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Effects of Climate Variability on Bushfire Regimes in the Bagoué Region, Côte d'Ivoire

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Bushfires are an important factor in the dynamics of savannah landscapes. This study is carried out in the Bagoué region to evaluate the relationships between climatic variability and bushfire regimes. To achieve this objective, rainfall and temperature data were analyzed. The information's were collected with 300 heads of household surveyed, 100 in Boundiali, Kouto and Tengrela were selected, respectively. A purposive sampling was defined according to the following criteria: any person who uses fires in agricultural activity; the respondent must be at least 30 years old and have been in the survey for at least 20 years. The results recorded from 1990 to 2002, showed that the rainfall was increased at 14.8%followed by a 10.7% and was decreased between 2003 and 2020 in Boundiali. Average annual rainfall was 1,408.99 mm, with a 13.2% increase between 1990 and 2002 and a 20.1% deficit between 2003 and 2020. Average annual rainfall in Tengrela also showed

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h1,515.9 mm, with a surplus of 171.5 mm, i.e. an increase of 12.8% from 1990 to 2002 and a rainfall deficit of 9.2% from 2003 to 2020. Temperatures rise to 0.7°C, 0.74°C and 0.74°C in Boundiali, Kouto and Tengrela between 1990 and 2020, respectively. Three fire periods were identified with lowest intensities and frequencies. The combination of rainfall declining, the temperatures increasing, the highest dry biomass, and the agricultural activities contributes to the emergence of bushfires in the Bagoué region. This study highlights the importance of addressing these factors to mitigate the impact of bushfires. This research highlights the importance of considering climatic factors in understanding bushfire dynamics in savannah landscapes.

Keywords: Bagoué; bushfires intensity; climate variability; savanah landscape.

1. INTRODUCTION

Climate disturbances have been perceived through a strong rainfall deficit since the 1970 [1-3]. These climate disturbances lead to poor rainfall distribution, droughts, violent winds and rising temperatures [2-6]. Indeed, recent variations in the current climate, including rising temperatures and falling rainfall, are said to intensify conditions for the ignition and spread of fires in savannahs [7]. In Côte d'Ivoire, work on rainfall variability has focused on pockets of drought and water deficit, with considerable decreases in rainfall heights since 1960 and the onset of the drought marked by the year 1999 [3,8-12]. Since then, the savannah that was the orthocenter of bushfires is more affected by rainfall and thermal variations. Poor spatio-temporal distribution of rainfall can lead to pockets of drought, making it easier for bushfires to start. In addition, climate change has consequences for biodiversity, the economy and agriculture, and would prolong droughts, exacerbating bushfires [13,14]. Faced with this situation, bushfire regimes must be managed, taking into account the influences of climate change and considering preventive practices to avoid dangerous situations. For this reason, knowledge of certain potential climatic parameters (rainfall, temperature) in impacted areas and their influence on bushfires is essential. So, the questions that arise are as follows: How has the climate evolved in the Bagoué region between 1990 and 2020? What are the resulting bushfire regimes during the dry season? What is the relationship between climate variability and bushfire regimes? This article examines the impact of climate variability on bushfire regimes in the Bagoué region. Specifically, the aim was to understand climatic variability, characterize bushfire regimes during the dry season, and then determine the relationship between climatic variability and bushfire regimes.

2. MATERIALS AND METHODS

2.1 Study Site

The Study was carried out in the Bagoué region, located in the north of Côte d'Ivoire between latitudes 10°45'00''N and 9°00'00''N and longitudes 6°00'00''W and 7°00'00''W. It has a predominantly agricultural population estimated at 515,890 inhabitants and a surface area of 16,644 km² (RGPH). It has an average annual rainfall of 895.89mm and a temperature that ranges from 22.13°C to 29.14°C. The relief is characterized by hills and plains at altitudes ranging from 350 to 400 m, with a predominance of plateaus at altitudes ranging from 300 to 500 m (Regional Agricultural Directorate of Boundiali).

2.2 CLIMATIC DATA

Rainfall data for Bagoué are provided by the Regional Directorate of Agriculture in Boundiali, while temperature data are provided by SODEXAM. Rainfall data outliers in the time series were decelerated using the Rclimdex application [15].

2.3 Schemes and Sampling Methods

Surveys were carried out among 300 heads of household (farmers, hunters, herders), i.e. 100 heads of household per locality (Boundiali, Kouto, Tengrela). These surveys were based on purposive and/or quota sampling, defined according to the following criteria: any person who uses fires in their agricultural activity in the localities of Boundiali, Kouto and Tengrela; the respondent was required to be at least 30 years old and to have been living in the locality for at least 20 years. The information sought was collected from December 21, 2022 to the February 23, 2023 and from May 11, 2023 to July 30, 2023. It covered fire regimes, crops grown, climate and their impacts on fire regimes.

