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Spatio-temporal Analysis of Drought Trends Recorded during the Wettest Months in the Mouhoun-Comoé Basin in Burkina Faso (Africa): an Analysis using Z-score and Linear Regression

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KEYWORDS

- drought
- soil moisture
- z-score
- linear regression
- correlation
- Mouhoun-Comoé basin
- Africa

ABSTRACT

Meteorological drought is a natural phenomenon that occurs when there is insufficient rainfall over a more or less prolonged period. In West African countries, and particularly in Burkina Faso, this situation undermines agricultural systems. Knowledge of the spatio-temporal trends of drought is essential for optimal management of water resources and effective planning of sustainable agricultural activities. The aim of this study is the analysis of the spatio-temporal trends of drought in the Mouhoun-Comoé basin in Burkina Faso. To this end, the study used CHIRPS rainfall data in raster and CSV file form for July and August, as well as soil moisture (0-10 cm) at 1-, 2- and 3-month scales for the period 1994-2024. The data were analysed using the z-score index, linear regression and correlation. The study shows that the upward trend in drought oscillates between extreme drought and mild drought. The decade 1994-2004 was characterised by extreme drought, followed by a decrease in drought throughout the basin during the decade 2005-2014. Finally, in the decade 2015-2024, a phase of high humidity was observed throughout the basin. Drought trends have had an impact on soil moisture levels, particularly in the valleys of the basin. This situation has a negative impact on agricultural production in the basin. This situation is forcing farmers to use crops that have more or less water tolerance in order to cope with the drought.

Introduction

Climate change is the most pressing global threat (Sharma et al., 2021). It directly or indirectly affects our ecosystem (Kulikov et al., 2014). Sea ice, lakes and coastal ecosystems are severely affected (Grimm et al., 2013). Agriculture, livestock systems and human livelihoods are also being undermined globally (Ghahramani & Moore, 2016; Habtemariam et al., 2017; Duku et al., 2018; Batool et al., 2019). Watersheds and their ecosystems are not spared. Indeed, a change in the services provided by watershed ecosystems has been observed in the Po basin (Italy) and the Red basin (Vietnam), as shown by Pham et al. (2019). In Iran, in the Sirvan basin, the cumulative effect of land use changes, reduced rainfall and increased temperatures has affected the amount of water in the basin. The same is true for the Yellow River basin in China (Yang et al., 2021). In the alpine basin of the Tibetan Plateau in China, vegetation dynamics

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around the basin have been observed as a result of climate change and drought (D'uo et al., 2021). The Heihe basin is more affected by rainfall variability, which causes variations in water runoff (Liu et al., 2024). Xiong et al. (2024) finds that 168 of the world's basins are experiencing spatio-temporal changes. According to the authors, the upward trends in the standardised precipitation index (PSI) are more pronounced in basins in arid zones than in those in humid zones. At the same time, six basins are identified as hot spots with an increase in PSI between 2003 and 2021: the Don, Yellow, Haihe, Rio Grande, Sao Francisco and Ganges basins.

In Africa, watersheds and their ecosystems are the economic lungs of vulnerable populations. However, they are also subject to the vagaries of climate variability, which has a negative impact on the water resources of these catchments (Séne et al., 2024). In southern Africa, basins such as the Limpopo, the Orange, the Okavango and the Zambezi have been severely affected by the level of drought (Abiodun et al., 2019). Burkina Faso has four of them. Most hydro-agricultural and hydro-electric schemes depend directly on them. However, two of them are of vital importance: the Mouhoun and Nakambè basins. All the country's dams, large and small, have been built on these two basins. For this reason, several studies have been carried out on these two basins. For example, studies have focused on climate variability in the Vranso sub-basin, where climate variability has affected surface water levels (Yameogo & Sawadogo, 2024), and on its consequences for water flow in the Mouhoun sub-basin (Zouré et al., 2023), as well as in the Nakambè basin (Gbohoui et al., 2020). Other studies are looking at the dynamics of land use, which is reducing water resources in the Nakambè basin.

In the Sudano-Sahelian and Sudanese zones of Burkina Faso, rainfall remains the main source of water. Climatic variability, reflected in both increasing and decreasing rainfall (Yameogo, 2025), causes frequent droughts, and the basins are not spared. The wettest periods, particularly July and August, record an average rainfall of 130 mm per year, while August records an average of 230 mm per year. However, most studies focus on the Nakambè basin and use the Standardised Precipitation Index (SPI) and the Standardised Precipitation Evapotranspiration Index (SPEI) (Fowé et al., 2023). Some studies compare the SPI and SPEI to assess the level of drought in the Massili (Nakambè) basin (Guira et al., 2022; Bontogho et al., 2023), while others use the Effective Reconnaissance Drought Index to assess the level of drought in the Massili basin (Bontogho et al., 2024). The Mouhoun-Comoé is the largest watershed in Burkina Faso and its surface water resources are used by millions of people for socio-economic activities and food production. However, few studies have been carried out in this basin to understand the spatio-temporal evolution of droughts and their impact on soil moisture. Analysis of spatial and temporal trends in drought provides useful information for effective planning and management of water resources. Therefore, studying the evolution of these phenomena during the wettest months is essential for identifying the negative effects of climate change.

The aim of this study is to analyze the spatio-temporal trends of droughts during the two wettest months (July and August) in the Mouhoun-Comoé watershed in Burkina Faso. Its uniqueness lies in the use of CHIRPS data, which are used for drought monitoring by the Famine Early Warning Systems Network (FEWS NET) of the United States Agency for International Development (USAID).

Materials and methods

Study area

The Mouhoun-Comoé basin was selected for this study. The Mouhoun basin covers an area of 113,896 km^2 and includes all or part of the Boucle du Mouhoun, Cascades, Centre-West, Hauts-Bassins, North and South-West regions. Figure 1 shows the location of the study area.

According to the Köppen classification, the Mouhoun-Comoé basin is divided into two climatic zones: the hot semi-arid climate and the tropical savanna climate (Figure 2).

The average rainfall is 240 mm per year in August and 178 mm per year in July. Temperatures vary from July to August. In August, the maximum temperature is 35.45°C, the average temperature is 27.23°C, and the minimum temperature is 23°C. In July, maximum temperatures are 32°C, average temperatures are 28°C, and minimum temperatures are 23.72°C. Figure 3 below shows rainfall and temperatures in the Mouhoun-Comoé watershed.

Climate data and Normality

Monthly rainfall (for July and August) and soil moisture data for July and August for the study area were obtained from the Climate Hazards Group InfraRed Precipitation with Stations (CHIRPS) database on the US Agency for International Development Famine Early Warning Systems Network (FEWS NET) website. CHIRPS was developed by the Climate Hazards Group at the University of California, Santa Barbara (UCSB) and the US Geological Survey (USGS) (Aksu & Akgul, 2020).

The data and products will be available for download from the Famine Early Warning Systems Network (FEWS NET) data portal (Senay et al., 2023; Senay et al., 2015). The latter provides z-score data and soil moisture in the form

