Pasturing and Grazing Efficacy on the Riparian Greenery along River Benue in North East Nigeria

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Abstract:
The study investigated into the effect of grazing on the riparian vegetation along river Benue in Adamawa state Nigeria. Survey and observation design method were used to compare vegetation cover, distribution and composition. Study area was categorized into upper and lower section of riparian and was stratified into grazed and nongrazed. The study sites were delineated into fifty-nine (59) quadrats, observation technique was used to collect data on grazing effects on vegetation composition. Descriptive statistics, components analysis and paired T-test were used to analyze data. Study revealed, decrease in plant species productivity, plant vigor/resilience, diversity in native palatable species and increase in plant species extinction, diversity of on non-palatable native species as effects of grazing on vegetation. There is a variation in the distribution, composition diversity of plan species amidst grazed and nongrazed sites at p = 0.05 of the paired T-test result. Decline in plant growth 0.759 and decrease in plant species diversity 0.748 are some of the loaded variable for the enormous change in vegetation structure due to grazing. Themeda triandra and Cynodon dactylon are the most affected plants sensitive to grazing effects, while Aristida mutabilis and imperata cylindra are the friendliest to grazing due to their unpalatable nature. Grazing effects amidst the upper and lower riparian sections is almost some with the effect severe on plant growth in all the sections with 22 percent. Study recommends that; as a matter of policy, governments at and federal level, traditional and community leaders should adopt modern grazing strategies or measure. Should empower and encourage the community base organizations, traditional authorities to participate at the grass root development and implementation of environmental law or policies. Community leaders and government should support a culture of understanding, that will promote ranching science curriculum to educate the adult learners skills of constructing a grazing management disposition.
Keywords: *Grazing, Riparian, Flora, Effects River.*

1. Introduction

Vegetation of riparian areas plays a significant role in the sustainability of the environment by sunlight conversion into energy; it enriches the composition, abundances and diversity of plant species and promoting the development of biodiversity (Ehrhart and Hansen, 2014; Theobold, et al, 2010). Riparian vegetation is fundamental to the survival of wildlife, and society through its socio-economic values (Morris & Reich, 2013).

However, despite the importance of the vegetation, threats to such environmental resources have become a universal problem. Unsustainable harvests of bio-resources and uncontrolled livestock grazing are some of the threats affecting sustainability and quality of riparian vegetation. Such threats have severe effects on vegetation productivity, composition and regeneration of plant community (Julien, 2014). The conservation of riparian vegetation along river Benue and grazing activities has long been established as conflicting due to their interdependence and vulnerability as resources. The fact is that, both are resources that needed to be managed harmoniously, as both has been critical to the development of biodiversity and the survival of society (Bastin, *et al.,* 2012; Onouha, 2008).

River Benue with its catchments provided the major drainage plains and diverse riparian ecosystem in the North East (Onouha, 2008). The riparian vegetation of Nigeria is in deplorable situation especially that of river Benue in Adamawa north east of Nigeria. The usefulness of the vegetation is being distracted by the intensified uncontrolled grazing along the riparian (Adefioye, 2013; Onouha, 2008). Many decry over the

situation, for example Linus. *et al.*, (2014), lamented over vanishing of the vegetation benefits along the riparian areas and the hardship it has on livelihood of households across the communities.

Cattle grazing are the main occupation among the communities in Adamawa area and overgrazing is eminent due to uncontrolled grazing. This phenomenon is usually the result of too large numbers of livestock living foraging intensively in one location, it can also be caused by poorly managed grazing methods causing many effects on vegetation and economy. It reduces edible plant life in an area leading to degradation of vegetation in the riparian and resulting into needs becoming more prevalent. It causes erosion of the soil, stopped fish from migrating and productivity. It causes scarcity of quality and quantity of water downstream, increases temperature, drought and navigability.

It exposes rivers to intrusion of sedimentation and degrade non-farming socio – economic activities including fishing along the river Vegetation is one of the most dynamic and vital components of the riparian ecology, with a diverse, productive biodiversity and numerous benefits that are essential to both human beings and animals. Unfortunately, the profound rate at which the vegetation is degrading is alarming and regrettable. The purpose of this study is to investigate into the effect of grazing on the riparian vegetation along river Benue in Adamawa state, Nigeria. Specifically, the study examined how livestock grazing affects the various vegetation structure in the riparian along the river Benue in Nigeria

Literature Review

Zoheir, (2011) and Hansen. *et al.,* (2015), explain the effects of grazing on riparian vegetation through defoliation, trampling and browsing processes on plant species. These processes lead to redistribution of nutrients and redistribution of plants by transporting seed and other propagules from one location to another. Mel. *et al.,* (2013) observed adverse effects of grazing on the physical composition of vegetation which can reduce the value of the resource.

