Global Scientific JOURNALS

GSJ: Volume 7, Issue 11, November 2019, Online: ISSN 2320-9186
www.globalscientificjournal.com

SEASONALITY IMPLICATIONS ON SUSTAINABLE AGRO-PASTORAL MANAGEMENT SYSTEMS IN THE MENCHUM AGRARIAN LANDSCAPE OF CAMEROON

KOMETA SUNDAY SHENDE & KANG EDWIN MUA

ABSTRACT

The complex topographic landscape of the Menchum Division of Cameroon with varied rolling chains of highlands, valleys, plateaux and plains provide great premium and prospects for agro-pastoral activities. Wet season crops cultivation is practiced in the varied landscape with grazing predominantly occupying the upland savannah area. Dry seasonal grazing is carried out alongside crops cultivation in the wetlands. With no defined boundaries of both cropland and rangeland and with each activity constantly in need of available soil moisture and water resources, the implication is manifested in conflicts. This study examines the seasonality implications on water resources, soil moisture and savannah vegetation all of which are vital to agro-pastoral systems in Menchum. Field observation, interviews and administration of questionnaires were major methods for data collection. The rainfall and temperature data were obtained from the Aguli Guage Station. Potential evapotranspiration (PEt) was obtained using the Braney-Criddle Method. Data were analyzed using the 4 Points Likert Scale and the Chi Square Goodness of Fit. Findings reveal that the concept of carrying capacity remains impossible to the pastoralists given that the natural vegetation for grazing does not have a homogenous cover. It further presents the strengths and weaknesses of both the opportunistic and agro-ecological management systems in view of the unprecedented changes in the socio-economic and environmental conditions of the area. The study recommends sustainable agro-pastoral management systems through assisting the farmers and pastoralists in savannah areas to carry out their raison d'être for livelihood sustenance.

KEY WORDS: Seasonality, crop cultivation, Transhumance, Agro-pastoral Management systems, Dry Seasonal grazing, conflict

INTRODUCTION:

The complex topographic landscape of the Menchum Division of Cameroon, with varied rolling chains of highlands, valleys, plateaux and plains provide great premium and prospects for agro-pastoral activities. The topographic landscape falls within the Western Highlands of Cameroon which is characterized by growing human and livestock population. It is an area where the quest for land, water and pastures remains an emerging environmental problem. Historically, the ecological evidences show that the present grasslands of this high plateau region were once montane forest and woodland. Ndenecho (2012) considers the forests at an altitudinal level above 900m as sub-montane forests. The initial vegetation has been converted to intensive agro-

pastoral systems which are a corner stone for sustainable livelihood. Seasonal climatic variability in most parts of Western Highlands of Cameroon like elsewhere is not favourable for free range grazing all-year-round. The logical solution has been the search for feeds through free range grazing in available pasture eldorados elsewhere out of their traditional wet season highland areas (Lambi & Ngwa 2009).

The "free rider" activity with no defined boundaries for both cropland and rangeland impact negatively on the environment given the continuous search for available soil moisture and water resources especially during the harsh (dry season) months of the year. Ekpoh (2007) stated that the agricultural systems in semi-arid areas are more susceptible to the vagaries of weather than elsewhere in the tropics. The paradox is the underdevelopment of pasturelands, the growth of unwanted species in rangelands yearly, burning of grasslands and crop damage in Menchum at a time when the area is witnessing a major shifts in the climatic elements. The effect of climate on the agro-pastoral systems is related to variabilities in the local climates rather than in global climate patterns. Climate change and seasonal variability have an effect on both crop production and livestock sectors. Degrading environmental conditions for crops and plant growth increased pressure on soil and water are signposts due to the that agro-pastoral systems will over time lose their productivity. This necessitates the need for sustainable agro-pastoral systems as an adaptation against the impacts of climate change in the area.

On the complex landscape of the Menchum Division, wet season crops cultivation is practiced alongside grazing, which predominantly occupies the upland savannah zone. In the . dry season, grazing is carried out alongside crops production in the wetlands. With no defined boundaries for both cropland and rangeland and with each activity constantly in search for available soil moisture and water resources, the implication is manifested in land use conflicts. Therefore, bearing in mind the seasonality effect which accelerates water scarcity desiccates the soil and leads to the insufficiency of green pastures, transhumance and agro-ecological translocation are commonplace.