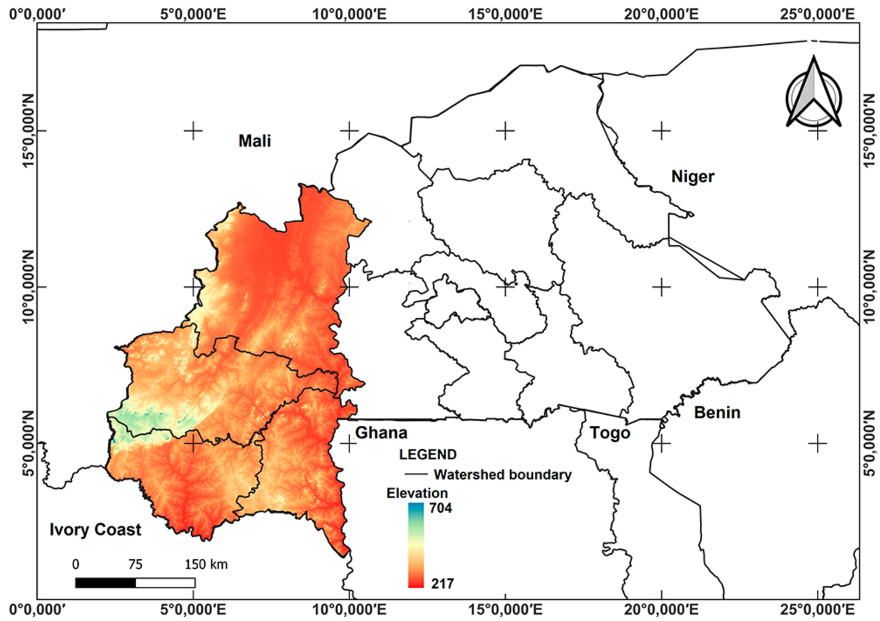

Figure 1. Geographical location of the Mouhoun-Comoé basin

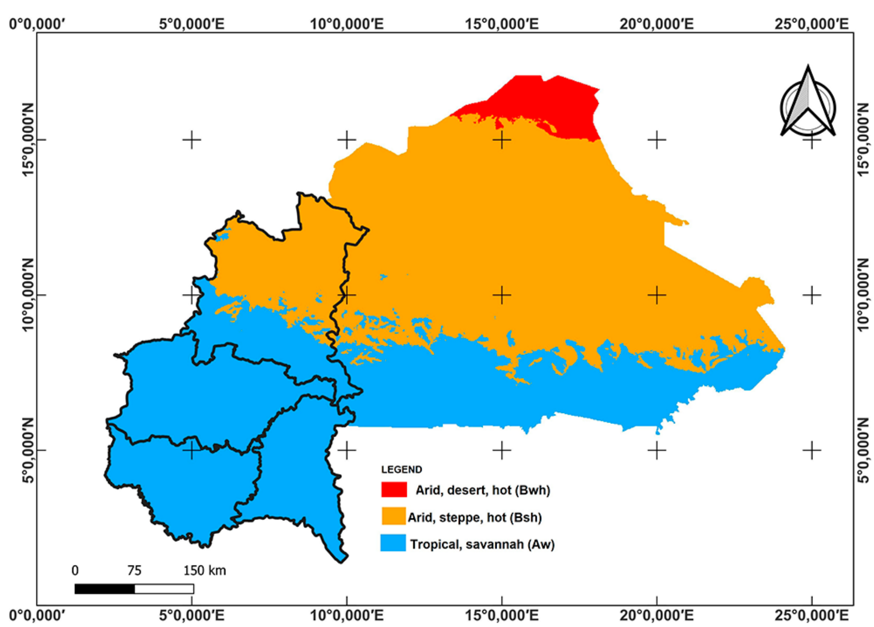

Figure 2. Watershed climate zone according to Köppen classification 1991-2020

of raster and CSV files for the Excel spreadsheet for the period 1994-2024, with time steps of one month, two months and three months. CHIRPS extends from 50° South latitude to 50° North latitude (and all longitudes) and covers the period from 1981 to the present, integrating satellite imagery at 0.05° resolution and in situ station data to produce gridded precipitation time series (Funk et al., 2015).The CHIRPS data have undergone a rigorous evaluation procedure that integrates satellite records and in situ station data, making them highly reliable for scientific research, including climate studies, hydrological modelling and agricultural assessments (Poste et al., 2024). As a result, several studies have used them, notably to characterise the spatio-temporal variability of drought in the Cauto basin in Cuba (Tran et al., 2024) or the Seyhan basin in southern Turkey (Orieschnig & Cavus, 2024). In Ethiopia, Alemu and Bawoke (2020) used CHIRPS data to analyse spatio-temporal rainfall trends in the Amhara region. The same is true for the study in Iraq (Ahmad et al., 2021) and Congo (Ahana et al., 2024). The z-score statistics are on a monthly scale, for the

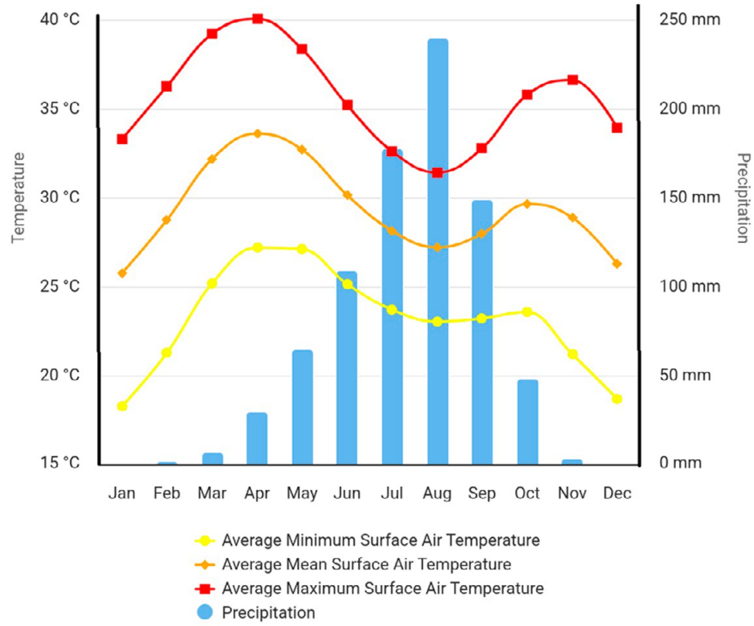

Figure 3. Precipitation and temperatures in the Mouhoun-Comoé basin

period 1994-2024, and are time series data. Checking the normality of the data therefore makes it possible to indicate the appropriate method of analysis. To this end, three normality tests have been used, as follows Shapiro-Wilk, Anderson-Darling and Lilliefors. The null hypothesis (H_0) of these tests is that the data follow a normal distribution. The alternative hypothesis (H_a) is that the data do not follow a normal distribution.

Method of trend analysis

In this study, linear regression was used to analyze the trend of the Z-score over the period from 1994 to 2024.

Linear regression

Linear regression is a parametric method that requires normality of the data and can be used to identify a linear trend and estimate its magnitude (U.S. Environmental Protection Agency, 2009). Linear regression analysis is commonly used to identify trends in climate variables over long periods of time (Feidas et al., 2004; Ghebrezgabher et al., 2016; Yaméogo & Sawadogo, 2024; Yanogo & Yameogo, 2023). Regression is based on the assumption that there is a linear relationship between the dependent variable (Y) and the independent variable (X). The linear regression equation is defined as follows (Rawlings et al., 1998):

$$Y = Ax + b \quad (1)$$

Where, Y indicates a dependent variable, x indicates an independent variable, and A is the slope of the line and b is the Y-intercept constant (Compaoré & Yaméogo, 2024).

If the direction coefficient of the trend equation is greater than zero, less than zero or equal to zero, then the sign of the trend is positive (increasing), negative (decreasing) or there is no trend (no change) respectively (Gavrilov et al., 2015).

Pearson's correlation coefficient

Pearson's correlation coefficient measures the strength of the linear relationship between two variables. If there is a strong linear relationship, the correlation coefficient is close to 1 or –1, and 0 means no linear relationship (U.S. Environmental Protection Agency, 2009, Athanasiou et al., 2017). It indicates the direction and 'strength' of the trend. A positive value of r indicates an increasing linear trend and a negative value indicates a decreasing linear trend. The trend is 'strong' if the absolute value of r varies between 0.6 and 0.8. The correlation coefficient r between the two variables X and Y is called the Pearson correlation and is calculated as follows (Athanasiou et al., 2017):

$$r = \frac{\sum_{i=1}^{n}\left(x_i - \bar{x}\right) - \left(y_i - \bar{y}\right)}{\sqrt{\sum_{i=1}^{n}\left(x_i - \bar{x}\right)^2}\sqrt{\sum_{i=1}^{n}\left(y_i - \bar{y}\right)^2}} \quad (2)$$

Where, $\bar{y} = (1/n)\left(\sum_{i=1}^{n} y_i\right)$, and $\bar{x} = (1/n)\left(\sum_{i=1}^{n} x_i\right)$

Statistical Z-Score (Z-Score)

The statistical Z score, or standard score, is used as another drought index (Wu et al., 2001). The standard score method is a simple approach that is used to standardise a set of data on the basis of its mean value and its standard deviation (Careto et al., 2024). It can be calculated by subtracting the long-term mean from an individual rainfall value, then dividing the difference by the standard deviation (Noor et al., 2020). The Z-score indicates the number of standard deviations that a rainfall value is above or below the mean (Dogan et al., 2012). The calculations are straightforward and can be performed on a variety of time scales. The Z-score applies to both dry and wet periods and, like the SPI, tolerates gaps in the data (WMO, 2016). Its mathematical formula is as follows (Wu et al., 2001):

$$Z_{score} = \frac{x_{ij} - \mu_i}{\sigma_i} \quad (3)$$

where Z is the symbol for the standard score, xij is precipitation of j month for period i, is mean, is standard deviation. Table 1 below shows the different interpretations of Z-score.

