

# Rainfall Variations and Socio-Spatial Changes in the Sahel: -The Case of Waza-Logone Area of the Far North Cameroon, 1970-2000

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DOI: <https://doi.org/10.47772/IJRISS.2026.10200019>

Received: 09 January 2026; Accepted: 19 January 2026; Published: 21 February 2026

## ABSTRACT

The Waza-Logone plain as many other parts of the Sahel, is characterized by two very contrasting seasons –a long dry season lasting for a large part of the year and a short rainy season lasting 4 to 5 months. There is a negative soil water balance due to high evapotranspiration which is more than 100mm per month. The volume and distribution of rainfall vary significantly from one year to another with frequent droughts..Information collected from household heads, community opinion leaders and field observations show that the essentially agro-pastoral populations have adopted many coping strategies. These include the extension of farming and rearing surfaces leading into the protected Waza National Park, a switch to the cultivation crops that require short rainy periods such as sorghum. Other adaptations include the collection and planting of Arabic gummosis and the combination of farming activities with handicraft works and/or commerce. Some animal breeders practice semi-nomadism and others transhumance as a means of adapting to the changing climatic conditions. These changes come with profound socio-spatial changes. Despite the populations' ability to adapt to variations in rainfall, many challenges persist. The increasing population pressure on limited and reducing water resources in the face of recurrent water shortages and droughts has exacerbated the situation. If urgent measures are not taken to control population growth and build drought resilient infrastructure, the socio-spatial mutations in his area could lead to more negative repercussions.

**Keywords:** climatic variability, Sahel, coping strategies, socio-spatial mutations.

## INTRODUCTION

Since 1969, unfavourable rainfall conditions have been recurrent in the Sahel. The 1970s and 80s were noted for rainfall deficits and the occurrence of devastating droughts (1972/73) and 1983/84). These droughts had negative human and economic consequences (Joussaume 2000, Diouf et al 2000)

