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Effect of Climate Change on Seasonality of Animal Feeds on Rangeland Productivity at Selected Sites of Khartoum State

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ABSTRACT

The impact of climate change on seasonality of rangeland productivity in Eastern Nile and Northwestern Omdurman was monitored during two successive years (2011 and 2012). Seven sites selected were within Khartoum state. Parameters investigated were range condition, nutritional value of plants, carrying capacity and plant palatability. The results showed that the contribution of different plant species to small ruminants (sheep & goats) and camels' diet as a percentage of pollens' plants measured in feces showed that Grass spp constituted more than 90% of all animals' diet except for two sites. Palatability of plant species as rated high, moderate, less and not palatable according to inhabitants' observation showed different preferences for different plant species. Woody species most preferred by sheep was *L. pyrotechnica*. In addition goats' most palatable woody species were: *A. ehrenbergiana, A. spirocarp.* Camel's most palatable woody species were: *A. ehrenbergiana, A. spirocarpa*. Pasture Condition Scoring (PCS) and Evaluation Site Methods (RESM) for both years showed better range condition in 2012 than 2011. Nutrient contents and digestible protein (%) of the main grasses, forbs and woody species for the different site at both middle and rainy season showed that; for grasses and CF showed the highest contents whereas, *P. turgidum* and *C. rotundus* showed higher ME. For forbs, *S. sesban* and *E. aegyptiaca* showed the highest digestible proteins. All woody vegetations species showed high CP contents and higher digestible proteins. Metabolism energy was better for Tundub and Abu Seweid on the Blue Nile site, whereas digestible protein tends to increase for the sites on the White Nile sites. Mineral contents and organic carbon measurements for the different species at different sites showed better calcium contents for plant cover at Tundub and Medaisees, whereas both potassium and phosphorous levels were better in the plant cover at Medaisees.

Key words: climate change, rangeland, seasonality, livestock, grazing, Sudan.

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INTRODUCTION

In tropical regions, a feed gab exists between the current rangeland production and the actual amount of dry matter especially of nutritious feed required to satisfy the animals on a year round basis. During the dry season, both quantity and quality of the pasture

herbage decline and fail to meet the maintenance requirements of grazing animals (Abusuwar and Yahia, 2010). Abusuwar and Darrag (2002) estimated a feed gap in Sudan of about 51% deficiency in dry matter of which 22% total digestible nutrients and 29% digestible protein. During the long dry season, tropical forages are characterized by having low protein content resulting in low animal intake and performance (Minson, 1982). The vast majority of the world's grazing lands occur in seasonal environments that are characterized by marked fluctuations in resource abundance. Among the most dynamic are the arid and semi arid regions of tropical Africa, where extended periods of dryness are punctuated by erratic rainfall and brief eruptions of forage production. Consumers that are highly opportunistic appear best able to persist in such environments (Jarman and Sinclair, 1979).

To maintain optimum productivity and sustainable use of rangeland resources, knowledge about the current rangeland condition is indispensable. Absence of adequate base-line information about the rangeland resources has been identified as one of the bottle-necks that hindered the development of rangelands and their ability to support domestic and wild herbivores. Close correlation exists between forage production, nutritive value and site conditions, seasonal differences, the age of plants and parts of plants, as well as many other factors (Von Maydell, 1986). Therefore, this study amid to gather data on the rangeland condition, assess the quality of livestock feed resources and estimate the correct carrying capacity.

MATERIALS AND METHODS

Area of Study

This study conducted at Khartoum state, to cover area of the rangeland that lies within Khartoum state. Soil type is dark cracking clay plains bisected by depressions and seasonal water courses covered with pale yellowish-white coarse sand and small gravels. A total of seven sites were selected, three in the Eastern part of the Blue Nile they were Wadi Tundub (15°42.330' N, 033° 06.278' E), Wadi El Farish (15° 42.289' N, 033° 06.283'E) and Wadi Abu Seweid (15° 37.133' N, 032°55.005'E) and four in the Northwestern part of the White Nile they were Wadi Medaisees(16° 12.223' N, 31° 41.392' E), Wadi Buhat(16° 20.395' N, 31° 48.686' E), Qoz Abu Dolou'a 72 Km or Q72 and Qoz Abu Dolou'a 42 Km or farish Hamid(16° 09.275' N, 31° 49.317' E).