Table 1. Different interpretations of Z-score

Z-score value	Drought/wetness condition
≤-2.0	Extreme drought
-1.90 to -1.50	Severe drought
-1.49 to -1.00	Moderate drought
-0.99 to 0.99	Mild drought
≥1.0	Normal wet condition

Source: Noor et al. (2020)

In addition, the raster z-score data were interpolated using QGIS 3.4 software to obtain the spatial evolution of z-scores in the Mouhoun-Comoé basin. Figure 4 below provides a summary of the data and methods used in the study.

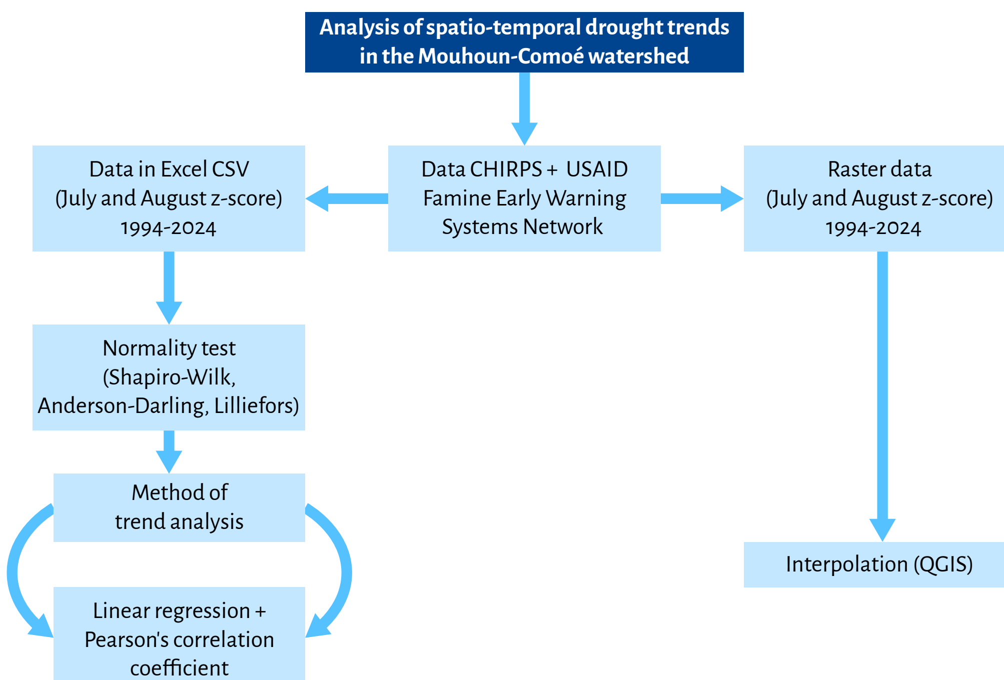

Figure 4. Outline the Data and Methods Used in the Study

Results and Discussion

Data normality over the 1994-2024 period

Overall, the data show a normal distribution over the period 1994-2024 (Table 2).

Temporal analysis of annual drought trends in the Mouhoun-Comoé basin

The analysis of drought in the wettest months of the basin shows an increasing trend over the period 1994-2024, as indicated by the positive leading coefficients (Figure 5).

Figure 5 shows an upward trend in the z-score, which indicates that conditions have become wetter and less dry over time. However, the trend remains weak and very weak. In fact, July and August in 1 month, 2 months and 3 months have very high correlation coefficients r=0.301, which shows a weak trend.

Table 2. Normality of data extracted from CHIRPS over the period 1994-2024

Test of normality	July			August		
	1month	2month	3month	1month	2month	3month
Shapiro-Wilk test	0.937	0.933	0.960	0.986	0.971	0.972
P-value	0.07	0.054	0.284	0.948	0.545	0.585
Alpha threshold	5%	5%	5%	5%	5%	5%
null hypothesis (H_0)	X	X	X	X	X	X
Alternative hypothesis (H_a)	-	-	-	-	-	-
Anderson-Darling	0.522	0.688	0.455	0.194	0.267	0.222
P-value	0.142	0.065	0.251	0.886	0.663	0.812
Alpha threshold	5%	5%	5%	5%	5%	5%
null hypothesis (H_0)	X	X	X	X	X	X
Alternative hypothesis (H_a)	-	-	-	-	-	-
Lilliefors test	0.125	0.140	0.112	0.092	0.090	0.077
P-value	0.250	0.778	0.626	0.731	0.502	0.914
Alpha threshold	5%	5%	5%	5%	5%	5%
null hypothesis (H_0)	X	X	X	X	X	X
Alternative hypothesis (H_a)	-	-	-	-	-	-

Source: CHIRPS, 1994-2024, X=Accepted, - : no Accepted

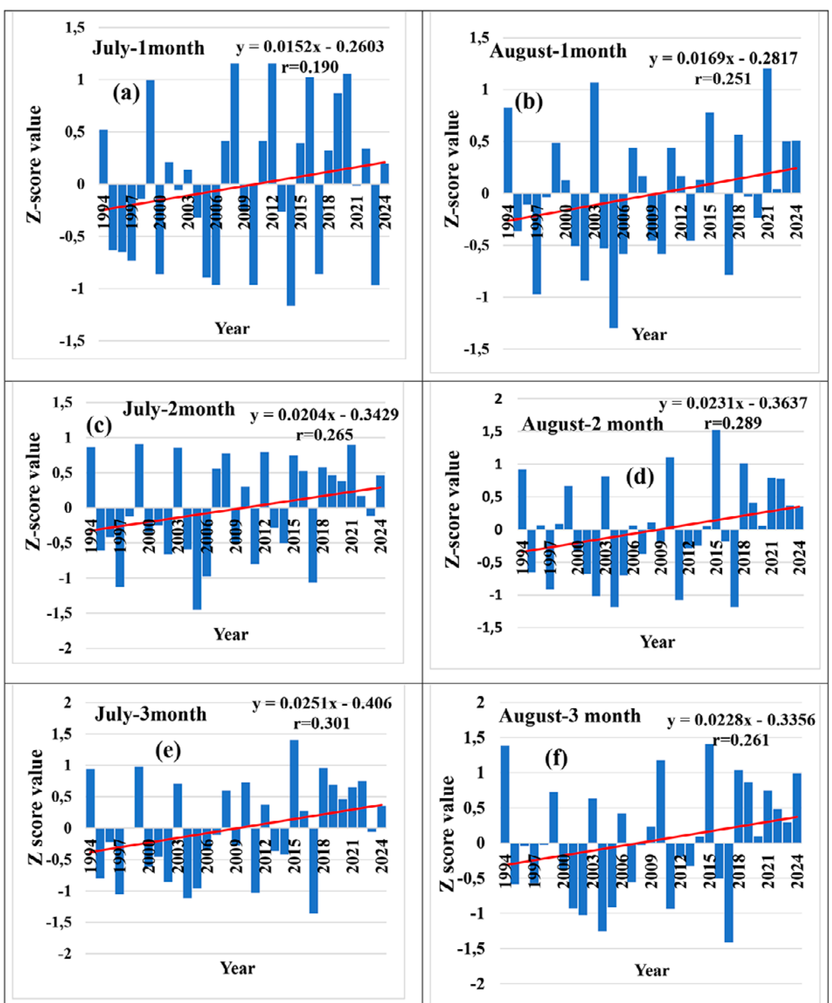

Figure 5. Time trend of z-score at different scales between 1994 and 2024

Temporal analysis of the ten-year trend of drought in the Mouhoun-Comoé basin

In Figure 6a, the decade 1994-2004 shows a decreasing z-score trend in August and an increasing trend in July. Conversely, the 2005-2014 decade shows an upward trend in both wet months. However, the decade 2015-2024 shows a differentiated trend, with an upward trend in August and a downward trend in July. Figure 6b shows an upward trend in the Z-score over 2 and 3 months in the decades 1994-2004 and 2005-2014 (in appendix). However, a downward trend is observed at the 1-month, 2-month and 3-month scales for the 1994-2004, 2005-2014 and 2015-2024 periods. The correlation coefficient r remains very low, indicating a slight increase. Overall, the 1994-2004 decade saw a period of moderate drought in the basin during the rainy months (July and August). In contrast, the 2005-2014 decade was characterised by a normal wet phase in the area. This situation continued during the decade 2015-2024.