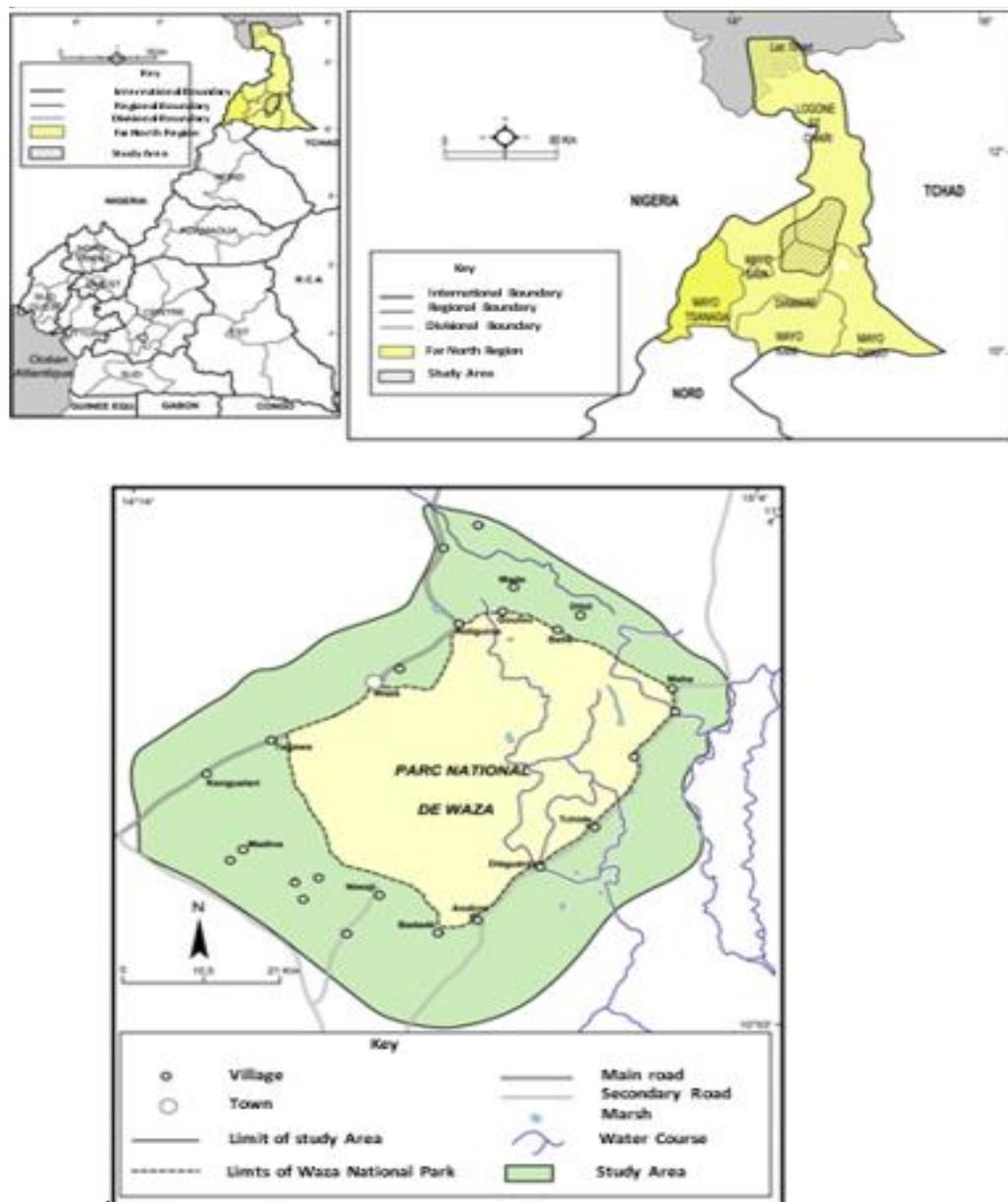
In the plains of North Mandara (For North Cameroon), these droughts extended beyond the 80s. Even though the period 1995-2005 was considered a humid period, drought years were still registered (Chetima, 2006). During years of sufficient rainfall intermittent droughts always disturb the agricultural cycle. The irregularity in the dates for the onset and end of rainfall greatly perturbs the agricultural calendar and causes uncertain food production.

The droughts of the 1980s and the construction of the Maga Dam reduced the surface area covered by flood water of the Waza-Logone plains, the pasture available during the dry season and the availability of surface water. Fishing activities, animal rearing and cultivation of sorghum around the Waza National Park have reduced drastically forcing large rural populations to leave the area. The population of wild animals and fishing grounds have reduced. Pastures are overexploited and many wild animals have been forced to move out of the zone thereby increasing the possibility of poaching (Noupa, 2004). Though the launching of the Waza-Logone Project of 1990 permitted the flooding of 30-70% of the plains, wild animals are continuously leaving the park. These animals destroy crops cultivated on flood plains in the dry season and small wildlife is exposed to poaching when they share the same water points with domestic animals. Conflicts over fishing grounds are common, sometimes resulting in deaths.

Despite the dynamism of the population of the Sahelian area, adaptation to climatic extremes (recurrent droughts) is not evident. Since the droughts of the 1970s, the populations living in the Sahel regions have undergone profound changes. Some animal breeders who lost their cattle during the drought years have become farmers, while others migrated to the more humid equatorial parts to work in plantations (Benins, 1990, 1993). During the humid years, that followed the drought years, farmers transformed their surplus harvest into animal capital (cattle, sheep and goats) thereby becoming agro-pastoralists. Also, essentially extensive agriculture practiced in the area is becoming progressively intensive and irrigation using water from permanent water courses has increased (Thiband et 2001). To the North of the Mandara Mountains, some peasants have reconstituted herds lost during the dry years of the 80s while others have become farmers. The production of cotton, the main cash crop of the area has dropped from 1200 kg/ha before 1970 to 500 kg/ha since 1988 in favour of the cultivation of less water-demanding crops (SODECOTON, 2018).

