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Effects of climate change on community based grazing lands management: A case study of the border between Nigeria and Niger Republic

Adamu Ahmed[1] and Ma'aruf Murtala[2]*

[1]Department of Geography,Bayero University, Kano, Kano State, Nigeria.
[2]Department of Geography, Sule Lamido University, Kafin Hausa, Jigawa State, Nigeria.

*Corresponding author. Email: maarufmurtala@gmail.com; Tel: +2348037918076.

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ABSTRACT: In recent years, climate changes have had serious and unprecedented effects in Nigeria and Niger Republic. These changes range from a rapid decrease in forest resources to social and economic effects with obvious environmental repercussions. This paper examined the effect of climate change on community based grazing land management between the border of Nigeria and the Niger Republic. The focus was made on identifying activities carried out in the area, identifying herders' encroachment routes and the perceived occurrence of climate change. Thus, data from Focus Group Discussions (FGD) and Questionnaire derived from the inhabitants were collected and analyzed. A total of 1,009 questionnaires out of the 1,020 given were used to collect data for the study. The results revealed that various forms of changing climatic patterns force arable farming into more and more marginal areas. When there is heavy pressure on grazing lands, the animals consume palatable vegetation faster than it can generate, and eventually, no vegetation remains. Continuing overgrazing is detrimental in the study area because it reduces primary productivity, impedes plant growth and survival and consequently alters species composition of the grasses, shrubs and forbs that provide livestock with food. The study further revealed that moderate grazing pressure increased plant diversity and soil and land health. Therefore, good pasture management is a remedy to sustainable utilization, among which proper grazing management serves as the key element of sustainable rangeland restoration. The study further recommends that the conservation of grazing land is the responsibility of all.

Keywords: Boarder, community, climate change, grazing land, management.

INTRODUCTION

Climate change refers to a change which is directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods (European Climate Support Network [ECSN], (2014). Changes in world climate are evidenced by the thawing of ice in high latitudes, ice-capped mountain tops and the global rise in sea levels, while some areas are becoming drier, others are getting wetter.

Nigeria, with a population of about two hundred million (200,000,000) people and fifteen million (15,000,000) cattle, is faced with the impacts of both climate change and unstoppable population growth, as this population is expected to double by 2050 (Olawale, 2021). Similar to other countries, Nigeria's enormous and rapidly expanding population straining the limited resources in the environment, which are also threatened by climate change (Moutari and Tan, 2008). The majority of the twelve million inhabitants that live in the Niger Republic, however, are rural resident who depends on agriculture (crops and animals or livestock) for their survival (Al Shudiefat et al., 2013). Thus, cross border movement of animals between

Niger and Nigeria is an important feature of livestock production in the region (Olawale, 2021).

Community grazing land management is an important source of livestock feed in developing countries (Dai *et al*., 2004). Grazing lands have huge untapped potential (Fuhlendorf and Engle, 2011), while, desertification, drought, unsuitable farming practices and overgrazing have left these lands in poor condition, which impacts rangeland conditions, both ecologically and socio-economically, in many ways (Mitchell, 2010). In the short term, it decreases forage availability for wildlife and livestock, over extended periods (Anabaraonye *et al*., 2019). Droughts can cause native plants to die out, soil to erode and water supplies to dry up (Murtala *et al*., 2018). In the northwestern part of Nigeria, continuing overgrazing is detrimental because it reduces primary productivity, impedes plant growth and survival, and alters species composition of the grasses, shrubs, and forbs that provide wildlife with food and cover (Fleischner, 2014). Grazing areas may be sustainably managed if their ecosystems are proposed and they are most productive when exploited for a range of purposes (Giannini *et al*., 2003). Traditional systems of rangeland management were successful in managing rangelands before the advent of technical and sophisticated management techniques (Ouled-Belgacem, 2012).

Extensive grazing in lands in dry areas, particularly in the Middle East, North Africa and the Sahel, has been possible for many centuries only because of the rigid social control exerted by the nomads themselves over the movements of their animals. These controls have now broken down, more as a result of outside influences than any other cause (Ebele and Emodi, 2016).