Range Condition

Two methods were used to evaluate pasture condition at each of the study sites; The Range Evaluation Site Method (Payne *et al*., 1979) which consist of a pasture rating. Pastures are rated according to quality, quantity and vigor. Each of these three factors was rated on a 25 point scale (0, 5,10,15,20 and 25) and added together to give an aggregate pasture condition score rating from 0-75. Six condition classes were 0-15, 20-30, 35-45, 50-60, 65-75 corresponding to very poor, poor, fair, good and excellent respectively.

Carrying Capacity

Number of animals of different species in Khartoum state was converted into tropical livestock units (TLU) at the rates: camels 1, cattle 0.7, sheep/goat 0.1 according to Heady, (1975). Total dry matter (Kg/ha) of each site was determined by summing up herbaceous DM and browse (Kg/ha) in order to determine the carrying capacity. A proper use factor (PUF) was calculated as 70% of the TDM of intermediate species (annuals of high palatability or perennials of low palatability and 40% of TDM of desirable species (perennials ranging from low to high palatability) according to Smith and Novelly (1997), the CC of each site was determined as by dividing PUF by 4100 (animal unit DM requirement per year). Average DM (Kg/ha) was determined by dividing the sum of TDM of the sites by 7 (number of sites) and the result was considered as an average DM produced by one ha of the area. This average was then multiplied by 2.1Mha (area of natural rangeland and forests at Khartoum state to maintain TDM (Kg/ha) produced by this area during 2011 and 2012. This figure was then compared with DM required by 77500 AU estimated in the area, and DM surplus or deficit was estimated.

Determination of Animal Diet Botanical Composition

A considerable amount of recent camel and sheep and goat feces was collected from each study site and kept in labeled paper bags. As for sheep and goat feces are difficult to distinguish, they were collected together. Feces samples were then taken to the laboratory for pollen analysis. Animal diet

botanical composition was determined using quantitative and qualitative analysis of pollen present in the animal feces as an indicator to the plant species consumed by the animals. The nutritive value was determined according to the AOAC (1985).

Statistical Analysis

Randomized Complete Block design was employed for herbaceous dry matter productivity, browse production, total herbaceous and browse density and woody cover as this design is suitable when environmental conditions are not under control. Analysis of variance (ANOVA) was carried out according to Steel and Torrie, (1980). Means were separated using the Duncan's Multiple Range Test (DMRT). Simple Coefficient of correlation (r) was calculated according to test correlation between different variables from the following formula.

RESULTS

Condition Scores

Condition scores and condition classes which resulted from the application of the Pasture Condition Scoring Method (PCS) in (2012) and the Range Evaluation Site Method (RESM) in 2011 and 2012 for the different sites are shown table (1). It is shown that the PCS for the year 2012 was good for all sites except for Buhat which showed poor score. REAM for the same year was good for most sites but showed excellent scores for both El-Farish and Abusaid at the Blue Nile site, and fair for Abu-Dolu'a on the White Nile site. The year 2011 showed less scoring condition, where two sites showed fair conditions (Tundub, and El Farish) on the Blue Nile site, and two showed poor conditions (Goz Abu Dolou'a and Abu Dolou'a) on the White Nile site.

Table 1: Condition scores and condition classes of the study sites in 2011 and 2012

Method	Year	Sites													
		T		F		A		M		B		G72		G42	
		Score	Class	Score	Class	Score	Class	Score	Class	Score	Class	Score	Class	Score	Class
PCS	2012	23	G	27	G	22	G	21	G	22	G	22	G	23	G
RESM	2011	45	F	35	F	50	G	50	G	60	G	30	P	30	P
RESM	2012	65	E	60	G	65	E	55	G	75	E	50	G	40	F

T= Tundub, F= El Farish, A= Abuseweid, M= Medaisees, B= Buhat, G72= Goz Abu Dolou'a Km 72, G42= Goz Abu Dolou'a Km 42. G= good, P= poor, F= fair, E= Excellent.

