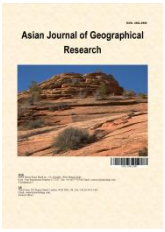

*Asian Journal of Geographical Research*

***Volume 7, Issue 2, Page 53-73, 2024; Article no.AJGR.116838***
***ISSN: 2582-2985***

# Climatic Variations and Challenges to Socio-economic Development amongst Mbororo Communities in Mbum Plateau, North West Region of Cameroon

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***Authors' contributions***

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

***Article Information***

DOI: https://doi.org/10.9734/ajgr/2024/v7i2231

**Open Peer Review History:**
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/116838

***Original Research Article***

***Received: 09/03/2024***
***Accepted: 13/05/2024***
***Published: 23/05/2024***

## ABSTRACT

This study sets out to investigate the challenges hindering Mbororo sources of livelihood in Mbum Plateau, North West Region of Cameroon. Explanatory research was used where it specify the nature and direction of the relationships between the studied variables. The study used mixed

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***Cite as:*** *Awudu , N., Ngwa , F. G., Paul , S. J., Randy , Y., & Nformi , N. R. (2024). Climatic Variations and Challenges to Socio-economic Development amongst Mbororo Communities in Mbum Plateau, North West Region of Cameroon. Asian Journal of Geographical Research, 7(2), 53–73. https://doi.org/10.9734/ajgr/2024/v7i2231*

methods of qualitative and quantitative approaches. The study employed the primary and secondary data sources to bring out realistic results. Rainfall Seasonality Index (SI) and Standardized Precipitation Index (SPI) were employed to assess the vulnerability of the agro-hydrological system to climate variation. The major primary data sources used were field survey, interviews and questionnaires. A total of 200 questionnaires were distributed using stratified random and snow ball sampling techniques. The data obtained was complemented by secondary sources from published and unpublished materials. Data collected during the field survey were analyzed through two statistical techniques. The qualitative data obtained was analyzed through the content analysis whereas themes and codes were given to the different opinions and perceptions of the informants and their frequencies and percentages were being determined from there. Data were presented in tables, charts, maps, and graphs with some attempted interpretations. Data were analyzed using the chi-square and multiple regression models. The findings revealed that climate variability, dwindling pasture and low streams discharge are having negative effects on Mbororo communities. It was observed from satellite images that, land use over the years has been changing with reducing aerial extent and quality of pasture, reducing water points in Mbum Plateau. In order to adapt the decreasing cattle numbers on the side of the Mborroro, they have taken farming, diving, hawking arm rubbery, and schooling as new livelihoods sustenance. The study recommends a sustainable pastoral activity by encouraging the introduction of drought resistant cattle species, Bracharia and Guatemala grass to supplement the natural pasture. MINEPAI should regularly control herd size so as to ensure ecosystem balance and avoid overgrazing. Transhumance tracts and areas should be well demarcated to avoid frequent farmer-grazers' conflicts and frequent cattle theft observed in the region.

*Keywords: Climatic challenges; socio-economic development; Mbororo; Mbum plateau.*

## 1. INTRODUCTION

Global population growth is about 8billion plus today. Most of these populations live in African and Asian countries pushing the ecological carrying capacity to its limit and to an extent far beyond human production and consumption patterns. Despite this ever growing population, development endeavors seems to have been tilted more toward solving the effects caused by this ever growing population rather than handling the causes. It has be predicted that two third of the world population will be living in cities by 2050 and 90% of urban population will be in Africa and Asia Africa (BBC News, 28th November; 2022). Population growth in most parts of West and Central Africa associated with rising demands for vegetable, food crops and animal products as well as providing jobs opportunities to the local people is becoming a great challenge in recent times. Policy Circle, [1], addressing the challenges of urbanization in Africa and providing policy discussions notice that most efforts today by national and international development initiatives in rural development has put more measures to improve livelihoods, create jobs and to an extent, reduced rural exodus which to them seems to have been jeopardizing the already rural livelihoods [2].

The efforts of these development initiators in rural areas have resulted in the expansion and intensification of agricultural production (crops and livestock) which supply food to the growing population. With this great stride towards development, the initiators seem to have driven the efforts towards wrong direction and ignore the real needs of the local population such as the Mbororo communities of Mbum plateau. In Mbum plateau where cattle breeding remains an important livelihood of the indigenous Mbororo, competition over dwindling range land resources between them and the local crop farmers is increasing land conflicts because the aerial coverage of grass for cattle has greatly dwindled. This is seriously threatening the livelihoods of the Mbororo communities at a time when the climate keeps on fluctuating besides dwindling water points [3,4] and rangeland [5]. The Mbororo who used to be pastoral nomads have today become sedentary cattle breeders. With this challenge to their livelihood, they have been confronted by the local Wimbum people who see them more like "strangers". The ever fluctuating climate has brought about emergence and re-emergent livestock diseases in the plateau. The increasing land conflicts in Mbum plateau between the Wimbum and Mbororo communities has greatly threatened them [6,5,2,7]. If these issues have to be resolved, the authorities charge with managing climate, rangeland and surface water resources need to develop a more sustainable option.

## 2. PROBLEM STATEMENT

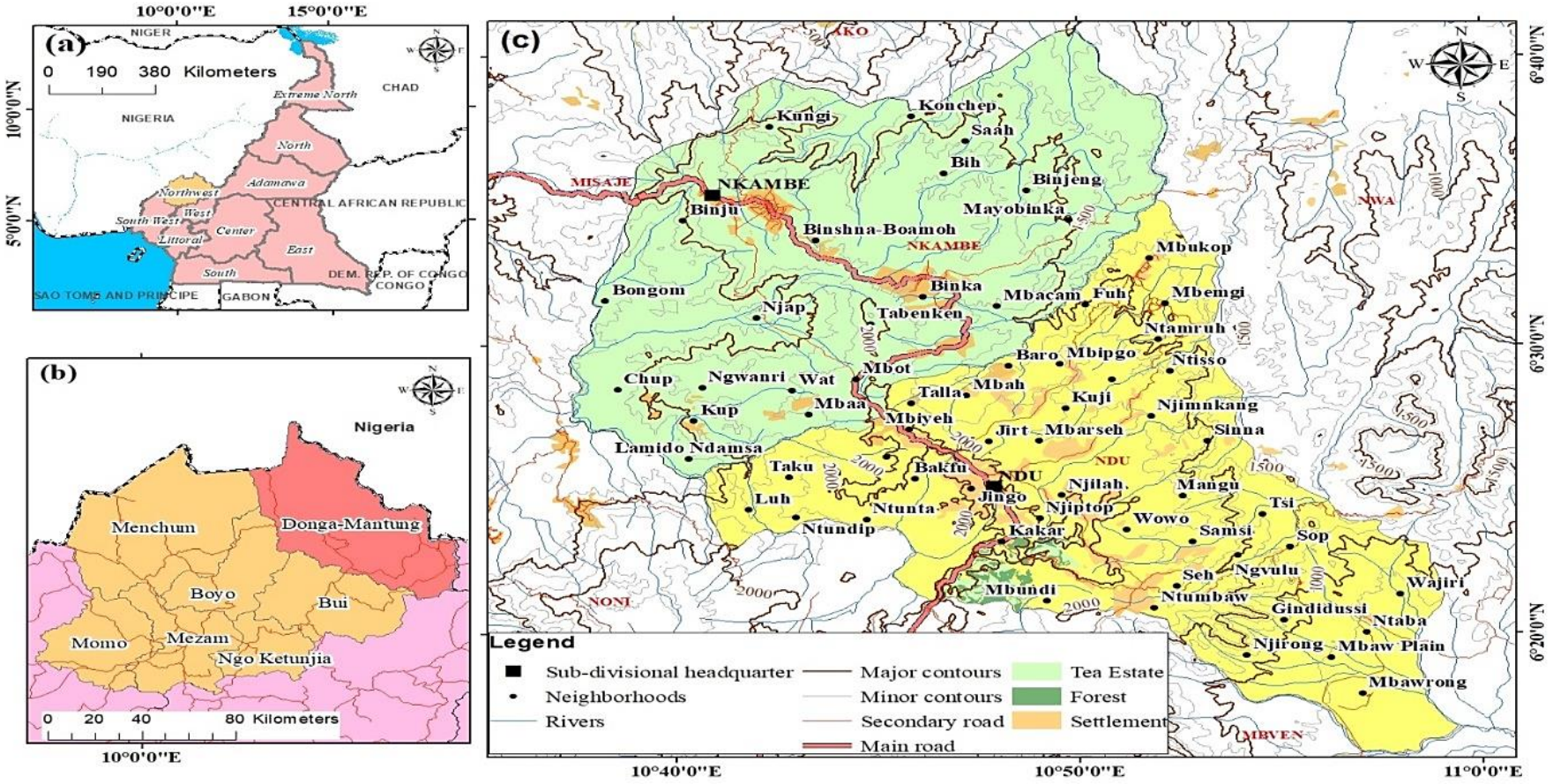
Between 1987 and 2022, Mbum Plateau witnessed population growth from 105,547 to 112,241 (Nkambe and Ndu councils, 2022). Today there is increased climatic fluctuations, land use conflicts, permanent settlements in range land and ever increasing crimes, dwindling water points, pasture land, health facilities and poor road network especially in the Mbororo communities of Mbawgong, Binka, Ntamru, Ntumbaw, Ntiso, Mangu and Mbajeng in Mbum plateau. The region has noticed alteration in its environmental components affecting the Indigenous Mbororo. Livestock rearing which is the main live sustenance of the Mbororo is today facing many challenges. The rangeland where the Mbororo people practice their activities has witnessed negative changes in vegetation, water availability, climatic fluctuations and increasing population that cultivate it for crop production. Over the years, the Mbororos have changed the ways they use to operate. This change seems to have coincided not only with the changes in cattle reduction but equally with some significant socio-economic transformations of their lifestyle. In an effort to modernize, some have constructed modern houses; others are into crop farming, while some have migrated to towns to take alternative economic activities. Those into crop activities are facing the eminent problem of land tenure with no direct access to the land. The growing numbers of Mbororo without cattle over the years in Mbum plateau in the midst of reducing range land as a result sedentary lifestyle on their side and construction of permanent settlement where only temporal structures are permitted possess many problems. The change of Mbororo livelihoods from pastoralism to a sedentary one seems to have caused many land use conflicts in Mbum Plateau. Population growth is expected to be accompanied by economic and social policies that circumvent problems such as shortages in social amenities. This identified lacunae need to be addressed, if forward-looking plans could be introduced to coordinate multiple sectors within the Mbororo communities, in the face of climatic fluctuation, increasing population, and landuse conflicts on the range land beside the changing lifestyles observed in Mbororo communities. This study therefore set out to assess the spatial Indigenous Mbororo challenges and sustainable development options in Mbum Plateau in view of improving the quality of their lives.