The seasonal variations in rainfall and temperature leads to disequilibrium between forage demand and forage availability. Therefore, the ability of the natural vegetation to react to the changing climatic and environmental conditions remains an issue of great concern. The fact that the highland range sites do not offer a homogenous vegetation cover for grazing pose a problem to the upland grazing activity and induces some reflections on the concepts of the carrying capacity. These activities are dictated by the availability of rainfall, evapotranspiration, soil moisture content and the drainage systems. Seasonality therefore continues to influence and alter the climatic parameters which exerts ecological stress on the system. The problem therefore necessitates the urgency for sustainable development plans. Therefore, development plans in the savannah regions given that farming activities are becoming more vulnerable to the variations in the hydro-climatic and environmental conditions. Both the farmers and herders are forced to take the opportunistic and agro-ecological approaches in their efforts to secure access to soil moisture, water resources and pastures. This study, thus, assesses the strengths, weaknesses, opportunities

and threats to the promotion of both the opportunistic and agro-ecological approaches as bases for sustainable agro-pastoral management systems in the Menchum topographic environment.

THE STUDY AREA

The Menchum Division is located between latitudes 6°20'N and 7°00'N of the Equator and between longitude 9°50'E and 10°30East of the Greenwich Meridian (Figure 1).

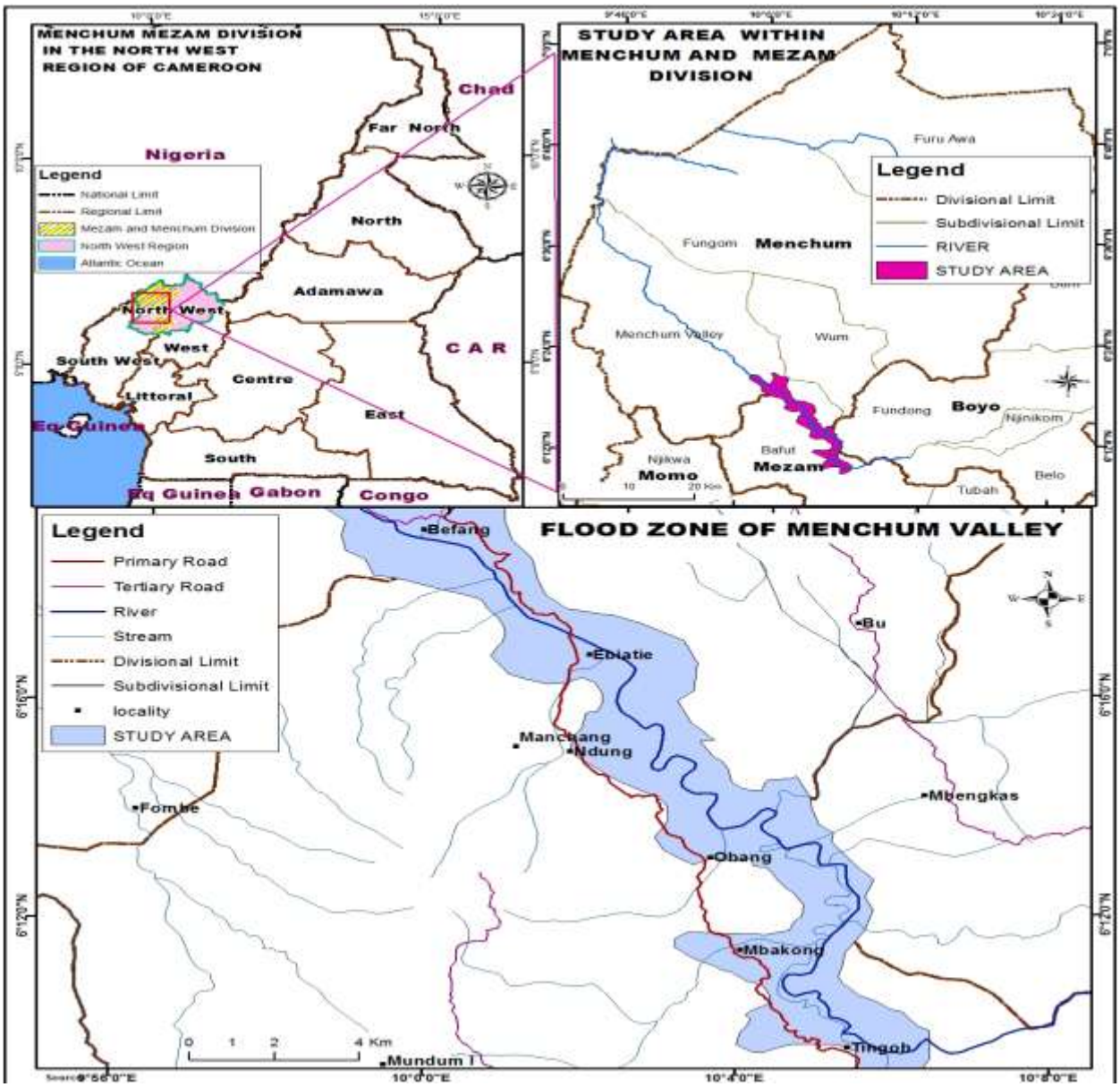


Figure 1: The Study Area
Source: Digitized from Google Earth (2016)

It is a complex topographic landscape composed of soaring mountain peaks, deep valleys, high lava plateaux and inter-montane plains. Two distinct land systems are identified in the area: the

inter-montane plain and the high plateau. The inter-montane plain is located at an average height of 900m above sea level and is known as the Menchum Basin. This plain is drained by the River Menchum and is equally known for recurrent seasonal flooding. In much the same way, the surrounding highlands, also known as the high plateaux, have average altitudes above 1650m.

Seasonal Variability