Proper grazing management is the key element of successful livestock production due to the fragile nature of the study area. Controlled grazing is an important aspect of pasture management. Rangeland resting or grazing-exclusion for a period of time is also another passive restoration technique to rehabilitate moderately degraded rangelands (Ouled-Belgacem, 2012). A typical example of range land restoration efforts which was related to this study was done in Tunisia, where rangeland resting has been practised traditionally, with increases in fodder production, soil organic matter, and biodiversity (Marques *et al*., 2016). Also, soil erosion has been observed in Niger, where the distribution of points of available water, building water harvesting structures, and facilitating passageways for herds have been adopted as passive restoration techniques to rehabilitate rangelands, which is proved to be successful to reduce the overgrazing problem by 30 to 40% (Marques, *et al.,* 2016).

In the border of Nigeria and the Niger Republics, community pasture management is the panacea to sustainable peace which is bedeviled by a series of climatic changes (UNCCD, 2004). The study area is dominated by subsistence farmers and herdsmen, both groups are stakeholders in grazing area management and utilization. Grazing lands are grasslands, shrub lands, woodlands, wetlands, and deserts that are grazed by domestic livestock or wild animals (Moutari and Tan, 2008). There is a need to assess the effects of climate change on grazing areas in the Nigeria-Niger Republic border for an efficient economy and mutual understanding.

Thus, the thrust of this research is to assess the effects of climate change on community based land management in the border of Nigeria-Niger Republics, by assessing the land use undertaken within the grazing land and climatic change occurrence, identify the efforts of the individuals and community in grazing land restoration, examine animal route-encroachment in the study area and identify type of animal raised in the area.

MATERIALS AND METHODS

Study area

The study area comprises three villages that shared borders with the Niger Republic in the Northern part of Jigawa State (Maigatari, Suletankarkar and Galadi), and three villages in the Southern parts of Niger (Bangaya, Dungas and Mallaua) (Figure 1). A reconnaissance survey was conducted in the selected villages for familiarization with the environment in terms of geographical landscape, the socio-cultural characteristics of the inhabitants and to interact with the farmers and herdsmen that are direct users of grazing reserves. The study area is approximately located on latitudes 12° 35'N and 13° O5'N, and longitude 8° 4O'E to 9° 55'E.

The study area may be classified into tropical continental and semi-arid continental climatic zones. The southern part of the study area comprises Bangaya, Dungas and Mallaua with total rainfall ranging from 300 to 400 mm annually. The northern part of the study area which comprises Maigatari, Suletankarkar and Galadi receives less amount of rainfall compared to other parts of the state, there is an erratic rain pattern. The drought period is a common occurrence (Murtala *et al*., 2018). The area is characterized by the strong seasonality of the climate with a short rainy season and a long intensity of the dry season. Rainfall is a very critical element in the region because of its deficiency during the dry season. The mean annual rainfall in the study area is about 400 mm. The temperature is warm and hot throughout the year, even though there is a slightly cool period between November and February. The mean annual temperature is about 28°C; the coolest month has varied values of temperature 23°C and 38°C in the hottest month (April/May). Evapotranspiration is very high in the area. It is estimated to be about 75% of the annual rainfall. The duration of the sunlight in a year is very high while, relative humidity is about 49 to 50 per cent yearly. Thus this area whose climate is dominated by seasonal variations has four main seasons; Cool-dry season from December-January, Hot-dry season from