2.3.1 Dispersion indices for climatic parameters

Climatic variables such as temperature, humidity, wind and rainfall were processed using the arithmetic mean and frequency. The arithmetic mean is the fundamental central tendency parameter. It was used to characterize the average climatic condition of the area and to develop a number of dispersion indices in the time series, according to the following formula:

$$\overline{X} = \frac{1}{n}\sum_{i=1}^{n} x_i \qquad (1)$$

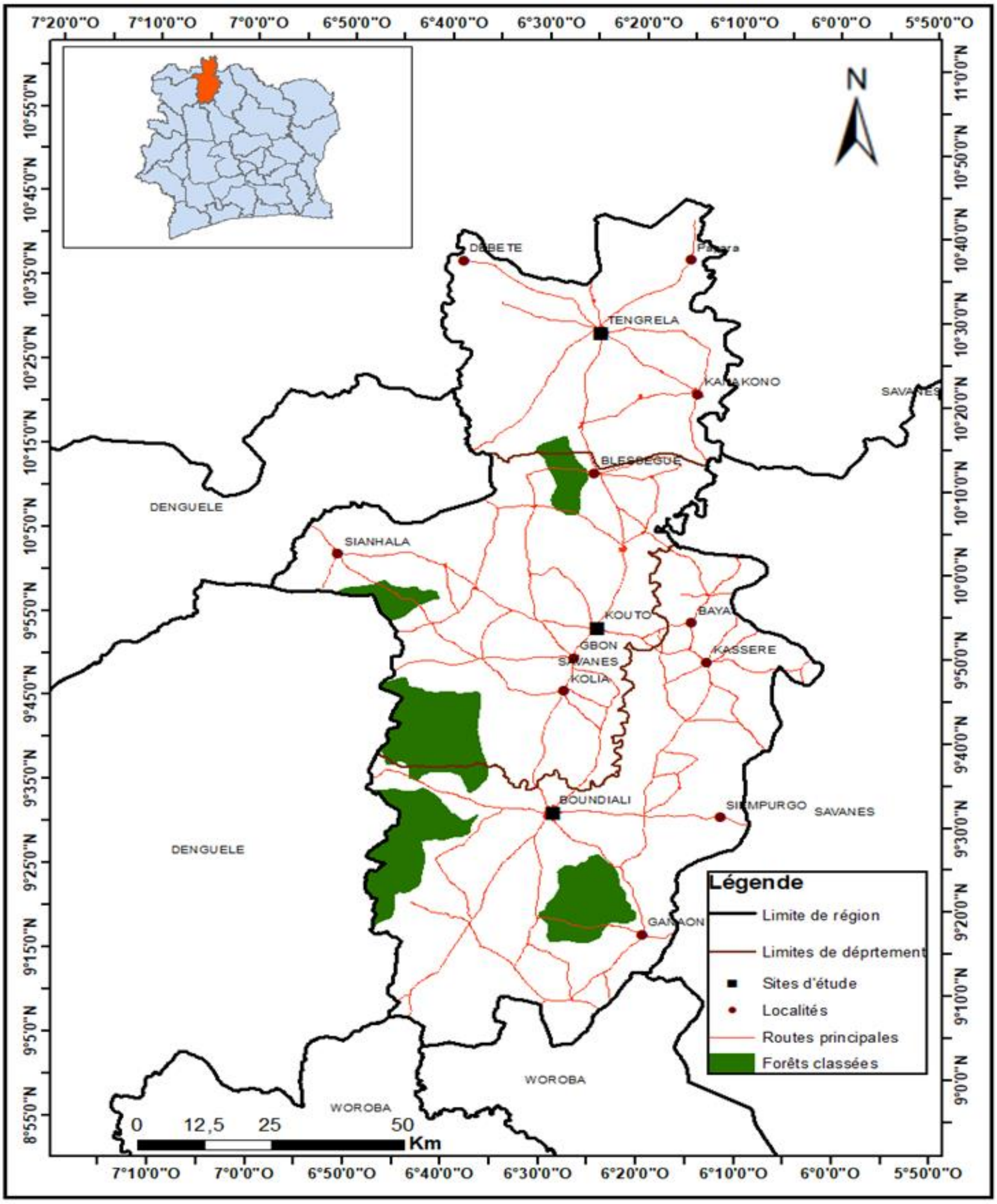


Fig. 1. Localization of study sites (Source: LATIG/IGT)

2.3.2 Standardized Precipitation Index determination

The Standardized Precipitation Index (SPI) is a rainfall index, characterized by its simplicity of use and, has the advantage of highlighting surplus years, normal years and deficit years [13,9]. It has been used to assess the severity of drought in maize, groundnut, cashew and cotton-growing areas in Côte d'Ivoire. This Index measures the deviation of annual rainfall from the series mean in relation to the standard deviation, using the following formula:

$$Iij = \frac{(X_{ij} - \bar{X}i)}{ói} \quad (2)$$

With: Iij = Standardized Rainfall Index; Xij = Cumulative rainfall per year; $\bar{X}$i= Series mean; ó(x) = Series standard deviation.