## 3. MATERIAL AND METHODS

### 3.1 Study Area

The Nkambe Plateau lies between Longitudes 10°50´48´´ east of the Greenwich Meridian and Latitudes 6°20´02´´ and 6°41´25´´ north of the Equator, and Longitudes 10°23´03´´ and 11°55´48´´ east of the Greenwich Meridian. It constitutes the area covered by the Nkambe Central (which doubles as the Divisional headquarter for Donga-Mantung) and Ndu Sub-Divisions. Nkambe Plateau shares common borders to the West with Misaje Sub-Division, to the North Ako Sub-Division, to the North-East Nwa Sub-Division, and to the South, South-East/South-West Bui Division (Shuffle Topography Mission, 2024). The principal tribal group in the Nkambe Plateau is the Mbum, whose ancestors are believed to have hailed from Tikari in Adamawa, Cameroon. Their local dialect is Limbum. Nkambe Plateau is made up of forty-one (41) villages, with a population of 120,781 inhabitants covering a total surface area of 2112.4 km2 (CVUC-visited, 2024), and has a population density of 57.2 persons per km2. Most inhabitants in the Nkambe Plateau are peasants with land as the lone source of livelihood (Map 1).

Mbum plateau have two distinctive ecological sub zones and consequently two climatic features. It has a real tropical climate of Sudan Cameroon type which has given rise to a cloud type of forest cover. Generally, the plateau is colder than the plain. The rainy season is eight months; longer than the dry season (four months) and runs from Mid-March to Mid-November. The maximum rainfall is in the months of July, August and September, with annual maximum attaining 2,332.8mm, and minimum of 1,685.8mm (Cameroon Tea Estate (CTE) Ndu Plantation Weather Station, 2015). But unlike previously when rainfall begins in mid-March, the trends from 1995 up to date have shown that rainfall progressively starts close to the first half of January. The extent of the dry season varies because of the existence of the North East Trade Winds. The extent of the rainy season varies by the existence of the South West Monsoon which carries moist air from the Atlantic Ocean into the hinter land. The rainy season generally begins in mid-March and ends in mid-November with rainfall amounts varying between 1,300mm to 1,900mm per annum. The mean annual range of temperature in Ndu hardly exceeds 5$^{o}$C. Annually, rainfall ranges from




**Map 1. Location of the Nkambe Plateau**

*a=Northwest Region in Cameroon b= Nkambe Plateau in the Northwest Region c=A Layout of Nkambe Plateau*
*Source: Adapted from the Shuffle Topography Mission, http:/www2.jpl.nasa.gov/srtm-visited, 2024*

1300mm to 3000mm and a mean of 2000mm. Ndu has the Cameroonian type of climate characterized by topographically-induced rainfall. In the dry season, Mbum plateau experience cold mornings and hot afternoons while the rainy seasons are generally warm. The relative humidity in the dry season is less than 40% while in the rainy season, relative humidity ranges from 80-95% especially from June to September. Livestock rearing is done on the hills where there is abundant pasture in the wet season and intermittent streams and springs flow. During the dry season, most of the pasture dries up while intermittent and ephemeral streams disappears forcing livestock farmers to move down valleys where some crops are trampled upon by cattle causing farmer-grazier conflicts. Mbum plateau has four vegetation types; grassland, savanna with trees and shrubs, forest and wooded savanna. The dominant grass species include hyparrhenia and sporobus that is good for grazing. There is a reduction in grass as one move from valleys to slopes and hills. The grassland of Mbakop, Ntamru, Mbangong, Maka, Mayo Binka and Binshu could be considered plagioclimax. In the 19th Century or so, cattle rearing were concentrated on hill slopes for fear of pasture scarcity and tsetse flies downslopes [8]. Of recent, owing to the depletion of grazing land many cattle graze on valley creation farmer-grazier conflicts.

## 3.2 Research Design

Explanatory research was used were it specify the nature and direction of the relationships between the studied variables. It also uses probability sampling since the researcher generalize the results from the sample to the entire population. The pre-designed EpiData Version 3.1 (Epi Data Association, Odense Denmark, 2008) database which has an in-built consistency and validation checks, helped in minimizing entry errors during data entry. Exploratory statistics continued with further consistency, data range and validation checks in SPSS VERSION 21.0 (IBM Inc., 2012) whereby outliers were sorted out using Box plots and invalid codes using frequency analysis. Boxplot is efficient in sorting out outliers because it demarcates them on a graph and at the same time indicates their exact position in the database such that they can easily be traced and verified. This approach to exploring data was particularly important for the variable dealing with household size which was a scale (continuous variable). The verification of questionable entries was equally facilitated by the fact that all copies of the data collection instrument were given codes and which codes were also entered into the data base and could help refer the instrument for eventual crosschecking. The sample flow chart consists of explaining the variation in the sample from the expected sample size to the sample validated for analysis after exploratory statistics.

## 3.3 Research Strategy

The study used mixed methods of qualitative and quantitative approaches. The use of the mixed methods approach helped to offset the weaknesses of either the quantitative or qualitative research [8]. The study also adopted the survey research strategy to collect data on spatial challenges and planning implications in the Mborroro communities of Mbum plateau. The principal research instruments used for this survey research were the questionnaires and an interview guide, in which each of the respondents answered the same set of questions. A case study research strategy was used to generate a comprehensive understanding of a complicated matter of interests in the natural context. The survey research strategy was used to collect information on challenges and planning options. Through the simple random and snow ball sampling techniques, 200 questionnaires were administered to the different household heads. Structured interview guides were administered through the stratified techniques. Primary data sources for the study were equally obtained through observations. Secondary data for the study were obtained through the review of published and unpublished articles, offline and online libraries, magazines, database and reviewing of daily records of some private social facility centers.

## 3.4 Data Analysis

Data collected during the field survey were analyzed through two statistical techniques. The qualitative data obtained was analyzed through the content analysis whereas themes and codes were given to the different opinions and perceptions of the informants and their frequencies and percentages were being determined from there. Inferential statistical techniques were equally used during the analysis. Here, mean and variance were mostly used. The results of the analysis were visualized on graphs, tables, pie-charts, line graph, histograms and plates. The limitations to the study were that, since Mbum plateau is prone

with the ongoing political crisis, it was very difficult for the researchers to survey the entire are. In this case, Ardos, the various sub-chiefs were chosen. The independent variable for this study is climate. The elements of climate considered are rainfall and temperature. Each variable was analyzed in detail with respect to its contribution to climate variability. Mean Annual, Inter-annual and Seasonal Variations; Measures of Standard Deviations, Variances and specifically, Coefficient of Variation (CV) for rainfall reliability will be analysed systematically. Decadal variations of all climatic elements for this study and specifically, percentage changes in rainfall and temperature. All decadal variations were treated as anomalies to establish trends, illustrated in graphs (time series analysis), fitted with $R^2$ and linear equations (Coefficient of Determination to show the percentage change of each climatic element). Both qualitative and quantitative techniques were, thus, employed in data analysis. Several climatic elements (rainfall, temperature) influence the climate of the Mbum Plateau. To make sense out of these and to determine change over time, monthly means, annual means, mean annual anomalies, running means, decadal means, decadal anomalies were analysed.

Where: $X_n$ = mean rainfall for month N
$R$ = mean annual rainfall

In the same vein, the Standardised Precipitation Index (SPI) was calculated. The SPI is a tool which was developed primarily for defining and monitoring drought. It allows an analyst to determine the rarity of a drought at a given time scale (temporal resolution) of interest for any rainfall station with historic data. It can also be used to determine periods of anomalously wet events. Conceptually, SPI is the number of standard deviations by which the precipitation values recorded for a location would differ from the mean over certain periods. In statistical terms, the SPI is equivalent to the Z-score.

$$Z - score = x - \frac{\mu}{\delta}$$ (McKee *et al.*, 1993)

Where:

Z-score expresses the $x$ score's distance from the mean (μ) in standard deviation ($\delta$) units.

Statistically, the SPI is based on the cumulative probability of a given rainfall event occurring at a station. SPI was used to assess the occurrence of drought incidents in the Mbum Plateau. All anomaly graphs generated from the data were fitted with trend lines and linear equations. The trend lines indicate increase or decrease in the elements under study.

Rainfall Seasonality Index (SI) and Standardized Precipitation Index (SPI) were employed to assess the vulnerability of the livestock system to climate variation. Both SPI and SI are dimensionless. Consistency and relationships between these climatic elements was analysed systematically. All inter-annual and seasonal variations were treated as anomalies to establish trends, illustrated in graphs, fitted with $R^2$ and linear equations to show variations in each climatic element. Other measures of central tendencies for these weather elements included Standard Deviation (σ), Variance and Coefficient of Variation (CV).

CV is calculated thus:

$$\sigma = \frac{\sqrt{\Sigma(\mathrm{Y} - \bar{\mathrm{Y}})}^2}{\mathrm{N}}$$

$$CV = \sigma * \frac{100}{\bar{\mathrm{Y}}}$$

Where: $\bar{Y}$ = mean
N = sample size

From these analyses, tables were generated to summarise climatic characteristics. The drought vulnerability for this study is assessed by reconstructing historical occurrence on an 8-months' time scale, beginning from March (onset of first rains) and ending in October (end of wet season). This time scale is the wet season, where water is relatively more available and cattle production venture is rain-fed. Detailed scenarios were presented, where the frequency of droughts was assessed on an annual basis. Typical dry season months (November, December, January and February) were not used in assessing SPI for this study because these are normal drought season months. This drought season is one where cattle and water resources, as well as other components of the natural and human environments are most vulnerable to weather conditions due to water scarcity. Anomalies were calculated for all climatic elements analysed for this study. Anomalies are calculated thus: $\frac{Mean}{\mu} * 10$

## 3.5 Ethical Consideration

Ethically, the respondents' responses were kept confidential by the researchers. Precautions

against Covid 19 and cholera were highly practice during field survey. Also, authorization was taken from the Ardors and the sub-chiefs to carry out the study. Another aspect of ethics was administrative procedures in which council officers, divisional and regional delegations prevented the researchers from directly contacting their Mayors and delegates in charge of data for population, cattle, health facilities, and other socio-economic infrastructure in the Plateau. Consequently, the first contacted workers of these establishments who knew of a possible procedure were consulted and then the researchers asked those who were willing to cooperate, for a possible discussion.