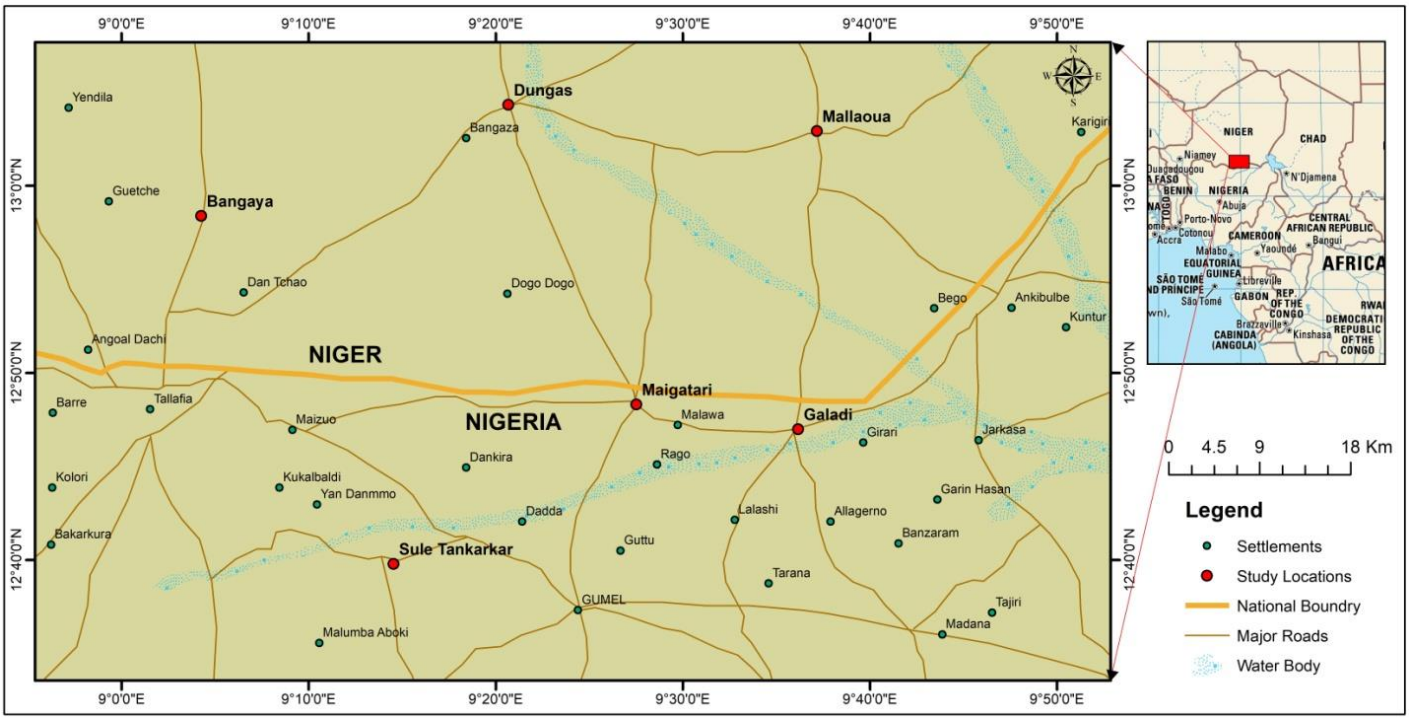

Figure 1. Map showing villages of the study area along the Nigeria-Niger Republics boarder.

March-May, Warn-wet season from May/June to September and a season of decreasing rainfall from October to November (Murtala *et. al,* 2018).

The climate is controlled by the interplay of the tropical marine (MT) air mass which originates over the Atlantic Ocean to the south (Ati *et al*., 2009) and the tropical continental (CT) air mass which originates over the Sahara desert to the north. The Inter Tropical Discontinuity (ITD) and the prevailing wind are the dividing zones between the cool and dry, sometimes dusty CT air mass and the warm and wet MT air mass (Easterling *et al*., 2000). The ITD itself is a zone of tropical, weak frontal weather conditions which, in west Africa, swings from latitude 5°N at the lowest sun period (December) to latitude 18°N at the highest-sun period (June). It is believed that the ITD advances northwards at about 160 km/month resulting in a relatively gradual urgent of rains from the south to the north, but it retreats southwards at about 320 km/month to cause a more rapid end of rains. The northward advance is associated with southerly winds while the southwards retreat is associated with northerly winds known locally as Harmattan (Abdulkarim *et al*., 2015).

Sources of data

Primary and secondary source of data were used. The primary sources of data used in this research involved the use of structured questionnaires and focus group discussion. The secondary source of data used was literatures from related work.

Sampling design

The study is conducted in six border areas of Maigatari, Suletankarkar and Galadi in Nigerian side and Bangaya, Dungas and Mallaua on the side of the Niger Republic. It focuses on the farmers and herdsmen that are direct users of grazing reserves. The reasons for selecting these areas are, in spite of little rainfall and scanty vegetation, they have abundance of livestock. There are competition for the little reserves for farming and grazing, this often leads to conflict in the areas. Similarly, these communities are easily accessible in terms of road networks.