Indicators Used for Pasture Condition Scoring

At all sites the species present were of intermediate desirability to animals. Also at all sites diversity of plants was broad. Plant density of species is more than 95%, for Tundub, Farish, Abusewaid and Buhant. Plant vigour was strong at Tundub and Farish. Tundub also showed legumes at stand were more than 40%. Severity of plant use was the heaviest at Buhant, G72 and Farish Hamad (Table 2). Grazing was spotty at Farish, intermediate at Tundub and uniform at other sites. Soil erosion was severe at Madeasis, intermediate at Abusewaid and Buhat. Percent covered woody canopy was more 40%at Tundub, Buhat and Abusewaid, whereas, it constituted less than 11% at both G72 and Farish Hamad. Both sites also showed plant residue. However, both Tundub and Farish showed deficiency in plant residue. Pasture scores were nearly similar and good at all sites.

Carrying Capacity

Total dry matter (TDM) (Kg/ha), consumable forage and carrying capacity (CC) (ha/AU/3 month), during 2011 and 2012 are shown in table (3). CC generally was improved from 2011 to 2012 as TDM was increased. Abuseweid showed the highest CC during both years, while Farish Hamid showed the lowest (Table 3).

Plant Palatability

The palatability of all plant species to different animal species (camels, sheep and goats) in each study site was evaluated by interviewing local community members especially the elders. The species were assigned +++ if highly palatable, ++ if moderate, + if less palatable and 0 if not palatable (table 4).

Table 2: Indicators used the pasture condition scoring

Category	Sites						
	T	**F**	**A**	**M**	**B**	**G72**	**F H**
Plant desirability: the species present are mostly: 0 1 2 3 4 undesirable Intermediate Desirable	3	3	3	3	3	3	3
Plant diversity: the diversity of plant is: 0 1 2 3 4 narrow<2 medium 3-4 broad>5	4	4	4	4	4	4	4
Plant density: the percent ground cover of desirable and intermediate species are: 0 1 2 3 4 < 55 65 75 85 > 95	4	4	4	2	4	0	0
Plant vigour: desirable and intermediate species are: 0 1 2 3 4 weak medium strong	4	3	4	2	3	3	2
Legume in stand: the percentage of the total biomass which is legume: 0 1 2 3 4 < 10 10-19 20-29 30-39 > 40	3	3	2	1	2	0	2
Severity of use: the degree of frequency of use is: 0 2 4 2 0 light moderate heavy	0	0	0	2	4	0	0
Uniformity of use: the uniformity of grazing is: 0 1 2 3 4 spotty intermediate Uniform	2	0	3	4	4	4	4
Soil erosion: sheet, rill, gully and stream bank erosion is: 0 1 2 3 4 severe moderate slight	4	4	2	0	0	4	4
Woody canopy: percentage covered by a woody canopy is: 0 1 2 3 4 > 40 31-40 21-30 11-20 < 11	0	3	0	3	0	4	4
Plant residue: dead and decaying plant material is: 0 2 4 2 0 deficient appropriate excessive	4	4	2	2	2	0	0
Pasture condition score	28	28	24	23	26	22	23
Pasture condition class	Good	Good	Good	Good	Good	Good	Good

T=Tundub, F= El Farish, A= Abu Seweid, M= Medaisees, B= Buhat, G72= Goz Abu Dolou'a Km 72 & F H= Farish Hamid). Adopted from Cosgrove *et al*. (1996).

Table 3: Total dry matter (TDM) (Kg/ha), consumable forage and carrying capacity (CC) (ha/TLU/3 month) of the study sites.

Site	Years					
	2011			2012		
	TDM (Kg/ha)	Consumable forage	CC (ha/TLU/3 month.)	TDM (Kg/ha)	Consumable forage	CC (ha/AU/yr.)
Tundub	141.76	9923.20	0.17	704.18	49292.60	0.11
El Farish	137.84	9648.80	0.17	1171.49	82004.30	0.11
Abuseweid	616.78	43174.60	0.12	1724.62	120723.40	0.11
Medaisees	421.38	29496.60	0.10	1151.23	80586.10	0.11
Buhat	191.81	13426.70	0.15	541.74	37921.80	0.12
Q72	171.10	11977.00	0.16	1236.88	8658.16	0.18
FH	18.63	1304.10	0.52	232.83	16298.10	0.14

Table 4: Main herbaceous species in the study area and their palatability to different animal species