## 4. RESULTS

### 4.1 Climatic Variations in Mbum Plateau

Rainfall, temperature and relative humidity of Mbum Plateau has been fluctuating seasonal, monthly and annually. The fluctuation has affected human life negative as well as crops and animals grown on the plateau. The nature of dwindling vegetation and streams on the plateau has some links to thus climatic variability and change.

Fig. 1a and 1b shows minimum temperature variations in Mbum Plateau (nkambe and Ndu) from 1999 to 2022 and from 1981 to 2022 respectively. The minimum temperature trend in the plateau has been increasing as notice in frequent agricultural and hydrological drought affecting crops and livestock negatively. This has also affects animal and human health. Mean temperature anomalies are peculiar in 1983, 1997/1998 and 2013. The 1983 events were because of the drought that prevailed all over West Africa. The 2013 episode was caused by drought. The mean annual temperature has been increasing in Ndu (Fig. 1b).

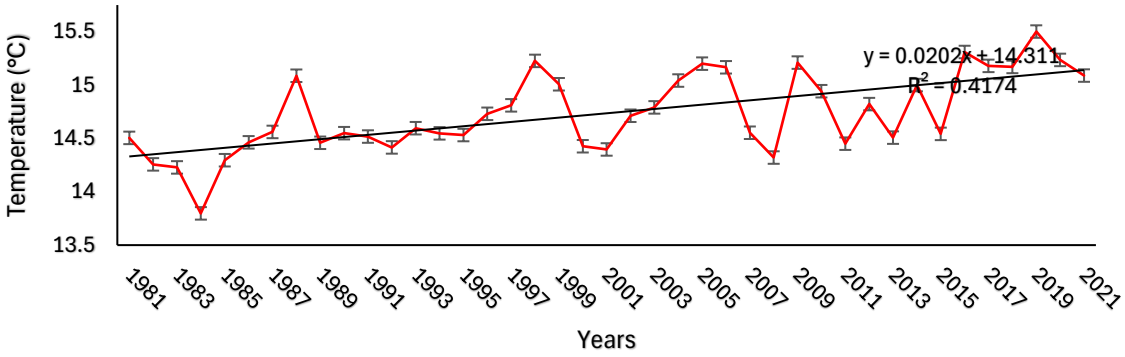



**Fig. 1a. Variations in minimum temperatures of Nkambe**

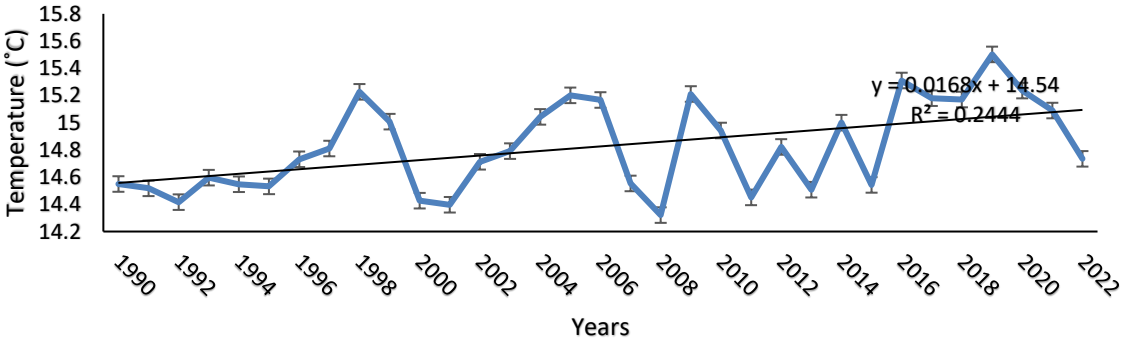



**Fig. 1b. Variations in minimum temperatures of Ndu**
**Source: Fieldwork, 2023**

The maximum annual temperature trend for Ndu and Nkambe have been increasing, with a slight increasing trend. The anomaly was noticed in 2005 as result of the prolonged dry season that was characterized by souring temperatures (Fig. 2a&b). The increase is more for Nkambe than Ndu as observed from the linear line.