Clark (2010), reviewed livestock impacts on riparian vegetation quality with special reference to humid temperate regions, and that impact of grazing may vary with climate, landscape level factors. Also, uncontrolled access by cattle in riparian areas can have a devastating effect on riparian ecosystems. Abt. *et al*., (2014), concur that cattle access to riparian vegetation can and does dislodge vegetation stability and productivity.

Fischer. *et al.,* (2010), explained damage on vegetation physical structure by grazing trampling activities. Fleischner (2014), cites a number of examples where defoliation by grazing herbivores altered plant height and canopy cover, and changed species composition to include structurally different types of plants. According to Walker (2014), overgrazing can significantly reduce biomass production of any environment by an average 52 per cent, reduced aboveground net primary productivity by less than 20 percent (Buckhouse and Gifford, 2010). However, as stocking density increases, cattle are forced to graze the available forage more evenly and be less selective, potentially decreasing the competition for nutrients from less palatable species (Fischer. *et al.*, 2010; Hairsine.*et al.*,2012).

Bohn and Buckhouse (2012), unveiled that grazing remove plants from ground cover more especially grasses and herbaceous species, which are damaged through trampling. This lead to loss of ground cover and biomass of vegetation, through the loss of grazing-sensitive species, that cause declines in native plant diversity. Buckhouse and Gifford (2010) and Fleischner (2014), observed preferentially graze effects on native palatable plant species, which either removing them from a site or reducing them to compact, low tussocks, or rosettes.

Trimble and Mendel (2011), explains that trees and shrubs are usually moderately affected by grazing in the short term, but over longer time become increasingly degraded. Overgrazing restricts the recruitments of most plant species particularly overstorey plants, which prevents the replacement of plant species. Pettit

(2009), observed that grazing in Australia usually goes hand-in-hand with the clearing of overstorey vegetation and that heavy grazing can result in the development of even-aged stands of vegetation, and reduce species diversity.

Trampling by cattle disturb the plant roots outside soil and in most cases, as it completely destroys the plants species (Bothwell. *et al.*, 2013). However, loss of vegetation can have detrimental long-term effects, Fleischner, (2014) also added that trampling damages plant roots and causes roots to become concentrated near the soil surface. Clary and Booth (2013), argue trampling may prevent plants from acquiring sufficient resources for vigorous growth. Bryant. *et al.*, (2012), found browsing and trampling on Kentucky bluegrass *(Poa pratensis)* pastures to a l-inch (2.5 cm) stubble height reduced vegetation cover, lowered yields due to continuously grazed season long which has implications.

The impact of livestock grazing in grassland riparian can have a significant effect on vegetation structural characteristics and has been the subject of many reviews (Greenwood and McKenzie, 2011; Bilotta. *et al.*, 2013). The effects of grazing on vegetation characteristics are, in part, dependent on diversity and palatability of species. According to Marlow (,2015), a major vegetation change that has taken place in mountain riparian systems of the Pacific Northwest is replacement of native bunch grass with Kentucky blue grass. It was established as dominant invasive species in native bunch grass meadows due to grazing by herbivores and subsequent site deterioration (Voliand, 2009).

Kauffman, *et al.*, (2009) and Scholefield and Hall (2011), found that exotic grasses such as meadow timothy *(Phleum pratense)* were more attuned to savanna riparian environments which replaced the native sedges and mesic forbs. Cattle grazing were found to be influential on spacing of plants and plant width of the riparian zone. Marcuson (2013), found shrub production to be 13 times greater in an ungrazed area than in severely overgrazed area. Davis (2012; Evenden and Kauffman 2010) and Kauffman (2012) found alders (Alnus sp.) and willows*(Silk*s.) provided 75 percent shade cover over areas that had been devoid of shrub canopy cover before exclosures.

Methodology

The riparian areas along river Benue starting from Lamurde the areas below the joining of river Gongola a tributary in Adamawa State, extending upstream to Fufore across seven local governments is the study site. The study applied quantitative survey and observational design which were used for data collection. Study site was divided into upper and lower sections of the riparian, and each section was stratified into grazed and non-grazed. A macro plot of 10 m x50 m was delineated along a transit line of 11250 metres in the grazed upper areas and on transit line of 6750 metres of the non-grazed areas. In the upper section, a total of 36 of 10 m x 50 m was delineated. With 22 in the grazed and 14 in the non-grazed site of the section grouped as A. Similarly, a 10 m x 50m macro plot were delineated along a transect line of 18250 metres in the grazed lower areas and on a transect line of 11250 metres of the non-grazed areas of the lower riparian. In the lower section, the grazed areas of 18250 have 36 macro plot of 10 m x 50 m and the non-grazed areas of 11250 have 23 macro plot of 10 m x50 m grouped as B. Grazed areas of upper section have 22 quadrats and non-grazed have 14 quadrats, upper section has 36 quadrats. Lower sections of the riparian have 36 quadrats in the grazed areas and 23 quadrats in non- grazed. the non-grazed areas of upper and lower sections in total has 37 quadrat plots. In total there were 95 plots observed and study recorded grazing effects on plant community at 60 cm interval transects using the line intercept approach. All data were coded and entered into the computer Special Package for Social Sciences (SPSS23) and Excel were used in data analysis, descriptive statistics such as frequencies, percentages and inferential statistics like Pearson's correlation were used to determine relationship. Tables, charts and figures were used in presenting the analysed data.

