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AGRICULTURAL LAND USE AND LAND DEGRADATION IN ADAMAWA STATE.

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ABSTRACT

This paper examines the relationships between cultivation, livestock grazing and land degradation in Adamawa State. The main objective was to identify areas with major symptoms of degradation, such as rills and gullies, and determine the main causal factor(s), whether cultivation or grazing. Thus, areas of varying intensity of cultivation and livestock grazing were delineated and detailed field investigations for evidence of degradation carried out. Three maps, population density, cultivation intensity and livestock grazing blocks were produced and examined in detail to establish the role of each in land degradation and a forth map, erosion intensity produced. The results obtained show more symptoms of degradation (78.26%) in the cultivated sites. It was therefore argued that in Adamawa State there is evidence of a reversal of the tragedy of the commons' thesis, where farmlands, which are more privately and permanently owned than grazing lands, appeared more degraded. The implications of this to resources use policy formulation were highlighted.

KEY WORDS: Farmlands, grazing lands, land degradation, population growth and tragedy of the commons.

INTRODUCTION

It is widely acknowledged that severe land degradation is a common menace to most of the world's agricultural regions and the problem is growing as more marginal lands are being brought into production. Most contemporary research reports, however, suggest the existence of close relationships between population growth, land ownership, use and management on the one hand and land degradation (Millington, 1992, Lopez, 1998, and Mendelssohn and Dinar, 1999). Thus, numerous theories have been put forward to explain, for instance, the relationships between natural resource (land) use, management and tenure particularly with respect to rangelands, and land degradation (Hardin, 1988, Behnke, 1994 and Lane and Moorhead, 1995). One of such theories, argued to be the most widely held by policy makers in Africa (Lane and Moorhead, 1995), *is the tragedy of the commons.*

The basic thrust of *the tragedy of the commons* theory is that communal tenure system is economically inferior and do not provide for sound management, hence it is ultimately self-destructive. The theory argued that sustainable environmental policy could best be achieved through the promotion of private property as a means of attaining equity, efficiency and overall rational use of resources. It is thought that individuals can ensure protective measures against negative environmental externalities that characterises the commons. Others, however, recognised that *communal tenure arrangements can increase tenure security and provide a (limited) basis for land transactions in ways that are more cost-effective than freehold titles* (Deininger and Binswanger, 1999; p. 248).

Although an enormous literature exists on land use, tenure and land degradation (Tukur and Adebayo, 1994, Omar, 1996 and Tukur and Ray, 2000) no satisfactory explanation has yet been provided on the relative contribution of cultivation (on generally permanently owned lands) and livestock grazing (mainly in communal lands) on rill and gully development in the country in general and Adamawa State in particular. A study of this nature that aimed at empirical testing and evaluation of the tragedy of the commons thesis is quite imperative. It is most desirable especially for formulating policy interventions that would help improve political stability, enhance the sustainability of resource use, arrest environmental degradation and promote overall efficiency of land use. It is envisaged that such policy interventions are likely better achieved in Nigeria in general and Adamawa State in particular, under the present democratic rule than ever before.

The Study Area

Adamawa State, located at the north-eastern part of Nigeria, lies between latitude 7^0 and 11^0N and longitude 11 and 14^0E covering an area of about 38,741 km^2 with a population of 2,722,622 (Projected from 1991 census figures). The state is characterised by a rugged terrain with hills and mountains constituting about 27% of the total land mass (Tukur, 1999). Maximum temperatures in the state can be as high as 40^0C while the minimum could be as low as 19^0C. Mean monthly temperatures range from 26^0C in the south to 27^0C in the north. The mean annual where rainfall starts late May and ends mid September) to 900 mm in the central part (lat. 9 - 10^0N with early May to mid October rains) and 1600 mm in the southern part (below lat. 9^0N experiencing rains from early April to late October). Altitude, however, influences and punctuates this normal pattern in both temperatures and rainfall distribution. The northern half of the state is generally of sudan savanna vegetation and in the

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southern part it is of the guinea savanna type. The vegetation outlook is similarly punctuated and distorted by large-scale deforestation resulting from harvest of wood for fuel and other domestic needs and expansion of agricultural lands.