**Location of the Area of study**

The Area covered by this study lies between latitudes 11°10 and 11°55 north of the equator and 14° 20 and 14° 40 east of the Greenwich Meridian. This area is limited to the south by Yagoua Limani dunes, to the north by the ridge that separates Rivers Djogoufa and Ndekeya, to the east by Lugumatya and to the west by the Federal Republic of Nigeria (**Map1**).



**Figure 1: Location of the Study Areas**

## Definition of concepts

**Rainfall variability:** refers to fluctuations of rainfall values around the average within a period of less than 30 years. In other words, it refers to variations in the alternation between wet and dry periods or the irregularities that characterize the onset and the end of seasons or the shortening or prolongation of the rainy and dry seasons.

**Date of the start of the rainy season:** This is the date that rainfall starts. This date varies depending on whether we are using the hydrologic, climatic or agronomic definitions. In this study, the agronomic and climatic definitions are used.

The agronomic and climatic definitions use the dates of the start and end of the dry or rainy seasons.

The climatic criterion defines the duration of the rainy season as the period between the date of appearance of the first rains and the date of the last rainfall of the year.

The agronomic definition defines the start of the rainy season as the first time that rain falls for at least three consecutive days and attains 20 ml. There must not be more than 7 days of no rainfall in 30 days. The last day of rainfall in this area is often after 1<sup>st</sup> September and is the period followed by 20 consecutive days of no rainfall.

## Social mutations, socio-spatial mutations

This refers to the brutal or progressive functional changes within a geographic space characterized by new behavioural patterns in response to unusual climatic conditions or new economic contexts. These mutations involve:

The movement of agricultural labour, peasants or animal breeders to regions with better conditions  
Changes in methods of soil exploitation, reconversion of farmers and animal breeders  
Changes in methods of water management and access to land.

## Sahel

It is an area found between the Guinea Savanna to the south and the Sahara Desert to the North. It is an area characterized by a tropical arid or semi-arid climate with seasonal variations in climatic conditions due to the influence of Monsoon Winds from the Gulf of Guinea and the Harmattan Winds from the Sahara Desert. The north and south limits correspond to isoyets 600 mm and 150 mm respectively (Diouf et al, 2000 and Houerou, 2007). The availability of water resources is low and the vegetation is made up of degraded steppe. The Sahel region of Cameroon extends from the Northern parts of Mount Mondara right to the Northern limits of the country around the Diamaré-Logone plain.

## Protected areas

Protected surfaces are protected in order to preserve their biodiversity and enhance their rational use (Binot et al, 2005)

## Reasons for Choice of the Study Area

The periphery of Waza National Park attracts populations from different horizons, due to the availability of surface water (the clay soil has a high water retaining ability and suitable land for the cultivation of sorghum after flood retreat and the availability of animal pasture. Peasants from neighbouring localities (Kousseri, Mora, Maroua and even Banki in neighbouring Nigeria move there to cultivate sorghum when floods retreat. Some peasants have abandoned their farms and have migrated to the Waza-Logone area to be employed on farms. After the harvest season, many peasants live on harvesting wood, hunting or sinking fish ponds. With the increasing scarcity of water resources as a result of recurrent droughts in the Sahel, flood plains with permanent water have become centres of attraction for animal breeders, fishermen and farmers. The struggle for access to this increasingly scarce source has resulted in many dynamics and conflicts that need to be properly examined.

## Data and Methods

### Sources of Data

Data for this study come from a variety of sources which include:

The use of aerial photographs and satellite images to analyze spatial changes in land exploitation and the vegetation cover

Use of meteorological statistics available at the meteorological stations in Mora, Kousseri, Bildar and Maroua information provided by Cotton Development Corporation (SODECOTON).

During the collection of data from households, the study zone was divided, into study zones which correspond to administrative subdivisions. In each subdivision, all tribal groups were retained for the survey. In each tribe, all the villages were surveyed. 10-20% of households in each village were interviewed depending on their availability.