In addition, to better observe interannual variations in climatic parameters, it was necessary to eliminate point fluctuations by means of Hanning's non-recursive low-pass filter of order 2 [2]. Thus, the mathematical formula for the Hanning non-recursive low-pass filter of order 2 is as follows:

$$x(t)=0{,}06x(t-2)+0{,}25x(t-1)+0{,}38x(t)+0{,}25x(t+1)+0{,}06x(t+2) \quad (3)$$

Where: x(t) = total weighted rainfall in year t, x(t-2) and x(t-1) = total observed rainfall for two years preceding year t, x(t+2) and x(t+1) = total observed rainfall for two years following year t.

The Iij indicates whether the area is irrigated (wet) or not (dry). This classification was made into six (6) classes according to the degree of dryness (Table 1).

Table 1. Drought classification in relation to Iij value

Class Iij	Dryness degree
Iij>2	Does not exist
0<Iij<1	Medium humidity
1<Iij<2	High humidity
-1<Iij<0	Average dryness
-2<Iij<-1	Severe drought

Source: Bergaoui and al., 2001

2.3.3 Method to assess the effects of climatic variability on fire regimes

We carried out a correlation test to measure the relationship of influence between the various bushfire regime variables and climatic variables (rainfall and temperature). The linear correlation coefficient, also known as Pearson's correlation coefficient, measures the strength and direction of the relationship between two variables [16]. It is calculated by normalizing the covariance of the variables by the product of their standard deviations. The coefficient ranges from -1 to +1. A correlation coefficient of 1 indicates a strong positive correlation, meaning that as one variable increases, the other variable increases as well. A correlation coefficient of -1 indicates a strong negative correlation, meaning that as one variable decreases, the other variable decreases. A correlation coefficient between 0.5 and 1 indicates a strong positive correlation with high intensity, while a correlation coefficient between 0 and 0.5 indicates a weak positive correlation with low intensity. A correlation coefficient of 0 implies no correlation or independence between the variables. A correlation coefficient between -0.5 and -1 indicates a strong negative correlation.

2.3.4 Data processing

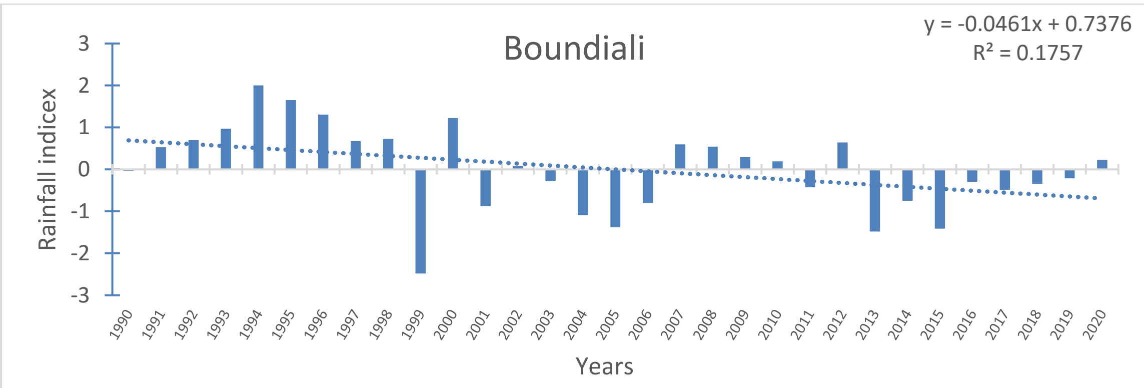
The Arc GIS version 10.3 mapping software was used to produce the map. The data from the questionnaire surveys are mainly qualitative and quantitative. Once the data had been collected, the questionnaires were tabulated, entered and organized in Excel, and each variable was coded in a code book. The data were then analyzed using Microsoft SPSS version 22.0 (IBM, New York, USA).