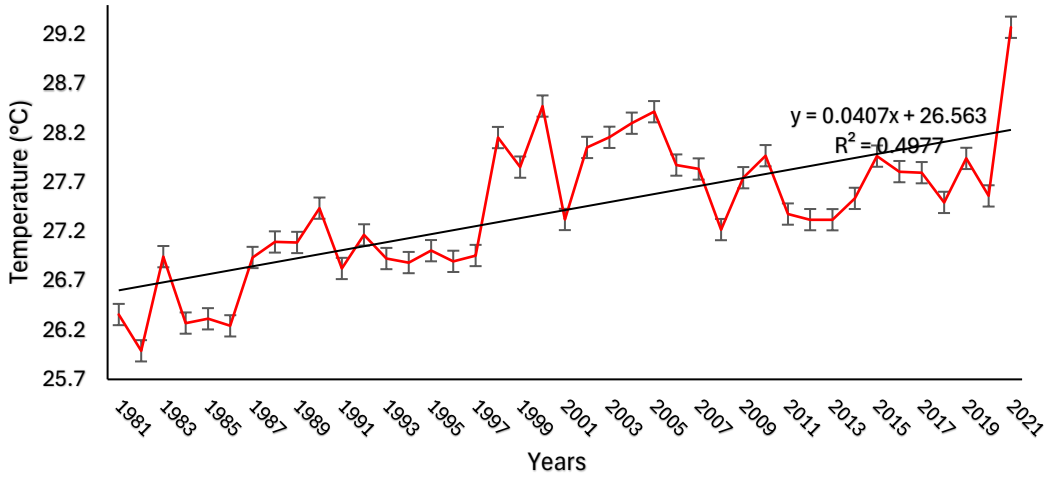



**Fig. 2a. Variations in maximum temperatures of Nkambe**

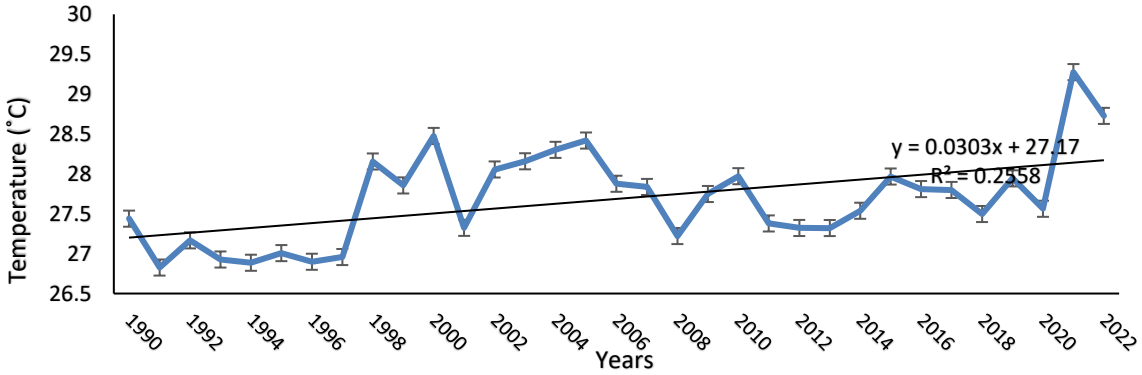



**Fig. 2b. Variations in maximum temperatures of Ndu**

*Source: Fieldwork, 2023*

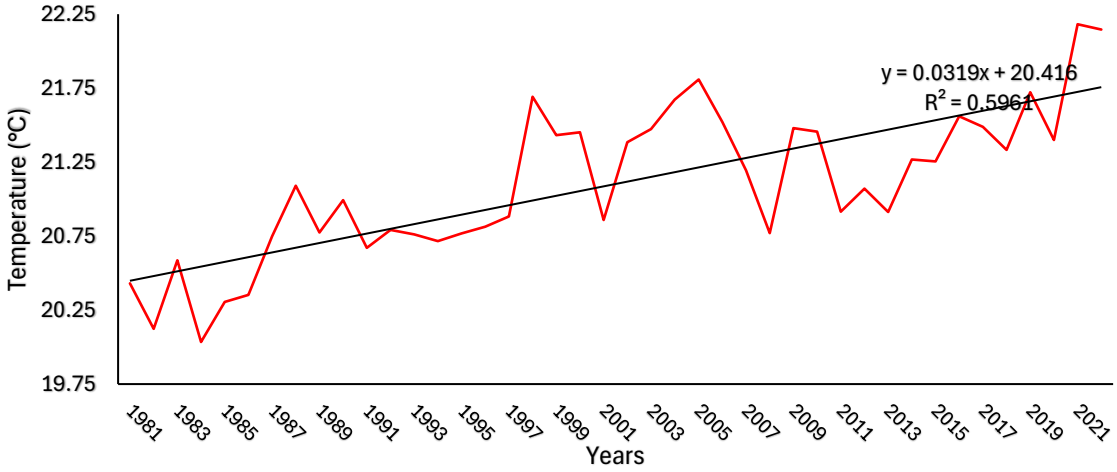



**Fig. 3a. Mean temperature variations of Nkambe**

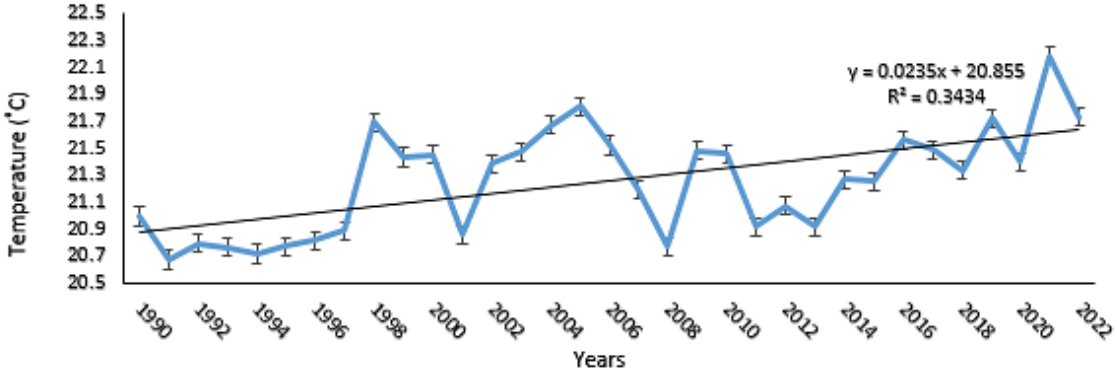



**Fig. 3b. Mean Temperature variations of Ndu**
*Source: Fieldwork, 2023*

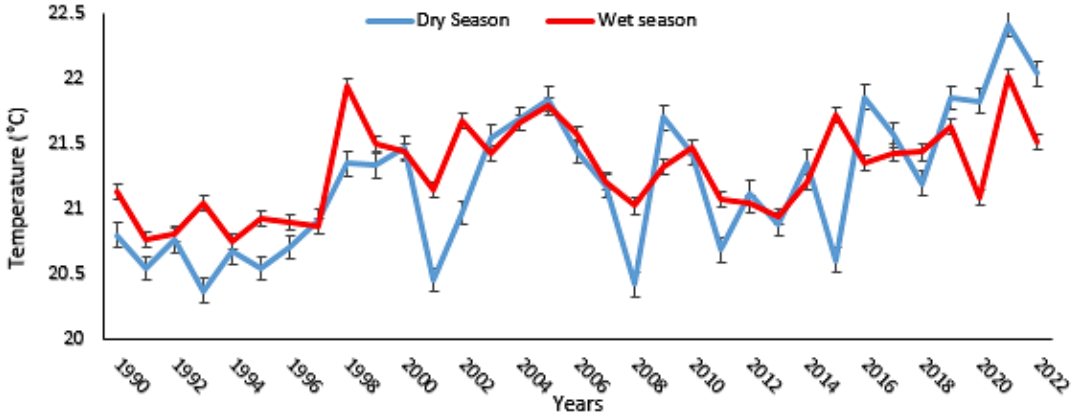



**Fig. 4. Seasonal temperature pattern (1990-2022)**
*Source: Fieldwork, 2023*

Fig. 3&b revealed mean monthly temperature trends of Nkambe and Ndu fluctuating on an increasing rate as noticed from the linear line. Abnormal temperature has a zig-zag shape meaning of recent it is increasing from January to March and falls to July month and there off in December. The abnormal temperature affects livestock (cattle) production through heat stress and occurrence of diseases. High temperature leads tow humidity that affects animal health. The lowest mean is observed in April and May and highest in January, February and December.

Fig. 4 revealed seasonal temperature trends (wet and dry) of Mbum fluctuating on an increasing rate for wet season and on a decreasing rate dry season as noticed from the linear line. Abnormal temperature of recent it is increasing from January to March and falls to July month and there off in December. The abnormal temperature affects livestock (cattle) production through heat stress and occurrence of diseases. High temperature leads tow humidity that affects animal health. The lowest mean is observed in April and May and highest in January, February and December.

## 4.2 Rainfall Variations in Mbum Plateau

Substantial changes in annual rainfall have been noted in the tropics and many changes have been accompanied by changes in rainfall seasonality. Although seasonality as measured by seasonality index has not changed significantly, the frequencies of dry months and longer dry periods are markedly higher in drier phases. The relative intensity of the dry seasons has changed significantly since the late 19$^{th}$ Century. Rainfall seasonality is a complex concept encompassing a few partial independent attribute. Rainfall Seasonality (SI) (Table 1) refers to the tendency for a place to have more rainfall in certain months than in others [8].

**Table 1. Rainfall seasonality index classes**

| Rainfall Regime | SI class limits |
|---|---|
| Very equable | ≤0.19 |
| Equable but with a definite wetter season | 0.20-0.39 |
| Rather seasonal with a shorter drier season | 0.40-0.59 |
| Seasonal | 0.60-0.79 |
| *Markedly seasonal with a long drier season* | *0.80-0.99* |
| Most rain in 3 months or less | 1.00-1.19 |
| Extreme, almost all rain in 1-2 months | ≥1.20 |

*Source: Walsh and Lawler, 1981*

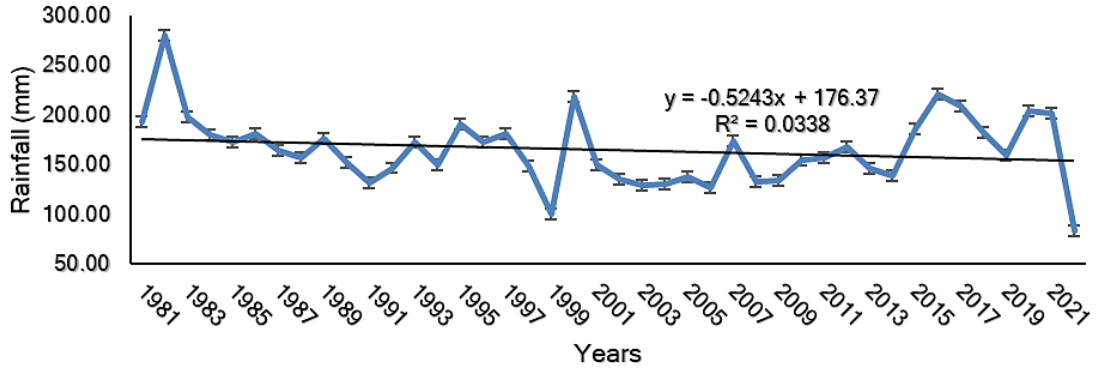



**Fig. 5a. Annual rainfall variations of Ndu**

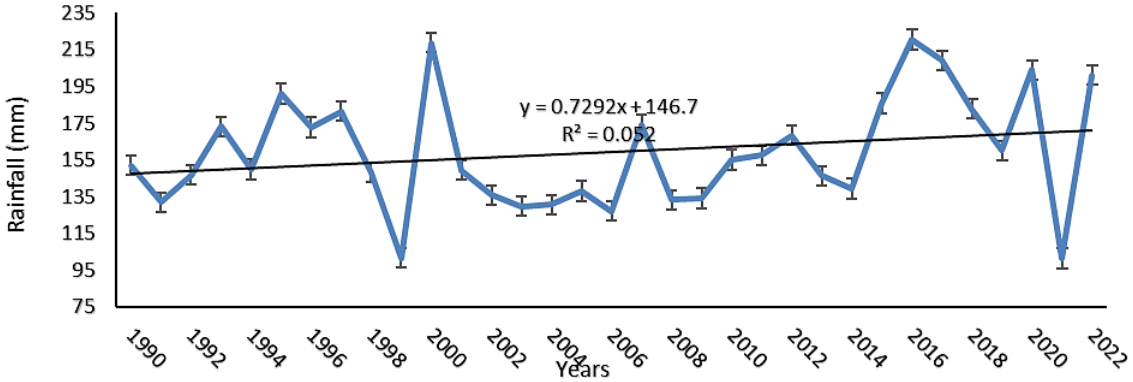



**Fig. 5b. Annual rainfall variations of NKambe**

*Source: Fieldwork, 2023*

SI is the sum of the absolute deviations of mean monthly rainfalls from the overall monthly mean divided by the mean annual rainfall. SI is dimensionless (does not have units of measurement, but class limits and regimes). The SI across Mbum Plateau is as follows: Nkambe (0.91) and Ndu (0.92). This finding is similar to that of [8] on standardised precipitation Index valuation on crop production response as well as that of [9] on rainfall characteristics in Ndu and Douala in Cameroon.

The CV values reveal that rainfall is reliable for water resources over Mbum Plateau. The rainfall in Mbum Plateau is seasonal with heavy showers occurring from April to October (wet season) and with the onset of the dry season, (November to March) water resources shrink because evaporation exceeds precipitation. The, CV may, thus, not be the best index for water resources planning and management. Mbum Plateau is in the tropical savannah *(Aw)* climatic type according to Köppen's 1936 climatic classification. The drought years of 1962 to 1964,

1972 to 1974, 1981 to 1984, the El Niño (1997/98) and the 2005/2006 prolonged dry season tends to distort the CV values as a dependable factor for agriculture and water resources planning. The Coefficient of Variation indicates only the fluctuation about the mean but never gives a clear indication about the general trend whether rainfall is increasing or decreasing given that the data was collected for up to a period of over 40 years for Nkambe and Ndu. Rainfall anomalies provide a better illustration in the general trends and fluctuations in rainfall. It is evident that rainfall has been decreasing through time (Fig. 5a&b).

From Fig. 5a&b, rainfall on Mbum Plateau (Ndu and Nkambe) is *markedly seasonal with a long drier season*. Normally, one would expect that the SI would be *seasonal* (0.60-0.79). The rainfall pattern has been fluctuating with an increasing trend. The rain fall pattern is an indicator of climate variability and long-term climate change. The markedly seasonal rainfall with a long drier season is because of prolonged dry periods that lead to a delay in the onset of the rainy season. Again, when the wet season begins in April, dry conditions will still prevail after several weeks, such that consistent rains prevail as from July.

The frequent prolonged dry periods across the Mbum Plateau is assessed by reconstructing historical occurrence on a 9-months' time scale, beginning from March (onset of first rains) and ending in October (end of wet season). This time scale reflects the critical part of the grazing calendar. In this study, SPI is used to assess the vulnerability of cattle and water resources to droughts. The trends (Fig. 6a&b) give a clear picture of drought episodes in Mbum Plateau over time. A detailed scenario is presented, where the frequency of meteorological droughts has been assessed on a decadal time scale. Typical dry season months (November, December, January and February) are not used in assessing SPI because these are normal dry season months. This dry season is one where cattle and water resources, as well as other components of the natural and human environments are most vulnerable to weather conditions due to water scarcity. Like SI, SPI is dimensionless.