Apart from household interviews, interviews were conducted with many groups and opinion leaders such as:

- peasants in groups
- traditional leaders
- Interview of agricultural extension workers, NGOs and workers of SODECOTON

Group interviews were carried out through focus group discussions.

### Statistical Treatment of Agro-Climatic Statistics

This treatment is carried out using descriptive inferential methods. The analysis of interannual variability in rainfall is carried out using the equation.

$$Y_1 = \frac{X_1 - \bar{X}_C}{\delta} \quad \bar{X} = \text{mean annual rainfall}$$

$\delta$  = standard deviation of annual rainfall

$Y_1$  = reduced deviation of annual in dice

The relationship between rainfall variation and crop yields is established through the calculation of coefficients of correlation and the linear regression equation ( $Y = ax + b$ ).

This is done in order to show that rainfall partly influences crop yield and can lead peasants to adopt coping strategies.

### Research Questions

This study is based on the following question:

- ❖ What is the pattern of rainfall in the Waza-Logone Plains of the Sahel Region of Cameroon since 1970 and what are the spatial-social changes provoked by this pattern?

### Characteristics of the Area of Study

The Waza National Park is found in the Logone Plain in the Sahel part of Cameroon. Significant socio-spatial mutations have been taking place around this protected zone as a result of frequent extreme unprecedented variations in rainfall.

## Relief

Waza-Logone plain has an average altitude of 312 mm. Its surface presents a gentle slope with many dunes the most important being the Waza-Badadaye which extends for close to 13 km. The near-flat nature of the area facilitates the flooding of a large during the rainy season.

## Drainage

The hydrographic network plays an important role in agricultural production in the area. Apart from the Logone River which is permanent, other watercourses are temporal. The volume of these watercourses increases rapidly during periods of rainfall causing floods but later reduce rapidly when the rains go away. The dynamism of the hydrographic network results in alternating periods of flood and flood retreat.

## A Vegetation in High Demand, A Rare and Protected Fauna

This area is covered by a steppe vegetation that is adapted to its relief. Upstream at the town of Waza where submersion of the land is brief and limited, a vegetable of Acacia has developed. The vegetation is often under attack by wildlife and domestic animals. This vegetation is also exploited for firewood. The lack of sufficient means for livelihood causes many people to hunt even in the protected areas.

## Climate

The climate of this area shows extreme variations in rainfall, temperature and relative humidity both within the year and between the years. These variations are governed by the changing position of the inter-tropical convergence zone. The period of high relative humidity is from May to September and more especially between July and August. The length of the dry season varies between 6 and 9 months with no rains registered within the period of November to February. The Waza-Logone plain registers the highest temperature in Cameroon. The mean temperature is always above 25°C with an annual range of 13.2°C. The inter-annual temperature range is 6.3°C (SODECOTON, 2018). These climatic conditions influence the occupation and exploitation of the Logone plain. The varying nature of the climatic conditions pushes the populations to adopt many adaptation strategies.

## Population

The population of this area is multi-ethnic and highly unevenly distributed. The population of the localities that are found at the limits of the Waza Park is estimated to be 300.000 people. 50% of this population is less than 15 years and the average population density is 81 persons per square kilometre (BUCREP, 2005). In the subdivisions of Mora and Petté, this population density is 101 and 110 persons per Km<sup>2</sup> respectively but more to south around Waza, this density reduces to 32 persons per square kilometre.

## Tribal Communities.

In the Waza-Logone Plains, many communities exist. Some communities are essentially fishermen, others are farmers and others are animal breeders. They have been settled here for many centuries. These are the kotoko, Kanuri, Choa Arabs, Musgum and Peuls.

**Kotoko** – initially they showed little interest in agriculture as they were essentially fishermen but today, many of them have turned to the cultivation of sorghum. Money derived from animal rearing is reinvested into rice farming. Their cohabitation with the Musgum is conflictual and essentially linked to the management of water resources.