The general climate of the Western Highlands resembles that of West Africa with a rainy season between Mid March and Mid November and the dry season between November and March (Hawkins and Brunt, 1965 cited in Ndenecho 2012). Temperature inversion occurs in the valleys and depressions. The flow of cold night air into the lowlands and plains results in a much reduced temperature than is expected. During the day, warm air rises and carries along moisture which forms cloud and misty conditions on the plateaux. The harmattan winds which are often heavily laden with dust are an important characteristics of the weather.

Rainfall varies between 1650mm to 2200mm a year in the dry season. It is intensive between July and September. Generally, January and February have the lowest relative humidity (45 to 52%). The average monthly humidity exceeds 80% in July and August and reduces progressively in the months of September to February. During the rainy mist and low clouds occur frequently. Mountain areas (peaks) have maximum temperatures of 17-19^{0}C, and minimum temperatures of 30-10^{0}C. The rainfall in these mountain areas exceeds 3050mm per year. Due to the prevalence of orographic clouds humidity is high and insolation is low. The highlands of the Wum Plateau lie between 1100mm and 1650mm above sea level. They are characterized by mist and orographic clouds. Climatic conditions are highly variable and often characterized by strong winds. On the other hand, the Menchum Plain is hot and very sunny. Mean annual maximum temperature is between 25ºC to 29ºC and the mean annual rainfall varies between 1200 and 1650mm.

On the Menchum plain an valley are colluvial soils in the foot hill zone and alluvial soils in the ponded swamps and low-lying flood plain zones. In the low land areas, these appear as organic soils, moderately organic soils and weakly gleyed soils, depending on the drainage condition. Because of the availability of water, and the high content of organic matter, the hydromorphic soils are of good quality. The main disadvantage of this soil is that it is poorly drained characteristics. During the dry season, average monthly evaporation of 156.2mm occurs which makes flood zones alternative areas for dry season pasture. With regard to the socio-economic activities on the highlands, the main activity carried out is cattle rearing while on the plains, there is swamp rice and food crop cultivation. Over the years, the pastoral people have adapted their grazing management to these natural variations in pasture ecological resources by using transhumance as a stabilizing strategy to overcome the dry seasons fodder deficiencies.