For Nkambe, 1981-2021, the SPI values ranged from -0.92 to 1.28. There were 2 episodes of moderately wet; 4 episodes of mildly wet and 4 episodes of mild dryness. The decade 1989-1991 had SPI values of -1.78 to 1.05 (Fig. 6a). This was marked by 1 episode of moderately wet; 2 episodes of mildly wet; 4 episodes of mild dryness; 2 episodes of moderate dryness and 1 episode of severe dryness during the 1997 drought. During the 1999-2009 decade, the SPI values ranged from -1.18 to 0.39. There were 4 episodes of mildly wet; 5 episodes of mild dryness and 1 episode of moderate dryness. From 1981-2021, the SPI values were -0.58 to 3.45; 1 episode of extreme wetness (SPI of 3.45 in 1996); 4 episodes of mildly wet and 5 episodes of mild dryness. For the decade 1997-2006, the SPI values were -0.88-3.36. This was characterised by 1 episode of extreme wetness (SPI of 3.36 in 1999); 5 episodes of mild dryness and 2 episodes of moderate dryness. From 2007-2015, the SPI values were -1.66 to 2.79; 1 episode of extreme wetness (SPI of 2.79 in 2009); 2 episodes of mildly wet; 5 episodes of mild dryness and 2 episodes of moderate dryness.

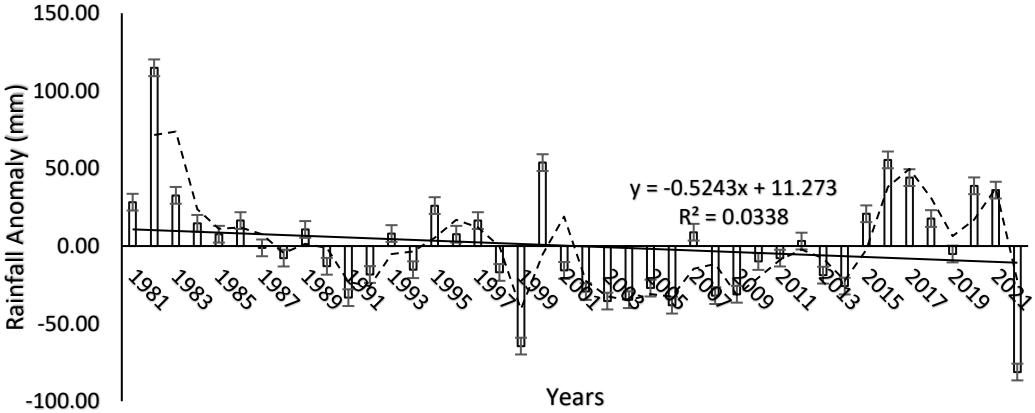



**Fig. 6a. Rainfall anomaly of Nkambe**
*Source: Fieldwork, 2023*

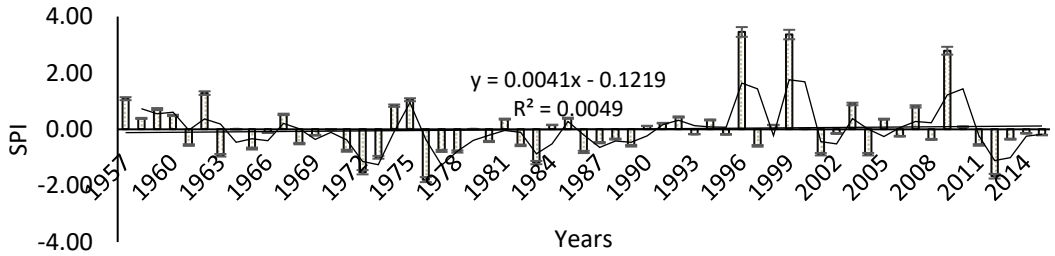



**Fig. 6b. Standardised precipitation index (SPI) for Ndu, (1957-2015)**
*Source: Fieldwork, 2023*

The mean annual rainfall has been on a slight increase between 1957–2022 in Ndu. Since 2010, rainfall has been decreasing at this location. For Ndu (Fig. 6b), 1957-1966, the SPI values ranged from -0.92 to 1.28. There were 2 episodes of moderately wet; 4 episodes of mildly wet and 4 episodes of mild dryness. The decade 1967-1976 had SPI values of -1.78 to 1.05. This was marked by 1 episode of moderately wet; 2 episodes of mildly wet; 4 episodes of mild dryness; 2 episodes of moderate dryness and 1 episode of severe dryness during the 1976 drought. During the 1977-1986 decade, the SPI values ranged from -1.18 to 0.39. There were 4 episodes of mildly wet; 5 episodes of mild dryness and 1 episode of moderate dryness. From 1987-1996, the SPI values were -0.58 to 3.45; 1 episode of extreme wetness (SPI of 3.45 in 1996); 4 episodes of mildly wet and 5 episodes of mild dryness. For the decade 1997-2006, the SPI values were -0.88-3.36. This was characterized by 1 episode of extreme wetness (SPI of 3.36 in 1999); 5 episodes of mild dryness and 2 episodes of moderate dryness. From 2007-2022, the SPI values were -1.66 to 2.79; 1 episode of extreme wetness (SPI of 2.79 in 2009); 2 episodes of mildly wet; 5 episodes of mild dryness and 2 episodes of moderate dryness. There has been a slight increase in rainfall trend in Ndu between 1957–2015 by a factor of ($R^2$=0.005), with majority of the years having rainfall deficits below the average. The El Nino years of 1963, 1972-1973, 1997-1998, 2014-2016 have clearly shown rainfall deficits. This climatic fluctuation has also negatively impacted on vegetation and hydrology of Mbum Plateau.

## 4.3 Dwindling Vegetation and Cattle Production

According to the Divisional Delegate of MINEPIA Donga-Mantung, about 65% of the Mbum Plateau range land has been destroys by bracken fern (*Pteridium aquilinum*) which affects cattle production reducing grazing size. This plant is allelopathic that has substance which excreted from the plant are leached into the soil. Bracken fern causes a medical problem known as enzootic hematuria in animals. This results in the appearance of blood in the urine of cattle. Fresh bracken fern is more toxic than dry one. Since it grows well in the wet season, it is often very tempting to cattle which in most cases are eaten by cattle as pasture. Today, the percentage areal coverage of vegetation types in Mbum Plateau is as follows: *asporobolo africanas 35%, Pennisetu clandestiun 15%, Hyparrhenia spp 15%, bracken fern 20%* and weed 15%. The relative high percentage areal coverage of bracken fern is because it has the capacity to multiply fast and occupy vast expanses of land. In the course of it growth, it shades the underground palatable vegetation from sunlight, reducing metabolic activities denying cattle the right to feed on pasture. The different activities now carried on range land have made it to greatly dwindle over the years. Satellite image revealed that in 1980, tea occupied 14.74%, settlement 5.29%, farm and grazing land 79.69%. In 2022, tea covers 0.47%, settlement 7.51%, farm and grassland 82.55%.

## 4.4 Water Scarcity and Its Effects on Pastoral Activities

Water scarcity is an impediment to pastoral activities. Field survey revealed that only 20% of Mborroro have access to pipe borne water in Mbum Plateau. Majority, (80%) travel over half a kilometer to access water that are even untreated and serve for drinking as most from the source with cattle. Because cattle greatly consume water more humans, the demand for it among the Mborroro exceeds that of the local Wimbum people. Field observation revealed that some 20-30years ago, water was about three

times than those existing today in Mbum Plateau. The planting of Eucalyptus especially of water has greatly caused water points to dwindle. Reduced trends of evapotranspiration (y=18.56x+157.7, R2=0.102) has also help in reducing stream discharge. The herders today depend on very few water points for their cattle and the dry season, situation is often worst. The deplorable conditions cause animals to lose weight and easily attack by diseases. In the dry season, there high turbidity in springs and streams especially in Ntumbaw, Binka, Binshu, Nkwitang, Kungi and Mbarseh as animals drink and mess on the water body. This situation increases ingested germs and diseases like rider pest, tuberculosis, and haemorrhagic septicaemia, and diarrhea prevalence amongst animals (Table 2).

**Table 2. periodical changes in land use and land cover change in Mbum Plateau**

| Landuse | Area in 1980($km^2$) | Area in 2022 ($km^2$) | Percentage change |
|---|---|---|---|
| Settlement | 36.80 | 78.17 | 112 |
| Farm land | 362.98 | 492.35 | 35.6 |
| Grazing land | 447.98 | 317.78 | -29 |
| Forest | 143.58 | 11481 | -19 |
| Eucalyptus | 43.58 | 58.93 | 35 |
| Tea estate | 5.98 | 6.27 | 0.04 |
| Wetland | 64.71 | 42.82 | 33.82 |
| Natural woodland | 12.96 | 7.12 | -45 |
| **Total** | **1118.25** | **1118.25** | ***I*** |

*Source: Figures calculated from landsat Image Processing 1980 and 2022*

**Table 3. Annual water supply in natural forested and eucalyptus catchments of the Mbum Plateau**

| Catchment area | 1980 | 2024 | Ecological nature | Estimated annual water capacity (m3) | Nature of water flow |
|---|---|---|---|---|---|
| Njap | 1 | 1 | Forested | 148.6 | Gravity flow |
| Binshu | 1 | 0 | 100% deforested | 247.9 | Pumped |
| Binka | 1 | 1 | Forested | 189.7 | Gravity flow |
| Mbot | 1 | 0 | 100% forested | 66.8 | Irregular |
| Bikop | 1 | 0 | 100% forested | 83.3 | Irregular |
| Wat | 1 | 1 | 100% forested | 87.7 | Gravity flow |
| Mbaa | 1 | 1 | 100% forested | 299.9 | Gravity flow |
| Chup | 1 | 1 | 100% forested | 29.2 | Gravity flow |
| Boyon | 1 | 0 | 100% forested | 89.3 | Gravity flow |
| Mayo-binka | 1 | 1 | 100% forested | 103 | Gravity flow |
| Mbukop-Taku | 1 | 1 | 100% forested | 23.1 | Seasonal |
| Ntundip | 1 | 1 | 100% forested | 99.9 | Irregular |
| Njitop | 3 | 0 | 100% forested | 167 | Gravity flow |
| Ndu | 1 | 0 | 100% forested | 199.8 | Irregular |
| Wowo | 1 | 1 | Forested | 97.2 | Seasonal |
| Mbarseh | 4 | 1 | 100% forested | 82.1 | Gravity flow |
| Mbawgong | 3 | 1 | 100% forested | 53.6 | Seasonal |
| Nkwitang | 3 | 1 | 100% forested | 67.3 | Gravity flow |
| Mangu | 5 | 2 | Planted eucalytus | 56.5 | Gravity flow |
| kaka | 3 | 0 | 100% forested | 20.1 | Irregular |
| Ntumbaw | 2 | 0 | 100% forested | 19.2 | Irregular |
| Mbafung | 1 | 0 | 100% forested | 301 | Regular |
| Tukop | 2 | 0 | 100% forested | 22.2 | Irregular |
| Njipku | 2 | 2 | Planted Eucalyptu | 23 | Seasonal |
| Lvu | 5 | 0 | 100% forested | 23 | Seasonal |
| Nkambe | 3 | 0 | 100% forested | 25 | Irregular |