**Kanuri:** These were initially farmers but they have begun rearing goats, sheep and cattle. They plant sorghum and use plant residues to make animal feed in order to face the scarcity of pasture during dry periods. They are found in Waza, Petté and Mora subdivisions.

**Musgum:** Like the Kanuris, they are found in all the subdivisions that border the Waza National Park.

**Choa Arabs:** They are also found in many villages in the area. Choa Arabs live a semi-nomadic or transhumant life depending on the seasons. They only move to the Logone Plain during the dry season.

**Peul:** Initially animal breeders, Peuls of this region practice agriculture as well as well as other non-pastoral activities. Their way of life is governed by frequent droughts.

**An Economy that is Vulnerable to climatic Hazards.**

The economy is based on agriculture, fishing and animal rearing. These activities are largely influenced by climatic variations.

**Agriculture**

The population cultivates cotton and essentially cereals, for subsistence. The main subsistence crops cultivated are millet, sorghum and rice. They are cultivated on small parcels, especially in the subdivision of Mora. Cotton produced is sold to SODECOTON which provides seeds, pesticides and fertilizers to the farmers. Since 1990, the average land area devoted to the cultivation of cotton has been on a decline. This is explained by the drop in the price of cotton and the rise in the price of millet.

**Animal Rearing**

This is the second most important activity in the area after agriculture. It employs about 50% of the population. It is mostly practiced by Choa Arabs and Peuls who practice semi-nomadism. The Kanuri, Musgum and Kotoko own few cattle and practice mostly sedentary animal rearing. This region receives cattle during the dry season from Kousseri, Diamaré and from Nigeria and Niger.

Fishing is practised in the marshes, canals and other water sources of the Waza-Logone floodplain. The fish catch here is about 12000 tons per year (Chetima, B, 2006). Part of the catch is consumed and part is sold fresh or smoked.

**Variability in Rainfall and its Impacts on Agro-Pastoral Activities Around the Waza National Park.**

The section examines how climatic conditions have influenced and continue to influence socio-spatial dynamics around the Waza National Park. It analyses inter-annual variations in rainfall and its incidence on agro-pastoral activities, spatial dynamics and the development of new activities.

**Annual Variations in Rainfall.**

Globally, the period 1970-90 witnessed rainfall deficiencies while the years 1974-1978 and 1981 registered rainfall amounts that were largely above average (table 1).

**Table 1: Humid and Dry Seasons from 1970 to 2000**

Decades	Years of Deficiencies	Humid Years
1970	5	5
1980	10	0
1990	3	7
2000	3	7

**Source: Meteorological Stations of the Study Area**

From 1970 to the decade 2000, there were more years of rainfall deficits than those of rainfall surplus (21 years of rainfall deficits and only 19 years of surplus).

### Variations in the Yearly Unset and End of rainfall

In the Waza-Logone Plains, as in other parts of the Sahel, dates for the unset of rainfall vary enormously; irrespective of the definitions used. When the climatic criterion is considered, this onset varies from the beginning of April to the second half of June but when the agronomic criterion is considered, the onset of rainfall is from mid-June while rainfall only becomes effective in July with a rainfall frequency of 70.5%.

Variations in the length of rainfall vary depending on the criterion used. When the climatic criterion is used this average was 174 days for the period 1970-2006 but when the agronomic criteria is used, this period reduces to 111 days. There exists a significant yearly variation in the length of the dry season (149-190 days when the climatic criterion is used and 84 - 130 days when the agronomic criterion is used.

**Table 2: Distribution of Months of the Start of Rainfall (Climatic and Agronomic Criteria) by Decades (1970-2000)**

Decades	Climatic Criterion			Agronomic Criterion			
	March	April	May	May	June	July	August
1970	20	50	30	10	60	30	0
1980	20	40	40	40	20	30	10
1990	10	70	20	20	10	70	0
2000	0	85	15	29	57	14	0

Source: Meteorological Stations of the Study Area

Irrespective of the criterion, the dates for the start of rainfall vary significantly from year to year (tables 2 and 3).