Research findings

The grazing effects on vegetation of riparian area along river Benue

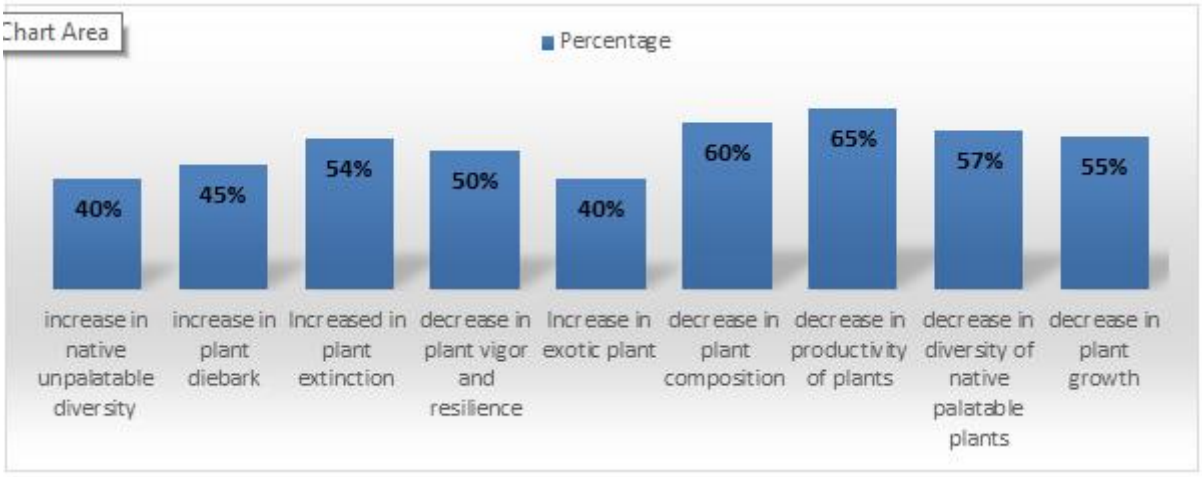


Figure 1; Percentage of grazing effects on plant species along riparian area

Results in Figure 1, indicate the severity of grazing effects on plant species in the riparian. Some of the adversities are: decrease in the growth of plant species 55 percent of the respondents consented to that. A decrease in the diversity of the native palatable species (e.g. *Aristida mutabilis, Themeda triandra* and *Cynodon dactylon, p, africana*) concur by 57 percent of the respondents. Severe decrease in plant species productivity (e, g *Celtis Africana*) affixed by 65 percent of the respondents. Others include decrease in plant composition (heterogeneity) 60 percent of the respondents' assert and an increase in the diversity of exotic weeds in the riparian (e.g. *Learsia hexandra, algae*) mentioned by 40 percent of the respondents.

A decrease in plant vigor/resilience (e.g. *Carissa spinarum*(shrub) and *Cynodon dactylon* (grass) 50 percent of the respondents advanced it. Increase in extinction of sensitive plants to grazing (e.g. *vangueria infausta, clausina anisata*) was profess by 54 percent of the respondents. There is an increase in the widespread of diebark of plants (e.g. *Eucalyptus spp*) 45 percent assert to the information and finally increase in the diversity of unpalatable native (e.g. *Imperata Cylindrica-Speargrass Aristida mutabilis, Chlorophytum dalziere and Rucinus cominunis*) due to ebb of palatable vegetation covered as mentioned by 40 percent of the respondents in the area.The identified grazing effects on riparian vegetation in Figure 1 above, was subjected to principal components analysis (factor analysis) to determine the true loading of the effects on grazing activities in the riparian as in Table 1

Table 1: Principal components analysis of grazing effect on riparian vegetation

Rotated Component Matrix[a]

	Component	
	1	2
Decline in plants growth	.759	
Decrease in diversity of native palatable plants	.748	
Decrease in productivity of plants	.668	
Increase in diversity of unpalatable native plant	.638	
Increase in die bark of plant	.583	
Decrease in plant composition.		.711
Increase in diversity of exotic weeds		.629
Increase extinction of plants		.594
Decrease in vigor/resilience of plant		.584
Total of Eigenvalue	**2.910**	**1.762**
% of variance	**29.102**	**17.621**
Cumulative %	**29.102**	**46.723**

The results in Table 1 indicate the most loaded grazing effect on the riparian vegetation which are; decline in plant growth (0.759), decrease in diversity of native palatable plants (0.748), and decrease in productivity (poor yield) of plant (0.668) have large loadings on factor 1. While decline in plant composition (0.711), and increase diversity of invasive weeds (0.629) had large loadings on factor 2. Factor 1 and factor 2

explain 29.102 percent and 17.621 percent of variation in the data respectively. In other words, it implies that factor 1 and factor 2 are the eminent contributors of grazing effects on the plant community in the riparian area.