Focus group discussion

In generating data from this method, the study group were divided into six group comprises of research assistant, 5 farmers, 5 herdsmen and a traditional leader. These stakeholders believe that grazing by livestock in the area is the main activity and the communities showed a great interest in the discussion. Other important land use types are fuel wood collection, farming and hunting, though is practice in smaller level. In view of this, the same questions were discussed in all the groups. Android phone video/sound recording devices along with pen and jotter were used to capture discussions. Thus, simple descriptive statistics which comprise frequency, percentages and charts were used to present the farmers' and herders' views from the questionnaire and FGD.

Sampling technique and sampling size

A multi-stage sampling technique was used for the study. In the first stage, the communities in the study area were clustered into six groups. In the second stage, the purposive sampling technique was used to select the communities from the six (6) groups. Thus, the sampling size was based on Krejcie and Morgan's (1970) sampling size determination. It stated that where a population range is between 500,000 and 10,000,000, the sample size is 783 at a 95% confidence level and a 3.5% margin of error. This 3.5% margin of error was chosen in order to minimize the margin of error as smaller sample sizes will yield larger margins of error. Therefore, the sample size of 1,020 was adequate and used for this research. However, from the 1,020 copies of the questionnaire issued, 1009 were successfully filled and returned. The response rate was therefore 98.9% which was considered adequate for analysis, result presentation, discussion and conclusion. According to Bennet (1997), Rosegrant and Cline (2003), and Moutari and Tan (2008), a response rate of above 95% of respondents is adequate to represent the study sample and offer adequate information for the analysis.

The third stage involved the use of a purposive sampling technique to determine the actual farmers and herders from which respondents were drawn. These farmers and herders were already identified during the reconnaissance survey.

Validity and reliability of the research instrument

In order to give the final shape, the questionnaire was pre-tested with 120 respondents (10 farmers and 10 herders were purposively sampled from each of the six selected communities). Based on the pretest results, necessary corrections, modifications, alternations and adjustments were made through expert counseling. Furthermore, to determine the internal consistency of the data, it was finally subjected to Cronbach Alpha statistical analysis using SPSS, where a reliability co-efficient of 0.89 was obtained. This indicates that the items were consistent and reliable to be used for the study.

Thus, the study areas were further sub divided into twelve units each with a research assistant and participants drawn from the farmers, herders and community leaders. Each research area is divided into 2 groups, the first group is to work on the onset of the rainy season between the period of June- September and the second group is to work on the period of harvest which is between October-December, this is because these periods are critical for all the ecosystem conflicts.

Data analyses

The primary data collected were analyzed using based on descriptive statistics (Frequency distribution, tables and charts) and the use of a five points Likert Scale (LS) as follows: SA=Strongly Agree, A=Agree, UD=Undecided, DA=Disagree, and SD=Strongly Disagree. Values assigned to those options were 5, 4, 3, 2 and 1 respectively.

Consequently, based on the calculated five LS points, the mean score of the respondents is 3.0. Therefore, factors with mean scores less than 3.0 means not significant while, those with mean score above 3.0 means significant factors. A mean score of exactly 3.0 indicates undecided on the level of significance of climate change on community based grazing land management in the study areas.

RESULTS AND DISCUSSION

Focus group discussion

Fleishner (2014) model was employed to analyze the interactions at the FGD schedules used in the study area. The following are key findings on the assessment of community based grazing lands management in the border of Nigeria-Niger Republics:

The research area been a marginal one, has a lot of ecosystem conflicts with farmers and herders struggling for the scarce resources. However, it was recognized that there are more cattle grazing in the Nigeria side and more goats, sheep and camels in the Niger Republic side. These animals do graze to the tune of about 200/hectare of land which is by far above the standard. The focus group further estimated that around 95 per cent of fuel need in the area is met by plants in the grazing lands. This is in tune with findings by In Paper Magazine (2011) that established in one of its research that the destruction of the rangelands is not because of over population and pressure of livestock on the land but also because of overuse of trees, shrubs and bushes as fuel. It has been estimated that around 75 per cent of fuel needed in rural areas is met by plants in rangelands.