*Source, [4] complemented by field work in 2024*

**Table 4. Regression results**

| Variable | Rainfall | Temperature | Humidity | Cattle output |
|---|---|---|---|---|
| Rainfall | 1.0000000 | 0.21049 | -0.037972 | 0.128148 |
| Temperature | 0.212049 | 1.000000 | 0.337841 | 0.104576 |
| Humidity | -0.037972 | 0.337841 | 1.000000 | -0.024993 |
| Cattle output | 0.128148 | 0.104576 | -0.024993 | 1.000000 |
| | **Rainfall** | **Temperature** | **Humidity** | **Cattle output** |
| Mean | 1931.562 | 17.85588 | 70.13843 | 36197.03 |
| Median | 1971.500 | 17.37083 | 70.10750 | 31564.00 |
| Maximum | 2375.400 | 19.81667 | 78.25000 | 58606.00 |
| Minimum | 1466.700 | 16.48333 | 61.73333 | 18676.00 |
| Standard deviation | 226.4012 | 1.158238 | 3.079842 | 10252.72 |
| Skewness | -0.146066 | 0.751115 | -0.280711 | 0.244037 |
| Kurtosis | 2.449095 | 1.921359 | 4.943394 | 2.866970 |
| Jarque-Bera | 0.550852 | 4.845225 | 5.796961 | 0.362542 |
| Probability | 0.759249 | 0.088690 | 0.055107 | 0.834209 |
| Observations | 34 | 34 | 34 | 34 |

*Source: Field work.*

**Table 5. Seasonal patterns of cattle diseases and vaccine employed to reduce it on the field**

| Wet season | Vaccine | Dry season | Vaccine |
|---|---|---|---|
| Endo parasite effect caused by ring worm and tape worm | Levamizole and ivomectin | Rinderpest | Bovipestova |
| Ecto-parasite effects caused by heavy tick infestation and ring worm | Cypermcthrin spray | Trypasonomiasis | Trypanocide or trypanmedium |
| Foot and mouth disease | Vaccine not available | Tuberculosis | Locally treated |
| Mastitis and babesisiasis (tick fever) | | Contagious bovin plearopremonia | Pastoral |
| Lumpi skin disease | Nodolovax | Haemorrahagicseptica emia | Nodolovax |
| | | Black quarter | Pelyvax |

*Source: Divisional Delegation for Livestock, Fisheries and Animal Husbandry: Donga-mantung Division 2023*

Landuse and landcover changes in Mbum Plateau from 1980 to 2022 (Table 2) have been changing with direct negative implication on water availability to both human and cattle. Surface area for settlement increased from 36.80km2 in 1980 to 78.17km$^2$ in 2022 indicating a 112% increase. Farm plot also increased from 362.98km2 to 492.35km2 showing a 35.6% increased within 42years. Eucalyptus increased from 43.58km2 to 59.93km2 representing an increase of 35%. Grazing land, forest and natural wood land witnessed a decrease of -29%, -19% and -45% respectively. Increase in area coverage by eucalyptus has negatively affect water discharge and availability. This findings is in line with that of [4,6,5] showing that the human pressure on water source is negatively impacting on water supply on the Plateau. Field observation showed that trees increase rainfall (65%), moderate temperature and increase atmospheric humidity (86%), increase stream discharge (76%) and content soil from erosion (65%). It should understand that eucalyptus consumes atleast 30liters of water a day, thus replacing natural vegetation with this species like in Mbum Plateau has cause server water crisis in some neighbourhoods as seen in Table 3.

The initial pasture (Table 3) cover of the area some years ago was guinea and Sudan savanna and recently it has mostly been colonized by Braken fern. This is a clear indication that, climate is changing and this has contributed to significant changes in the pasture land. Years with high rainfall as it is the case between 1980 and 1999 in Ndu, nutritive pasture for cattle was highly favourable. But with the decreasing trends of rainfall since 2000, Braken fern is pre-dominating the area. As climatic elements changed overtime, the initial ecological equilibrium conditions, which were formerly favouring the growth and multiplication of cattle

pasture, changed equally over the years. This finding corroborates that of [7] and [3] studying the effect of montane forest of Ndu and water crisis in Nkambe Highland respectively.

Agriculture activity has great impact on landuse changes (45%), planting of eucalyptus 26% and cattle grazing 20%. This finding is similar to that of [4,7,6] who all indicated environmental destruction especially eucalyptus plannting in Nkambe plateau has increase water crisis. Today, market gardeners have expose more wet lands for more evapotranspiration. This is very common in villages of Mangu, Njipnkang and Ngarum that cultivate huckleberry in the dry season. Animal pastures within certain areas of Mbum Plateau have changed from its initial form and it is now colonized by wild shrub. This finding is proven by the fact that, out of the 200 cattle graziers who were randomly selected, over 64% of herders believed that pasture availability for cattle has reduced in supply lately. This is opposed to 36% of the herders who hold that pasture available for cattle is significant and unlimited and therefore can effectively sustain the carrying capacity of grazing animals. As rainfall decreases, the quality of pasture is negatively affected as this was observed by graziers in 2010/2011, 20017/2018, 2019 and 2020.

The parametric test was used to show whether climate influences cattle production in Mbum plateau. This was done using the multiple regression model.

$$Y=a+b1x1+b2x2+b3x3+bnxn+e$$

Where Y= cattle output
A+b1+The predictor variables
b1=the partial regression coefficients
a= the constant term
e=the stochastic error term

From this quantitative result (Table 4), it was realized that our constant term is positive, meaning that, there is a positive relationship between the constant term and cattle production. The results show that a 1% increase in constant term will bring about 1.9% increases in cattle production all things held constant. Skewness result indicated higher values of rainfall in earlier years, lower temperature and higher values of relative humidity as well in Mbum Plateau. R-square result revealed that, when rainfall increases, cattle output increase. This implies that, when rainfall increase by 1mm, cattle output increase to about 5 cattle. This is very true because during the rainy season abundant pasture for cattle encourage their productivity as well as their weight. The reverse occurs in the dry season forcing herders to move on transhumance. The result was also observed for temperature. When temperature increases by $1^0$C, cattle increase by about 894. This is a deviation from reality as when temperature increases cattle witness discomfort with heat stress, increase intensity of pest and diseases especially in the dry season. This is so because dry season is accompanied by reduction in size and quality of pasture as well as water availability. The result of relative humidity shows that when the value increase, cattle output falls. This is true because increase in the value of relative humidity is associated with discomfort and cattle diseases. A 1% increase in the value of relative humidity brings about 183 cattle reduction. This could further be explained from the quantity of milk production the often reduced during peak periods of rainfall.

The probability results show that, rainfall amount is the main important elements that should be considered when taking decision concerning cattle production. Rainfall and temperature fluctuations are hardly adaptable by herders and can only be mitigated. The probability results shows that 0.6 cases of dwindling cattle of Mbum plateau is cause by fluctuating climatic elements and 0.4 is cause by other human influence. This could be explained by population increase, frequent land conflicts, social changes within the Mborroro communities and the perception of life that has negatively affected them. The Granger Causality results revealed that rainfall, temperature and humidity influence one another. The Mborroro have changed their rearing method from pastoral nomadism to a sedentarism method as a result of life modernization and increasing encroachment of population into grazing land. The changing lifestyle of the Mborroro has made the cattle to greatly dwindle.

Formerly the Mborroro women were highly involved in the selling of milk but today milk production has greatly reduced from about 5litters per cattle in the 1970s to 1190s and today ranging between 1.5 to 2litters per cattle. From 80 households sampled on the field, an average of 4-6 children were schooling some 20-30 years ago per community but today, each Mborroro family has about 4-5 children in school. The main source of capital to fund the family comes from cattle farms which have reduced. With this

situation, some Ardos like Bakari of Ntisaw started leasing grazing land to the local Wimbum people who were mounting presure with the local chiefs. Ardo Mbuye of Mbawngong had to surrender his power to his son Bonjaye in 2011 simply because he had no cattle which are the source of power. The leasing of grazing land in Mangu, Mbawngong, Binka, Nkwitang and Ntisaw by some Mborroro is mounting tension between them and the local Wimbum. As a result of trying to resolve the mounting tension, Fon Nformi (Fon of Ndu) started distributing part of grazing land in Nkwitang, Ntisaw, Mbawngong which have fuel the difference between Mborroro and Wimbum communities.

The impacts of climate variability in the cattle production sector of Mbum Plateau include the decrease in production, emerging food insecurity, floods, the prevalence of pests and diseases, rising temperatures, dry spells after the first rains, soil erosion and leaching, the drying up of water bodies, the reduction in the volume of streams and farmer-grazier conflicts. The impact of climate vulnerability has been expressed in the recurrent dry spells after the first rains, with a perception score of 63.2%, while 3.7% with the no perception and 21.1% of don't know perception. Farmer-grazier conflicts too have been impacted by climate vulnerability with a perception of 63.4%, 28.4% of no perception and 8.2 % of do not know perception. The drying up of streams and springs had the lowest perception of 44.4% with 20.1% of no perception and 35.5% of don't know perception. This then gives a deeper meaning to understanding of the impact of climate variability in Mbum Plateau. Looking therefore at the trends with reference to impacts of climate variability, dry spells, reduction in water and farmer-grazier conflicts had the highest perceptions as compared to the drying up of streams, rising temperature, food insecurity and floods. All these show an increasing trend with a Coefficient of Determination ($R^2$) of 4.28%.

