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SUSCEPTIBILITY TO THREATS AND THREAT SEVERITY OF ADAMAWA RANGELANDS, NIGERIA

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ABSTRACT

This study was undertaken to assess rangeland susceptibility to threats and their severity in Adamawa rangelands, Northeast Nigeria. Structured questionnaires were used to elicit information from both pastoralists and the management of the range sites. Data on threats factors was analyzed using prevalent threat, range sites susceptibility, the mean score of threat factors and the relative threat factor severity indices. Threats to biodiversity, their prevalence and the number of range sites they occurred showed that invasion by undesirable plants, over-exploitation of forage resources, and bush fires occurred in the three range sites with 100% prevalent threat indices. Diseases and pests, conflicts and settlement policy problems occurred in two of the range sites with 66.7% prevalent threat indices. While farmer encroachment, erosion drought, population increase, poaching and problems associated with rangeland policies occurred in one of the range sites with prevalent threat indices of 33.3%. The threats with the highest severity indices include over-exploitation of forage resources (96%), conflicts (82%), invasion by undesirable plant species (96%), drought (83.8%), diseases and pests (76%). The lowest threats include flood (6%), population settlement (13.5%), rangeland policy (26%) and population increase increase (27.5%) among others. 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.

Keywords: Threats; range sites; undesirable plants; poaching; bush fires.

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INTRODUCTION

Rangelands are ecologically important for their high species diversity, 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 for 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 and constructional materials as well as source of income.

The Task Group on Unity of Concepts and Terminology-TGUCT (1995) reported that rangeland health does not only build on the traditional range approach that considers plant community type in relation to site potential, but also adds new and important indicators of natural processes and functions. Range health is measured by comparing the functioning of ecological processes on an area of a rangeland to a standard known as an ecological site. An ecological site is similar to the concept of range site, but broader lists of characteristics are described. It is a dynamic kind of land with specific physical characteristics that differs from other kinds of land in its ability to produce a distinctive kind and amount of vegetation.

Recent investigations have shown that some current management practices in many areas have proved inappropriate on rangelands. These practices have resulted in accelerated soil erosion, increased numbers and distribution of weeds and feral animals, reduced water quality, soil salinity, decline of and changes to native plant communities, and decreased biodiversity. This has led to significant areas of the rangelands being degraded, calling into question their long term sustainability under current management practices (Benhke, 1994). The Ministry of Lands Resettlement and Environment (MLRE) (2003) in Rwanda, identified some major threats to rangeland resources/biodiversity and grouped them as follows: firstly, natural threats which include erosion, floods, drought, proliferation of competitive species, diseases and pests; secondly, man-induced threats which are population pressure, overexploitation of biological resources, uncontrolled introduction of exotic species, poaching, bush fires, conflicts and wars; and thirdly, threats associated with policy, legal, institutional shortcomings and human resources which include policy-related threats, legal framework related threats, and institutional framework related threats.

Prolonged drought affects rangeland habitats and leads to a drastic reduction of varieties and species because it does not allow certain species to regenerate. This phenomenon of drought, combined with the high degradation of land, contributes to the rapid progress of the desertification process and the loss of rangeland resources. The proliferation of certain competitive species inhibits the regeneration of ligneous and grassy species. This speeds up, among other factors, the formation of clearings. Such is the case with *Sericostachys scandens* in forests. For a long time, this plant has been living in balance with other ligneous plants because herbivores grazed it. Today, with the extinction of these herbivores, this creeper, with some varieties of the fern, have become intrusive and destructive (MLRE, 2003).Blench (1995) reported that some populations of biodiversity are the target of various diseases and pests. In normal times, the damage is not very noticeable. It however happens that epidemics occur and cause massive destruction as was the case with the destruction of cypress reforestation by the *Cinnera cupressis* by the end of 1980s. Others are the destruction of crops and other plants by caterpillars, and the destruction of *Pinus* forests in the Congo-Nile ridge in 1998. Food crops and industrial crops are regularly attacked by diseases, insects and different pests.

