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Comparative evaluation of the condition and trends of some rangelands in Adamawa State, Nigeria

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ABSTRACT

This research compared the conditions and trends of some range sites of Adamawa State, Nigeria. Variables used to evaluate the conditions of trends of the range sites included herbaceous ground cover, botanical composition of herbaceous vegetation, plant vigour, litter, erosion on sites, and tree/shrub densities. Score card and the standard range condition classes were used in condition range. Results of range conditions and trends, which directly reflected the health of the sites, indicated that the three range sites were in fair conditions with the values of 57% for Gongoshi, 55.6% for Guyaku and 48.7% for Chekelek sites. The stocking rates of the range sites were 0.584 Tropical Livestock Unit per hectare per year (TLU/ha/yr) and 0.622 TLU/ha/yr for Gongoshi and Guyaku (both in the Guinea Savanna) and 0.552 TLU/ha/yr for Chekelek, located in the Sudan Savanna. Proper monitoring and enforcement of the laws guiding the use and disuse of the range site should be thoroughly observed so as to improve the condition and trend of the sites.

KEYWORDS: Range, condition, trends, Gongoshi, Guyaku, Chekelek

Introduction

A range is a broad, wide and unfenced area on which animals graze and roam. They comprise the low rainfall and variable climate, arid and semi-arid areas and, north of the Tropic of Capricorn and some seasonally high rainfall areas. The main ecosystem types are shrublands, native grasslands and woodlands (Blecnch and Sommer, 1999; Khobe, 2014). Boundaries to rangelands are not clearly defined; they vary according to variation in climatic conditions. Rangelands are homes to a significant number of species of animals and plants with a high value in both scientific terms and leisure (Moore, 1970). Several terms for the main world's rangelands: South American Savanna, African Savanna, Eurasian steppe, Indian Savanna, Australian grasslands and North American prairies. It is a broader term than grasslands, encompassing areas where woody vegetation is dominant; moreover, it is a term common in texts looking at land from the viewpoint of livestock production (Bourlière, 1983; Coupland, 1993).

Range condition refers to the present state of a range in relation to what it could be with a given set of environmental and managerial factors. Range condition measures range deterioration and improvement. It is used as a guide to ensure sustainable land use, determine grazing capacity and adjust stocking rates, identify

potential responses to range environment programmes such as bush control or reseeding and evaluate the nest locations to fences and water facilities to improve utilisation within pasture (Heady and Heady, 1982; Pieper and Beck, 1990; Khobe *et al.*, 2009).

Akosim *et al*. (2004) defined range condition as the state of health and vigour of a range in relation to its full productive potential. The range condition concept evolved in response to grazing management problems on western rangelands going back to the early 1900's. The range condition approach has worked well in semi-arid grasslands and has been well accepted by ranchers and wildlife managers. It relies on description of relatively undisturbed range sites and their plant communities (Adams *et al*., 2005).

Rangelands are ecologically important for their high species diversity and ecological and geo-morphological integrity (Coupland, 1993). The economic importance of rangelands world-wide is extremely variable according to the socio-economic system in which they are found. In developed economies, such as Australia and America, rangelands are essentially marginal terrain suitable for low-intensity stock-rearing and hunting. In Africa and Central Asia, rangelands are essential to the subsistence of pastoralists and farmers (Blench and Sommer, 1999). Rangelands are also of socio-cultural importance to both indigenous and non-indigenous people, particularly in the provision of forage, source of wood products, food, fodder, medicines, construction materials as well as a source of income.

Rangelands the world over are faced with so many pressures which are in most cases inimical to their health. Groombridge (1992) observed significant pressures on biodiversity on rangelands; depressed net incomes, land use conversion, fire suppression, invasion by woody and alien species, grazing pressure by domestic livestock, residential and industrial developments, urbanisation, agriculture, mining, industrialisation, road construction, linear developments such as roads and pipelines as well as climate change, and these threats are for practical purposes, irreversible. The overall impacts are reduction and fragmentation, and impaired natural ecosystem functions.