METHODS

An assessment of agro-ecological resources was made on two topographic units in different ecological zones. The combination of altitude, temperature inversions, slope variation, mist and cloud cover as well as the edaphic conditions and topographic sites accounted for the spatial composition and variation of the two land units (inter-montane plain and high plateaux). Some sites in both the plains and upland plateaux were selected to understand the operation of the different climatic parameters, different land uses, the edaphic conditions and vegetation cover, taking into consideration the seasonal variability and it effect on spatial vegetation cover. The main parameters under study were the altitude, drainage conditions, seasonal moisture content, vegetation and land use. With the help of documented data, these variables were easily studied to establish the changes in these parameters over space and time and determine the essence to adopt sustainable management approaches for livelihood sustenance. Data for temperatures, rainfall and evapotranspiration were obtained from the Tingo-Aguili Guage Station. In a similar way, data from field observation, interviews and questionnaires were obtained from the indigenous agro-pastoral communities. Aspects on the periods of transhumance, opportunities and constraints to the management systems were established and evaluated. The 4 Points Likert Scale Analysis and the Chi-Square Goodness of fits were used to analyze the data. Evapotranspiration was estimated using the deficit of flow. The potential evapotranspiration was obtained using the Braney-Criddle Method. The formula applied is as follows:

Potential Evapotranspiration (ETP) = K/100 (45.5 TC+ 810)…(EtP in mm).
Where; TC = Average monthly temperature (%)
P = percentage of daytime hours of the year occurring during each month of growing period
K = an empirical coefficient for each crop under consideration. These values are:
K1 =1.15 for Rice
K2 =0.85 for Maize, coffee, forage crops
K = 0.75 for groundnuts, Irish potatoes
K = 0.70 for Beans, orchard crops (plantains and bananas).
ETP data for the main crops considered for the Menchum Floodplain are presented in Table 2.

- The annual ETP is as follows:
  -2055mm for rice
  -1518mm for maize and forage
  -1340mm for groundnuts
  -1250mm for Bananas/plantains

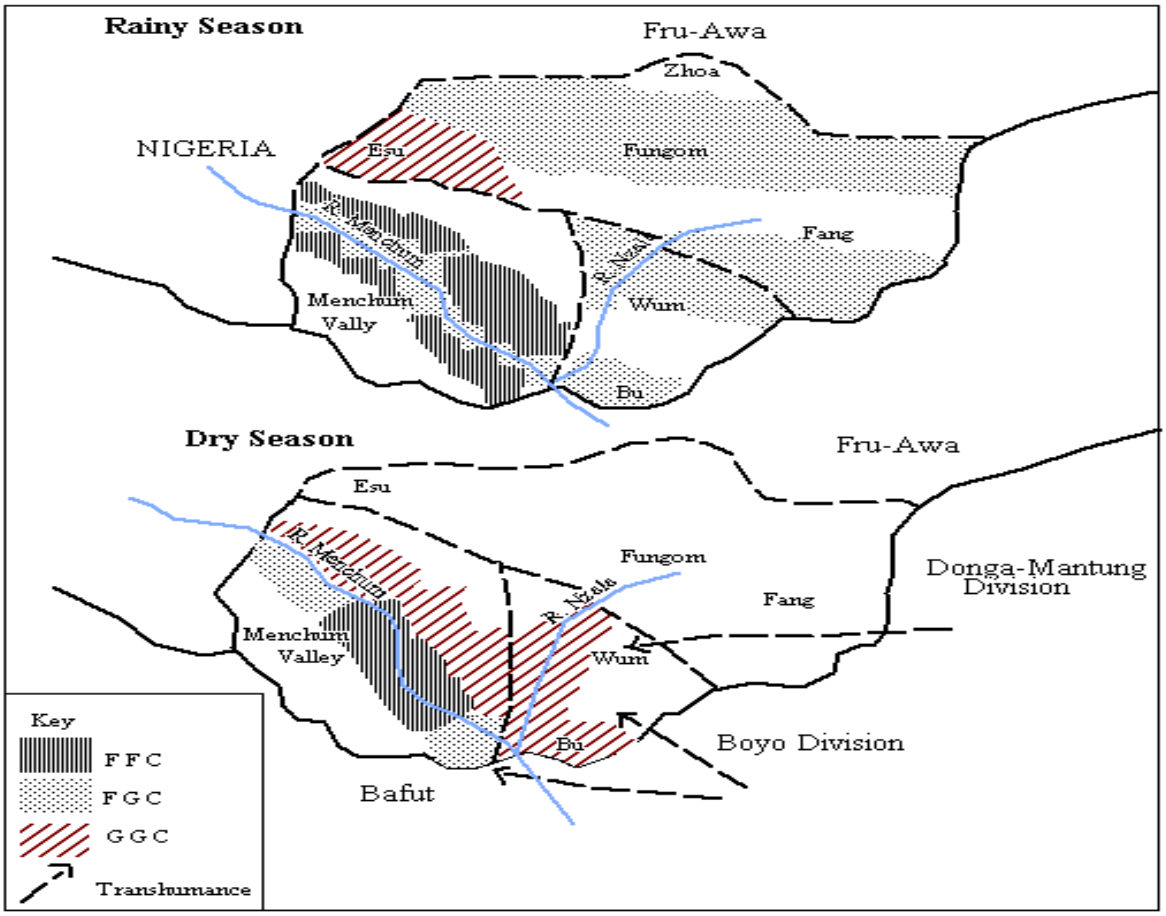
The analyzed data were presented in the form of charts, tables and graphs to facilitate understanding of the seasonal influence on the natural vegetation cover in which pastoral activity depends on for survival.