Spatial analysis of drought trends in the Mouhoun-Comoé basin

- Annual spatial trend of drought in the two wettest months

Figure 7a below shows a significant change in droughts in the Mouhoun-Comoé basin between 1994 and 2024. On a 1-month scale, extreme drought is observed in July in the south-eastern part of the basin and wetness in the north-western part. In August, however, the north-western zone remains wet (z-score = 1.87) in 2015-2024, while the rest of the basin experiences moderate drought (z-score = -0.95). On a two-month scale, a zone of severe drought is marked from the south-east to the centre of the basin in July (figure b in appendix). A wet phase was also observed towards the far north-west of the basin. In August, the moisture continued to spread from the far north-west to the west. The rest of the basin also experienced a period of light to moderate drought. Over a three-month

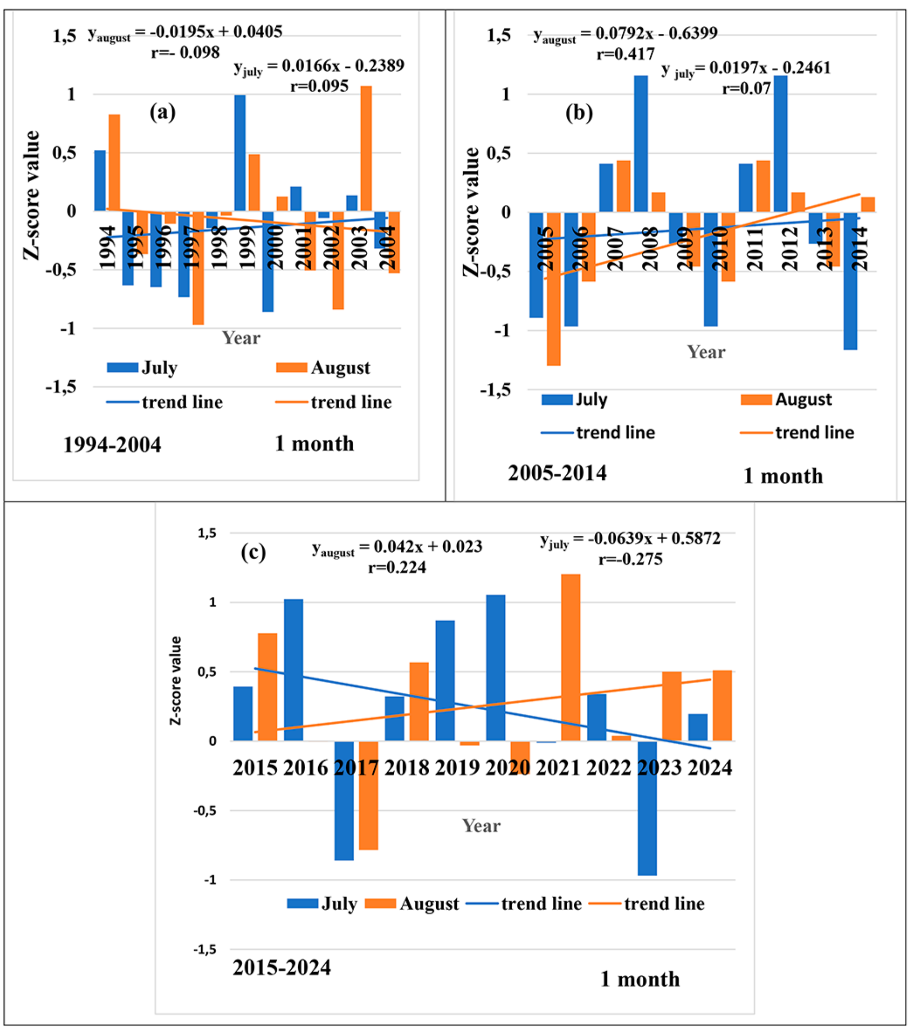

Figure 6a. Decadal evolution of Z-score on a one-month scale

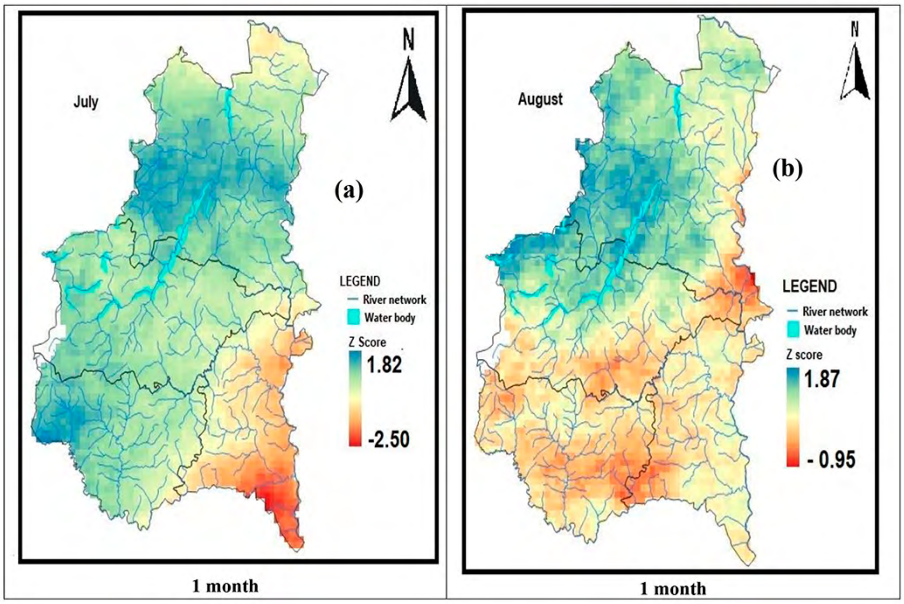

Figure 7a. Spatial trend in drought on a monthly scale over the period 1994-2024

period, the basin is almost completely dry, with the exception of the northern zone (in appendix). In August, an area of high humidity moves westwards and moderate to extreme drought affects the rest of the basin.

Spatial analysis of drought trends in the Mouhoun-Comoé basin over a ten-year period

- the case of July on a 1-month, 2-month and 3-month scale

July's drought was highly variable in the Mouhoun-Comoé basin. On a monthly scale, the spatial evolution of the drought is oriented towards the south-west of the basin. The decade 1994-2004 was characterised by extreme drought (z-score of -2.06 in Figure 8a.g) in the west and centre of the basin. Only the extreme southwest of the basin was wet. In Figure 8a.h, mild drought prevailed over most of the basin, except in the north. Figure 8a.i shows a trend towards normalisation of moisture across the basin. However, there is a slight drought in the southwest.

Figure 8b.j shows that over a two-month period, drought occurs in the west and centre of the basin. Other areas of the basin fluctuate between mild and moderate drought. Figure 8b.k shows a drought zone with a z-score between 0.80 and -1.8. The areas that were in extreme drought in Figure 8b.j have become wetter in Figure 8b.k (in appendix). This trend continues in Figure 8b.l, but with a slight