The nature of the terrain, climatic and ecological characteristics combined to dictate agricultural practices, the cultivation of various crops and livestock management strategies. The land use and management practices adopted in turn determine the nature and extent of degradation within each of the production systems.

METHODOLOGY

The paper is largely a synthesis of a detailed study of Adamawa State that spanned over a period of five years (1994 - 1998) culminating in the production of a text entitled *Adamawa State in Maps*. Thus, maps of population distribution pattern, (Nwagboso and Uyanga, 1999), cultivation practices (Sajo and Kadams, 1999) and Livestock management (Tukur and Ardo, 1999) were adapted and analysed to explain the relationships between land use and land degradation (as represented by rill and gully erosion).

Six locations (10 x 10 km) of varying intensity of cultivation, livestock grazing and population density were delineated and detailed survey carried out to determine the extent and causes of rills and gullies. These systematically chosen locations are places around Girei, Mubi, Michika, Lamurde, Mayo Belwa and Ganye (see Fig. 4). In each site measurements of rill/gully length, width and depth were carried out. Width and depth were measured at every 10 and 20 metre intervals for short (≤200m) and long (> 200m) rills/gullies respectively. Simple computations of percentage, averages and comparative statistical test (Chi-squared) were used to compare the intensity and extent of degradation on arable and pasture lands.

RESULTS AND DISCUSSION

Analysis of the works (maps) relied upon or adapted for this study reveal that areas of high population density (101 – 250 persons/km^2 – see Fig. 1) are Girei (within Greater Yola), Mubi and Michika. These are old settlements with long and noteworthy antecedents. Girei at the outskirts of Yola the Adamawa State capital city, for example, emerged as a military fortress in the days of jihad and continue to enjoy that historical and political significance but more importantly its proximity to Yola made it possible for people in Yola to depend on the lands around Girei for cultivation and grazing. Similarly, Mubi, the provincial headquarters of the then Sardauna province, is a significant border town of high commercial cum strategic importance that attracted high population concentration since pre-colonial days. Its high agricultural population and long history of cultivation made it the first area in present day Adamawa State to have started soil conservation practices (Tukur and Ray, 2000). So also is Michika, at the foot of the remarkable Mandara and kamale mountains (the Mandara Empire being *the most powerful and highly organized enemy that the Emirs of Adamawa had to face* – Kirk-Greene, 1969 p. 127) that has high population that is historically noted for its agricultural practices. Lamurde and Mayo Belwa are areas of moderate population density (51 – 150 persons/km^2) with, however, a lot of local concentrations

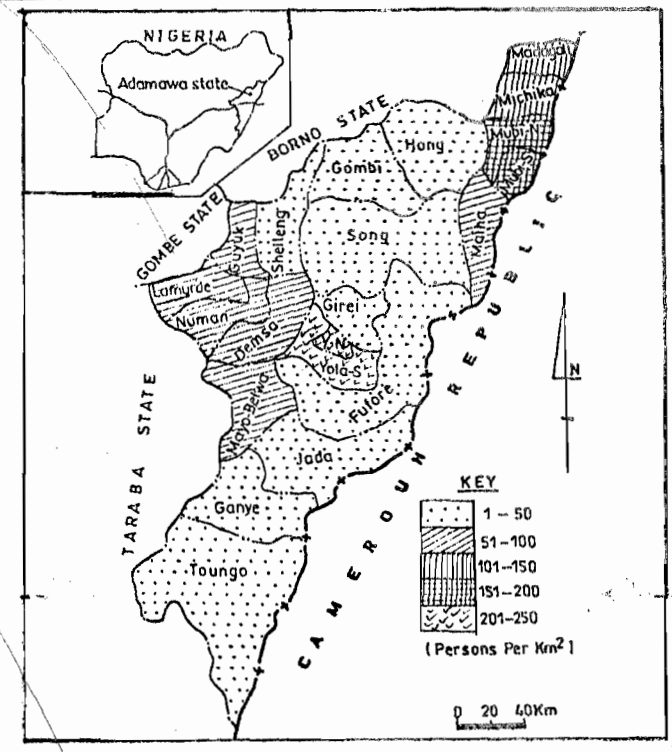

FIG. 1: POPULATION DENSITY IN ADAMAWA
(Source: Adopted from Nwagboso & Uyanga, 1999)