Decade	Climatic criterion			Agronomic Criterion		
	September	October	November	September	October	November
1970	0	80	20	10	90	0
1980	10	80	10	20	70	10
1990	30	70	30	50	50	0
2000	0	100	0	0	100	0

Source: Meteorological Stations of the Study Area

Like the dates for the start of the rainy season, those of its end also vary from year to year no matter the criterion considered.

These different forms of climatic variations influence agro-pastoral activities.

### Climatic variability, Agro-pastoral Activities and Spatial Mutations (Dynamics)

#### Climatic Variations and Agricultural Yields around the Waza Park.

Globally, there is an inverse relationship between the surface of land devoted to the cultivation of cotton and rainfall. This was observed in 2002 and 2005. When the date for the start of the agronomic rainy is late as in 2003 when it started on July 30<sup>th</sup> the surface of land devoted to cotton production reduces.

This assertion is confirmed by the coefficient of correlation between the surface area used for cotton cultivation and the date for the onset of rainfall which was 0.41. This coefficient is higher than that between the date for the

onset of rainfall and total annual rainfall which is – 0.03.

### **Rainfall Variations and Crop Yields**

The yields of sorghum that is grown on the floodplains in the dry season increase with rainfall up to 750 mm and above this value, the yield reduces. The coefficient of correlation between annual total rainfall and yield shows that sorghum planted after the retreat of water from floodplains is less dependent on rainfall than sorghum that is planted during rainy periods (correlation coefficients of 0.21 and 0.41 respectively).

### **Migration of Farmers and Spatial Dynamics**

The Maga Dam was constructed in 1990 and the reduction of rainfall witnessed in the 1980s greatly reduced the submerged surface and the duration of floods in the lowlands around Waza (Sighomnou, 2003). This resulted in many years of reduction of crop yields and a reduction in the number of farmers that converged into this area. Vast areas of land were abandoned. For some time now, farmers from other localities have started converging into the area and recapturing land that was once abandoned. This new dynamic is stimulated by the increase in rainfall starting from 1990 and the opening of some outlets of the Maga Dam which have increased the land surface that is flooded during the rainy season.

### **Photo No.1 Extension of Farms up to the Limits with the Park**

#### **a) Belle b) South of the Park**

At Belle (3a) separation of farms from the Park has reduced to a narrow band of less than 1m while in ( b) the buffer zone between the park and farms has been encroached upon.





The surface area that is temporarily flooded has increased the land surface that is cultivated after flood retreat. Vast surfaces of land have been cleared in marshy areas at the limits of the park to give way to farmlands for the cultivation of sorghum.

Between 2000 and 2007, two new villages were created in some formerly deserted areas around the Waza National Park. Some pasture lands were converted to sorghum farmlands. At the eastern end of the park, rice cultivation was introduced in the 1980s. The land surface that is bare or occupied by acacia has increased to the detriment of the surface formerly covered by grass.



**Photo 2:** New Settlement Established at the Limits of Waza National Park 2000 and 2006

With improved rainfall, new settlements have been established betweenin this area as the The creation of these settlements have increased the population pressure on the increasing scarce natural resources leading to the modification in the geographic space.

### Changes in Crops Cultivated

Over the years, there has been a gradual shift in the crops cultivated. In many parts of the Waza-logone Plains, farmers are shifting from the cultivation of cotton to the cultivation of onion and sorghum which require short growth periods. Due to the fact that the cultivation of sorghum requires less maintenance, vast areas of land are devoted to its cultivation to the detriment of pasture land. This situation has led to farmers-graziers conflicts.

### Seasonal Migration and Space Dynamics

Every year, the region of Waza receives two categories of in-migrants. These are paid farm labourers and those who go there to work on their own accounts. The cultivation of sorghum after flood retreat consists of preparing the parcels and transplanting the young crops.