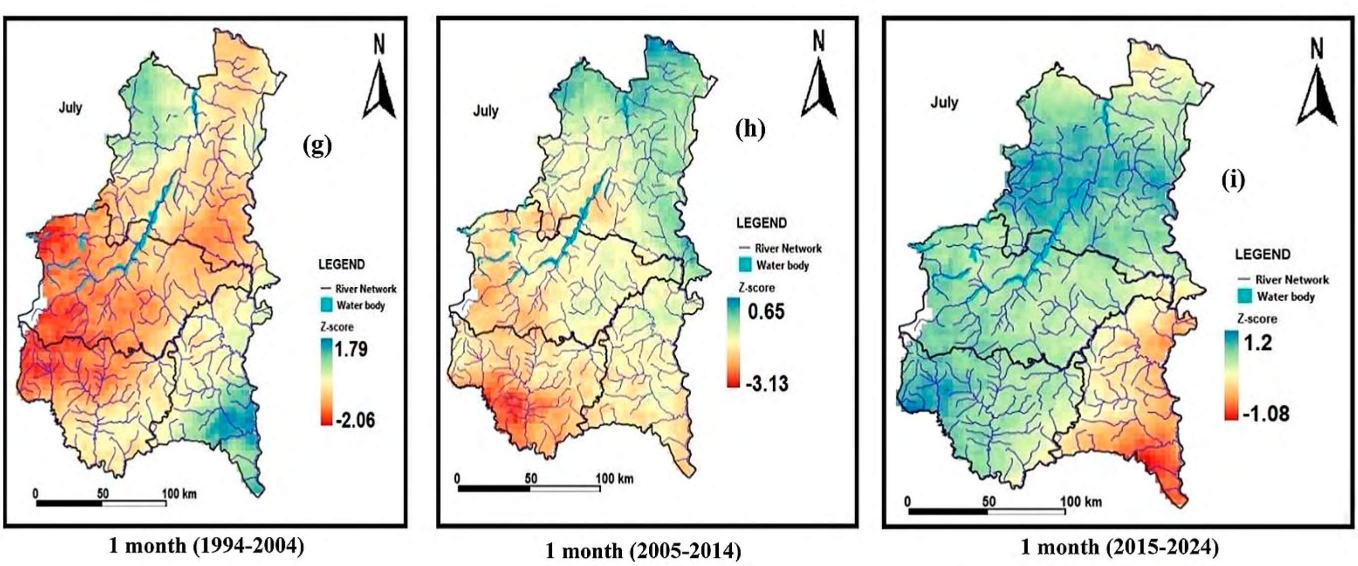

Figure 8a. Ten-year spatial trend in July drought for the period 1994-2024

concentration of drought in the south-western part of the basin (in appendix).

Figure 8b.m shows that over a three-month period, the western and central parts of the basin are in a dry phase. However, the south-western zone is in a wet phase. The drought is receding, with only one occurrence in the southwestern part of the basin (Figure 8b.n) (in appendix). The wet phase is observed towards the west and north-west of the basin, while a moderate drought phase is observed in the south-western part of the basin during the period 2015-2024.

- the case of August on a 1-month, 2-month and 3-month scale

Figures 9a.p, q and r show the spatial evolution of drought in August, the wettest month in Burkina Faso. During the decade 1994-2004, the western, northern and central parts of the basin experienced moderate to extreme drought. In the decade 2005-2014, these drought zones decreased and are now located in the north and south-west of the basin. Finally, in the period 2015-2024, drought, which has become moderate, continues to decrease and is now located in the south and extreme south-west of the basin.

Careto et al., 2024; Ogunrinde et al., 2025). It varies considerably in space and time across the basin. The work of Ndehedehe et al. (2016) confirms the same trends. The authors found a variable trend in the SPI index over the period 1979-2013 in the Volta basin, which includes the Mouhoun-Comoé basin. This temporal trend is punctuated by periods of more or less severe wetness and drought. Other studies carried out in the Mouhoun sub-basin in Burkina Faso have found similar results. Compaoré and Yameogo (2024) and Yaméogo and Sawadogo (2024) found a temporal evolution of the SPI index characterised by wet and dry phases between 1980 and 2021.

Drought in the Mouhoun-Comoé basin and its impact on soil moisture in the valleys

Drought affects soil moisture in the basin. There is a strong correlation between z-score and soil moisture (depth 0-10 cm) in July and August for the period 1994-2024. The correlation coefficients vary between 0.85 and 0.58, with high to very high levels of significance (p-value varies between 0.002 and 0.0013). The correlations are weaker and insignificant for July on a 2-month scale and for August on a

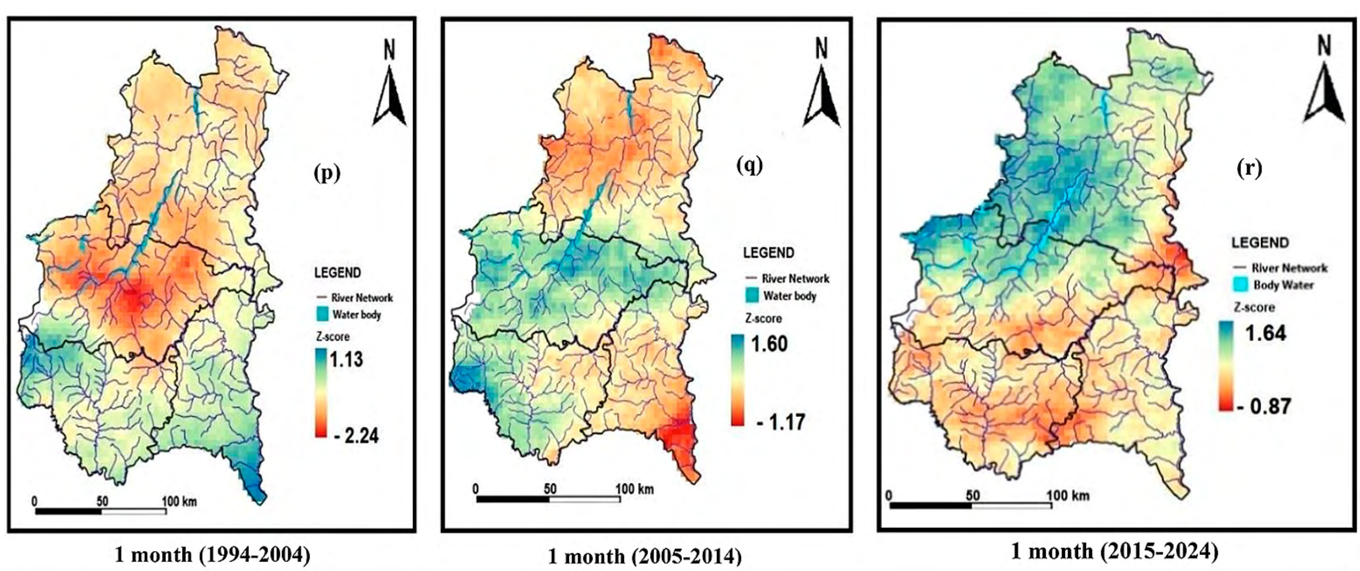

Figure 9a. Ten-year spatial trend in August drought between 1994 and 2024

A similar trend can be seen in Figures 9b.s, t, u (in appendix). The situation changes when we move to the three-month scale. Extreme drought dominates in the western and central parts of the basin, while the rest of the basin experiences moderate drought. Only the extreme southern and south-western parts of the basin experience a wet phase.

Meteorological drought is a category of long-term natural disasters that develops gradually and is caused by periods of abnormally low precipitation (Kumari et al., 2023;

3-month scale. Overall, the upward trend in drought is reflected in soil moisture in the Mouhoun-Comoé catchment. The trend lines also show an upward trend for July on a 1-month scale and for August on a 1-month, 2-month and 3-month scale. Table 3 below shows the different correlation coefficients and directional coefficients at different time scales.

Table 3 shows that drought affects the Mouhoun-Comoé basin during the wettest months (July and August). This situation affects the valleys, especially the Sourou

Table 3. Strong correlation between the z-score and the soil moisture at different scales in the catchment area for the period from 1994 to 2024

Soil moisture-z-score	correlation coefficient	p-Value	Relationship
Soil moisture 10 cm-z-score (1 month july)	0.835	**0.003**	Very significant
Soil moisture 10 cm-z-score (1 month august)	-0.69	**0.027**	Significant
Soil moisture 10 cm-z-score (2 month july)	0.163	0.65	Non-Significant
Soil moisture 10 cm-z-score (2 month august)	0.85	**0.002**	Very significant
Soil moisture 10 cm-z-score (3 month july)	0.86	**0.002**	Very significant
Soil moisture 10 cm-z-score (3 month august)	0.58	**0.078**	Weak Significant

valley in the extreme north of the watershed. In this valley, more than 3,800 ha of land have been developed out of an estimated potential of 30,000 ha. These cultivated areas are farmed by rural residents and privately by more than 3,000 producers organised in eleven agricultural cooperatives, four producer groups and seventeen agricultural entrepreneurs or agribusinesses. However, extreme to moderate droughts are common in this valley, with direct consequences for soil moisture (Figure 10a.a, b,c).