However, the variables loaded on the factor 1 and factor 2 are responsible for the enormous ecological changes in the riparian along the river. The eigenvalue of 1.762 for the effect of grazing shows a large difference in plant species growth and diversity decline of palatable native from the rest of the effects. It is sufficient to describe a meaningful control of grazing pressure on the riparian plant community species; this indicate plant species are delicate to upset of grazing activities. The cumulative Eigenvalue of 46.723 is a strong evidence of livestock influence in the riparian, that grazing of vegetation accounts for 46 percent of vegetation decline in the riparian.

Variation in grazing effects amidst upper and lower riparian sections

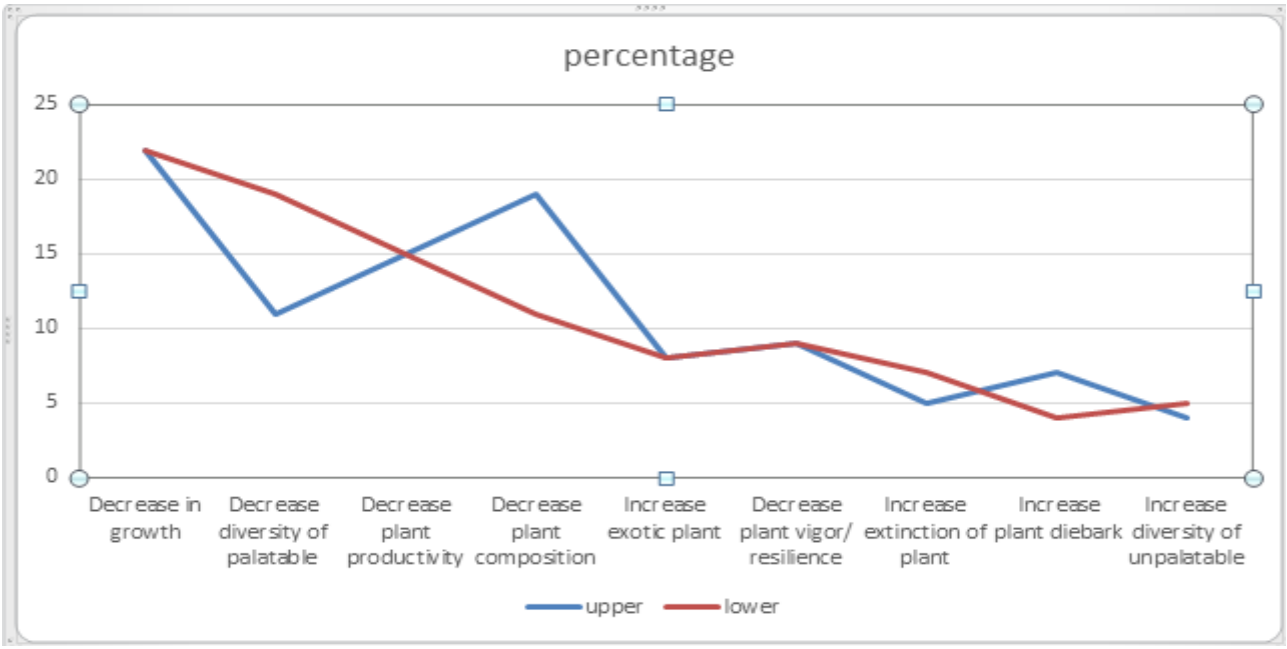


Figure 2: Percentage of grazing effects on plant species along riparian area

The results in Figure 2, reveals difference in grazing effects on the plant community amidst the upper and lower section of the riparian. Grazing effects on the vegetation in both sections differed slightly among species categories. Plant growth is most affected with 22 percent decrease severity; follow by a decline in the diversity of native palatable 19 percent, and a decrease in the plant productivity 15 percent. An increase in diversity of invasive species 8 percent. Others are; increase in extinction of grazing –sensitive plants 7 percent, decrease in the vigor and resilience of plants 9 percent. Also an increase in the diebark of plant 4 percent as one of the severe effects and finally increase in the diversity of native unpalatable plants 5 percent.