DISCUSSION OF FINDINGS

Seasonality Effects and Agro-pastoral Activities

It was important to look at the strengths and weaknesses of the opportunistic and agro-ecological approaches practiced by both the farmers and herders for their raison d'être. Field observation

was focused on the two main land systems (the highland plateau and the floodplain zone). Transhumance starts in December with the movement of cattle from the Esu, Weh and Wum highlands into the valley flood plains of the Menchum Valley (Fig. 2). During the dry season, the water table falls below normal level and the extensive grassland vegetation becomes dry and no longer palatable to the herds that absolutely depend on it. The herdsmen and their cattle are therefore forced to migrate temporarily to the wetlands while waiting for the upland grasslands to be burnt to allow fresh grass to grow. Transhumance down slope into the valleys and wetlands for fresh pasture and water has often been the major process behind the recurrent farmer-grazier conflicts in Menchum (Fig. 2). The availability of fresh pasture and water in the valleys and wetlands in the same way generates grazier- grazier conflict. It is equally worth nothing that the herdsmen often move down into the valleys with the thought that crops would have been harvested by the time they reach the flood plains.



FFC = Farmer-framer conflict; FGC = Framer-grazier conflict; GGC = Grazier-grazier conflict
Figure 2: Transhumance and Spatial Distribution of Land use Conflict in Menchum Division
Source: Field Work, (2017)

However, this is not usually the case since crops like potatoes and cassava take much longer to mature and be ready for harvest. These crops (potatoes, cocoa yams and cassava) often get ready

in December and January which are the peak months of transhumance causing massive destructions to crops.

Table 1 shows how rainfall as a climatic parameter influences transhumance which eventually leads to conflicts. On the floodplain where the water table is high, ETP varies between 1172mm (mean minimum) and 1400mm (mean maximum). Measurement is done using a potential evaporation lysimeter installed at Aguili by (SEDA 1983). Over the years 2005-2017 as in Table 2, there is an average ETP of 1070mm per year. Transhumance is inversely related to rainfall and soil moisture content. Periods of positive rainfall events witness a reduction in the transhumance period.

Table 1: Rainfall deviations and transhumance/conflicts anomaly in Menchum Division

Years	Total rainfall (mm)	Mean annual rainfall deviations (mm)	Rainfall anomaly (%)	No. of conflicts by transhumance	Mean annual Conflicts/transhumance Deviation	Transhumance/conflicts anomaly (%)
2006	2159	204	9.44	865	-75	-8.67
2007	2220	265	11.93	980	40	4.08
2008	1626	-329	-20.23	1680	740	44.05
2009	1994	39	1.96	650	-290	-44.6
2010	1936	-19	-0.98	504	-436	-86.5
2011	1978	23	1.16	576	-364	-63.2
2012	2073	118	5.69	786	-154	-19.6
2013	2123	168	7.91	873	-67	-7.67
2014	1890	-65	-3.43	1056	116	10.98
2015	1865	-90	-4.83	1088	148	13.60
2016	1828	-127	-6.94	1094	154	14.08
2017	1773	-182	-10.27	1130	190	16.81
Total	23465	5	-7.7	7107	2	-126.64

Mean annual Rainfall=1955 Mean annual conflicts=940

Source: Estimates from the Delegation of Agriculture and Rural Development and field compilation

Table 1 shows that the agricultural calendar in the Menchum Division is a function of complex environmental characteristics such as rainfall, temperature, drainage and soils. Field findings revealed that from November to May, food crops such as corn, cassava, cocoyams, groundnuts and vegetables along the flood plain are intensively cultivated. Soil moisture equally varies with the seasons despite the complex topographic nature of the wetlands. The soil moisture deficit is severe and highly pronounced during the months of December, January and February in the dry deason (Table 2).