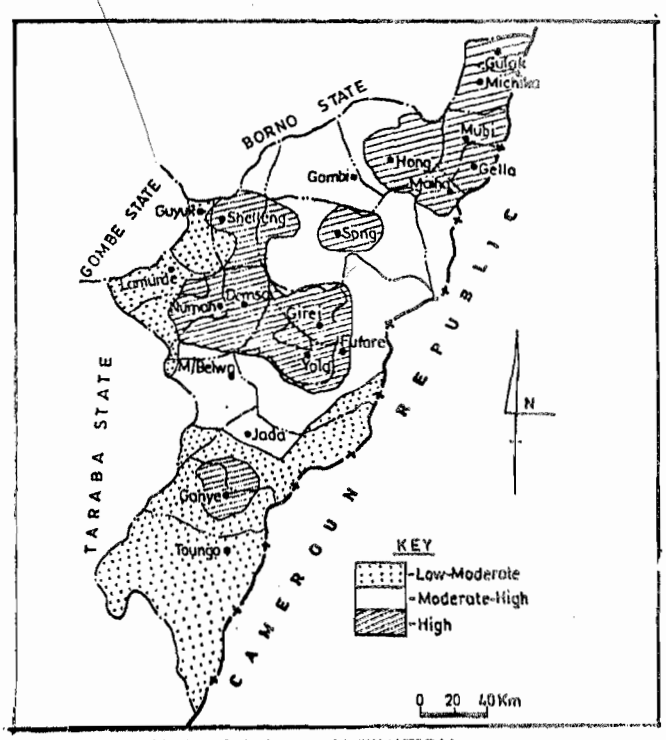

FIG. 2: INTENSITY OF CULTIVATION
(Source: Adopted from Sajo & Kadams, 1999)

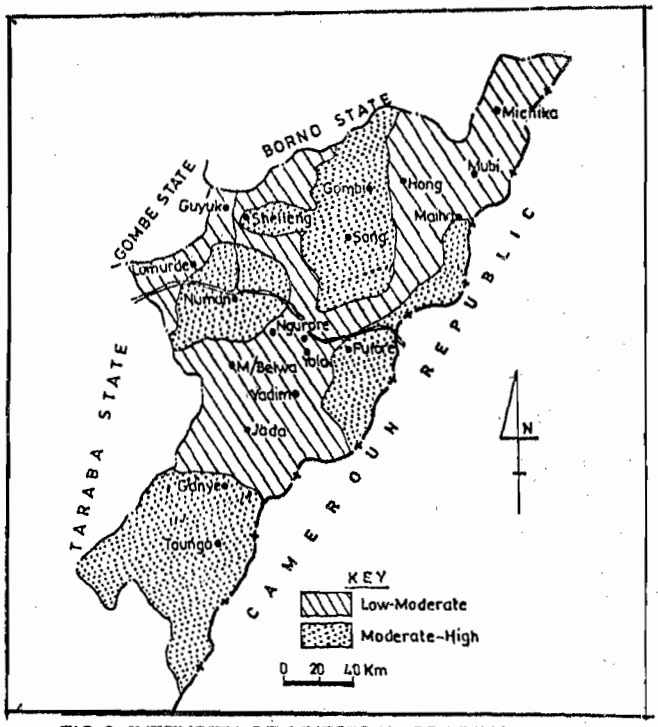

FIG. 3: INTENSITY OF LIVESTOCK GRAZING
(Source:-Adapted from Tukur & Ardo, 1999)