The poor and dilapidated structures on cattle breeding sector significantly contribute to a drop in cattle number as revealed by 55% Mborroro interviewed on the field. Farmer graziers conflicts is the continuous struggle for the use of one and the same piece of land between two sets of people: graziers and crop cultivators and among graziers themselves. In this situation, there is always trespassing by one of the groups in each other's preferred zone of activities. These conflicts are rampant in Mbum Plateau as most graziers are today leaving for transhumance before the stipulated time when most second cycled crops (cocoyam, beans, cassava and sweet yams) are only completely removed from the farms by the 30$^{th}$ of December. We equally observed that farmer-glaziers conflicts are not confined to transhumance zones in Mbum Plateau but have been extended to their night paddock zones in the highlands where 76% of the graziers do not have fences for their cattle to sleep. As such, during the night periods, many cattle stray into crop farms destroying crops.

The farmer-grazers conflicts are very common in Binka, Mbawngong, Ntiso, Mangu, and Ntumbaw. Trans-humance rapidly spread contagious diseases and endangers cattle life. An early departure on transhumance sometimes means that the animals miss out on the vaccination. These herds endanger other that are vaccinated. The cattle moved into areas infested with ticks, tse-tse flies associated with trypasonomisis, swamps infested with arthropod vectors of arboviruses. The most common diseases on transhumance areas of Mbaw and Dumbo include: foot and mouth, bovine pleuropneumonia, trpasonomiasis, Anthrax and blackleg, Black quarter. Herders on their side are attack by brucellosis and tuberculosis. The recurrent conflicts have resulted to some Mborroro herders migrating permanently out of the region to Foumban, Sabongari, Tibati, Foumbot and Nigeria. Currently, it has been observed that the time for cattle herders to move with their herds to the lowlands has not changed significantly. Instead, the return movement to highlands has changed overtime. This is so because the late onsets of rains delays pasture rejuvenation on highland areas thus forcing graziers to stay longer in the lowlands unlike before. Formally the month of March usually marked the movement of cattle to the highlands. Nowadays, this movement has shifted more to May (due to the shifting patterns of rainfall which is the main source of input to pasture). The prolonged stay in the lowlands has resulted in farmers-graziers conflict as both calendar of activities of farmers and grazers coincides with each other. This goes to justify what [10,11] mentioned earlier. This is so because as of May, most of the crops have grown to a certain level of maturity. As such, their freshness attracts cattle owing to the fact that grass which was formally grazed on is no longer available to sustain their numbers [12].

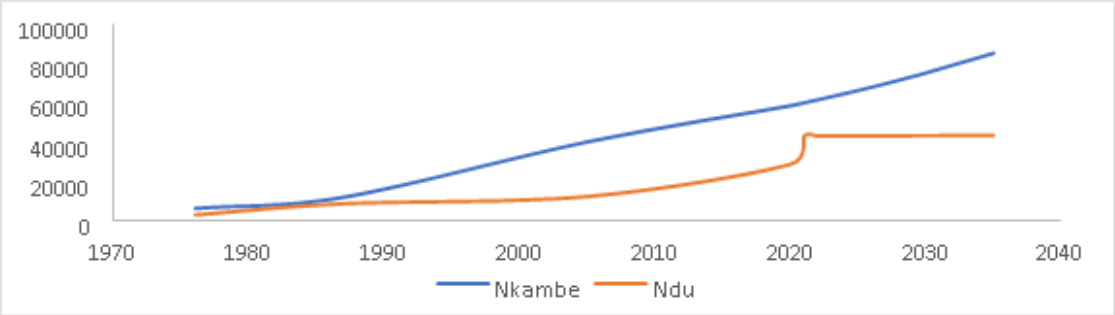



**Fig. 7. Population Projection of Nkambe and Ndu Sub-divisions (Mbum plateau) and a projection to 2035**

*Source: 3rd GPHC BUCREP 2005 and the researchers' projections to 2035*

The most common disease of the area is the foot and mouth disease locally called "Pial and Mborow" respectively. Cattle affected by these diseases are seen lying on the ground for long hours. This is due to their inability to trek or stand for long and graze on the natural pasture. Babesiosis, a disease which emerged few years back, could be linked to Climate variability. It causes animals to urinate blood. Its spread is so rapid that over 40% of cattle have contracted it. This disease is said to have emerged due to the late onset of rains in Mbum Plateau. Another climate variable-related disease is ecto-parasite (ticks), flies and flees. The prevalence rate of climate- related diseases, are higher among the Mborroro breed that graze on common pasture land (Table 5) [13].

Mborroro have a holistic view of cattle and they search for the cause of a disease both naturally and the sick cows are monitored through taste, reaction to touch and smells. In this process, supernatural methods such as consultation of gods are also made use of. This has not been very conducive with the constant climatic variability noticed on the Mbum Plateau.

## 4.5 Population Growth

Results revealed that the reasons for the population growth in Mbum plateau with Ndu sub division constituted the highest population in 1987 (27.19%) and 2005 (27.39%) and Nkambe central which had 25.66% in 1987 and 23.35% in 2005. The main factors contributing to the population growth: natural increase 39.5%, immigration 39.5% and government policy through the setting up of administrative units 21.1%.

This steady increase (Fig. 7) in population coupled with the dwindling natural resources has been revealed by the landuse change map of 1980 and 2013. This finding further renders the cattle sector vulnerable as revealed by the increasing farmer-graziers problems was gotten from conflict files at Ndu and Nkambe municipal councils from 1993-2020. Many grazing fields are gradually being colonized by non-palatable bracken fern grass species which is poisonous to cattle when consumed [14].

## 4.6 The Changing Social and Economic Structure of Mborroro Community

From the entry of the Mborroro in Mbum Plateau, they lifestyles have been changing. They have moved from temporal housing structures to permanent house, from nomadic rearers to sedentary and crop farmers [15].

## 4.7 The Traditional Lifestyle and Labour Distribution of the Mborroro

The traditional lifestyle of the Mborroro is very unique and interesting, for their daily and seasonal movement is determined by their animal needs such as food, water and animal protection. Most of these needs were available at various times and in different places in quantities adequate to ensure the survival of the herds and of the households that depends on them. Mborroro man and his wife had very few possessions and maintain a small family. This made it very easy for them to move from place to place and whenever they settled, round huts is constructed with a few sticks and straw which is readily available in the savanna. They look down on agriculture and prefer to buy whatever they need from the local Wimbum people. The Mborroro who are indigenous people in Cameroon claimed their origin in the country although they had no permanent settlement in an effort to sustain their herding activities. Men's

responsibilities are numerous as the management of the herd falls on them. But children in their capacity as apprentices also contributed to the labour force. Men ensured corporate existence of the family and provide for the house. They protected the animals from carnivores and raiding tribes. They cater upon the animals to distance pasture lands, make weapons like guns, knives, swords, herding sticks, bow and arrow, find grazing sites, build camps and fences, performed soil and water tests. Girls and women wove mats, spun cotton into thread, make household decorations and collect herbs and vegetation. They buy food from the market, milk the cows, churned the milk, make the butter, sell milk and butter and do craft work such as decorating calabashes. The women and girls also grow vegetable and raised poultry and non-ruminant stock. They clean the compound, looked after the disable animals, fetch water, collect firewood, collect wild-food, help in making temporary shelter and bore and nurtured the children. Sometime the women prepared dakere (a mixture of corn fufu, milk and sugar) for sale. They also fried some chewable like makara, maser and pancake for sale. This lifestyle has changed as most of them no longer have cattle and resorted to different occupation, leasing and selling range land, schooling beside creation of water points. Mborroro Ardos who are without cattle today such Bakari of Ntisaw, Mbuye of Mbawngong and other notable have even left the plateau elsewhere [16].

With the changing lifestyles of the Mborroro, transhumance has been intensified. Coupled with the changing climate, the scarcity of drinking water up slopes of Wat, Binshu, Binka, Nkambe, Mbawngong, Ntisaw, Nkwintang, Mangu and Ntubaw besides reducing quality and quantity of pasture has increase more pressure on Mborroro communities. In the course of transhumance cattle up slopes descend to Mbaw plain, Misaje and Dumbo. This process has inherent problems. Mborroro often loss stocks due the prevalence of animal diseases accompanied with poor access to veterinary attention and their high dependence on enthno-verterinary medicine with doubtful outcomes. Foot-to-mouth diseases, black quarter, lice and tick are very common on transhumance tracks. Transhumance is another source tension between the Wimbum and the Mborroro communities. In the course of this process, cattle pass through farms destroying crops initiating farmer-grazier conflicts. Some cattle fall in cliffs and large gullies. The environmental causes of farmer-grazier conflicts varies from rugged relief (20%), soil exhaustion and scarcity of land due to absence of boundaries between grazing and crop farming lands (40%), leasing of pastoral land 10% and settlement on range land 10%. Since low lands are often small for graziers and crop farmers, there is bound to be clashes with both parties accusing each other of encroaching on the land meant for them. The introduction of hollow frontiers to the farmers and graziers has instead increase conflict between them in Dumbo, Misaje and Mbaw plain especially in the dry season when they are scrambling for it to carry out their activities. The farmer-grazier conflicts existed but not as pronounced as nowadays. Interviews conducted with the mborroro communities revealed that 75% were constantly moving because they do not want to stay under a shameful situation of the area they once role with cattle, 64% were for increasing herder-herder conflicts being on the increase, 20% neutral and 16% said farmer-graziers conflicts were on the rise. This situation is common in Mbawngong, Ntumbaw, Ntamru, Binka, Wat, and Ntisaw. At first, Ardo's position was reserved only to the Mborroro that had the highest number of cattle in the community but nowadays, some natives have been given the position posing conflicts between Mborroro herders. Many are taking different professions while others have leave the plateau to other favourable grounds [17].

From milking cattle Mborroro women were engaged in dakere production (mixture of corn fufu, milk and sugar) for sale. With reduction in cattle and grassland, the women have emancipated themselves from secluded life and now into restaurant and even farming. They now plant crops like corn, beans and cassava. This is because most of them are unable to meet the cost of food in the local markets beside the fact they do not have enough cattle to sale like before. Many both men and women are moving into towns and cities to gain employment in night watchmen (28%), hawkers (30%), drivers (40% and security guards (23%). Some after receiving their salaries entered second clothes business alongside their night watch duties, others have open stores in Bamenda, Bafoussam, Douala and Kumbo. Some are involved traditional herbs business moving and selling traditional medicine.