Materials and Methods

Study Area

Adamawa State is located at the North eastern part of Nigeria. It lies between latitude 7º and 11ºN of the equator and between longitude 11º and 14ºE of the Greenwich Meridian. It shares common boundary with Taraba State in the south and west, Gombe State in its North West and Borno to the North. Adamawa State has an international boundary with Cameroun Republic along its eastern border. The State covers a land area of about 39,741km^2 (Fig. 1) (Adebayo, 1999).The major vegetation formations in the State are the Guinea and the Sudan Savanna. Within each formation is an interspersion of thickets, Savanna woodland, open grass Savanna and fringing forests in the river valley (Akosim *et al*., 1999).

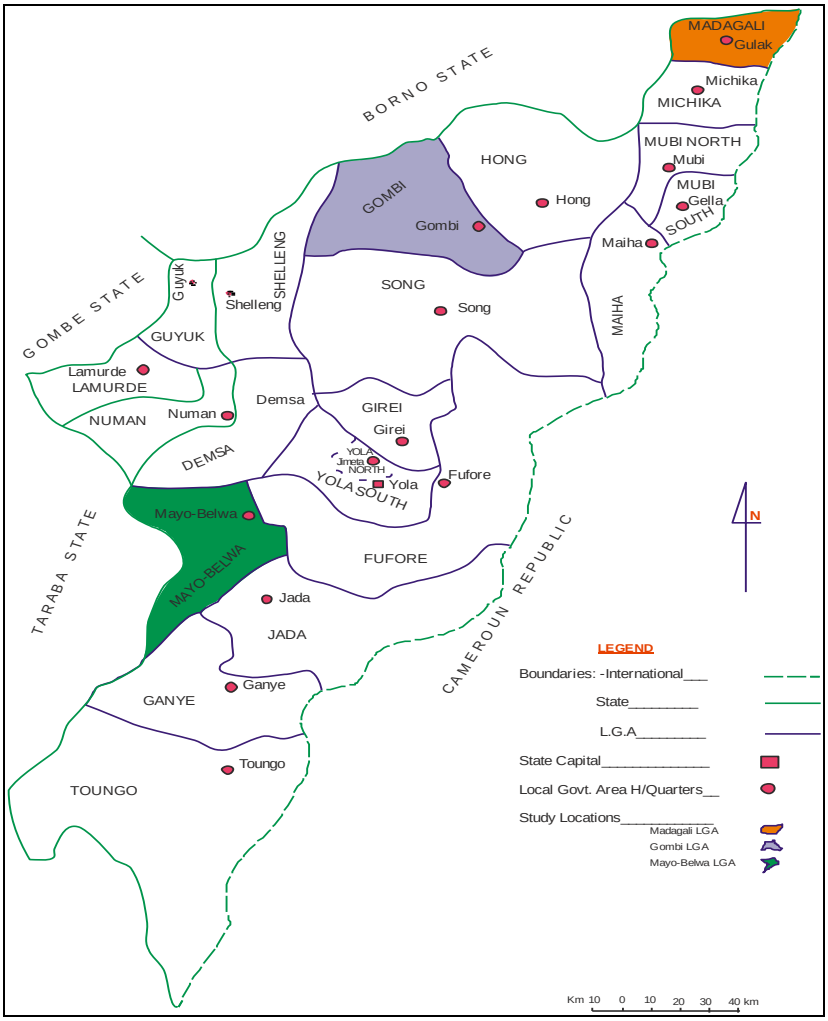

Figure 1: Adamawa State Showing the Study Locations
Source: Adebayo (1999)

Evaluation of Range Condition and Trend

The following variables were used to evaluate the conditions of the range sites.