Species	Palatability		
	Sheep	Goats	Camels
Aristida mutabilis	+	+++	+
Indigofera hochstetteri	+++	+	++
Tribulus terrestris	+++	+	++
Tribulus pentandrus	+++	+	++
Portulaca oleracea	+++	++	++
Portulaca quadrifida	+++	++	++
Corchorus oletorius	+	+	+
Corchorus depressus	+++	+	+
Boerhavia repens	+++	++	++
Amaranthus gracizans	+	+	+
Urochloa tricopus	+	+++	++
Ocimum bacilicum	+	0	+
Euphorbia aegyptiaca	+++	++	+
Sesabania sesban	++	+	+
Ipomoea sinensis	+++	+	+
Ipomoea cordofana	++	+	+
Solanum.dubium	0	0	0
Celosia argentia	+	0	0
Ccnchrus biflorus	+	+++	++
Momordica tuberose	0	0	0
Sorghum arundinaceum	+	+++	++
Digera muricata	+	0	+
Aristolochia bracteolate	+	0	0
Dactelochtenium aegyptium	+	+++	++
Morettia sp.	+	0	+
Cyperus rotundus	+	+++	+
Echenocloha colona	+	+++	++
Zaleya pentandra	+++	+	++
Citrullus sp.	0	0	0
Panicum turgidum	+	+++	+++

+++= highly palatable, ++ moderate, += less palatable, 0= not palatable

Animal Diet Botanical Composition

Contributions of different forage species to small ruminants (Sheep, goats and camels) diet are shown in table (5). Except for Farish and Buhat, Grass spices contributed to more than 90% of all animal species, although at Tundub and Farish, it constituted about 82% and 75% of camel diet respectively. *Amaranthus spp* and *Indigofera spp* constituted about 73 and 68% of sheep and goat diets at Buhat and Farish, respectively. However, *Acacia spp* constituted32% of sheep and goat diets only at Buhat Table (5).

Table 5: Contribution of different plant species to small ruminants (sheep & goats) and camels diet as a percentage of pollen in the feces from each of the study sites.

Pollen type	Sites											
	Tundub		Farish		Abuseweid		Medaisees		Buhat		G. Abudolou'a	
	S&G	C	S&G	C	S&G	C	S&G	C	S&G	C	S&G	C
Grass spp.	94.77	82.71	31.49	75.29	92.64	97.53	97.53	97.40	16.67	30.50	94.38	96.72
Tribulus spp.		5.26		14.04	6.69	2.34	0.33	2.01		12.5	1.12	3.28
Acacia spp.	0.65	12.03		10.67	0.13	0.13	0.33	0.10	32.50	12		
Indigofera spp.	4.58		68.51				2.01	0.13			0.37	
Amaranthus spp.								0.13	50.73	12.50		
Portulaca spp.											4.12	

S&G: sheep and goats, C= camels

Nutritional value, digestibility

Nutrient contents and digestibility (%) of the main grasses, forbs and woody species from the study area collected at the middle of the rainy season is shown in table (6). For grasses, *E. colona* and *A. mutabilis* CF showed the highest contents whereas, P. *turgidum*, *U. tricopus* and *C.s rotundus* showed higher ME. For forbs, *S. sesban*, *A. bracteolate* and *E. aegyptiaca* showed the highest digestible proteins. For woody vegetations, all species showed high CP contents and higher digestible proteins. Nutrient contents (%) and digestibility (%) of some browse species in the study area collected at the end of the dry season showed that similar patterns for both nutrient contents and digestibility table 6.

Nutrient contents and digestibility (%) of grasses + forbs composite samples at the end of the wet season from each of the study sites is shown in table (7) the nutritive values are nearly the same, however, ME was better for Tundub and Abu Seweid on the Blue Nile site, whereas digestibility tends to increase for the sites on the White Nile Sites.