Figure 10a.a, b,c, and figure 10b.d,e,f (in appendix) shows that there is a strong change in soil moisture in the Sourou Valley. In fact, the decade 1994-2004 and 2015-2024 is interrupted by relatively positive soil moisture in the Sourou Valley for the month of July. However, in the period 2005-2014, the valley is affected by a decrease in soil moisture. This situation could affect the crops grown by the rural population. Soil moisture in August also varies from decade to decade. In 1994-2004, soil moisture in the valley was low. In the period 2005-2014, an improvement in moisture was observed. The period 2015-2024 is characterized by a high level of soil moisture in the Sourou valley, reflecting a decade in the wet phase. The other valleys in the Mouhoun-Comoé basin are also affected by drought (Figure 11a.a.b).

Figure 11a shows that the decade 1994-2004 (Figure 11a.a) and the decade 2005-2014 (Figure 11a.b) are characterized by a decrease in soil moisture in the valleys for the month of July. However, the 2015-2024 decade is charac-

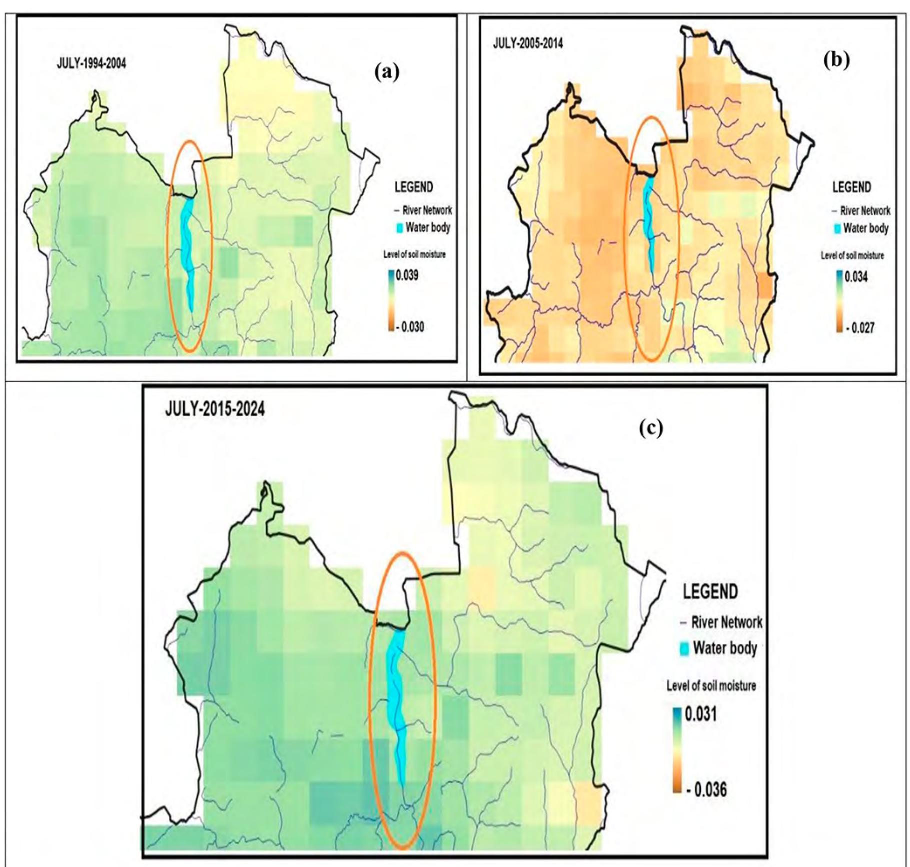

Figure 10a. Ten-year change in soil moisture in the Sourou Valley between 1994 and 2024

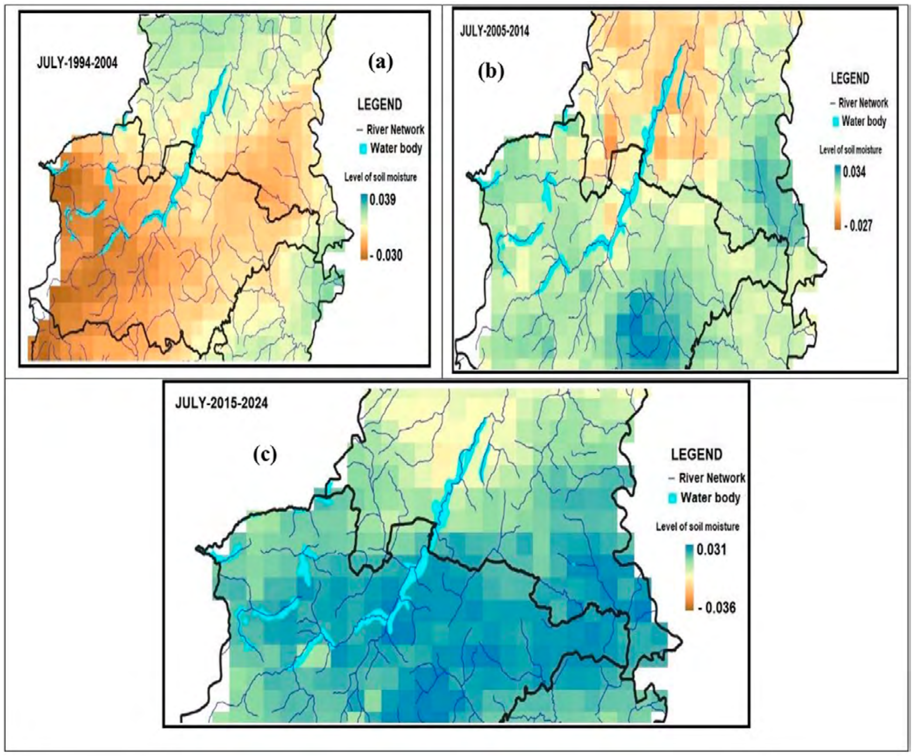

Figure 11a. Ten-year change in humidity in the other valleys of the basin between 1994 and 2024

terized by high soil moisture. For the month of August, the 1994-2024 decade (Figure 11b.d) is characterized by a significant decrease in soil moisture (in appendix). Soil moisture improved during the 2005-2014 decade (Figure 11b.e) (in appendix). The 2015-2024 decade shows significant soil moisture in July. The trend of increasing soil moisture in the basin is confirmed by the Yaméogo study (2025). The study shows an upward trend in soil moisture, but it is highly variable in the Mouhoun basin. This situation could be explained by the increase in rainfall in the country. The study by Yameogo and Rouamba (2024) shows that Burkina Faso experienced a period of flooding between 2005 and 2020. This suggests an increase in rainfall between 2005 and 2020. Several other studies in the country confirm the wet phase. Compaoré and Yaméogo (2024) observed an upward trend in rainfall in the Centre-West region between 2001 and 2021. Work by Yaméogo and Sawadogo (2024) in the Mouhoun sub-basin (vranso) over the period 1980-2014 shows an upward trend in rainfall. Another study by Yanogo and Yaméogo (2023) on the south-western region of Burkina Faso (part of the Mouhoun Basin), in the high basins, shows increasing rainfall phases over the period 2011-2020, as also observed by Karambiri and Gansaonre (2023). The study by Yanogo and Yaméogo (2023) also finds an increase in extreme rainfall, but the southwest region is less affected than the north. A general trend of increasing precipitation has also been observed across West Africa. Ilori and Ajayi (2020) note that the wet phase began on the African continent in the 1990s. Other studies, such as those by Damberg and Agha-Kouchak (2014) and Fuentes et al. (2022), show different results from previous studies at local and regional level. Indeed, Damberg and Agha-Kouchak (2014) show a significant positive trend in drought areas on Southern Hemisphere lands (Africa, Northern India and parts of the Mediterranean), while no significant trend is observed on Northern Hemisphere lands between 1980 and 2012. This means that watersheds in the southern hemisphere are more affected. These results are similar to those of Fuentes et al (2022), who show that all continents are affected by drought, particularly Africa and Southeast Asia. However, according to the same authors, drought severity is more pronounced in the Horn of Africa and East Africa, while West Africa is moderately affected. These results differ from those of the study area in that the time frame (1980-2012) of the study by Damberg and Agha-Kouchak (2014) corresponds to a dry period in West Africa, whereas this study focuses on a wet period (1994-2024). This could explain the difference in results. The results of Fuentes et al. (2022) partially support our study, since they observe a less extensive wet phase in 2019

This wet phase (positive z-score over the period 2015-2024), accompanied by an increase in soil moisture in the Mouhoun-Comoé basin, will have an impact on agricultural crops, which cannot tolerate permanent humidity. This situation is more damaging for crops located in the valleys of the basin. Bossa (2020) notes that, under these conditions, the agricultural development of wetlands faces the risk of hydric flooding, which prevents the establishment of crops or damages them. Week and Wizor (2020) and Reed et al. (2022) add that this situation could have a negative impact on the food security of African populations.