In the upper section, of the riparian, effects on vegetation has no distinction compared to the lower section. However, little variation exists in the severity on each attribute in same section: decrease in plant growth is more severe with 22 percent. Follow by a decline in vegetation composition 19 percent; diversity decline in the native palatable plant 11 percent; decrease in the productivity of plants 15 percent. While an increase in the diversity of exotic (invasive) species 8 percent and increase in the diversity of unpalatable native 4 percent.

Others are: increase in the diebark of tree plants 7 percent; decrease in the vigor and resilience of species 9 percent; decrease in the composition of plant percent and finally the extinction of grazing sensitive plant 5 percent. Variation in the effects amidst the riparian sections were due to factors like: difference in vegetation type, riparian gradients and width, frequency and intensity of grazing herds.

Table 2: Difference in observed mean density of plant species covers (paired t –test)

Species life form	**Non- grazed**	**Grazed**	***P***
Canopy cover (trees)	13.20	26.25	0.002
Under storey cover	8.05	31.10	0.003
Tussock grass cover	5.23	14.14	0.002
Shrubs cover	6.01	10.30	0.004
Forb cover	8.21	10.01	0.001
Herbaceous/ cryptogam cover	2.15	7.32	0.004

*significance at p value = 0.05

The results in Table 2 reveals the effects of livestock grazing on the vegetation density. The species life-form covers in the study areas are dominated by *Caesalpiniaceae* family (e.g. *Cynometra*) and *Sapotaceae* family (e.g. *Lophira alata*) which was observed by study to be greater at (p=0.002) in the non-grazed areas compared to the grazed areas. The small tree/climbers plant life-forms of the understorey cover dominated by *Zygophylluaceae* (e. g *Balanites aegyptiaca*) and Epiphytes (e. g *Loranthus*), were much larger at (p=0.003) in the non-grazed as per what was found in the grazed site. The shrub life-form covers dominated by families of *Papilionaceae* (e.g. *Angylocorlyx oligophyllus*) and *Sapindaceae* (e.g. *Chytranthus macrobortys*) species was larger at (p=0.026) on the non-grazed area compared to the grazed areas.

Herbaceous / cryptogams plant life-form covers dominated by *Alectra virgotanherns* and *Aeschynonse neglectra* were much larger at (p=0.004) in the non-grazed compared to the grazed areas The tussock grasses life-form covers of the riparian dominated by Tridx *combretum, Helichsysum Cameroonense* and *Panniiretum purpuseum* (*Elephant grass*) families were much larger (p=0.004) in non-grazed compared to the grazed areas. The forb plant life-forms cover in the riparian dominated by *Rytzynica aryantea* and *Rubiaceae* families (e.g. *Moralia senegalensis* and *Apocynceae* (e.g. *Saba florida*) were much larger (p=0.001) in non-grazed area compared to the grazed areas of the riparian.

More woody species in the non-grazed compared to the grazed this indicate that, woody species breakthrough very quickly under a riparian condition free from grazing disturbances. The Paired t-test indicated difference in the responses of plant species heterogeneity amidst the non-grazed and the grazed areas of the riparian. The difference was found significant at p=0.05 greater than p=value of each in Table 7, and resultant effect was due to pressures from the grazing processes on the grazed site.

Table 3: Observed most affected and resilient species along riparian of river Benue

Riparian plant species affected	Potential effects			
Stream bank species	Vigor/Resilience	Productivity	Diversity	Extinction
Lophira alata	Decrease	decrease	decrease	Increase
Cynometra Ananta	Decrease	decrease	Decrease	Increase
Diospyris Spp	Decrease	decreased	Decrease	Increase
P, africana	Decrease	decrease	Decrease	Increase
Celtis africana	decrease	decrease	Decrease	Increase
Carissa spinarum	Increase	increase	Increase	decrease
Imperata cylindra	increase	increase	increase	decrease
Aristida mutabilis	Increase	increase	increase	decrease
Themeda triandra	Decrease	decrease	decrease	increase
Cynodon dactylon	Increase	increase	Increase	Decrease
Cenhrus cilliaris	Increase	increase	Increase	Decrease
Hyparrhenia Spp	Decrease	decrease	Decrease	Decrease
Xanthium	Increase	increase	Increase	Decrease
Penniseum	Increase	Increased	Increase	Decrease
Chlorophytum D	Increase	increase	Increase	decreased

The study findings in Table 3 indicates the most sensitive and resilient species to grazing in the riparian area along river Benue.

The productivity of the vegetation species in terms of vigor and biomass declined due to grazing effect. plants like *Themeda triandra*, *Cynodon dactylon,* Prunus *africana* and *Celtis africana* are the most sensitive plants to grazing. Lesser number of such species were found in the grazed site, if grazing persist in the riparian such species will completely disappear or go into extinction. Plant species such as *Monocymbium ceresiiforms*, *Araceae* (*Pistia stratiles*) and other tree species such as *Erythrophleum ivorense* belongs to the class of most disturbed plant species vulnerable to grazing actions.