Table 6: Nutrient contents and digestible protein percentage of the main grasses, forbs and woody species from the study area collected at the middle of the rainy season

Grasses	DM%	CP%	CF%	EE%	Ash%	NFE%	ME	DP
Panicum turgidum	94.78	2.88	12.31	0.62	4.73	74.25	12.83	57.45
Urochloa tricopus	95.50	2.57	11.67	0.52	3.80	76.95	12.30	63.31
Echonochloa colona	95.21	2.44	20.24	1.59	3.72	67.22	9.80	57.98
Aristida mutabilis	95.94	3.11	23.20	1.81	3.24	64.58	8.18	67.85
Cyperus rotundus	95.46	2.61	11.62	0.54	3.42	77.28	14.08	56.96
Overall mean	**95.38**	**2.72**	**15.81**	**1.02**	**3.78**	**72.06**	**11.44**	**60.71**
Forbs								
Portulaca oleracea	95.35	2.45	12.19	0.46	3.61	76.65	14.02	57.69
Tribulus terrestris	95.32	2.32	12.12	0.51	3.30	77.07	11.89	62.32
Indigofera hochstetteri	95.42	2.54	12.21	0.62	3.82	76.25	11.88	64.21
Ipomoea sinensis	95.35	2.88	12.78	0.48	4.13	75.09	11.94	62.22
Portulaca quadrifida	95.66	3.12	13.99	0.82	3.53	74.21	11.22	62.63
Morettia sp	95.32	2.59	12.45	1.12	3.63	75.54	11.55	63.13
Tribulus pentandrus	94.92	2.65	12.16	0.89	3.33	75.91	11.61	61.86
Boerhavia repens	95.33	2.80	12.70	0.52	3.63	75.69	11.60	61.93
Zaleya pentandra	95.45	2.66	12.52	0.62	3.63	76.03	11.67	62.64
Amaranthus gracizans	95.10	2.23	16.90	1.80	4.40	69.78	9.90	61.32
Sesabania sesban	95.08	4.18	11.60	1.11	6.61	71.58	9.21	76.41
Aristolochia bracteolate	90.66	4.50	12.52	1.61	4.91	67.12	9.95	86.06
Euphorbia aegyptiaca	95.32	5.32	19.19	1.83	7.02	61.96	9.10	73.22
Overall mean (forb)	**94.94**	**3.10**	**13.33**	**0.95**	**4.27**	**73.30**	**11.20**	**65.82**
Overall mean (forb+gras.)	**95.06**	**2.99**	**14.02**	**0.97**	**4.13**	**69.57**	**22.27**	**64.40**
Woody								
Acacia radiana	95.22	21.41	21.45	2.73	6.22	43.42	10.82	67.19
Acacia seyal	95.32	21.19	20.83	2.67	5.21	45.43	10.78	66.96
Acacia nubica	95.62	19.37	23.03	2.52	4.71	45.99	10.65	67.33
Acacia ehrenbergiana	96.02	19.00	22.42	2.52	4.53	47.57	9.88	65.98
Ziziphus spina-christi	95.46	14.07	18.33	2.57	3.74	56.76	9.64	67.22
Maerua crassifolia	95.43	14.61	19.40	1.71	7.09	62.62	9.75	74.78
Overall mean	**95.51**	**16.61**	**20.91**	**2.45**	**5.25**	**50.30**	**10.25**	**68.24**

Table 7: Nutrient contents and digestible protein percentages of composite samples (grasses + forbs) collected at the end of the wet season from each of the study sites

Sites	DM	CP	CF	EE	Ash	NFE	ME	DP
Tundub	95.46	2.47	12.13	0.48	3.69	76.69	14.04	57.50
El Farish	95.42	2.42	12.81	0.77	4.08	74.85	10.31	59.25
Abu Seweid	95.26	2.86	12.89	0.53	3.42	75.56	12.66	58.88
Medaisees	94.83	2.20	12.59	0.62	4.21	75.26	10.76	58.73
Buhat	95.34	2.12	17.02	1.77	4.42	70.01	9.88	60.76
G. Abu Dolou'a 72	95.10	2.77	12.79	0.87	3.54	75.38	11.50	62.53
G. Abu Dulou'a 42	95.41	2.49	12.77	2.02	3.79	75.09	10.83	61.00

Table 8. **Overall mean nutrients contents of the dominant, abundant and frequent herbaceous and woody species present at study sites at the middle of the rainy season**