This work must be executed within a very short lapse of time (one to one and a half months). This requires much labour which is supplied by seasonal labourers who come in the months of September and October. From September to October 2006, about 500 migrant labourers came to work in these localities Within the same period, 219 persons came there to work on their own account with 219 taking up permanent residence(Chetima,2006).

### Fishing, Rice Cultivation and Migration

In the course of the 1980s, years of rainfall deficits, fishermen, considered as climatic refugees came other regions including Nigeria for fishing. With the coming of more rainfall after 1990, and the opening of some outlets of the Maga Dam, fishing has become an important activity and the number of in-migrants working in the fishing sector has increased tremendously. Many in-migrants are fishermen and are also employed in digging fishing canals and planting rice. The digging of many canals has resulted in the rapid drainage of flood waters. These canals trap fish thereby facilitating their capture. This promotes over-exploitation and reduces sustainability.



**Photo 3 Fishing canals at Logamatya. These canals retain water and have become important fishing grounds during the dry season.**

On the rest of the plains (especially to the north and the east), canals have been constructed with the aim of retaining water. These canals are used as fishing sites during the dry season. However, the management of fishing

canals by fishermen always results in conflicts. This was the case of Zina (march 2007) in which the conflict between Kotoko and Musgum fishermen resulted to more than 30 deaths.

### Variations in Rainfall and Animal rearing

Animal rearing in this region requires permanent or seasonal displacements. Following the type of displacements, we can distinguish three types of animal rearing namely sedentary, transhumance and semi-nomadism.

#### Sedentary Animal Rearing

The sedentary rearing of goats, sheep and cattle of a few heads in neighbouring localities to the Waza National Park is becoming increasingly important. This activity has been highly encouraged by the insufficiency of pasture during the dry season and periods of droughts. Consequently, the number of animals reared depends on rainfall. Rainfall deficits (droughts) often result in the shortage of cereals thereby pushing animal breeders to sell some of their animals in order to buy cereals.

#### Transhumance

Transhumance is imposed onto the animal breeders by the variations in the dates of onset and end of rainfall. During the often long rainy seasons which are caused by the late start of rains and its early stop, many animal breeders lack water and pastures for their animals. Many of them are forced to migrate with their animals to the east of Waza National Park where there is perennial pasture.

#### Semi-Nomadism

In contrast to transhumance which necessitates displacements only during dry years, semi-nomadism takes place irrespective of the annual amount of rainfall. During the period from June to September, the flooded portions of Waza-Logone are impracticable for animal rearing and animal breeders are forced to move to unflooded parts that are not being cultivated. During the months of March and April, the animals return to the formerly flooded areas to feed on crop remains.

#### Foreign herds

The southern part of the Waza-Logone flood plain also receives many foreign herds. These foreign herds come from member countries of the Lake Basin Commission notably Nigeria and Niger. These animals feed on the pasture that develops in the dry season after the retreat of water from the floodplains. Sometimes, branches of acacia are cut to enable cattle to feed on them. This contributes to the loss of acacia plants (photo 4).



**Photo 4 :** Branches of acacia are cut for some ruminants to feed on. The continuous cutting of branches of trees to provide feed for animals usually ends up destroying the plants.



**Photo 5:** A Herd of Cattle Leaving the Waza-Logone Floodplain after the Unset of the First Rains of the Year.

Yearly movements in out and of the floodplain are regular. In search of pasture, nomadic cattle breeders move up to the limits of the Waza Park. Here the density of cattle per square kilometre moves from an average of less than 25 in neighbouring localities to the Waza National Park to about 29 (Seignobos et al, 2000).

### **Agro-pastoral Activities and Wildlife**

In this region, the practice of agro-pastoral activities which extend to the limits of the Waza National Park has resulted in domestic animals being attacked by wildlife and grains being consumed by wild birds.