Grazing caused a decline in grazing-sensitive plant species like *Ctenium newtonii*, decline in diversity of native palatable vegetation species like *Themeda triandra*, *Cynodon dactylon grass Chlorophytum dalzieri* and *pennisetum Spp*. Leading to reduction and loss of complex vegetation structure. Selective foraging had improved the diversity and dominance of grazing resistance or resilient of native unpalatable species (*imperata cylindrical- spear grass)*, *Aristida mutabilis*, Carissa *spinerum*, *Cynodon dactylon* and *Cenhrus cilliaris*). which leads to decrease in the diversity of native palatable species and increase in the dominance of the invasive species.

Comparison of Palatable and Non-Palatable Grass Cover

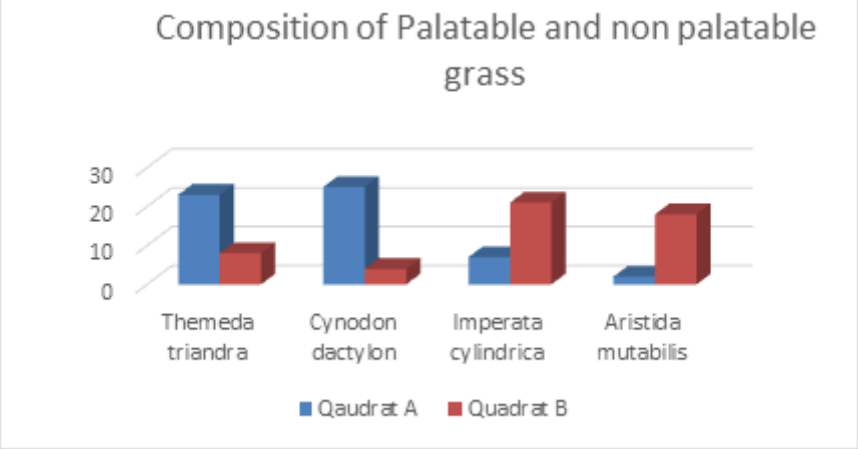


Figure3: Comparison of Palatable and Non-Palatable Grass Cover

Sampling with quadrats plots of a standard size was used for comparison of palatable and non –palatable grass cover in accordance with Cox 1990 method in both the grazed and non-grazed areas. The results of the study as indicated in Figure 3 showed native palatable grasses; Themeda *triandra* and *Cynodon dactylon* being decreased or reduced in the overgrazed areas, quadrats group A and native unpalatable grasses; *Imperata Cylindra- spear grass* and *Aristida mutabilis* dominate the overgrazed area quadrat group A. The result also indicated that native palatable grasses *Themeda triandra* and *Cynodon dactylon* are abundant in the non- grazed areas, quadrats group B and native unpalatable grasses *Aristida mutabilis* and *Imperata cylindra- spear grass* are non or fewer in the grazed areas.

Discussion

The study findings reveal that grazing was found to negatively affect plant communities along the riparian of river Benue. The study observed larger density and richness of plant life-form species in ungrazed area in the upper and lower section of the riparian compared to the grazed areas in the sections. The ungrazed areas in the sections were distinguished by old growth stands of plants life-form of tree, shrub, forb, tussock grass and cryptogams/herbaceous. On the contrast, the ungrazed areas were deficient in diversity of some plant life-form like the cryptogams and grass. The low diversity was attributed to the dominant tree stands that highjack the largest allotment of sunlight and nutrients. Indeed, numerous research had recorded that, an inconsiderable plant species privileged by absences of grazing could go up against small and juvenile plants (Brinson. *et al.*, 2013; and Dobson, 2013).

On the other hand, lesser density and richness of plant life-form were recorded in the grazed areas of both sections of the riparian. But, a great decrease in the diversity of the palatable native species amidst the plant life-form were recorded in the grazed areas along the riparian. Similarly, a diversity of native unpalatable (e.g. *Phonix dactylifera* and *Cenhrus Cilliaris*) and invasive species (e.g. *Learsia hexandra*) were recorded. This indicate that intensification of grazing in riparian lead to reduction in the palatable native species and promoting the dominance of the native unpalatable and invasive species (Glinski, 2011). Livestock grazing in the riparian had affected the competition ability of the native species among others by way of discriminate foraging as well trampling.

Subsequently, as a result of grazing intensity, a decrease in species growth, decline in heterogeneity, diebark, productivity and diversity in unpalatable were recorded as effects (Figure 1 and Table 1). This finding is in line with the mechanisms that veiled the central distraction assumption of complex interplay amidst needs drivers and resources pressures responses (EEA,2005). Some plant species along the riparian were found to be intolerant to grazing (*e.g. P africana*) which was found in the ungrazed area but missing in the grazed site.