Nutrient	Sites						
	Tundub	El Farish	Abuseweid	Medaisees	Buhat	G72	G42
CP	5.43	8.30	7.69	9.18	16.66	5.68	5.28
CF	15.66	17.77	16.80	16.90	16.59	14.51	16.28
EE	1.10	1.61	1.46	1.57	2.13	1.01	1.12
Ash	3.89	3.79	4.37	4.37	4.78	4.40	4.44
NFE	69.60	64.17	65.56	63.99	59.55	72.19	70.34
ME	12.45	11.00	11.49	10.94	10.18	11.13	11.54
Dig.	61.69	65.44	64.83	65.45	65.63	65.48	65.07

Crude protein content in the dominant, abundant and frequent herbaceous and woody species present at each of the study sites sampled at the middle of the rainy season were shown in table (8). They ranged show very low in all sites except for Buhat which showed higher CP concentration that support microbial activity. Other nutritive value showed nearly

similar contents, whereas ME and digestibility showed to support animal maintenance.
Change in nutritive values and digestibility for herbaceous species compared between the middle and end of rainy season, did not vary much although digestibility tended to decrease with the end of rainy season (table 9).

However, for woody species *Acacia ehrenbergiana* crude protein content was shown to be much higher during the rainy compared with the end of dry season table (10). Mineral contents for forbs and grass species composite sampled at all sites showed nearly similar concentrations (table 11).

Table 9: Change in nutritive value of herbaceous species between the middle and the end of the rainy season

Duration	Nutrients						
	CP	CF	EE	Ash	NFE	ME	Dig.
Mid rainy season	2.99	14.02	0.97	4.13	69.57	11.88	64.40
End of rainy season	2.25	12.61	0.58	3.73	75.70	12.34	58.54

Table 10: Change in nutritive value of woody species between the middle of the rainy season and the end of the rainy season

Seasons	Nutrients						
	CP	CF	EE	Ash	NFE	ME	Dig
Mid rainy season	19.00	22.42	2.52	4.53	47.57	9.88	65.98
End of dry season	4.20	39.34	0.63	6.29	51.73	8.20	68.05

Table 11: Mineral contents of forbs and grass species composite samples of the study sites

Sites	Ash%	Ca%	Mg%	K%	Na%	P%	N%	OC%
Wadi Tundub	29.90	5.00	0.90	2.44	0.10	0.14	0.30	19.24
Wadi El Farish	18.70	2.50	0.60	2.22	0.04	0.49	0.60	22.17
Wadi Abu Seweid	17.20	2.50	0.30	2.33	0.07	0.28	0.40	22.58
Wadi Medaisees	24.80	5.00	1.20	3.21	0.04	3.54	0.60	20.52
Wadi Buhat	20.00	2.30	0.50	2.10	0.04	0.14	0.30	22.15
Goz Abu Dolou'a Km 72	14.00	2.22	0.30	1.50	0.05	0.15	0.30	21.14
Goz Abu Dolou'a Km 42	14.59	2.50	0.60	1.71	0.06	0.18	0.50	23.19

DISCUSSION

Range Condition and Carrying Capacity

Application of the Pasture Condition Scoring Method (PCS) in (2012) and the Range Evaluation Site Method (RESM) in 2011 and 2012 for the different sites using the PCS for the year 2012 has shown that the condition was good for all sites except for Buhat which showed poor score. REAM for the same year was good for most sites with excellent scores for both El-Farish and Abusewaid at the Blue Nile site, and fair for Abu-Dolou'a on the White Nile site. The year 2011 showed less scoring condition, where two sites showed fair conditions (Tundub, and El Farish) on the Blue Nile site, and two showed poor conditions (Goz Abu Dolou'a and Abu Dolou'a) on the White Nile site. Such observations could be related to the carrying capacity and total dry matter (kg/ha) where a strong correlation was obtained in the year 2011 and weak correlation was obtained for the year 2012. As the range received less rain during 2011, this resulted in poor vegetation and higher competition of animal over meager resources. In 2012 more rain was received, good range condition led to less competition between animal as vegetation covers was plenty. Differences in scoring between different sites could be related to plant species biodiversity and that could be due to soil fertility and water holding capacity. CC guides developed by Payne *et al*., (1979) rating forage composition as desirable, intermediate or undesirable, was used in this study and it was rated as intermediate for all sites.