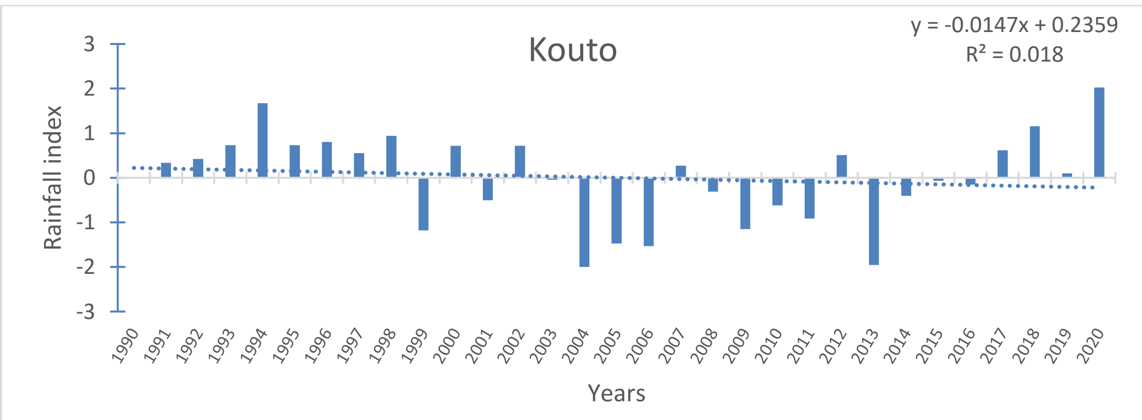
3. RESULTS

3.1 Rainfall and Temperature Inter-annual Variability from 1990 to 2020

The rainfall index makes it possible to determine the rainfall extremes experienced by the Bagoué region over the study period. The interannual rainfall dynamics study for the Bagoué region covers the period (1990 - 2020). The rainfall index of Nicholson presents rainfall trends in the Bagoué region, particularly in Boundiali, Kouto and Tengrela. In the Bagoué region, rainfall trends are generally downward. Between 1990 and 2002, Boundiali experienced a rainfall excess. During this wet period, rainfall indices ranged from -2.48 to 2. In addition, the average annual rainfall for the excess period was 1408.0 mm, well above the interannual average of 1226.5 mm from 1990 to 2020, i.e. a surplus of 181.5 mm. This means an increase of 14.8%

between 1990 and 2002. This period has seen a number of deficit years (1990, 1999, 2001). From 2003 to 2020, Boundiali as a whole underwent a period of rainfall deficit. The average for this period is an estimated 1095.41 mm, a rainfall deficit of 131.1 mm compared with the 1990-2020 inter-annual average of 1226.5 mm. This means a drop of 10.7% between 2003 and 2020. This period has seen some surplus years (2007, 2008, 2009, 2010, 2012 and 2020), but its rainfall remains on a downward trend from 1990 to 2020. The year 2013 marks the start of an intense drought, while 2020 heralds a resumption of rainfall in Boundiali. Between 1990 and 2002, Kouto had rainfall surpluses, with rainfall indices ranging from -1.94 to 1.94 and an average annual rainfall of 1,526.9 mm. This is well above the interannual average of 1349.2 mm from 1990 to 2020, a surplus of 177.7 mm. This represents a 13.2% increase between 1990 and 2002, with some deficit years (1990, 1999, 2001). From 2003 to 2020, Kouto in general experienced a period of rainfall deficit, with an estimated average of 1220.8 mm, i.e. a rainfall deficit of 306.1 mm compared with the 1990-2020 inter-annual average of 1526.9 mm. This represents a 20.1% drop between 2003 and 2020. This period has recorded some surplus years (2007, 2012, 2017, 2018, 2019 and 2020), but its rainfall remains on a downward trend from 1990 to 2020. The year 2003 is the start of an intense drought, while 2017 marks a recovery in rainfall in this locality. Tengrela saw a rainfall excess from 1990 to 2002. During this wet period, rainfall indices ranged from -1.2 to 1.7. Average annual rainfall during the surplus period was 1,515.9 mm. This is well above the interannual average of 1344.4 mm from 1990 to 2020, in excess of 171.5 mm, which represents a 12.8% increase between 1990 and 2002. This period also saw some deficit years (1999 and 2001). From 2003 to 2020, Tengrela as a whole experienced a rainfall deficit. The average for this period is around 1220.5 mm, a rainfall deficit of 123.9 mm compared with the inter-annual average of 1344.4 mm from 1990 to 2020. This represents a drop of 9.2% between 2003 and 2020. This period includes surplus years (2007, 2012, 2017, 2018, 2019 and 2020), but its rainfall is declining from 1990 to 2020. The year 2003 marks the start of a severe drought, while 2017 heralds a resumption of rainfall in Tengrela (Fig. 2).





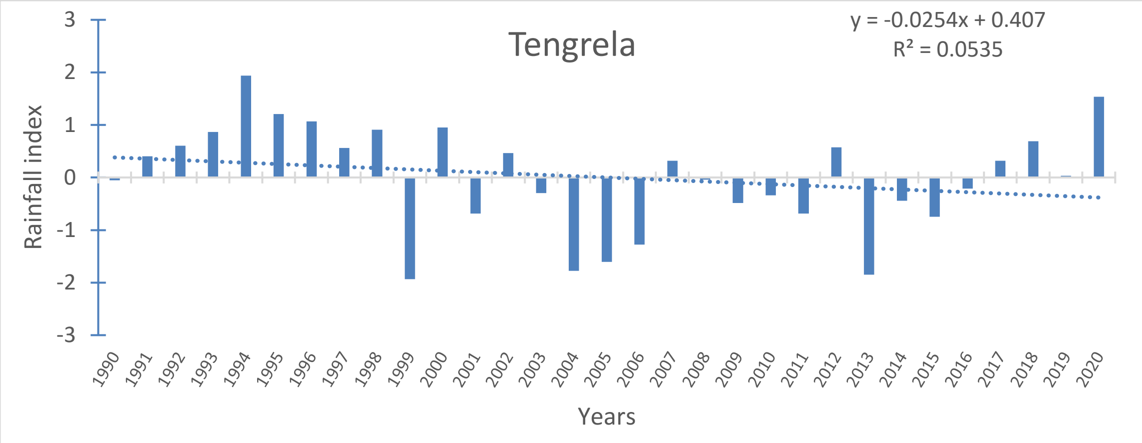


Fig. 2. Interannual rainfall variability in Bagoué region from 1990 to 2020.

