>		1		19	X	-
<i>Cymopogon nervatus</i>		1	X	-	X	-
<i>Brachiaria obtusiflora</i>		1	X	X	X	-
<i>Zornia glochidiata</i>	X	-		33	X	1
<i>Oldenlandia senegalensis</i>	X	-		5	X	-
<i>Cenchrus spp</i>	X	-		28		7
<i>Andropogon gayanus</i>	X	-		1	X	-
<i>Cyperus rotodus</i>	X	-		1	X	-
<i>Ipomea cordofana</i>	X	-		1	X	-
<i>Vossia cuspidata</i>	X	-	X	-		4
<i>Cynodon dactylon</i>	X	-	X	-		2
<i>Senna obtusifolia</i>	X	-	X	-		1
<i>Senna occidentalis</i>	X	-	X	-		1
<i>Hyparrhenia confinis</i>	X	-	X	-		1

= existence of species in site and X absence of species in site

Table (3.7) Plants species occurrence around the villages according to sedentary interview

Scientific name	Local name	Percentage
<i>Eragrostis spp</i>	Bano	47
<i>Cenchrus spp</i>	Haskanet	15
<i>Zornia glochidiata</i>	Shillini	17
<i>Dactyloctenium aegyptium</i>	Abu assaby	4
<i>Echinochloa colona</i>	Differa	5
<i>Sida cordofolia</i>	Nadah	6
<i>Oldenlandia senegalensis</i>	Tamr elfar	1
<i>Aristida spp</i>	Gaw	2
<i>Senna occidentalis</i>	Sorib	1
<i>Brachiaria obtusiflora</i>	Um geer	1

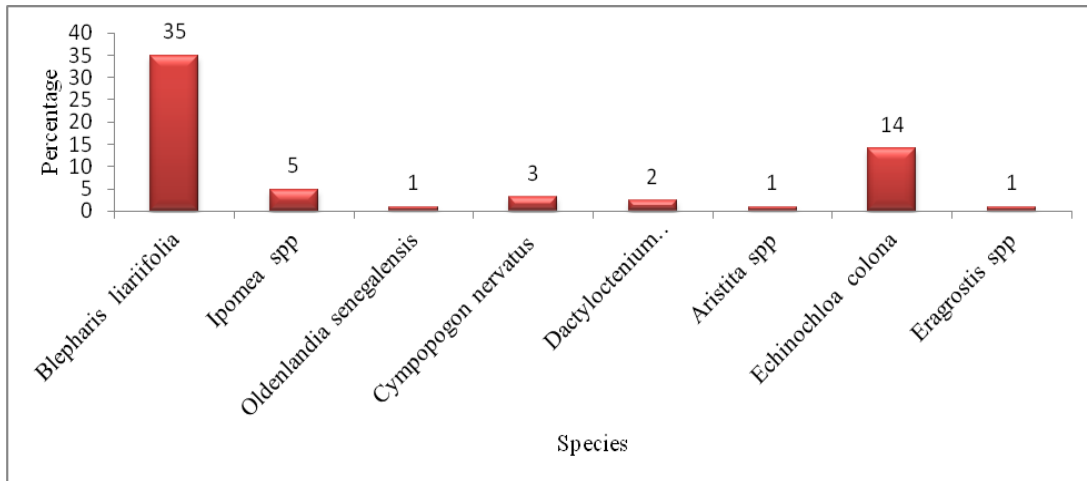


Figure (3.1) Plants species that disappeared at grazing areas according to mobile pastoralists

Plant species disappeared from grazing areas

Majority of respondents among pastoralists' families confirmed, that some species at the grazing areas disappeared from rangeland at rainy season domain "Makhraf" 35% of them said *Blepharis linariifolia*, 14% *Echinochloa colona*, followed by other species illustrated in fig (3.1). There were significant differences at ($P < 0.0001$) the respondents were asked also about species which replaced the species in range 50% of

them said *Sida cordofolia*, 4%, *Xanthium brasiliicum* fig (3.2) This could be attributed to overgrazing, overstocking and absence of range improvement activities in the area for a long. Ibrahim (2009) declared "That villagers in this area confirmed that some plant species disappeared around their villages such as *Blepharis linariifolia* and *Dactyloctenium aegyptium* decreased whereas; unpalatable species like *Zornia glochidiata*, *Senna occidentalis* and *Senna obtusifolia* increased."