i. Examination of the herbaceous ground cover

The Step-point method as described by Sutherland (1999) was used to examine herbaceous ground cover. Ten (10) permanent transects of 100m length were established in range site (Plate 3). Sampling points occurred along the transects at every 15th pace intervals. A square frame, 30cm x 30cm sub-divided internally into four 15cm square was employed (Plate 4). The frame was located by aligning one of the sub-division crossbars of the frame with the tip of the boot. Estimate of total herbaceous cover was made through direct observation in terms of

percentage in the area bounded by the frame (all standing herbaceous plants were considered as herbaceous cover).

ii. Assessment of the botanical composition

The Step-point method as described by Sutherland (1999) was used for the assessment of the botanical composition of herbaceous vegetation. Sampling was carried out along transects. Sampling points occurred along the transects at two paces (four strides) intervals. At each point, the researcher places his boot on the ground (so as not to disturb the plants). The herbaceous plant touching the tip of the boot was recorded. The plants were classified into desirable and undesirable plants on the basis of whether they are selected by the livestock for food or not. The result was expressed in percentage.

iii. Assessment of the plant vigour

Plant vigour was measured using the method described by Kershaw (1979). This involves the evaluation of the performance of plants using indices such as colour of leaves, leaf length and width, number of seedlings and number of leaves. On the basis of the evaluation, plant vigour was categorized as healthy; when the plants are robust, dark green in colour, numerous leaves and stocks with few or no dead plants, stunted; when the plants are pale, few leaves, fewer seedling and some dead plants and finally, weak; when the plants are very pale and sickly, few seeds, stalks and mostly short seedlings, and the plants could easily be pulled out of the soil.

iv. Examination of the litter cover

The Step-point method as described by Sutherland (1999) was used to examine litter cover. Sampling points occurred along the transects at every one pace (two strides) intervals. At each point, the boot was lowered and the material touching the tip of the boot was recorded. The number of points which the tip of the boot touched the litter was added up and the percentage calculated for each range site.

v. Assessment of range sites for erosion

Assessment of range sites for erosion followed the method described by Ola-Adams (1985) and modified by Akosim *et al*. (2004). Assessment for erosion took place within the Whittaker plots and by ocular or direct observation method. Erosion was None; when soil was covered with vegetation or litter and no apparent soil removal. Slight; when there was evidence of some soil removal and exposure of rock and pebbles and, Severe; when subsoil was exposed and gullies or sheet erosion were formed or in progress.

vi. Examination of tree and shrub density (woody plants)

The Point-Centred Quarter method as outlined by Nigerian Conservation Foundation/ World Wide Fund (NCF/WWF) (1987) and Kent and Coker (1992) for sampling trees and shrubs in the Savanna woodland was used because of its rapidity, simplicity and relative accuracy. Sampling points were located along the

established transects at ten (10) pace intervals. This interval was chosen to ensure that: -

- an individual plant was located within each quarter of each sampling point.
- an individual plant was not measured more than once.

The procedure consists of starting at the transect pole (ranging pole), and proceeding ten paces down the transect and placing the pointer into the ground at the tip of the boot, thus marking the sampling point. At each point, the author faced down the transect and spread his arms to the sides, thus marking four quadrants. These were indicated as A,B,C and D respectively, from left front clockwise to left rear. From the sampling point, the closest tree or shrub to the pointer in each quadrant was chosen as the sample. The distance from the point to the plant was measured and the species noted. The density of the woody plant species was calculated from the mean distance as follows:

Density = $(10{,}000m^2)/d^2$(NCF/WWF, 1987; Kent and Coker, 1992)

Where,
$10{,}000m^2$is the area of one hectare and it is a constant and d^2 is the square of the mean distance obtainable from the relation

d (mean distance) = S/N x 100/1

Where,
S = Sum of all distances
N = Number of distances measured

Data Analysis

The Score card and the Standard range condition class as developed by Ola-Adams (1985) and modified by Khobe and Ayuba (2010) for rating of the condition of rangeland sites was used for rating the rangelands.