Secondly, the focus group established that individuals and communities use different efforts to restore rangeland in the study area. Bush fallowing and rotational grazing are the main efforts used in restoring rangeland in the area. While communities of Niger Republic use culture and tradition as a way of restoring rangeland through prohibition such as seeking permission from community leaders for migrants before grazing their herds and taboo in setting fire to the bush in the months of November, December and January and in the period of the wet seasons as well as a prohibition of grazing on grazing land in the early period of rainy seasons. Members were usually aware of such prohibitions in their societies and made efforts to abide by them because they perceived them as effective in grazing land conservation. On the Nigeria side, there are public campaigns in the media on how to conserve grazing lands; farmers were also encouraged to explore peaceful avenues for conflict resolution, especially

Table 1. Activities carryout in the study area.

Activities	Number	Frequency	Percentage (%)
Fuel collection	199	199	19.70
Grazing	420	420	41.60
Hunting	140	140	13.88
Farming	190	190	18.83
Others	60	60	5.95
Total	1,009	1,009	100%

Source: Fieldwork, 2020.

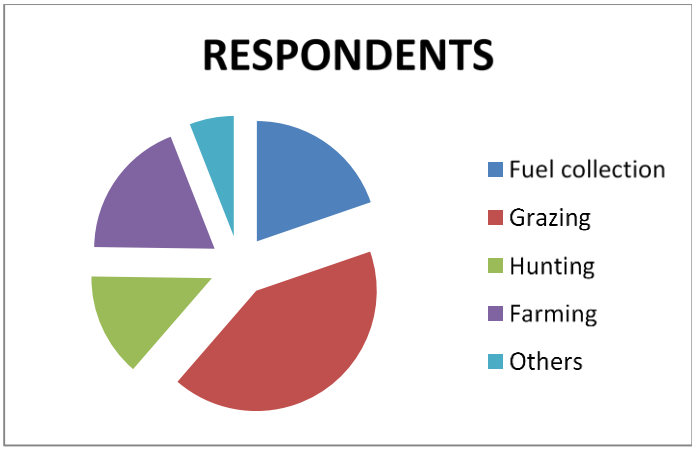

Figure 2. Major activities in the study area.

where there are trespasses by herders and or encroachment by fellow community members. It was also established that traditional and community leaders play a significant role in this regard, possibly because of their in depth knowledge of the area. People living in the study area accept and participate in these practices that not only restored grazing lands but enhance sustainable peace between farmers and herders.

Consequently, the findings revealed that at the onset of the rainy season during which farmers are struggling to plant their crops, there was no conflict with herders as they both tamed their animals, this is because the traditional leaders warn the community to do so. Therefore, people continue to feed their animals with herbs, forbs, tree leaves and other fodder supplements. Trouble started according to the findings during the harvesting period, as most of the herders released their animals carelessly into the farms thereby causing destruction to the farm produce, this often leads to conflicts.

The findings also revealed that herd productivity has risen significantly. Thus, by introducing managed grazing protocols and engaging the community, the CBRR is restoring local biodiversity while lessening the overexploitation of natural resources. In addition to benefits for the herding community and the environment, there has been a marked effect on community spirit. Young people now have more prospects for earning a living locally and are no longer feeling the need to migrate to larger urban areas.

Thus, these findings agree with the study conducted by Nawash *et al*. (2013) who observed that similar methods were used in Jordan, where climate change, overgrazing, desertification and a rapidly expanding population are combining to create huge imbalances between food security and natural resource management. Therefore, the Community Based Rangeland Rehabilitation (CBRR) is successfully improving the livelihood of sheep and goat herders and improving family hygiene in Jordan, which has greatly decreased illness among the community while increasing herd health.

Structured questionnaires

The Table 1 and Figure 2 shows that grazing by domestic animals are the main activities undertaken in the study area. This represents 41.60% of the total view of the respondents. Other important activities are fuel collection and farming which represent 19.70 and 18.33% respectively while hunting represents 13.88%. Other activities by the communities represent 5.95%. This has shown that in the study areas (Gumel, Maigatari, SuleTankarkar, Bangaya, Dungas, and Mallaua) activities are fully utilized in terms of numerous human activities.

Table 2 shows the shared opinion of 1,009 respondents. Thus, the majority of the respondents (66.60%) believed climate change is affecting Community Based Grazing Land Management, while 33.40% of the respondent thought otherwise. This show that climate change effects could be increasing in the study areas, and people living in the marginal areas of the study area can all participate in the restoration of grazing lands, which will enhance sustainable climatic conditions and sustainable peace. Grazing is the major land use type in the rangeland area of the border villages, and the respondents testified to this. Farmers residing near these grazing lands mainly depend upon rainwater. Whereas the herdsmen depend on their livestock for food, especially milk. It was also established that the production potential of livestock is being affected

Table 2. Is climatic change affecting community based grazing land management?