Regulations of access to biological resources in protected areas, wet areas and aquatic areas, are not respected. Many uncontrolled introductions of wild or domestic plant and animal species result in the disturbance of the native biological heritage which leads to the extinction of some species (GLOBE Southern Africa, 2000). Byers (1997) noted that man-induced threats are many and more harmful than natural threats; population pressure, overexploitation of biological resources, uncontrolled introduction of exotic species, poaching, as well as conflicts and wars among others are man-made threats. The world's population has been extremely growing and this has put pressure on the natural ecosystem. The effect of this pressure is an increased demand of natural resources (land, water, energy, and foodstuffs), land clearing for agriculture and grazing, house building, removal of species for traditional medical purposes, modification and destruction of habitats and deforestation which, ultimately, lead to the extinction of some species (Thomas *et al.*, 2000).

Land clearing usually leads to loss of genetic resources with ecological, medical, food, industrial and cultural values. Habitats for the fauna and the flora are thus destroyed. Land reclamation and the development of marshes and depressions cause hydric imbalances of wet ecosystems, and this affects the fauna and flora of these ecosystems. Population pressure has led to the depletion of arable land with serious reduction in arable surface area per capita. Owing to lack of intensification of technologies, man is compelled to look for new land for agriculture, stockbreeding and settlement (MLRE, 2003). The modification and destruction of natural ecosystems result in the loss of the fauna and the flora of these areas. Some plant and animal species become totally extinct; others become very rare or are remarkably reduced. The loss of the fauna and the flora is aggravated by poaching activities (De Queiroz, 1993).Overexploitation of biological resources has been one of the most important threats to biodiversity. In fact, the age-old use of certain irrational techniques and practices has resulted in the gradual reduction of the production and productivity of biological resources, the reduction of genetic potential and, ultimately, the extinction of some species (Mugabe, 1998).

Bush fires are serious threats to the rangeland fauna and the flora. Periodically, protected and non-protected areas are devastated by deliberate, criminal or accidental fires. The negative effects of these bush fires include extinction of the microfauna and microflora, disturbance and damage to the microfauna and microflora, disturbance of the hydrological regimes which may lead to the depletion of water sources, acceleration of erosion and modification of the physico-

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chemical composition of the soil and atmospheric pollution which may aggravate the problem of climatic change through the emission of gas with greenhouse effects (James, 1993).

Sectoral policies concerning biodiversity are for the most part old and need updating while others are clear and well elaborated but are not respected or properly implemented. Some do not exist or are in the process of development. On arid rangelands, technical interventions such as reseeding and fertilizer applications are constrained by risk of failure and expense, with limited potential financial returns. However, government policy can influence all stakeholders in arid rangelands either directly through taxation on higher stocking rates, by providing improved veterinary services and insurance services for pastoralists who keep sustainable stocking rates, or indirectly by improvement in road services, marketing facilities and extension facilities (West, 1993). Forage non-availability can be alleviated by supplementation with external feed inputs or extending the growing season by including legumes, forage herbs, shrubs and trees, provided it does not allow pastoral people to increase their stocking rate beyond the existing sustainable capacity of rangelands.

Many rangelands, which are not very far from large cities have potential to become large animal production centres, to fulfil some of the need for animal products of those cities. For example, improved transport, convenient markets and provision of feed supplies, such as agricultural and industrial by-products (wheat straw, wheat bran and cotton seed cake) can encourage pastoral people to increase production from individual animals rather than keeping large numbers of unproductive animals (MLRE, 2003). Susceptibility of Adamawa State rangelands resources to threats and their severity is a serious issue to address as far as livestock production in the area is concern (Thomas et al., 2000) hence, the need for this study which assessed the threat susceptibility of rangelands and its severity in the study area.

MATERIALS AND METHODS

Study Area

Adamawa State is located at the North eastern part of Nigeria. It lies between latitude 7^{o} and 11^{o}N of the equator and between longitude 11^{o} and 14^{o}E 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 boarder. 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 (Akosim *et al*., 1999).