Table 2: Average water levels along the flood plain during the dry season in the Menchum Basin

Months	Average range of flood waters level (cm) along the plain	Average range of water level (m) along the river channel
Nov	5-6	2.4
Dec	1.5-2	1.7
Jan-Feb	0	1.2

Source: Field work, (2016)

The off-cropping months coincide with the fall in soil moisture predominantly in the highland zones except where the supply of water into fields is only possible through irrigation (Fig. 3).

Figure 3: Flooded rice field in the Obang plain of the Menchum Valley
Source: Field work, (2016)

As a result, the plains and valleys with much water always serve as the alternative zones for dry season farming and grazing

On the other hand, during the wet months of July to September, the flood plain get flooded. This does not permit the cultivation of other crops such as maize, groundnut, cocoyams. Swamp rice cultivation is therefore the only dominant crop type during this time of the year. Table 3 shows the moisture balance and the seasonal agro-pastoral activity that can survive under varied amounts of soil moisture.

Findings revealed that most of these farmers depend largely on the produce from flood plain. Consequently, they do not only cultivate for subsistence but also for economic benefits as the farmers need money to pay their children;s school fees, for health and other expenses when the need arises. In this light, an assessment was carried out pertaining to the number of farmers as well as their estimated income generated from the sale of their farm produce (Table 4).

Table 4: Sampled income of some selected farmers at Obang in the Menchum River Basin

Village	Variables	<100.000 FCFA	100.000-200.000FCFA	>200000
Obang	Number of farmers	60	47	23
	Percentage	46.15	36.15	17.69

Source: Mua, (2016)

Field work confirms that the farmers at Obang are better placed as far as income generation is concerned. About 46.15% of the farmers have income of less than 100.000 FCFA and these are farmers who have small scale fields of 0.5 hectare and wh0 do not cultivate for economic purposes. 36.15% of the farmers accepted that their income ranges between 100.000 to 200.000 FCFA while 17.69% of the farmers agreed that their income from dry season crops cultivation is greater than 200.000 FCFA. However, this depends on the farmer's input. For example, some farmers cultivate vegetables and tomatoes at the same time in different fields. Consequently, their income is between 300.000 to 500.000 FCFA. The economic aspect of dry season cultivation along the flood plain of the Menchum River Basin looks more reliable and farmers are getting more and more involved in the exploitation of the flood plain for wetland farming (in the dry season).

Table 3: Moisture Balance (Blaney and Ciddle Method: Aguili-Menchum Basin

Months	J	F	M	A	M	J	JUL	A	S	O	N	D	Annual total
Rainfall (mm)	5	31	112	166	200	204	321	316	368	267	65	11	2066
T0C	22	21.5	22.9	22.3	21.5	20.6	20.3	20.1	20.3	20.7	21.2	21.6	20.5
ETP (mm) P1													
K1	1.15	172	161	181	174	179	170	174	164	169	164	170	2055
K2	0.85	127	119	133	128	132	128	126	121	125	121	126	1518
K3	0.75	112	105	118	113	116	111	113	107	110	107	111	1340
K4	0.70	105	98	110	106	108	103	104	100	103	100	103	1251
Moisture Deficit ETP-P1 -K1													
-K2	167	130	69	8.4							99	159	
-K3	122	88	21								56	115	
-K4	107	74	6.5								42	100	
	100	67									35	92	
	Dry season grazing and market gardening cultivation in the plain			Wet season upland grazing, rice and food crop cultivation of few food crops, mainly vegetable in the plain/wetland							Dry season grazing and vegetable cultivation in the plain		

Source: Computed Climatic Parameters from the Aguili Measurement Center-M.V (2016)

Table 4 shows that rice is the only crop that can survive in flooded area with the K1 value of 1.15 ETP rate and rainfall of about 2055mm. Maize and groundnuts have K2 and K3 with ETP of 0.85 and 0.75. These crops can survive under rainfall of about 1518mm and 1340mm respectively. The change in the soil moisture content is a function of seasonality within the Menchum agricultural landscape.