#### **Attack on Domestic Animals by Wildlife**

The reduction of pasture surfaces as a result of an increase in the land surface being used for agriculture and loss of pasture due to droughts, domestic animals encroach into the Waza National Park where some of them are killed by lions and hyenas.

#### **Grain Consuming Birds**

Sorghum cultivated during the dry period is more destroyed than that during the rainy season. This may be linked to the fact that during the rainy season, these birds live on wild grains and encroach less on planted grains. The intensification of grain cultivation after the wet years of the 1990s has brought many grain-consuming birds into the area.

#### **Social Changes and the Development of Seasonal Activities that are Less Vulnerable to Climatic Hazards.**

For close to 10 years, the harvesting of Arabic gummosis, trade in firewood, and netting of mats have become important activities in the area. These activities are less dependent on rainfall and permit peasants to reduce the impacts of droughts on their revenues.



**Photo 6:** Locally Made Mats Exposed for Sale

The making of mats is one of the activities that has been developed by the local population to complement revenue from agriculture or animal rearing that are often affected by recurrent droughts.

The harvesting of wild Arabic gummosis is not new in the region of Waza. Arabic gummosis is used locally as medicine in the treatment of certain skin diseases, dysentery and constipation. It is also used as ink in Koranic schools. Up to 1995, the traditional activities of the area (animal rearing, fishing and agriculture) were able to meet the basic needs of the population but with changing climatic conditions and population increase, the harvesting of wild Arabic gummosis and its cultivation has become a key activity.

Nursery of Arabic Gummosis- A crop that is very resistant to drought condition



Source; Photo taken the researcher in March, 2024

### **Brief Discussion of the Findings**

The Logone-Waza Flood Plain is a sensitive ecosystem facing many challenges specially climatic variability. Being an area that depends especially on rain-fed agro-pastoral activities, rainfall fluctuations have particularly important impacts on the local communities and their socio-spatial dynamics.

The discussion on rainfall variability and socio-spatial mutations in the Sahel, specifically in the Logone-Waza Flood Plain in the Far North Region of Cameroon, highlights the complex relationships between climate change, land use, and human activities

The Sahel region is highly vulnerable to climate change with rainfall variability affecting agriculture and livelihoods. Studies (Lhena, M,C, 2018) show that local communities adapt to these changes through different strategies, including changes in farming practices, migration and involvement in non-agro-pastoral activities such as commerce.

Recurrent droughts and changing rainfall patterns have severely affected crops yields and livestock in the Logone-Waza causing communities to shift to the cultivation of more drought resistant crops and alter their farming calendars. A key change is the movement of the population towards areas of greater water availability. The population has intensified practices such as flood-recession agriculture and has diversified income sources by getting into the selling of firewood, fishing, trading, mixing farming with other activities and seasonal labour migration.

Communities in this area have been dealing with climate whacks for ages, so they are pretty resourceful, however, government, non-governmental organizations need to provide more support to their efforts through the provision of climate-resilient infrastructure, improve water management and promote sustainable land use practices.

## CONCLUSION

This study aims to analyze the variations in rainfall as well as the resulting socio-spatial mutations. Rainfall statistics as well as survey information facilitated the determination of the succession of dry and humid years as well as the changes that go with this succession. A key outcome of this analysis is the fact that the years 1970-1980 were largely deficient in rainfall while since 1991, the situation has improved. To adapt to these changing climatic conditions, the population of Waza-Logone has adopted the cultivation of crops on the floodplains after the retreat of rainfall, the harvesting of wild Arabic gummosis and its cultivation, out-migration to more humid parts of Cameroon, fishing and commerce in firewood, etc. These have provoked important spatial and social changes in the area. Despite populations' ability to adapt to variations in rainfall, many challenges persist. According to the 5th Cameroon Household Survey carried out in 2021 population of this area is among the poorest in Cameroon. With the highest population growth rate in Cameroon, the pressure on the limited water resources in the face of recurrent water deficits is likely to exacerbate if urgent measures are not taken to control population growth here and in the whole of Sahel.

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