Inter-annual temperature dynamics in the Bagoué region for the period 1990 - 2020. In this region, the general trend of temperatures is downward. The average annual temperature between 1990 and 2005 was 25.96°C, while the average temperature between 2006 and 2020 was 26.66°C, or 0.70°C. This represents an increase of 2.66% compared to the mean temperature (26.30°C) over the period 1990 - 2020. The heavy period includes the exceptional years (1999, 2000, 2002, 2003, 2004 and 2005) and the light period includes the deficit years (2008, 2009, 2010, 2011, 2012 and 2020). Kouto also noted that the average inter-annual temperature between 1990 and 2005 was 25.33°C, while that of 2006 to 2020 is 26.07°C, an increase of 0.74°C. This represents an increase of 2.88% compared to the average temperature (25.69°C) of the study period. Thus, the heavy period includes the exceptional years (1999, 2000, 2004 and 2005) and the light period includes the deficit years (2008, 2011, 2012 and 2020). In Tengrela, the mean inter-annual temperature of the study period is 25.35°C. The mean annual temperature is 24.99 °C between 1990 and 2005, but 25.73 °C between 2006 and 2020, representing an increase of 0.74°C or 2.92%. The heavy period extends the exceptional years (1999, 2000, 2004 and 2005) and the light period extends the deficit years (2008, 2018 and 2020). During 2006, temperature increased and during 2020, temperature decreased (Fig. 3).

3.2 The Characterization of Fire Regimes in the Savanna During the Entire Dry Season

The periods of ignition in the savanna, both historically and in the present, are nearly identical in the Bagoué region. The dry season begins in October and ends in March. The experimental results (2021-2022) indicate that fires were observed during the dry season. The study identified three periods of ignition : the initial, intermediate, and final stages of the dry season. This is consistent with the periods of fire observed by the local population, which include the fires ignited at the start of the dry season (during the harvest), the fires ignited during the middle of the dry season (during the dry period), and the fires ignited at the end of the dry season (after the harmattan and the start of the agricultural season). Indeed, the field survey revealed that fires are extensively utilized during the mid-season dry period due to a multitude of factors, as reported by the majority of stakeholders (farmers, ranchers, hunters). However, the presence of dry biomass (dry grass, dry leaves, twigs) is one of the key factors influencing the ignition of a bushfire. Therefore, the intensification of these crusting fires is essentially favored by the availability of herbaceous sawdust biomass (Table 2).

However, the intensity of the fire varies throughout the dry season, from the beginning to the end. The majority of surveyed households reported that the current wildfires are less effective than those that occurred previously. For a minority, there is no longer any available fuel, and thus no intense or even very intense fires (Table 4).

The variation in the efficacy of pre- and current wildfire burning in the Bagoué region is nearly identical. It can be concluded that the efficacy of bushfires varies according to the timing of ignition. All of the surveyed household heads reported that fires lit at the beginning and end of the dry season are less effective than those lit in the middle of the season. However, there is no longer any available fuel for burning (Table 5).

In Côte d'Ivoire, the majority of wildfires occur in the center, east, and north regions, which correspond to the Bagoué area. The occurrence of wildfires is particularly prevalent in the Boundiali and Tengrela areas of the Bagoué region, with a lesser incidence in the Kouto zone. Indeed, the majority of current fires are relatively infrequent, with the number of fires recorded in the region over the past three decades being slightly lower than the average. The figures illustrate the responses obtained on the ground (Table 3).