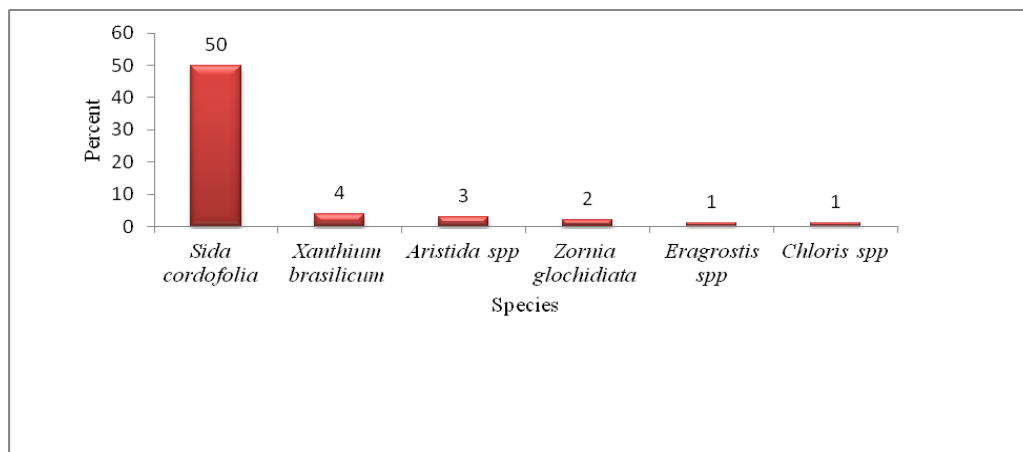


Figure (3.2) Plants species invaded grazing areas according to mobile pastoralist

Disappearance and invader plants species around villages

Asked sedentary respondents about species disappeared from area 35% of them said *Blepharis linariifolia*, 18% *Echinochloa colona*, fig (3.3), this may due to overstocking, overgrazing of more palatable species and absence of rangelands' improvement activities in the area. Also respondents investigated about the plants

species that replaced indigenous species in the area most of them 64% said *Sida cordofolia* represented as invader species but not prefer by livestock fig (3.4). The respondent indicated that *Sida cordofolia* species came with relief programme, which provided by USA Government at Nemarry's regime, since drought period in (1985), the strong indicators of rangelands deterioration at the study area were clear phenomenon.

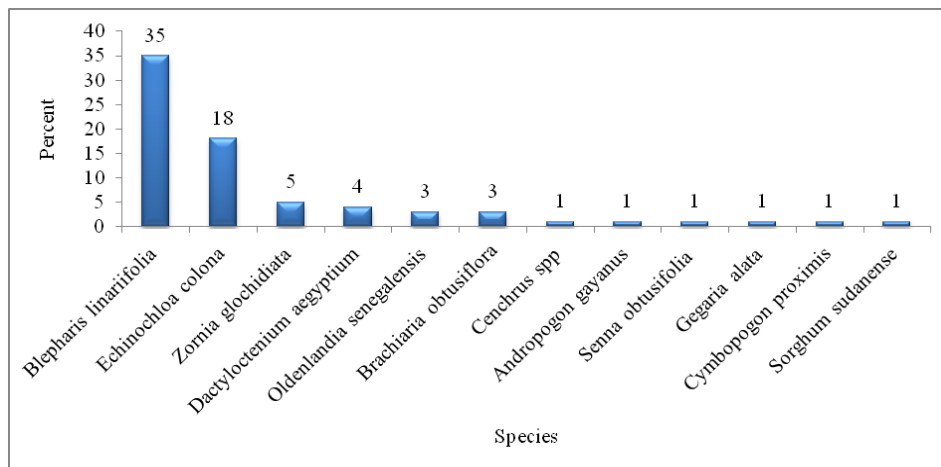


Figure (3.3) Plants species that disappeared around villages according to sedentary interview