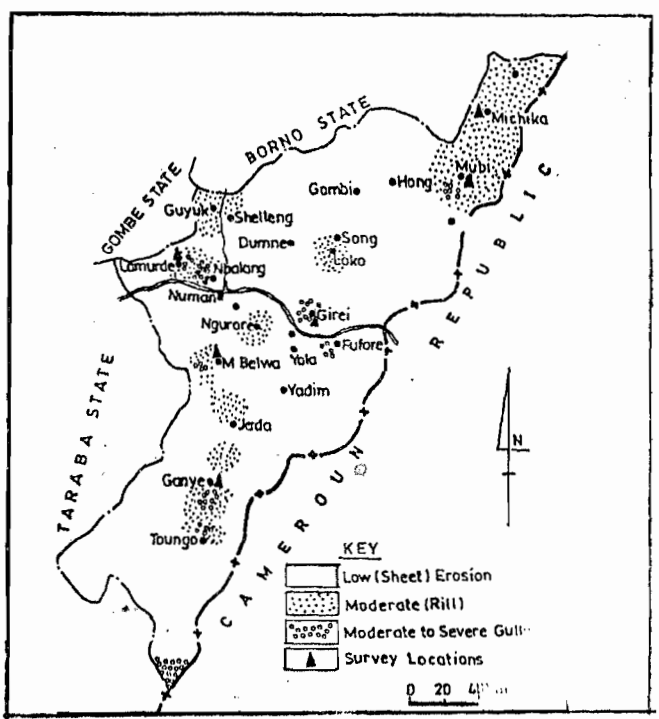

FIG. 4: SOIL EROSION IN ADAMAWA STATE
(Source:-Adapted from Ray, 1999)

of agricultural communities within the defined study sites. Ganye area is generally of low population density (≤50 persons/km^2), also with significant local variations.

From Fig. 2 it could be seen that areas of high population density, Girei, Mubi and Michika were also depicted as areas of high cultivation intensity with limited area around Ganye (an area of low population density) also showing high cultivation intensity of long history (Bdliya and Tukur, 1993). Mayo Belwa and Lamurde are shown as having moderate to high and low to moderate cultivation intensity respectively. This is a reflection of not only the population density in those places but also of cultural peculiarities of the areas. In terms of livestock grazing all areas, except Ganye, showed low to moderate concentration but this is only relative to the state as a whole. Ganye showed high concentration of livestock principally due to its favourable climatic and ecological characteristics for most part of the year. Livestock concentration around and within the study sites could be as high as 45 to 97 cattle per square kilometer to as low as 20 to 50 cattle per square kilometer depending on the season and area. This is largely a reflection of the management system in practice, basically nomadic and adaptive to seasonal rhythm (Tukur and Ardo, 1999).

The net results of the analysis show that areas of high population density coincided with areas of high cultivation intensity thus, justifying some of the points made elsewhere, that there is *ample evidence of the close connection between rural population growth, expansion of area cultivated, reduction of fallows, and declining agricultural productivity* (Lopez, 1998, p.106). In the case of the sites studied evidence of degradation as represented by rills and gullies may likely lead to decline in productivity. Areas of heavy grazing are, generally, in the less densely populated areas or at the periphery of the densely populated areas (see Figs. 1-3).

The results of the detailed survey of land degradation, presented in Table 1) show that the majority of the symptoms of degradation (78.26%) are in the arable lands. The arable lands also, have higher mean values in terms of length, width and depth of gullies. Thus, the mean length of gullies in farmlands was 306.5m while in the grazing lands it is 228.2 metres. Similarly, the mean width and depth in the farmlands is 3.8m and 1.9m respectively and in the grazing lands the corresponding figures are 2.66m and 1.18 metres. This justifies the reversal of the tragedy of the commons. The higher percentage (%) of the symptoms of degradation on farmlands in contrast to grazing lands confirms an opposite position to the basic thrust of the tragedy of the commons.