However, the species that was found sensitive to grazing and only available in the ungrazed area was *Cassipourea malosona*. Therefore, it can be richly argued that livestock grazing greatly affects plant species density, diversity and richness of the life- form on grazed area along the riparian. This is because the evidence of lesser woody species, palatable tussock grass and shrub in the grazed area indicate effect of grazing on the riparian vegetation of river Benue in Adamawa.

In affirmation to the above findings, a study by Adefioye (2013) revealed that, variation in the grazing effects amidst the riparian sections were due to factors like; the vegetation type which determined plant species availability and variability. Riparian gradients and width was found to be influential also on the vegetation variability of the section as it determines the habitat size and stream bank size. Large size of herds grazing on the riparian enhance overgrazing. Adefioye (2013), further observed that herds size was a strong facilitating factor in grazing effects on the plant community. Due to the undulating nature of riparian landscape around the Gotel hill in the upper course, forest vegetation dominated by *Banbacaceae* and *Vetbanceae* families of trees were predominant.

The vegetation of such kind favoured the availability and variability of edible bark trees and shrub, though grasses were mostly unpalatable to the grazing livestock. Climbers species like *Caesalpiniaceae* (*Dialup*

Guineense) and *Apocynaceae* are some of resilient species whose presence have often limited the grazing habits of livestock. Lower riparian has a savanna grassland vegetation which expedited wide riparian width with numerous perennial and annual plant species. Most of the predominant grass include; (e.g. *Cyperus papyous*) and shrub (*Anglocorlyx nilotica*) with several patches of Raphia palm (Phonix *dactylifera*). The lower riparian became attractive to large herds grazing due to presence of more palatable native grass and shrub of the grassland vegetation, in addition to the availability of water and shades. This finding agrees with that of Sherman. *et al*., (2013) who found that livestock preferred foraging, drinking and lounging on the grassland riparian especially in the dry season.

The selective foraging behaviors of the local breeds was also found to be a contributing factor to the much damage done on the lower section. This is because most of the local breeds dislike grazing on the undulating hills especially, the Gotel hill and its surrounding. This finding consented with Chaney. *et al*., (2010) and Fleischner, (2014), that livestock prefer grazing in the water shade stream channel to hills because of difficulties in going up the slope under gravity influence and sharpness of the riparian stream bank.

Despite the fact that grazing seems to be more severe in the lower section, the study found that plant species sensitive to grazing (e, g *Prunus africana* and *Carissa spinarum*) were severely affected in both upper and lower riparian buffers. This was significant on the density and diversity of riparian vegetation, enhancing decrease in the ecological functions. It was found by the study that, livestock grazing had damaged the riparian vegetation along river Benue. However, it should be noted that, the vegetation conditions can be kept good and stable with efficient ecological services as riparian. Therefore, the rights of use of "common land" in Nigeria which were and still been unregulated and traditional grazing practices should be re-examined and other areas relatively from human activities.

An extensive literature search did not locate peer-reviewed, empirical papers reporting a positive impact of grazing on riparian areas when those areas were compared to non-grazed sites, but some studies reported no statistical significant effects due to riparian grazing (Buckhouse and Gifford 2010; Samson. *et al.*, 2012). The authors of these papers usually explain this absence of statistically significant impacts due to stochastic or design problems associated with their research, rather than to grazing having no effect on vegetation, fish, and soil. They described such problems as: i) high variability among treatment plots, which masked treatment effects (Sarr. *et al*., 2009); ii) insufficient recovery periods after protection from grazing (Sedgwick and Knopf, 2012, Sarr. *et al.*, 2009); iii) heavy browsing and grazing by native herbivores (or trespassing cattle) on supposedly non-grazed sites plots (Clary. *et al.*, 2011); iv) unplanned disturbances such as flooding (Sedgwick and Knopf, 2012, Clary. *et al.*, 2011); iv) the unknown effects of a prior history of heavy grazing, which may have permanently altered stream vegetation function and prevented recovery of control plots (Tiedemann and Higgins, 2013). The absence of significant effects may also be due to investigators setting statistical significance at arbitrarily low levels (i.e. at $P<0.05$).

Marlow (2015), argues that many studies, such as those with few treatment replications or high spatial variability, have low power (i.e. poor ability) to detect environmental change.

Because of the possibility, that already depleted fish stocks could become endangered or important habitats become permanently altered, he argues that higher probability levels (i.e., $P<0.1$) are appropriate to test significance of hypotheses.