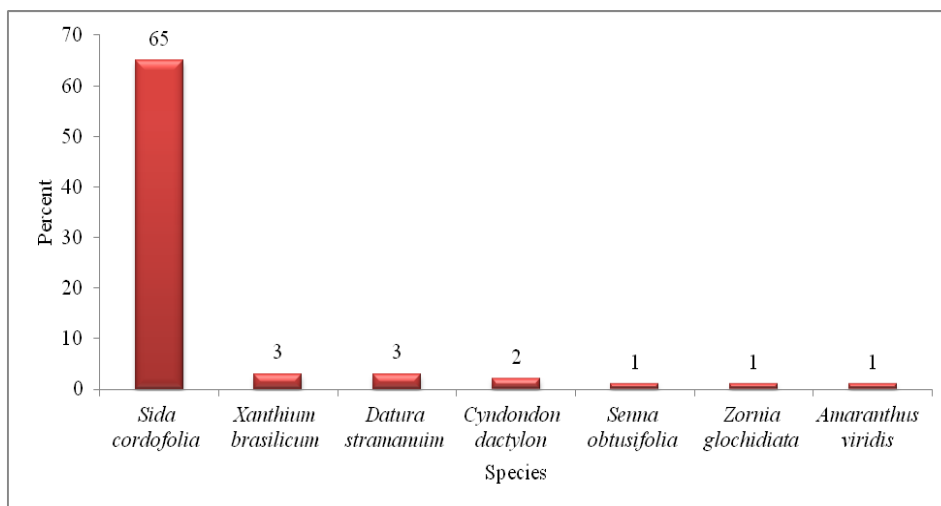


Figure (3.4) Plants species that invaded the area according to sedentary interview

Conclusion

The study showed that, the three soil types dominated with different plants species in the two rainy seasons. Some species disappeared of grazing areas such as *Blepharis linariifolia* and *Echinochloa colona*, which are considered most be the palatable species at the area and changed with less palatable species such as *Sida cordofolia* and *Xanthium brasiliicum*. Plants cover percentage and plant litters at the three soil types scored low values in the two seasons and the gardud site scored the highest percentage of bare soil for the two seasons. Some plant species such as *Dactyloctenium aegyptium*, *Echinochloa colona* and *Ipomea spp* were found at the three soil types, that species suitable in seeds broadcasting in the grazing area, the above results showed that rangelands condition at this area tend to deterioration, and that obviously was due to disappearance of most palatable species, and appearance of less palatable species at the grazing areas. According to results there a needs to practice range improvement such as broadcasting of native species seed, which appeared at the three soil types. The exotic and unpalatable species on grazing areas and control species are considered as invader species which appeared in recent years.

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تقييم الحالة الراهنة للمراعي في المناطق شبه الصحراء - دراسة حالة منطقة الديبيات ولاية جنوب كردفان محلية الدلنج - السودان

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المستخلص

أجريت الدراسة في ولاية جنوب كردفان بمحلية الدلنج في فترة بين (2013- 2014). تعتبر منطقة الدراسة من أهم المناطق الرعوية في إقليم شبه الصحراء في السودان وخاصة في موسم الأمطار. هدفت الدراسة إلى تقييم الحالة الراهنة للمراعي في المناطق شبه الصحراء في السودان. قسم المرعى في منطقة الدراسة إلى ثلاث أقسام بناءً على نوع التربة. تم استخدام طريقة اللوب (باركار وهيري, 1959م) لقياس مؤشرات النباتية في المرعى. وأيضاً تم استخدام طريقة كوادرات (وليم و أخرون, 1944م) لقياس التغطية الأرضية وتردد النباتات، هذا بالإضافة إلى إستبانة أستهدفت مجموعتين من الرعاة الرحل والمستقرين، تم إختيار عدد 100 فرد من الأسر الرعاة يمثلون رب الأسرة. أظهرت النتائج فروقات معنوية عالية جداً في جميع المؤشرات النباتية في ثلاثة ترب مختلفة، بنسبة التركيبة النباتية أظهرت ان التربة الرملية لها نسبة أكبر ويليهما التربة الطينية ثم التربة القردودية. واما التغطية الأرضية فأظهرت نسب متدنية في أنواع الترب الثلاث في موسمين. كما أن نسبة الأراضي الجرداء كانت عالية في التربة القردودية. وأيضاً أظهرت الدراسة إن هنالك نباتات أختفت في المراعى وظهرت نباتات أخرى غير مرغوبة للحيوانات . وأيضاً أظهرت الدراسة أنا ظاهرة التدهور في المرعى واضحة وذلك من خلال إنتشار النباتات الغازية وتدهور التربة.