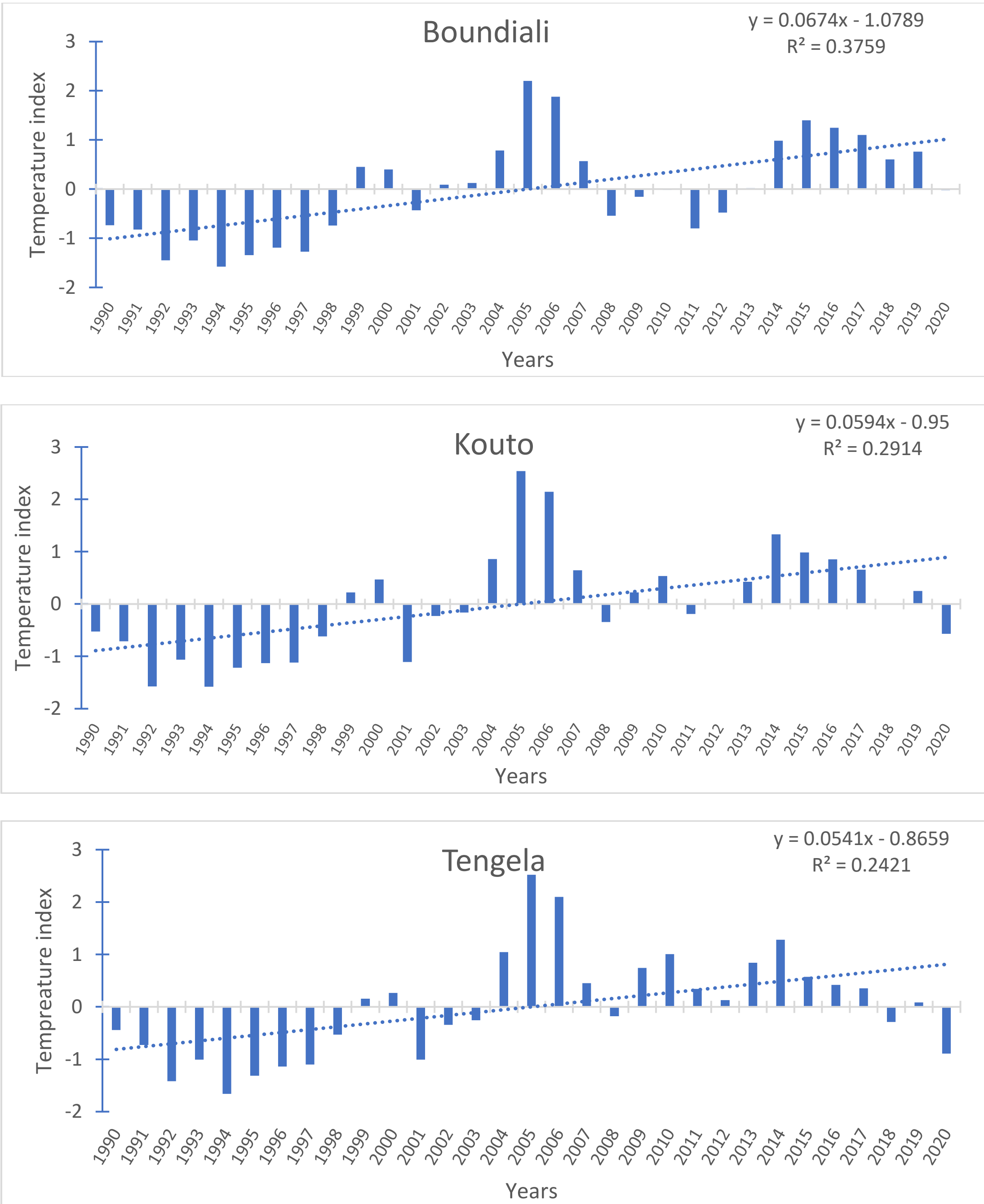


Fig. 3. Interannual temperature variability in Bagoué region from 1990 to 2020

Table 2. Comparison of the historical and contemporary ignition periods of wildfires in the Bagoué region

Localites	Bushfire periods	Previous (%)	Current (%)
Boundiali	Middle of the dry season	99	86
Kouto	Middle of the dry season	76	91
Tengrela	Middle of the dry season	100	98

Table 3. Variation in bushfire frequency in the Bagoué region

Localités	Variation of parameter	DSS		MSS		FSS	
		Previous (%)	Current (%)	Previous (%)	Current (%)	Previous (%)	Current (%)
Boundiali	Low frequency fire	98	96	7	51	48	70
	Moderately frequent fire	0	0	5	28	15	20
	Highly frequent fire	2	4	88	19	35	6
	No more fire	0	0	0	2	2	4
	Total	100	100	100	100	100	100
Kouto	Low frequency fire	90	100	4	43	40	56
	Moderately frequent fire	0	0	7	50	21	37
	Highly frequent fire	8	0	89	5	37	3
	No more fire	0	0	0	2	2	4
	Total	100	100	100	100	100	100
Tengrela	Low frequency fire	100	100	0	96	26	100
	Moderately frequent fire	0	0	0	4	50	0
	Highly frequent fire	0	0	100	0	24	0
	No more fire	0	0	0	0	0	0
	Total	100	100	100	100	100	100

DSS : Beginning of Dry Season ; MSS : Middle of Dry Season ; FSS : End of Dry Season