Gully erosion in the Mubi and Michika areas can be said to be heightened by rapid population increase leading to increased pressure on land and use of marginal lands (Ray, 1999 and Tukur and Ray 2000). This is further supported by the fact that intensity of erosion on agricultural lands is much higher in the more densely populated areas, with a mean gully length of 331.15m compared to the 242.80m in the farmlands of the less densely populated areas. Chi-squared test was used to determine if the incidence of gullies were a reflection of the distribution of farmlands and rangelands, postulating that there was no significant difference in the distribution of gullies between the two land use types. The result obtained (x^2 = 14.78 at 1 degree of freedom) suggests

Table 1: Rill and Gully Erosion Parameters in the Survey Site

Site	Location	Land use	Rill/Gully Parameters			Slope Angle (in degrees)
			Length (M)	Average width (M)	Average Depth (M)	
Girei	Girei 1	Arable	82	2	1.1	1 – 2
	Girei 2	Arable	105	2.4	1.6	1 – 3
	Sangere	Pasture	83	1.8	1.0	1 – 1.5
Mubi	Gaya	Arable	528	6.3	2.2	1.5 - 2
	Lamurde 1	Arable	418	5.2	2.4	1 -1.5
	Lamurde 2	Arable	368	5.6	1.5	1 – 1.5
	Paka 1	Arable	30	4.0	3.2	1 – 1.5
	Paka 2	Pasture	488	6.2	1.4	1 – 1.5
Michika	Micika	Arable	156	2.6	1.2	0.5 – 1
	Gada	Arable	78	3.3	1.8	0.5 – 1
	Tili	Arable	262	4.1	2.0	1 – 1.5
Lamurde	Lafiya 1	Arable	650	7.0	3.8	0.5 – 1
	Lafiya 2	Arable	539	6.1	3.3	0.5 – 1
	Gyawana 1	Arable	465	5.0	2.8	0.5 – 1
	Gyawana 2	Arable	225	5.0	2.8	0.5 – 1
M/Belwa	Bajama	Pasture	240	1.5	1.2	1 – 1.5
	M/Belwa	Arable	489	2.7	0.8	1 – 1.5
	Jereng	Pasture	85	1.2	0.5	1.5 – 2
	Gengle	Arable	154	1.6	1.	1 – 1.5
Ganye	Sugu	Arable	265	1.7	0.8	1 -2
	Gangtum	Pasture	145	2.6	1.8	1 – 1.5
	Buwangal	Arable	122	2.0	1.4	0.5 – 1
	A/Nyiri	Arable	180	1.4	1.0	1 – 2

Measurement were taken at various times between 1998 and 2001

that the hypothesis has to be rejected at the 0.01 levels.

A number of reasons could be deduced to account for the variation in the intensity of degradation between the land use types, arising from the management (use) of common range lands as compared to management of individually owned farmlands. One of the reasons has to do with land use pressure. Animal husbandry as is practiced in Adamawa State has a diffused pressure, with varying type and extent of stock mobility. Grazing is done over a larger area at various times of the year. As observed by Tukur and Ardo (1999, p.46) *most sedentary and all nomadic pastoralists practice extensive kind of management, undertaking varying extent of cyclical movements following climatic rhythms*. Crops production on the other hand is restricted to particular places that are continuously cultivated with little or no resting period as is the case with grazing. The cyclical movements alluded above allow for regeneration of vegetation (pasture) and improvement of soil condition on the rangeland thereby reducing the level of susceptibility of the soil to erosion. Farmlands on the other hand are increasingly facing considerable reduction in fallow periods leading to overuse and increased susceptibility to all forms of degradation.

CONCLUSION

In Adamawa State, at least for now, the major problem area in terms of land degradation is the farmlands, especially in and around the densely populated areas. Policy thrust to achieve sustainable use of the land must, therefore, first address the issue of soil erosion on farmlands in particular. To effectively address the issue, however, it is necessary to understand not only the farmland management practices in vogue but also the general disposition of the farmers themselves. There is also the need for collective action policy guidelines that define cultivation practices in each topographic and ecological zone, taking into consideration population density. The guidelines should also help regulate the use of open access land, ensure general efficiency in the use of resources, resolve ownership and use conflicts and arrest land degradation.

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