Sampling procedure and sample size

Purposive and simple random samplings were used to select respondents for the study. The respondents for the study were pastoralists and the range managers who dwell in and around the study sites. Three range sites were selected from the two agro-ecological zones in the State. A total of 400 pastoralists and range managers were selected from the range sites in a ratio proportional to the sizes of the sites. The method of proportional allocation technique where nh was replaced by M and Nh by h as described by Cochran (1997) was used for the sampling. The formula involved is as follows: -

$$M = (h \times n)/N$$

Where,

M = number of questionnaires administered in each range site.

n = total number of questionnaires administered

h = area of the individual range site (ha)

N = total area of all the range sites (ha).

The formula above was used to obtain the number of respondents sampled from each range site (Table 1).

Data collected

Two sets of questionnaires were used to obtain information from both pastoralists and managers of the range sites. Data were collected on socio-economic characteristics (age, gender, education, occupation, income and condition of livestock), threats (erosion, flood, drought, diseases and pests, invasion by undesirable plants, population increase, population resettlement, over-exploitation of forage resources, settlement policy, rangeland policy and occurrence), range management practices of both the pastoralists and management of the range sites.

Table 1: Sample Population

Agro-ecological Zone	Range Site Selected	Size of Range Site (ha)	Sample Population
Guinea savanna	Gongoshi	8,000	160
Guinea savanna	Guyaku	6,250	125
Sudan savanna	Chekelek	5,750	115
	Total	20,000	400

Source: Field survey (2011)

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Data analysis

Data on threats was analysed using Kiringe and Okello (2007) models presented below;

a. The Prevalent Threat Index (PTI) = P/R x 100/1

Where,

P = Number of pastoralists mentioning a particular threat factor;

R = Range officers of all range sites studied

b. Rangeland sites Susceptibility Index (RSSI) = T/I x 100/1

Where,

T=Number of threat types occurring; I=Total number of threat types identified in the study

c. The Mean Score of Threat Factors (MSTF) = S/H

Where,

S = Sum of all scores for that particular threat factor; H= The total number of respondents

d. The Relative Threat Factor Severity Index (RTFSI) = M/F

Where, M = The mean score of a particular threat factor; F = The maximum possible score

RESULTS

Threats types and rate of occurrence

The distribution of respondents according to types of threats and their rates of occurrences at Gongoshi range sites showed that the natural threats occurring in the area include erosion (52.0%), floods (6.0%), drought (76.0%), invasion by undesirable plants (96.0%) and incidences of diseases and pests (76.0%). Results also indicated that some of the man-induced threats occurring in the area are population increase (52.0%), population resettlement (50.0%), over-exploitation of forage resources (96.0%) and conflicts (82.0%).Threats related to policies, legal and institutional framework were settlement policy (14.0%) and rangeland policy (76.0%). The results on the rate at which threats occur at Gongoshi range site showed that 42.0% (63) of the respondents believe they occur seasonally while 82.0% (123) confirmed that they occur occasionally (Table 2).

The result at Guyaku range site in Table 2 showed that the natural threats occurring in the area were drought (52.5%), invasion by undesirable plants (57.5%) and incidences of diseases and pests (60.0%). It also indicated that some of the man-induced threats occurring in the area are population increase (27.5%), population resettlement (62.5%), over-exploitation of forage resources (78.3%), bush fires (85.0%) and conflicts (77.5%). Threats related policies, legal and institutional framework were settlement policy (90.0%) and rangeland policy (26.7%). The rate of occurrence of threats showed that 45.0% (54) of the respondents noted that the threats occur seasonally while 55.0% (66) reported the threats occur occasionally.

Also, the results of threat types at Chekelek range site in Table 2 showed the natural threats occurring in the area as erosion (56.8%), drought (83.8%), invasion by undesirable plants (54.0%) and incidences of diseases and pests (62.2%). The man-induced threats occurring in the area were population increase (78.4%), population resettlement (13.5%), over-exploitation of forage resources (54.1%), poaching (40.5%), bush fires (62.2%) and conflicts (73.0%). While the threats related policies, legal and institutional framework included settlement policy (75.7%) and rangeland policy (31.5%).Results on rate of occurrence of threats obtained showed that 43.2% (48) of the respondents indicated that the threats occur seasonally while 48.0% (63) reported that they occur occasionally.