Range Nutritive Value and Digestibility

Generally, grass species have lower nutritive value than browse trees. *Aristida mutabilis* dominated 5 sites out of 7 indicating its low nutritive value and low metabolizable energy (3.11% CP and 8.18% ME) hence less grazed by animals. Similar observations were obtained by Pflaumbaum (1994). Also *Indigofera hochstetteri* and *Boerhavia repens* dominated 5 sites during 2012 due to their low CP (~2%) content. It should be noted that CP contents was greatly reduced during the second year than first year and during dry than rainy seasons. Similarly, McDonald *et al*., (2000) indicated that the percentage dry matter digestibility of range grasses is closely related to their nutrient content. Furthermore, it was observed that, chemical composition of the

feed which in turn varies with the feed form (Luginbuhl *et al*., 1995; Sarwar *et al*., 1985 and Poppi *et al*., 1981) and the age of the plant, i.e. it decreases with the age (Harington and Wilson, 1984).

Grasses constituted the main diets of sheep and goats, while Acacia species contribution to camels' and goats' diet was higher than that for sheep. This would show goats browsing habits and their ability to reach leaves of browse trees. Similar observations were obtained by other authors (Abusuwar *et* and Yahia, 2010; Von Maydell, 1986). Furthermore, consumption of grasses by goats and camels was found to be much lower than sheep (Rutagwenda *et al*., 1990). Whereas camels prefer shrubs and forbs, cattle and buffaloes prefer grasses (Newmann, 1979). Thus cattle and camels complement each and do not compete for feed when grasses, shrubs and forbs grow in the same region. Livestock accepted the grass cultivars highest in phosphorus and potassium than those with low contents of these minerals (Leigh, 1961). Similarly, higher forage consumption was observed at Wadi Madesias where forages contained higher phosphorus and potassium.

Nutritive value of the plant cover for rainy and dry seasons and between years 2011 and 2012, showed better values during rainy than dry season and were better during 2012 than 2011. Grasses showed little changes in nutritive values, whereas the browse species showed sharp decline during the dry season and during 2011. This could be related to high reduction in leave to stem ratio as adaptation to dry weather and low water availability. This was in line with the results obtained by other workers (Abusuwar and Yahia, 2010; Fatur and Khadiga, 2007). Differences in the nutritive values obtained in different sites were more or less similar. However, Buhat showed high CP content (16.66%). This could be related to higher increase in browse trees percent from year 2011 to year 2012. Generally, metabolizable energy and digestible crude protein of plant cover could support animal maintenance during both seasons and both years. Mineral contents organic carbon of the soils showed that they could support plant cover. Water and overgrazing were the main limiting factors.

Finally, it could be pointed out that, factors other than nutrient content seem to have strong influences on the acceptability of plants by the animals. These factors include growth habit or position of the various plant parts in addition to features recognized by the animal senses of touch, taste and smell (Cowlishaw and Alder, 1960) such as presence of awns, spininess, hairness, stickiness, coarseness of texture and unfavorable odor from external glands on the plant or odor of volatile oil which causes rumen disorder (Heady, 1975). Climate, topography and soil are among the factors that affect palatability (Cook, 1959). Palatability determines the diets of various animal species (Kay *et al*., 1980 and Hofmann, 1973). As a result Von Maydell, (1986) assigned values to the different parts of trees/shrubs for their importance, palatability / nutritive value to different species of animals.

CONCLUSION

It could be concluded that selected range lands in Eastern Nile and Northwestern Omdurman showed differences in biodiversity including, grasses, forbs and woody browse trees as feed resources for animals. All sites shown very good condition score for grazing those observations could be related to the carrying capacity and total dry matter (kg/ha) where a strong correlation was fluctuated between years according to rainy season. Also it should be noted that CP contents was greatly reduced during dry than rainy seasons. Similarly, and the percentage dry matter digestibility of range grasses is closely related to their nutrient content. Livestock accepted the grass cultivars highest in phosphorus and potassium than those with low contents of these minerals so other area should be supplemented with those minerals. During dry season the nutritive value, metabolizable energy and digestible crude protein of the plant cover had sharp effect on biodiversity including, grasses, forbs and woody browse trees as feed resources for animals, Since, that grasses showed little changes in nutritive values, whereas the browse species showed sharp decline during the dry season, this could be related to high reduction in leave to stem ratio as adaptation to dry weather and low water availability. Generally the plant cover could support animal maintenance during both seasons and both years if they were decline.

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