Study areas	Agree	%	Disagree	%
Galadi	135	13.38	33	3.27
Maigatari	129	12.80	39	3.87
SuleTankarkar	90	8.92	78	7.73
Bangaya	98	9.70	70	6.98
Dungas	100	9.91	68	6.74
Mallaua	120	11.89	49	4.86
Total	672	66.60%	337	33.40%

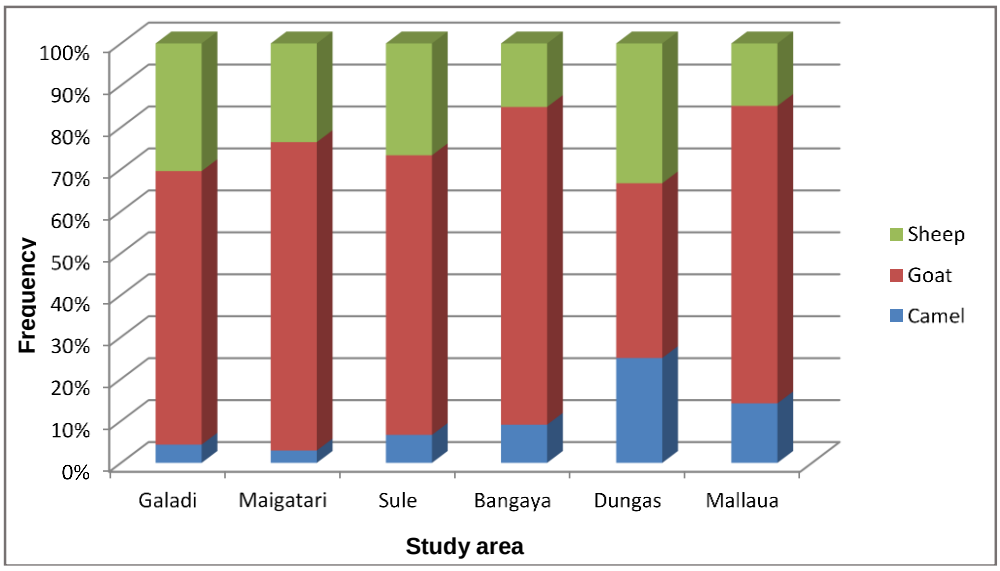

Figure 3. Animal raise in the study area.

owing to these effects. Overgrazing is a major cause of grazing land degradation in dry lands leading to desertification (Fleischner, 2014).

In the study area, various types of animals are reared (Figure 3). The Figure 3 indicated that almost 70% of the respondents raised goats and sheep. Similarly, cattle are equally raised in the area, which represents 27.1% of the total animals found in the area. However, of all the animals raised horse is the least. Camel is equally raised, it represents 9.2% of the total animals raised in the area, perhaps because of the semi-arid nature of the study area. Because of the numerous livestock found in the study area, grazing lands constitute an important resource. Giannini et al. (2003) observed that proper grazing land management is the best way of sustaining the pasture of the Sahel region, due to insufficient rainfall in the area, strategies to maintain the pasture are essential. If properly maintain grazing land can supports vegetation useful for grazing on which routine management of that vegetation is through manipulation of grazing rather than cultural practices.

Cattle route encroachment for Nigeria (Figure 4) and Niger (Figure 5) shows various types of activities leading to the encroachment of cattle routes in the study areas. Among the major ones are farming and shelterbelts by the communities. While encroachment by road construction represents the least. However, this shows that the authority needs to provide enough land for activities.