Conclusion

Agricultural activities are dependent on water resources. In Burkina Faso, watersheds are the main areas of agricultural activity. Recent droughts caused by extreme weather conditions have highlighted the need to better understand the impact of climate change on water resources in the Mouhoun-Comoé watershed. Understanding droughts during the wettest months is essential for agricultural planning. The aim of the study was to analyse the spatio-temporal trends of droughts in this basin. It showed that the basin experienced extreme, moderate and mild droughts on the scale of one, two and three months over the period 1994-2024. The ten-year analysis shows that the period 1994-2004 is generally characterised by extreme droughts. The other periods, 2005-2014 and 2015-2024, show a phase of humidity in the basin, with a significant increase in soil moisture. This situation could be detrimental to certain crops that do not like excess moisture. It is therefore essential that strategies to adapt to this new situation take into account the increasing humidity in the basin during the decade 2015-2024. Consequently, local and state authorities must encourage the use of water-intensive crops to adapt to the basin's new humidity.

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Appendix

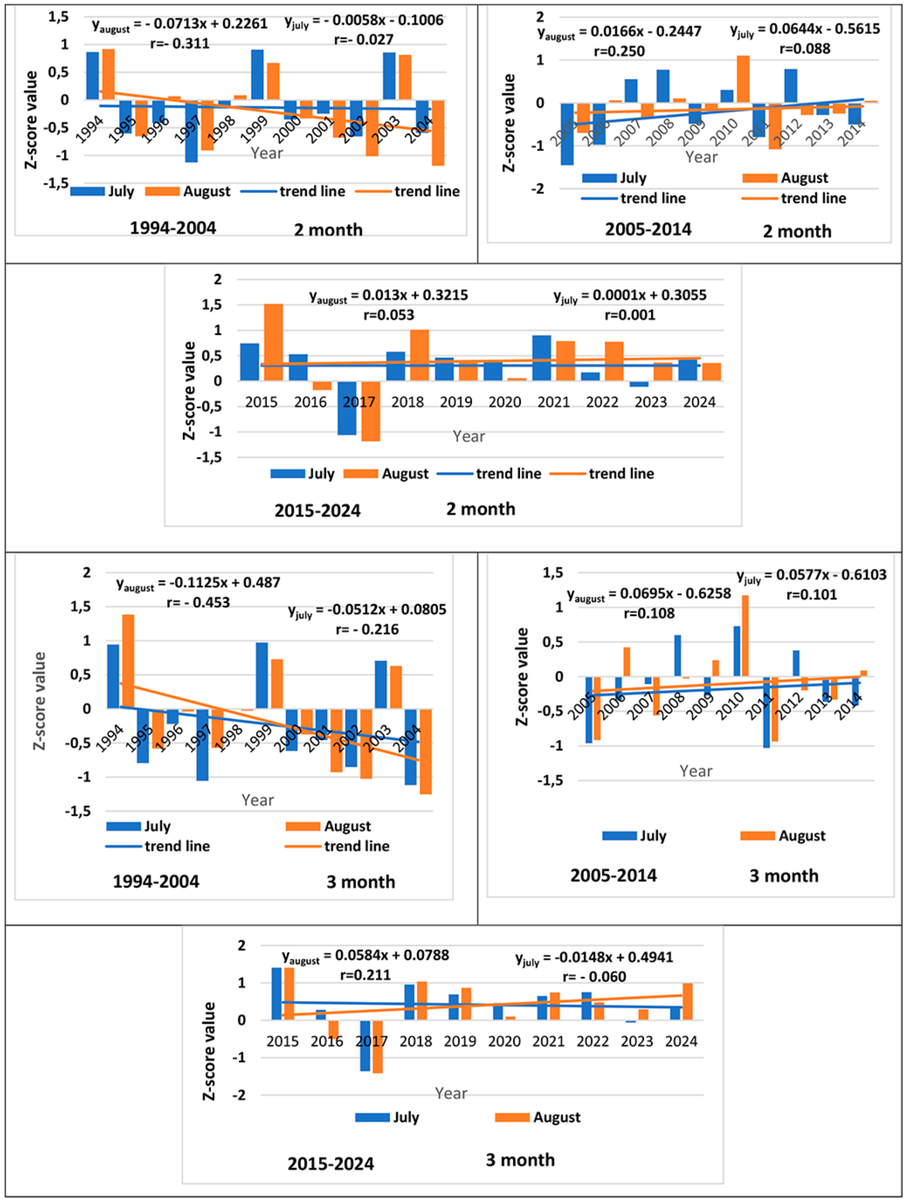

Figure 6b. Decadal evolution of Z-score on a two- and three-month scale

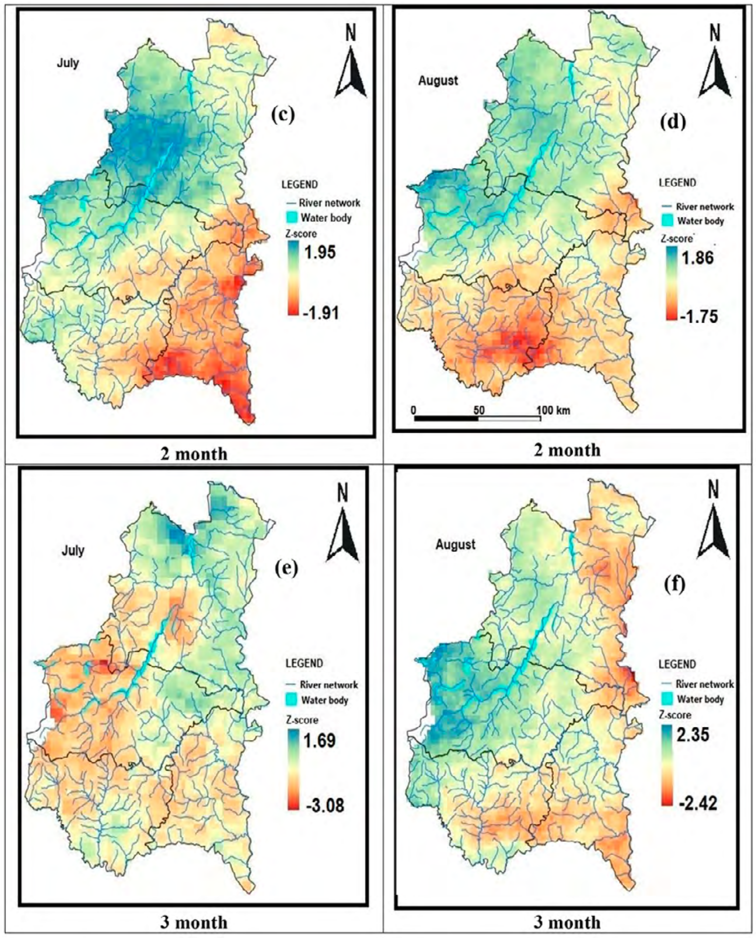

Figure 7b. Multiscale spatial trend of drought 1994-2024

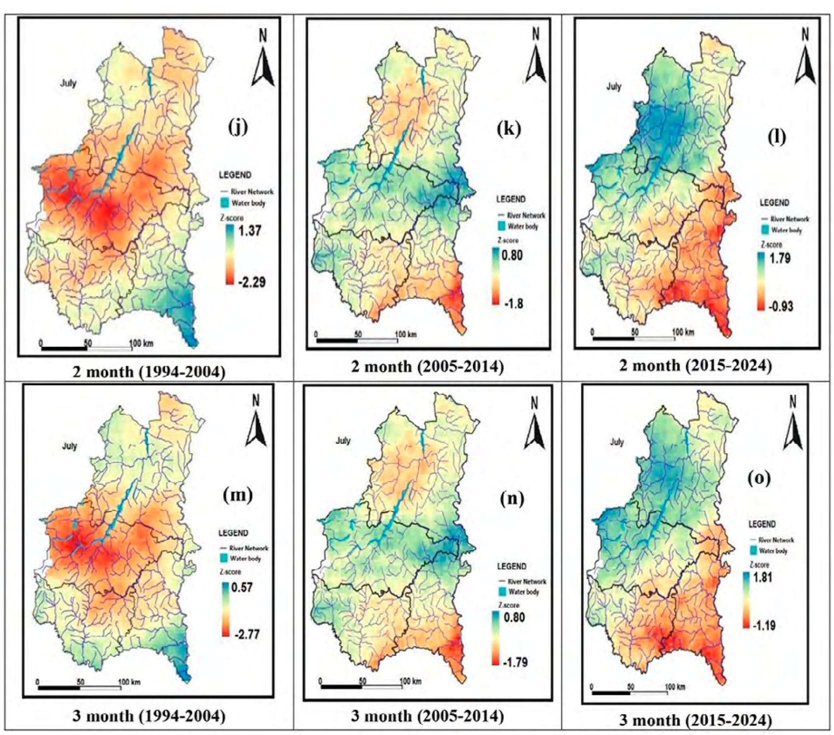

Figure 8b. Ten-year spatial trend of the July drought at different scales for the period from 1994 to 2024