Results

Herbaceous ground cover at the range sites

The result of the herbaceous ground cover in the range sites showed that in Gongoshi range site, the mean herbaceous ground cover was 70.52%, 61.07% in Guyaku range site, while the mean herbaceous ground cover for Chekelek was 60.14%. Result of the botanical composition of species in the range sites showed that the mean botanical composition of annuals (desirable) was 51.77% and perennials (desirable) 27.65% while that of the undesirable species was 21.18%. In Guyaku range site, the result indicated that the mean botanical composition of annuals (desirable) species was 50.02% and perennials (desirable) species (24.11%) while the undesirable species was 25.89%. In Chekelek range site, result obtained revealed that the mean botanical composition of annual (desirable) species was 42.94% and perennials (desirable) species (30.61%) while that of the undesirable species was 25.88% (Table 1).

Table 1 also showed the average values obtained for plant vigour, percentage litter cover, erosion and woody plant density in the study site. In Gongoshi range site, the mean result showed that the plant vigour was stunted, percentage litter cover was 73.4%, erosion on the site was slight and woody plant density was 1,158 woody plant/ha. For Guyaku range site, the result indicated the plant vigour as stunted, percentage litter cover was 77.8%, erosion on the site was slight and woody plant density was 1,024 woody plant/ha. In Chekelek range site, the mean result revealed plant vigour was stunted, percentage litter cover was 80.7%, erosion on the site was slight and woody plant density was 1,242 woody plant/ha.

Table 1: Conditions and Trends of Range Sites

Parameter		**Range Sites**		
		Gongoshi	**Guyaku**	**Chekelek**
Herbaceous Ground Cover (%)		70.52%	61.07%	60.14%
Botanical Composition (%)				
Desirable	Annuals	51.77	50.02	42.94
	Perennials	27.65	24.11	30.61
Undesirable		21.18	25.89	25.88
Plant Vigour		Stunted	Stunted	Stunted
Litter Cover (%)		73.4	77.8	80.7
Erosion Level		Slight	Slight	Slight
Woody Plant Density (No./ha)		1,158	1,024	1,242

Range condition rating and classes

The result of the range condition rating score card and the standard range condition classes at Gongoshi range site, the actual score showed 22% for lower layer cover while the botanical composition was 17% for annual species (desirable), 3.2% for perennial species (desirable), and 5.4% for undesirable species. The actual score for plant vigour was 1.5%, litter cover (3.1%), erosion (1.5%) and tree/shrub density (3.3 No./ha). The total actual score for Gongoshi range site was 57%. When this result (57%) was compared with the standard range condition class, it was found to be in a fair condition class. Similarly, at Guyaku range site, the actual score showed 18.6% for lower layer cover while the botanical composition was 17.5% for annual species (desirable), 5.2% for perennial species (desirable), and 4.7% for undesirable species. The actual score for plant vigour was 1.2%, litter cover (3.5%), erosion (1.5%) and tree/shrub density (3.5No./ha). The total actual score for Guyaku range site was 55.6%. When this result (55.6%) was compared with the standard range condition class, it was also in a fair condition class. While in Chekelek the result of the range condition rating score card and the standard range condition classes for the range sites showed the actual score of 18% for lower

layer cover while the botanical composition of herbaceous species was 11.5% for annual species (desirable), 3.0% for perennial species (desirable), and 4.9% for undesirable species. The actual score for plant vigour was 1.5%, litter cover (3.3%), erosion (1.5%) and tree/shrub density (325 No./ha). The total actual score for Gongoshi range site was 48.7%. When this result (48.7%) was compared with the standard range condition class, it was found to fall in a fair condition class (Tables 2 and 3).