Threats to plant resources at the range sites

Threats to biodiversity, their prevalence and the number of range sites they occurred showed that invasion by undesirable plants, over-exploitation of forage resources, and bush fires occurred in the three range sites with 100% prevalent threat indices. Diseases and pests, conflicts and settlement policy problems occurred in two of the range sites with 66.7% prevalent threat indices. While farmer encroachment, erosion drought, population increase, poaching and problems associated with rangeland policies occurred in one of the range sites with prevalent threat indices of 33.3% (Table 3).

Susceptibility of range sites to threats

The result of the susceptibility of range sites to threats and the susceptibility indices of rangeland sites at Gongoshi range site identified six threat (invasion by undesirable plants, over-exploitation of forage resources, bush fires, conflicts, rangeland policy and floods) with a Rangeland Sites Susceptibility Index (RSSI) of 6 (46.2%). Also at Guyaku seven threat were identified (invasion by undesirable plants, diseases and pests, over-exploitation of forage resources, bush fires, conflicts, farm encroachment and settlement policy) with a RSSI of 7 (53.9%), while at Chekelek nine threat were identified (invasion by undesirable plants, diseases and pests, over-exploitation of forage resources, bush fires, settlement policy, erosion, drought, population increase and poaching) with a RSSI of 9 (62.2) (Table 4).

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Mean score and relative threat factor severity index

The mean score threat factor (MSTF) and relative threat factor severity index (RTFSI) showed that over-exploitation of forage resources has the highest MSTF of 0.7622 with a RTFSI of 0.1185 while poaching had the least MSTF of 0.1181 with a RTFSI of 0.0179. Other threat factors have MSTF between 0.0236 and 0.0036 with RTFSI of 0.0179 and 0.1180 (Table 5).

Table 2: Threats Types and Rate of Occurrence at Gongoshi, Guyaku and Chekelek Range Sites

Indices	Frequency*		
	Gongoshi	Guyaku	Chekelek
Natural threats			
Erosion	78 (52.0)		63 (56.8)
Floods	9 (6.0)		
Drought	114 (76.0)	63 (52.5)	93 (83.8)
Invasion by undesirable plants	144 (96.0)	69 (57.5)	60 (54.0)
Diseases and pests	114 (76.0)	72 (60.0)	69 (62.2.)
Man – Induced threats			
Population increase	78 (52.0)	33 (27.5)	87 (78.4)
Population resettlement	75 (50.0)	75 (62.5)	15 (13.5)
Over-exploitation of forage resources	144 (96.0)	94 (78.3)	60 (54.1)
Conflicts	123 (82.0)	93 (77.5)	81 (73.0)
Bush fires		102 (85.0)	69 (62.2)
Poaching			45 (40.5)
Policy, legal and institutional threats			
Settlement policy	21 (14.0)	108 (90.0)	84 (75.7)
Rangeland policy	114 (76.0)	32 (26.7)	35 (31.5)
Rate of Occurrence			
Seasonally	63 (42.0)	54 (45.0)	48 (43.2)
Occasionally	123 (82.0)	66 (55.0)	63 (56.8)

* Multiple responses recorded; Values in parentheses are percentages

Source: Field Survey (2011)

Table 3: Threats and their Prevalent Indices at Gongoshi, Guyaku and Chekelek Range Sites

S/N	Threat factor identified by Range Managers	No. of Range sites where threat factor exists	Prevalent threat index (PTI) %
1.	Invasion by undesirable plants	3	100
2.	Diseases and pests	2	66.67
3.	Over-exploitation of forage resources	3	100
4.	Bush fires	3	100
5.	Conflicts	2	66.67
6.	Farmer encroachment	1	33.33
7.	Settlement policy	2	66.67
8.	Erosion	1	33.33

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9.	Drought	1	33.33
10.	Population increase	1	33.33
11.	Poaching	1	33.33
12.	Rangeland policy	1	33.33
13.	Floods	1	33.33

Source: Field Survey (2011)