These findings were in agreement with the study conducted by Adebowale (2014) in neighbouring Yobe State, northeastern Nigeria, that the demarcation of 1,000 km cattle routes has eliminated conflicts between herdsmen and farmers in the state. The demarcation of primary and secondary stock routes has provided the free movement of livestock across the state without encroachment into farmlands. In its recent report, the National Academy of Science suggests that the African permanent grazing land supports some 110 million head of cattle and 180 million head of sheep and goats, in addition to an unknown number of other ruminants, including wild species. In addition, Ekpoh (2007) concluded that in some communities, culture and tradition are applied to manage grazing land, community members were usually aware of such prohibitions in their societies

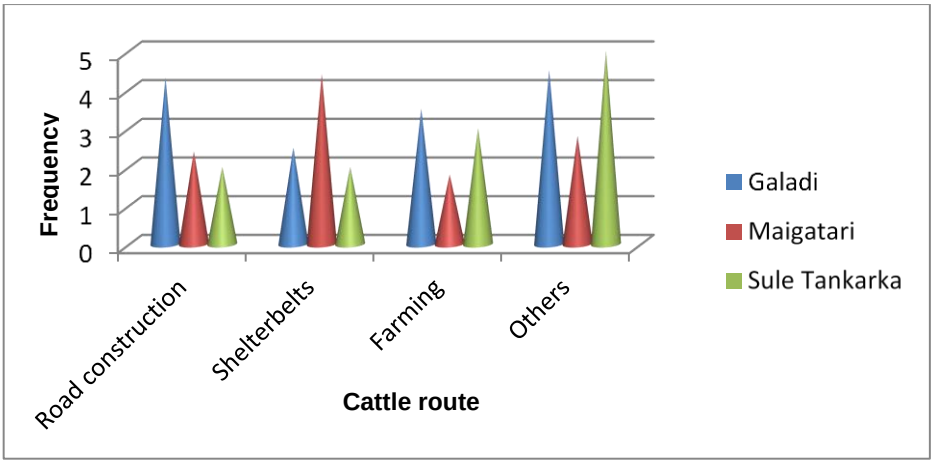

Figure 4. Cattle route encroachment in Nigeria.

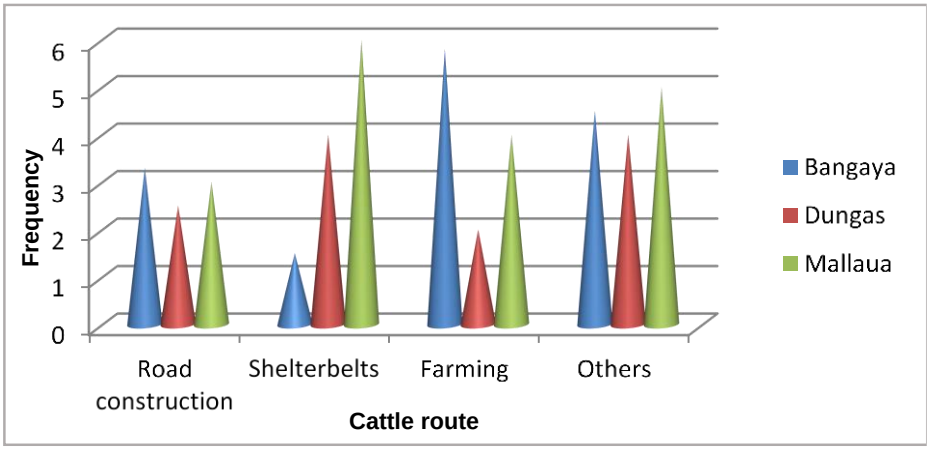

Figure 5. Cattle route encroachment in Niger Republic.

and made efforts to abide by them because they perceived them as effective in biodiversity conservation.

Conclusion and Recommendation

Generally speaking, grazing lands consist primarily of native plant communities managed, typically, for livestock production. Because they can embrace extensive native plant communities, grazing lands can serve as biodiversity repositories. Various human activities carried out were identified, and the occurrence of climate change and types of animal raised were all examined looking at the various activities carried out (That is, farming, fuel collection, grazing, and hunting, among others). In view of this, this study recommends developing a framework for strengthening the use of community based grazing land management in the study areas by the Ministries of Environment to minimize the effects of climate change should be a policy priority. In addition, improved varieties of crops should be given to farmers that can mature within the shortage possible period; this will check the effects of climate change. Similarly, animal feeds should be given to farmers at subsidized rates, in this regard, the feed processing industry should be located in the border communities, and all relevant persons involved in land ownership should work closely together.

CONFLICTS OF INTEREST

The authors declare that they have no conflict of interest.

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