Landscape and Agro-pastoral Activities

The highland areas are known for wet season grazing sites. During the rainy months of the year (March to October), migrant farmers encroach into the uplands to benefit from the dung deposits from grazing. During the dry season, herds are shared for transhumance and only a few cattle remain to graze around the permanent sites. Spatial analysis presents the following pasture composition in the rangeland of the Menchum Highlands; 35% of Sporobolus species, 15% of Hyparrhenia spp, 15% of Pennisetum clandestinum while 20% and 15% of the vegetation is natural, composed of Bracken ferns and weeds respectively. Given the non homogeneity of the natural vegetation cover and the seasonality effect on water and pasture resources, the search for palatability becomes obvious (Table 5). Sporobolus species is the most palatable for cattle while the bracken fern and weeds seem to be species that result from the degradation of the natural vegetation as a result of population pressure from the increasing number of cattle and soil compaction due to the pressure from the hoofs of the cattle. So the bracken fern and weeds are signals of natural vegetation degradation on the rangelands. This problem definitely has its role which is a direct impact on the agro-pastoral or land use conflicts that are known in this area.

Table 5: Transhumance and dry seasonal crop damage in the flood plain of the Menchum River Basin

Transhumance causes dry seasonal crop damage	Strongly Agreed	Agreed	Strongly Disagreed	Disagreed	Total
Frequency (f)	125	48	9	16	200
Percentage (%)	63.1	24.2	4.5	8.1	
Total Responses	173		25		
Total Percentage	87.13		12.60		

Source: Mua (2016)

Table 6 presents the sampled opinions of farmers and graziers on the effect of transhumance on crops in the flood plain of the Menchum Valley. The opinions were statistically tested using the Chi square test (Table 6)

Table 6: Difference between transhumance and dry seasonal crop damage in the flood plain of the Menchum River Basin

Variable	N	X^2	df	X^2	P=.05
Transhumance causes dry seasonal crop damage in the flood plain	200	72.35	2	5.99	P<0.5

Source: Field work, (2016)

The result shows that there is a statistically significant difference in the opinion of graziers and farmers on whether transhumance causes dry seasonal crop damage in the flood plain. The findings show that $X^2=72.35 > X^2_C=5.99$. The R test confirms that majority of the population (87.13%) were of the opinion that transhumance causes great damage to dry seasonal crops in the plain than those who disagreed (12.60%). Also, field work shows that rice cultivation is intensive between the months of June to October. Field preparation for rice cultivation begins in the months of April and ends in June. Harvesting of rice takes place in November and December after which the fields are left for transhumance activity(Table 7) which begins on the 26th of December to the 26th of February (according to the Prefectural Order for Menchum Valley).

Table 7: Agricultural Calendar in the Menchum River Basin

Monthly Activities		J	F	M	A	M	J	J	A	S	O	N	D
1	Preparation of rice fields												
2	Transplanting of rice												
3	Harvesting of rice from the fields												
4	Planting of Dry seasonal crops												
5	Harvesting of Dry seasonal crops												
6	Transhumance in the Menchum Basin												

Source: Field work, (2016)

Planting of other food crops such as maize, beans and huckleberry along the plain starts in November when the water table has dropped in anticipation that the available soil moisture would sustain crops growth. Harvesting is carried out in the months of February and March. This coincides with the transhumance period especially in February. This explains why crops damage is greater during the month of February when cattle are preparing to move upland (Figure 4).

Figure 4: Dry season cattle grazing along the Menchum River Basin
Source: Field work, (2016)

Besides, cattle from other neighbouring Divisions such as Boyo, Momo and Mezam the plain in order to survive the harsh climatic conditions that account for water and pasture scarcity in the upland areas.

CONCLUSION AND SUGGESTIONS

The simultaneous activities of crop cultivation and cattle grazing have received much attention in the Menchum Highland environment. Both activities contribute enormously to the livelihood of the people as main sources of income, food supply and employment. With little of man' s technological knowhow to prevent seasonal variability conditions, the only option is to adapt sustainably to the changing environmental and climatic conditions especially in the Savannah regions whose agro-pastoral activities depend on rainfall.