Table 4: Susceptibility of Gongoshi, Guyaku and Chekelek Range Sites to Threats

S/N	Range Site	Threat factor	Rangeland Site Susceptibility Index (RSSI)
1.	Gongoshi	1,3,4,5,12, 13	6 (46.15%)
2.	Guyaku	1,2,3,4,5,6,7	7 (53.85%)
3.	Chekelek	1,2,3,4,7,8,9,10,11	9 (62.23%)

Key: 1 - Invasion by undesirable plants; 2- Diseases and pests; 3 - Over-exploitation of forage resources; 4 - Bush fires; 5 – Conflicts; 6 - Farm encroachment; 7 - Settlement policy; 8 – Erosion; 9 – Drought; 10 - Population increase; 11 – Poaching; 12 - Rangeland policy, 13 – Floods

Field Survey (2011)

Table 5: Mean Score and Relative Threat Factor Severity Index of Gongoshi, Guyaku and Chekelek Range Sites

S/N	Threat factor identified by pastoralists	Mean score threat factor	Relative Threat Factor Severity Index	Ranking
1.	Bush fires	0.4488	0.0743	7
2.	Conflicts	0.7795	0.1180	2
3.	Diseases and pests	0.6693	0.1014	5
4.	Drought	0.7087	0.1073	4
5.	Erosion	0.3701	0.0560	11
6.	Floods	0.0236	0.0036	13
7.	Invasion by undesirable plants	0.7165	0.1085	3
8.	Over-exploitation of forage resources	0.7822	0.1185	1
9.	Poaching	0.1181	0.0179	12
10.	Population increase	0.5197	0.0787	8
11.	Population resettlement	0.4331	0.0656	10
12.	Rangeland policy	0.4751	0.0719	9
13.	Settlement policy	0.5591	0.0847	6

Source: Field Survey (2011)

Discussion

Findings on threats to rangeland resources, classified as natural, man-induced as well as policy, legal and institutional threats indicated that overgrazing, conflicts (farmer herder), invasion by undesirable plants, drought and diseases and

pests had the highest Relative Threat Factor Severity Index (RTFSI). These were followed by settlement policy, population increase, bushfire and rangeland policy. Prevalent Threat Index (PTI) results showed that invasion by undesirable plant species, overgrazing and bush fire recorded 100% each. Site Susceptibility Index (SSI) indicated that Gongoshi range site was more susceptible to farm encroachment than to other threats while Guyaku range site showed higher susceptibility to settlement policy than to other threats. Chekelek range site indicated higher susceptibility to drought than to all other threats.

Knowledge of the threats to the health of rangeland ecosystems of Adamawa State may be considered as the first step in the reversal of the trend towards deterioration. A major step towards recovery according to West (1993) is adequate policy arrangement which gives impetus to all other processes and measures that can be put in place to guarantee improvement on the rangeland conditions. Therefore, for the improvement of Adamawa rangelands, what is required are policy and institutional arrangements that will ensure reduction in overgrazing and invasion by undesirable plant species, drought and conflict mitigation, diseases, pests and wildlife control and management as well as rangeland management and conservation in general. The policy should be focused on promoting livestock production because of its livelihood and social importance; maintaining subsistence livestock production in designated communal areas with strong extension support; preserving livestock grazing by control of overgrazing and degradation; establishing community property regimes through community or group-based control; balancing social and economic functions of subsistence livestock production (e.g. fees); enabling communities to sub-lease or enter into a joint venture and introducing improved livestock management systems in communal grazing areas and ranches (Centre for Applied Research, 2004)

Conclusion and Recommendations

Factors militating against the range sites include overgrazing resulting in invasion by undesirable plant species, bushfire, drought, diseases and pests as well as lack of adequate policy and institutional arrangements. Findings on socio-economic characteristics of respondents found at the range sites indicated that the people contribute to the deterioration of the range sites.

In view of the findings above, the following recommendations were advanced:

i. Functional laws and effective surveillance should be put in place to control the incidence of wildfire.

ii. 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.

iii. Pests and diseases control should be carried out on the range sites.

iv. 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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