Authors have also attributed non-significant results to supplemental feeding of livestock (Sedgwick and Knopf, 2012), which resulted in lower forage consumption levels than originally prescribed, and to high recreational fishing, which obscured the negative effects of vegetation degeneration by grazing on fish population and other aquatic life. Therefore, it can be argued that severe vegetation damage such as loss of native plant species or extinction in palatable and medicinal plants cannot be reversed in just a few years of protection. This implies that stream vegetation can recover slowly or only over geological time scales.

In agreement to the findings of this study, the studies by Chaney. *et al.*, (2010); Platts, (2011), Elmore and Kauffman (2011); McIntosh. *et al.*, (2013); Fleischner, (2014); and Oholmart, (2011), all found that livestock grazing in riparian areas affect watershed plant community attributes, stream channel morphology, wildlife, fish and other vegetation-dependent organisms and water quality at both local and large scales through damaging of riparian vegetation.

In addition, Clary. *et al.*, (2011) also found that stock foraging strongly influences the stability and shape of the stream bank vegetation through its influence on ground cover species like *cryptogam* rates. This is because grazing can detrimentally influence the plant regeneration. They can both accelerate stream bank vegetation degradation, decrease stream bank buffers during flood events, largely due to excessive removal of vegetative ground cover. The consequence of both increase extinction and decreased diversity along the stream bank, can influence water temperature through decrease overhang plants. It can also increase in-channel deposition of sediments due to vegetation heterogeneity fragmentation. Both results can greatly degrade aquatic habitats. Moreover, transport of soils and fine organic materials from the site decreases the fertility of the soils and can reduce capacity to support vegetation of any type.

Furthermore, grazing alters the structure and function of riparian plant communities in several ways. Grazing, browsing, defoliation, and trampling can change the quantity and composition of plant species, as well as the quantity and depth of plant roots. Livestock can also change the vertical structure and distribution of vegetation.

Moreover, selective removal, and/or trampling damage, can alter the age structure of plant communities, this concurred with the observation of Clary, (2010). Therefore, controlling frequency of grazing is an important tool for minimizing the effect of defoliation. Proper frequency of grazing allows for a sufficient rest period for plants to recover from the defoliation event and prevent 'overgrazing'. If grazing is too frequent, overgrazing occurs and vigor and abundance of grazed plants can be reduced. If overgrazing persists, desirable forage species could be replaced by weedy annuals that have little or no forage value and the functioning of the plant community may be altered.

From the analysis, the variations in vegetation structure in the non-grazed and grazed sites unveiled a significant difference with Eigenvalue of 1.762 and large cumulative value of 46. 762 loaded on factor 1 and 2, holding grazing accountable. It also differences at P value < 0.05 which is greater than the paired t-test values in Table 1 which affirmed that grazing is strongly responsible for vegetation degradation. Therefore, the null hypothesis is rejected in favor of the alternative hypotheses, and differences in the vegetation structure is not by chance but rather due to grazing. And the little or minimal disturbance in the vegetation of the non-grazed sites was due to other factors like bush fire, drought, dissertation, bio- fuel harvest and others, rather than grazing associated processes in the riparian.

Conclusion

For the fact that there are environmental laws and policies safe guarding the Nigeria environmental natural resources, riparian resources seemed to have been ignored, as most of the laws focused on petroleum resources utilization and other areas like industries. Due to poor planning, development and implementations of environmental policies, uncontrolled or poor open livestock grazing had degraded riparian vegetation. Such effects of grazing are related primarily to the following processes: plant defoliation, animal traffic and redistribution of nutrients and plant propagules. Altering its structural composition and distribution which diffusely altered other components properties. However, with proper assessment, adequate planning and adoption of rightful grazing management strategies and strong application of environmental laws, the health of riparian areas can be improved and maintained. Finally, despite the policies, grazing in riparian areas have significant effect and include decline in plant community species, water quality, fish productivity and wildlife habitat and population, forage production and overall site ecological value and sustainability,

Recommendations

Based on the findings of the study, author recommends the following to enhance the quality and sustainability of riparian vegetation along river Benue:
Federal and State government agencies should support a culture of initiatives in public and private universities and other related research institutes to develop ranch management science curriculum, to teach Adults of nomadic and Agro- pastoralists skills of constructing livestock management disposition.

Professional bodies like Nigeria Environmental Study Team (NEST) and Fisheries Society of Nigeria (FSON) among others to produce plans and empowered to apprehend present degenerating condition of riparian vegetation flawed by grazing through encouraging riparian re-vegetate.
Federal and State legislators should as a matter of policy empower and encourage professional and community based organizations' like Farmer Development Union (FDU), National Association of Fishermen (NAOFM), Traditional authorities and community organizations, to participate in policy development and implementation at grass root.
Such participatory bodies in policy should also be encourage to embark on tree planting in the riparian, empowered to enhance implementation of grazing management strategies for sustainable riparian.

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