Table 4. Variation in bushfire intensity in the Bagoué region

Localités	Variation of parameter	DSS		MSS		FSS	
		Previous (%)	Current (%)	Previous (%)	Current (%)	Previous (%)	Current (%)
	Low intensity fire	96	96	7	50	78	83
	Medium intensity fire	4	3	8	41	10	13
Boundiali	High intensity fire	0	1	85	9	9	2
	No more fire	0	0	0	0	3	2
	Total	100	100	100	100	100	100
	Low intensity fire	98	98	5	40	43	55
	Medium intensity fire	2	1	4	51	19	41
Kouto	High intensity fire Feu	0	2	91	9	38	2
	No more fire	0	0	0	0	0	2
	Total	100	100	100	100	100	100
	Low intensity fire	100	100	19	75	100	100
	Medium intensity fire	0	0	0	25	0	0
Tengrela	High intensity fire	0	0	81	0	0	0
	No more fire	0	0	0	0	0	0
	Total	100	100	100	100	100	100

DSS : Beginning of Dry Season ; MSS : Middle of Dry Season ; FSS : End of Dry Season

Table 5. Variation in bushfire efficiency in the Bagoué region

Localities	Variation of parameter	DSS		MSS		FSS	
		% Avant	% Actuel	% Avant	% Actuel	% Avant	% Actuel
Boundiali	Low efficiency fire	99	98	9	10	73	73
	Moderately efficient fire	1	1	2	10	16	6
	Highly effective fire	0	1	89	80	11	21
	No more fires	0	0	0	0	0	0
	Total	100	100	100	100	100	100
Kouto	Low efficiency fire	98	100	6	21	19	44
	Moderately efficient fire	1	0	8	52	30	50
	Highly effective fire	1	0	86	26	51	6
	No more fires	0	0	0	1	0	0
	Total	100	100	100	100	100	100
Tengrela	Low efficiency fire	100	100	0	6	50	66
	Moderately efficient fire	0	0	0	44	50	34
	Highly effective fire	0	0	100	50	0	0
	No more fires	0	0	0	0	0	0
	Total	100	100	100	100	100	100

DSS : Beginning of Dry Season ; MSS : Middle of Dry Season ; FSS : End of Dry Season

Table 6. Correlation between climate variability and fire regime

Climatic parameters		**Periods Bush Fires.**	**Bushfire Intensity _Dry Season Start**	**Bushfire Intensity _Middle _Dry Season**	**Bushfire Intensity _Dry Season End**	**Bushfire Efficiency _Dry Season Start**	**Bushfire Efficiency _Middle Dry Season**	**Bushfire Efficiency _Dry Season End**	**BushFire Frequency**
Rainfall	Pearson correlation	0,151	0,163	0,116	0,082	**-0,217**	**-0,018**	**-0,241**	0,093
	P	0,352	0,315	0,477	0,615	0,178	0,912	0,134	0,567
Temperature	Pearson correlation	0,206	**-0,061**	**-0,126**	**-0,211**	**-0,300**	0,046	**-0,214**	0,032
	P	0,40	0,710	0,44	0,192	0,060	0,776	0,185	0,40

Significance Level : 5%

3.3 Effects of Climatic Variability (Rainfall and Temperature) on Bushfire Regimes

The Table 6 shows the analysis of the correlation between rainfall and fire regime variables, followed by that between temperature and fire regime variables. Indeed, the fire variables (PFB, IDSS, IMSS, IFSS, FFB) are positively correlated with rainfall but very weakly so respectively (r=0.151; p=0.352), (r=0.163; p=0.315), (r=0.116; p= 0.477), (r= 0.082; p= 0.082) and (r= 0.093; p= 0.567); this means that the PFB, IDSS, IMSS, IFSS and FFB variables increase when rainfall decreases, with low intensity. Whereas the fire regime variables (EDSS, EMSS, EFSS) are negatively correlated with rainfall respectively (r= -0.217; p= 0.178), (r= -0.018; p= 0.912), (r= -0.241; p= 0.134); this shows that increasing rainfall leads to a decrease in the EDSS, EMSS and EFSS variables, with low intensity. However, there was no significant effect between fire regime variables and rainfall. On the other hand, the fire regime variables (PFB, EMSS, FFB) are positively correlated with temperature, but very weakly so respectively, (r= 0.206; p= 0.40), (r= 0.046; p= 0.776), (r= 0.032; p= 0.40); this indicates that PFB, EMSS and FFB increase as temperature decreases, with low intensity. Table 6. Correlation between climatic variability and fire regime. While the fire regime variables (IDSS, IMSS, IFSS, EDSS, EFSS) are negatively correlated with temperature respectively, (r= -0.061 ; p= 0.710), (r= -0.126 ; p= 0.44), (r= -0.211 ; p= 0.192), (r= -0.300 ; p= 0.060); this shows that the IDSS, IMSS, IFSS, EDSS and EFSS variables decrease when rainfall increases, with low intensity. But there was no significant difference between temperature and fire regime variables.