Various suggestions have been made in the light of conflict prevention and natural resource management. Mwasi (2001) stated that conflicts can be avoided through planning and control of changing production systems by making the choice and allocation of land use activities consistent with the principle of sustainable development. This is eminent of the agro-pastoral practices in the Menchum Highlands that call for strict respect and implementation of the Prefectural Order spelling out the transhumance periods and the off-farming periods.Farmers should respect the Prefectural Order of the Menchum Valley Sub Division which prescribes that, farmers should ensure their crops are harvested on or before the 26th of December to give room for cattle to feed on the pasture and the left stalks. Otherwise, farmers' fields should be well

protected from cattle encroachment. This is to reduce the rate of crops destruction and conflict between the farmers and the graziers.

The graziers are advised to effectively control their cattle along the plain and not to ignore or intentionally allow their cattle to feed on crops. This is because field work shows that farmers cannot do without dry season cultivation of vegetables, maize and groundnuts on the plain. Consequently, dry season farming and dry season grazing must operate together during this period along the plain. The only way is to control cattle since crops do not move but cattle move and their movement can and must be controlled their herdsmen. The graziers should equally respect the Prefectural Order which specifies that cattle should not be found along the flood plain on or before the 26th of December. This is because early transhumance usually causes massive destruction of crops as the tendency for cattle to meet crops in the fields is high.

The study suggests that both the opportunistic and agro-ecological approaches should be carried out to effectively manage the coexistence of crop cultivation and grazing in the Menchum Division of Cameroon. The herds should benefit from the crop residuals in the flood plain after harvest and farmers should intend benefit from the dung during floodplain dry seasonal grazing. Water harvesting for both crops and dry seasonal grazing should be enhanced through drilling of boreholes and creation of small dammed lakes in the flood plain.

REFERENCES

Adams, W.M. (1986): Traditional agriculture and water use in the Sokoto valley, Nigeria. - *The Geographical J*., 152 (1): 30-43.

Ekpoh I J. (2007): Climate and Society in Northern Nigeria; Rainfall Variability and Farming, *Journal of applied Social Sciences,* Vol. 6, No. 1&2, (2007)

Fogwe Z. N. (2010) Ecological Adaptability and Slope-Trait Considerations for Water and Soil Conservation on the Vulnerable Oku-Kom Plateau in the Western Highland of Cameroon *J Hum Ecol, 30(1):19-25 (2010*)

Hawkins P. & Brunts, M. (1965): The Soils and Ecology of West Cameroon Vol.1, Report to the Government of Cameroon. Expanded Programme of Technical Assistance, 1083, FAO, Rome.

Kang E. M. (2013): Resource Utilization and Conflict Management in Menchum Division, North West Region of Cameroon. Unpublished M.Sc Thesis, Department of Geography, University of Buea, 172p.

Kometa S. S & Kang E. M. (2016): Land Resource Utilization, Conflict and Implication for Development in Menchum Division, Cameroon. International Journal of Resource and Environmental Management, Vol.1, No.2 October, 2016.

Kometa, S. S. (2008): Wetlands Exploitation and its Environmental Impact; The case of Bafoussam-Bamenda Axis of the Western Highlands of Cameroon. *Applied journal of Social and Management Sciences*, University of Buea.

Lambi C. M & Ngwa A. C. (2009): Conflictual Wetland Utilization in Ngoketunjia Division, the Upper Nun Valley of Cameroon, Journal of Applied Social Sciences, Uiversity of Buea, Cameroon

Mwasi, B. (2001): Land use Conflicts Resolution in a Fragile Ecosystem Using Multiple-Criteria Evaluation (MCE) and GIS based Decision Support System (DSS) International Conference on Spatial Information for Sustainable Development, Nairobi Kenya 2^{nd} –5^{th} October, 2001.

Ndenecho, E. (2012): Freshwater and Coastal Resource Management in Cameroon, Building Resistance and Resilience to Climate Change. ISBN978-9952-621-06-4.

SEDA, (1983): Etude D'identification Du Sous Project Developpement Rural Integre de la Valee de La Menchum