In the same light, some after mismanagement of their cattle started stealing cattle and attacking businessmen and women along major high ways. This is very common between Kom roads and Lus road in Nwa Sub-division, Ntumbaw and

Mbaw road in Ndu Sub-division. They sometimes they lot passengers, collect money and other properties. The statistics from Nkambe Central prison revealed that, the number of Mborroro inmates keeps increasing 19 in 2014 to 47 in 2023. This is more link to the fact that their cattle has greatly dwindled. From the household intervieved, 80% revealed that some 20 years ago, they either had two children or one in school but today they have an average of 6-8 children in school. Statistics gotten from the Divisional Delegate of Primary Education for Dunga-Mantung Division, 789 Mborroro children are found in schools in Mbum Plateau. The problem of water scarcity has been looked into by the Municipal council of Nkambe in collaboration with Mborroro Cultural and Development Asssociation Mborroro Cultural and Development Association (MBOSCUDA), the Mborroro communities under Ardo Sally, Ndemsa and Usmanu where pipe borne water has been constructed. The main problem now is maintenance as most of them lived secluded lifestyles, finding it difficult to carry out community work.

### 4.8 Limitation to the Changing Social and Economic Lifestyle in the Mborroro Communities

The Mborroro faced a lot of problems like predicting climatic variability, diseases prevalence, reducing drinking water point for cattle, increase in food prices, constant encroachment of population into range land and modernization of their archaic culture. Out of the 200 sampled Mborroro, 80% revealed wrong climatic prediction, 8% talked of archaic lifestyles, 15% high cost and 45% insisted all the problems. Although some of the Mborroro have adapted to climatic fluctuation through change of pastoral calendar, breeding of new hybrid cattle species, predicting drought or extreme dry season and poverty remain a great task. The problem is more because only few weather stations exist on the plateau that does not spread climatic information to the citizens. Findings revealed that, in the past, the species of cattle reared in Mbum Plateau were all local breeds. These breeds included the red Fulani, Gudali and the white Fulani which are not resistant to pests and diseases, and produces only one to two liters of milk a day. They equally lose a lot of weight hence low meat content during the dry season. The Houston breed imported from the USA (with white and black strips) is purposely for the fact that it produces a lot of milk. Contrary to the local breed which produces 1–2 litres of milk a day, the Houston breed produces 5 to 17litres daily. With the importation of this species, the problem of inadequate milk could be partially solved, but given the fact that it is very expensive and most cattle graziers cannot afford it the problem still remain. The Mborroro have not been able to adequately adapt to present situation due to their inability to resist the current situation of low rainfall and high temperatures with a consequent reduction in pasture land. As a result of these problems, graziers in rangelands of Mborroro communities have resorted to improved cattle breeds. The construction of animal dips which is conducive for treating ecto-parasite of cattle is expensive for the Mborroro, the new adaptation has remain in their minds as a result of hardship. Adaptation to some Mborroro remains difficult as they attribute it to the anger of the ‘gods.’ Many refused resistant hybrid and cattle treatment provided by the government preferring their local ones.

## 5. CONCLUSION

Cattle breeding remain the main livelihoods of many Mborroro which supplements and enriches their dietary. It provides animal waste as manure, beef and milk. The Mborroro of Mbum plateau engage in this activity with virtually no economic resource due to free rangeland their native methods of treating cattle diseases. The Mborroro without cattle today on the plateau has greatly reduced as a result of climatic fluctuation, dwindling rangeland and water points as well as their changing lifestyles toward modernization the is strange within their communities. Drought has been very common in a situation where the Mborroro hardly supplement their cattle with grass nor water points. This predisposes the Mborroro communities’ climatic hazards which directly impact on their economic and social lives. While strongly recommending that an understanding of climate and socioeconomic lifestyles changes of Mborroro should be motivated with sustainable life skills, human health and food security by improving on cattle breeding should also be looked into my the Government. It is important that pest and disease contentment measures should be properly enforced in Mbum Plateau. Climatic data should be analyse and information from it spread to the local communities so as to minimize negative impact on the communities.

## 6. RECOMMENDATION

There is need for collection, processing and dissemination of the weather information that

consider a more specific area rather than generalization based on the zones. This can be done by establishing automated weather stations in Mbum (Nkambe and Ndu) Plateau. Skills development training for the poor Mborroro to prepare them for diversification particularly during periods of low agricultural output is also important. Similarly, targeted policy interventions should be investigated to promote agro-based industries to create employment opportunities to the Mborroro communities as a way of encouragement and morale booster for herdsmen. Adequate and quality health education should be mounted in the various bush settlement so as to improve on health condition of the Mborroro. Campaign on detecting environmental changes and health effects from drug and reports should be reported to MINEPIA authorities for investigation. Through this, many unfriendly drugs may be withdrawn from the market. Grazing certificates should be issues to legal graziers and they should be adequately sensitized to demarcate grazing from farm land using bark wire not bamboo which cattle can easily breakthrough. More dialoque platform should be created by the local council which promotes amicable settlement of farmers and graziers to minimize farmer-graziers conflicts. MINEPIA should encourage pastoral extension and sociology that can change the Mborroro behavior through education and information dissemination on the plateau. Regulations should be implemented to manage transhumance so as to reduce the risk of losing animals during the process. This will further reduce farmer-graziers conflicts that are frequent on the plateau. The planting of eucalyptus should be restricted and encourage planting of natural vegetation on watersheds.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

## REFERENCES


1. Africa Policy Circle. Addressing the challenges of urbanization in Africa. A summary of the 2019 Africa Policy Circle discussions; 2020.
2. Ngwani A, Balgah SN, Kimengsi JN. Urban planning challenges and prospects in Nkambe town, North West Region of Cameroon. Journal of Geography, Environment and Earth International. 2020; 24(5):83 to 95.
   Article No, JGEESI. 51401
3. Nfor JT, Umaru B, Achankeng ET, Tsalefac M. Land and water resources management in Nkambe highlands of Cameroon. Challenges and perspectives. Joint proceedings of the 27th Soil Science Society of East Africa and the 6th African Soil Science Society; 2013.
   Nakuru, Kenya. Nkambe council (2020). Land Use Plan (LUP) for Nkambe town; 2013.
4. Niba MLF, Kinyui CN, Mbu BK. Drainage basin anthroponisation and implication on water availability in the Mbum Plateau of Cameroon. International Journal of National Resource Ecology and management. 2022;22:7(3):121-131.
   Available:http://www.sciencepublishingg group.com/j/ijnrem
   DOI:co://648/j.ijnrem,20220703.11.
   ISSN:2575-3088(Print); issn:2575-3061
5. Ngawni A. Impact of environmental change on the Mborroro ethnic group of the Mbum Platea, North West Region of Cameroon. Unpublished MSc. thesis of the department of Geography, University of Buea in Cameroon; 2016.
6. Amawa S.G., Kimengsi JN, Tata ES, Awambeng AE. The implications of climate variability on market gardening in Santa Sub-Division, Northwest Region of Cameroon. Environment and Natural Resources Research. 2015;5(2):14-23.
7. Nganjo NR, Wanie CM, Akei ML. The effects of deforestation of tropical montane forest on drinking water supply in Ndu Sub-Division, North West Region of Cameroon. Journal of Sustainable Resource Management. 2016;2.
8. Tume SJP, Fogwe ZN. Standardised precipitation index valuation of crop production responses to climate variability on the Bui Plateau, Northwest Region of Cameroon. Journal of Arts and Humanities. 2018;1(2):21-38.
9. Tume SJP. Rainfall characteristics of the Bamenda highlands and coastal lowlands of Cameroon: Examples from Ndu and Douala. Celebrating ten years of restless rest in Land mark research and Human resource development: Festchrift for professor emeritus Cornilius Mbifung Lambi. Volume one section two. Climate change, variability and adaptations; 2023.
10. Lambi CM, Revisiting the environmental trilogy: Man, environment and resources. In Lambi, C.M., (Ed.): Environmental

issues: Problems and prospects. unique printers, Bamenda, Ndu council (2012). Council development Plan (CDP). 2001; 105–117.

11. Balgah RA, Kimengsi JN, Wirbam BMJ, Forti KA. Farmers Knowledge and Perceptions to Climate Variability in Northwest Cameroon. World Journal of Social Science Research. 2016;3(3):261-273.
12. Ngoran Hassan Afoni. An assessment of impact and adaptation strategies to climate variability within the agricultural sector in Bui Division, North West Region, Cameroon. Unpublihed PhD Thesis submitted in Department of Geography, Faculty of Social and Management Sciences, University of Buea; 2023.
13. Ngwani A, Roland N, Funwi GN, Randy N. Spatial planning challenges and implications on the development of Nkambe and Ndu secondary towns in the North West Region of Cameroon. International Journal of Current Research in Multidisplinary (IJCRM). 2023;8(2):01 to 14.
14. Ngawni A. Growth and development of secondary towns: Spatial planning implications in Donga Mantung Division in Cameroon. Unpublished Ph.D thesis of the department of Geography, University of Buea in Cameroon; 2022.
15. Tume SJP, Zetem CC, Nulah SM, Ateh EN, Mbuh BK, Nyuyfoni SR, Ahfembombi LL, Kwei J. Climate Change and Food Security in the Bamenda Highlands of Cameroon. In Squires, V.R., & Mahesh K. Gaur, M.K., (Eds., 2020): Food Security and Land Use Change under Conditions of Climate Variability: A Multidimensional Perspective. Springer Cham. 2020;107-124.
16. Tume SJP, Kongnso ME, Nyukighan MB, Dindze NE, Njodzeka GN. Stakeholders in climate change communication in the Northwest Region of Cameroon. In Tume SJP, Tanyanyiwa VI, (Eds.),: Climate Change Perception and Changing Agents in Africa & South Asia. Vernon Press, Wilmington. 2018;97-116.
17. World Meteorological Organisation. Standardized precipitation index user guide. WMO. Geneva. 2012;(1090):50.



*Peer-review history:*
*The peer review history for this paper can be accessed here:*
*https://www.sdiarticle5.com/review-history/116838*