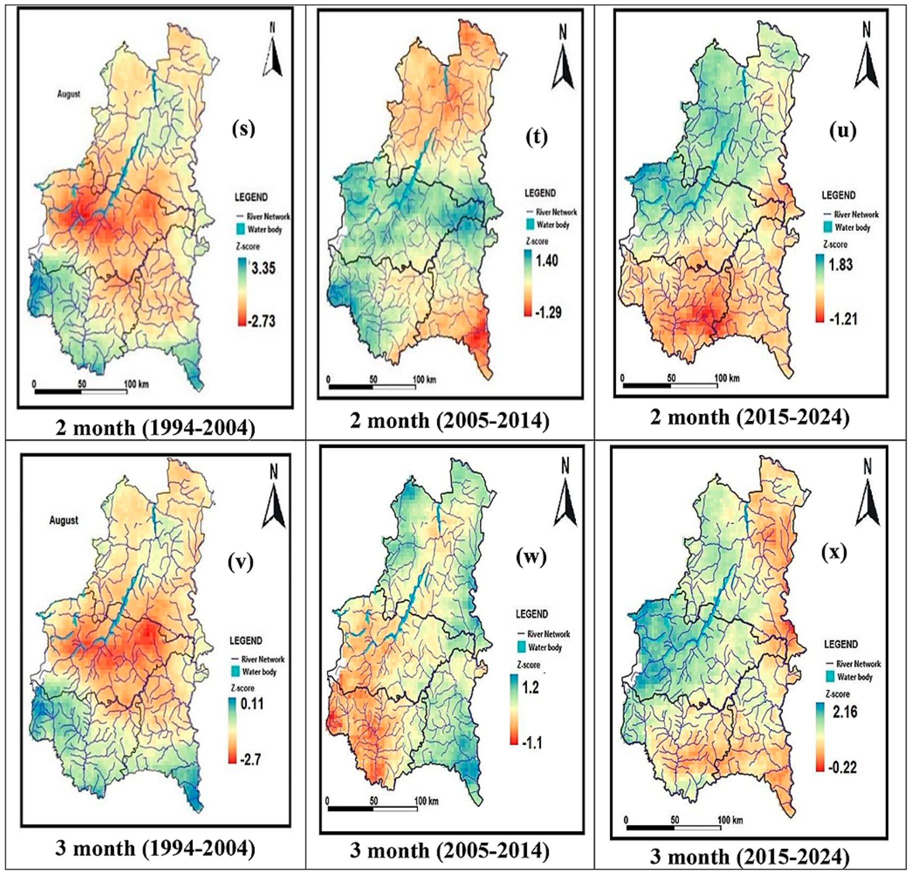

Figure 9b. Decadal spatial evolution of August drought at different scales between 1994 and 2024

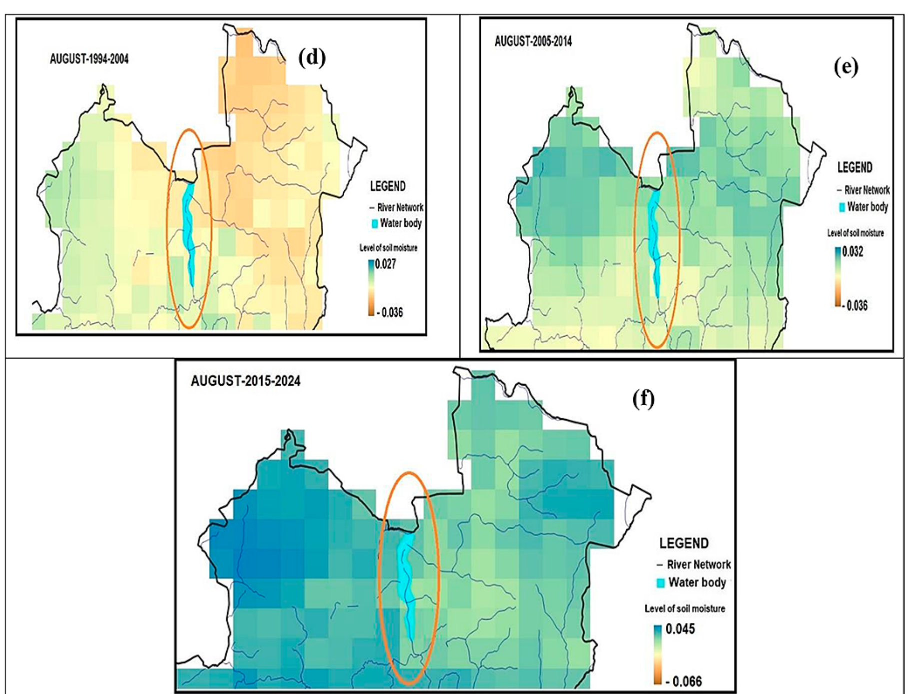

Figure 10b. Ten-year change in soil moisture in the Sourou valley at different scales between 1994 and 2024

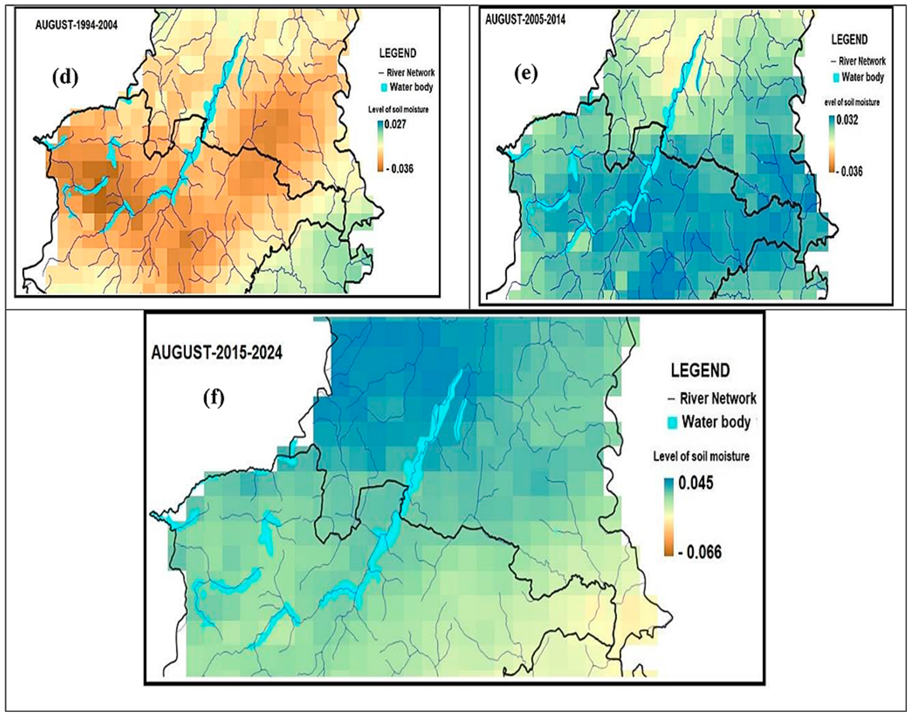

Figure 11b. Decadal trend in humidity in the other valleys of the basin on 2- and 3-month scales between 1994 and 2024