Table 2: Condition Rating Score Card at the Range Sites

S/N	Factors	Quantity	Scale of Score	Actual Score (%)		
				Gongoshi	Guyaku	Chekelek
1.	Lower layer cover	75-100%	25-32			
		50-74%	17-24	22	18.5	18
		25-49%	9-16			
		5-24%	2-8			
		<5%	0-7			
2.	Botanical Composition	75-100%	24-17			
	Annual species (Desirable)	50-74%	18-13	17	17.5	11.5
		25-49%	12-7			
		5-24%	6-1			
		<5%	0			
	Perennial species	0-5%	8-7			
	(Desirable)	6-25%	6-5		5.2	
		26-50%	4-3	3.2		3.0
		51-75%	2-1			
		76-100%	0			
	Undesirable Species	0-5%	8-7			
		6-25%	6-5	5.4	4.7	
		26-50%	4-3			4.9
		51-75%	2-1			
		76-100%	0			
3.	Plant Vigour	Healthy	4-3			
		Stunted	2-1	1.5	1.2	1.5
		Weak	0			
4.	Litter Cover	>50%	4-3	3.1	3.5	3.3
		20-50%	2-1			
		<20%	0			
5.	Erosion	None	4-3			
		Slight	2-1	1.5	1.5	1.5
		Severe	0			
6.	Tree/Shrub Density	0-250/ha	16-13			
	(Woody Plants)	251-500	12-9			
		501-1,000	8-5			
		1,001-2,000	4-1	3.3	3.5	3.2
		>2,000	0			
	Total Actual Score			57	55.6	48.7

Table 3: Standard Range Condition Classes

Class	Total Score (%)	Actual Score (%)		
		Gongoshi	Guyaku	Chekelek
Excellent	80 – 100			
Good	60 – 79			
Fair	40 – 59	57	55.6	48.7
Poor	20 – 39			
Very Poor	0 – 19			

Discussion

Analysis of range condition and its rating indicated that Gongoshi, Guyaku and Chekelek range sites are fair; 57% for Gongoshi, 55.6% for Guyaku and 48.7% for Chekelek range sites (Tables 2 and 3). The results of this study showed that the desirable species (desirable and perennial) constitute about 79.42% of the herbaceous vegetation for Gongoshi, 74.13% for Guyaku and 73.44% for Chekelek range sites respectively. With a mean percentage herbaceous ground cover of 70.52% for Gongoshi, 61.07% for Guyaku and 60.14% for Guyaku range sites. However, results of the analysis of soil factors such as litter cover and gullies; plant factors such as vigour tend to suggest a downward trend or deterioration in the range condition. These indicators of deteriorating range, may not be unconnected with some practices on the range sites, such as unplanned burning, lack of grazing management, over-exploitation of forage resources and farmer encroachment. Ola-Adams (1985) reported that a range in fair condition is either on downward or upward trend depending on its plant composition, plant vigour, litter cover, erosion and woody plant density. Although burning and grazing are widely used in range management particularly in regions of moderate to heavy rainfall (Heady and Heady, 1982), indiscriminate and unplanned use of these tools was reported by Lauvenroth and Laycock (1989) as being the principal cause of deterioration in range condition. Therefore, it would be expected that the ranges of Gongoshi, Guyaku and Chekelek range sites will move to an excellent condition if burning and grazing, over-exploitation of forage resources and farmer encroachment are planned for the range sites. In addition, measures to check over-exploitation of forage resources and farmer encroachment would go a long way to improve the condition of the range sites.

Conclusion

The analysis of range conditions and trend indicated that the three range sites are in fair condition but on a downward trend which showed that most of the herbaceous plant species were relatively low in abundance. In this study, the plant composition at both herbaceous and woody layers indicated the availability of desirable plant species for both human and animal needs. Although over 90% of herbaceous plant species utilised by livestock in the Savanna ecosystem are represented on the sites, they occur at relatively low densities than those consumed by humans. On the other hand, when the results of plant vigour, litter cover, erosion

and woody plants are considered, they are such that can favour the growth and abundance of herbaceous plants.

Recommendations

Based on the findings from this study, the following recommendations were made: -

i. Planned burning combined with reseeding of the range sites should be carried out to improve on the composition and abundance of forage resources of the rangelands.
ii. Pests and diseases control should be carried out in order to improve the forage yield and productivity of the range sites.
iii. Education and enlightenment programmes on principles and practice of range management and conservation should be organised for the pastoralists who utilise the range sites.

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