4. DISCUSSION

The Bagoué region displays pronounced variability in climatic conditions, as evidenced by the occurrence of extreme rainfall and temperature regimes over the period 1990-2020. Rainfall is highly variable, with alternating years of deficit and surplus. The rainfall trend in the region is downward. Between 1990 and 2002, Boundiali rainfall showed a rainfall surplus of 181.5 mm, representing an increase of 14.8% between 1990 and 2002. This period was characterized by the appearance of deficit years, notably in 1990, 1999 and 2001. From 2003 to 2020, Boundiali saw a rainfall deficit of 131.1 mm, a decrease of 10.7% over this period. During this period, some years saw above-average levels of rainfall, notably 2007, 2008, 2009, 2010, 2012 and 2020. Nevertheless, the general trend between 1990 and 2020 indicates a reduction in rainfall levels. From 1990 to 2002, Kouto rainfall increase with a value of 13.2% or 177.7 mm. However, there were also years when rainfall was below average, notably in 1990, 1999 and 2001. From 2003 to 2020, the rainfall deficit for Kouto reached 306.1 mm, a decrease of 20.1%. This period was marked by years of excess rainfall (2007, 2012, 2017, 2018, 2019 and 2020), but rainfall levels followed a downward trajectory from 1990 to 2020. Tengrela also saw a rainfall surplus from 1990 to 2002, with an increase of 12.8% between 1990 and 2002. In addition, during this period, precipitation was below average for several years, notably in 1999 and 2001. From 2003 to 2020, Tengrela saw a rainfall deficit of 123.9 mm, a decrease of 9.2% between 2003 and 2020. The period in question includes years with surplus rainfall, including 2007, 2012, 2017, 2018, 2019 and 2020. Despite the aforementioned exceptions, precipitation nevertheless fell between 1990 and 2020. Similar results were recorded with [17] and [18], which showed a decline in rainfall over long periods of drought and a contraction of the rainy season over a short period. In addition, research by [3] has also documented a decline in rainfall, evidenced by prolonged dry periods and a reduction in the duration of rainy seasons over a relatively short period. These results differ, however, from those presented by [19], who observed an increase in rainfall. As for temperature, it is characterized by alternating deficit and surplus years, with increases of 0.7°C, (i.e. 2.66%), 0.74°C (i.e. 2.88%), 0.74°C (i.e. 2.92%) respectively in Boundiali, Kouto and Tengrela over the period 1990 - 2020. These results are in line with those of who showed an increase in the temperature trend in their respective studies [20].

The occurrence of bushfires is influenced by various meteorological factors, such as reduced rainfall and increased temperature. Higher temperatures make dry vegetation more vulnerable, while rainfall during the rainy season reduces the risk of bushfires. In the Bagoué region, agropastoral practices help reduce the spread of bushfires [21]. The Boundiali and Tengrela zones experience more frequent bushfires compared to the Kouto zone, which can be attributed to agropastoral activities. Recent bushfires in the region have been less frequent compared to those in the past 30 years, with a slight downward trend. Studies have shown that annual agriculture contributes to the perpetuation of fires, while peasant agriculture does not. These results are in line with those by [12,22-28], who have shown that annual agriculture perpetuates fire, while perennial agriculture reduces fire frequency as farmers maintain and protect orchards against fire. In the Bagoué region, previous and current bush-fire seasons are virtually identical. The dry season begins in October and ends at the month of March [5,12,28-31].

The correlation between rainfall and fire regime variables suggests that actors in bush areas tend to set fires when there is a decrease in rainfall. This is because lower rainfall levels are necessary for starting fires in the bush. However, the effectiveness of fire burning depends on the amount of rainfall and how it is distributed over time. A small but well-distributed amount of rain is more effective at suppressing fires compared to a large amount of rain falling in a short period. This means that it is not the quantity of water that prevents bushfires, but rather the seasonal distribution and regularity of rainfall. Temperature also plays a role, as it can directly affect the heating or cooling of fuels and indirectly impact atmospheric humidity. Farmers, herders, and hunters set fires in the bush when rainfall decreases, as less rainfall is needed to ignite fires. However, the efficiency of fire-burning depends on the amount and distribution of rainfall. Temperature can directly or indirectly affect fuel heating or cooling. As a result, biomass fuels exposed to sunlight heat up faster than those under vegetation cover [4-5,12,16].

5. CONCLUSION

This study analyzes the relationship between climate variability and bushfire regimes in the Bagoué savannah region. The rainfall was increased at 14.8% followed by a 10.7% and was decreased between 2003 and 2020 in Boundiali from 1990 to 2002. Average annual rainfall was 1,408.99 mm, with a 13.2% increase between 1990 and 2002 and a 20.1% deficit between 2003 and 2020. Rainfall in Tengrela also showed similar variations. Temperatures rise to 0.7°C, 0.74°C and 0.74°C in Boundiali, Kouto and Tengrela between 1990 and 2020, respectively. Three fire periods were identified with lowest intensities and frequencies. The combination of rainfall declining, the temperatures increasing, the highest dry biomass, and the agricultural activities contributes to the emergence of bushfires in the Bagoué region. This study highlights the importance of addressing these factors to mitigate the impact of bushfires. These results indicate that, despite climatic variations, fire regimes have maintained similar characteristics over time.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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