



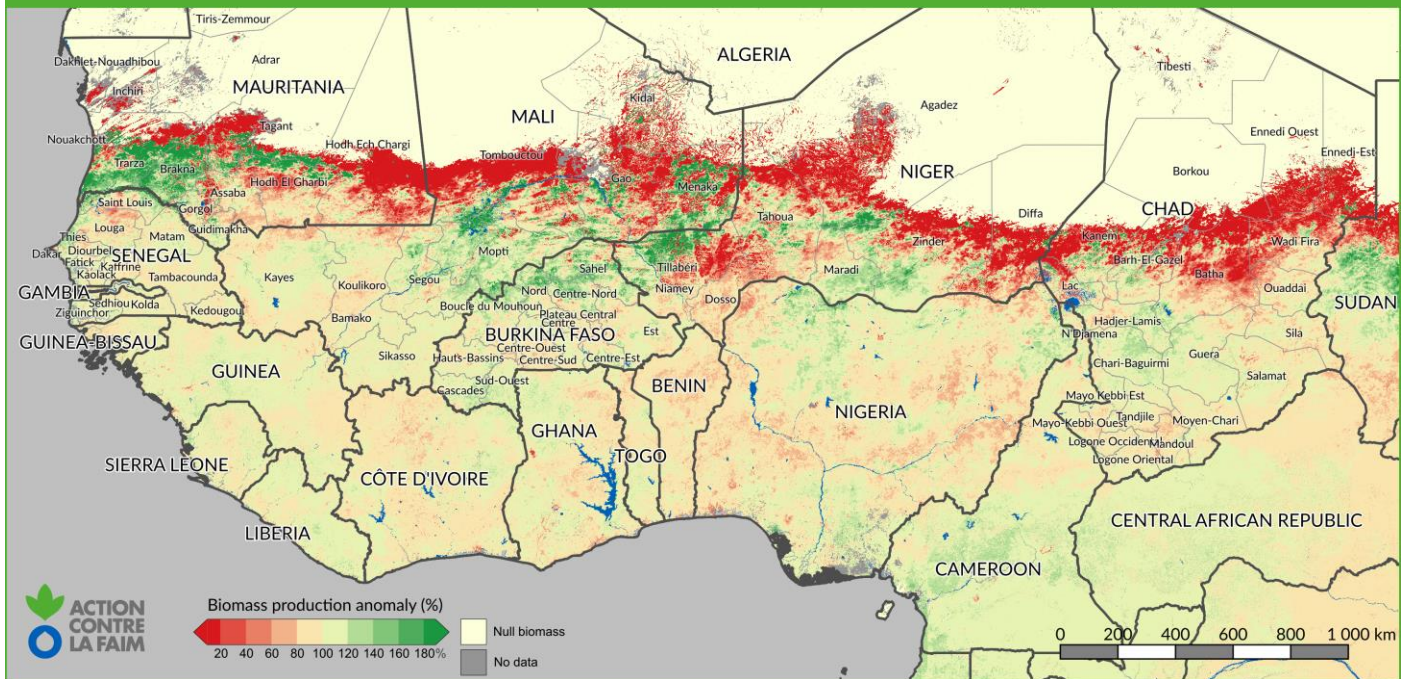
BIOMASS PRODUCTION IN 2023 ANALYSIS AND OUTLOOK FOR 2024

SAHEL REGIONAL REPORT

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MAP 1: ANOMALY OF BIOMASS PRODUCTION FOR YEAR 2023 IN PERCENT



HIGHLIGHTS

- Biomass production globally close to normal in the Sahelian zone of West Africa
- Biomass production higher than normal in the southwest of Mauritania, extending to the northern border of Senegal and the central Sahel region and in Burkina Faso
- Very low biomass production in the northern limit of the Sahelian belt
- Very low biomass production in the Lake Chad basin area
- Negative biomass production anomalies along the coastal countries, particularly in Benin
- High vulnerability in the northern border of the Sahel
- Security issues severely hinder the mobility of herds and access to pastures and water resources in the Central Sahel. This is in addition to mobility restrictions towards the coastal countries, especially Benin and Togo

INTRODUCTION

This document provides a quantitative assessment of the quality of the 2023 growing season in West Africa. The analysis primarily focuses on the Sahelian regions of West Africa, with an overview of the coastal countries.

The year 2023 follows a 2022 rainy season that was generally good to very good overall and even exceptional in Mauritania, as well as in the pastoral and agropastoral areas of Mali and Chad. However, there were areas with low production in 2022, particularly in the region of the three borders and also in the coastal countries.

The 2023 rainy season was early but marked by dry spells at the beginning and, in some places, during the mid-season. The overall rainfall situation is close to normal but heterogeneous with areas experiencing moderate to significant deficits. Streamflow is normal to slightly above the levels of recent decades.

The region is witnessing increasing insecurity, combined with institutional instability, adding to ecological disruptions and the impacts of climate change. Furthermore, due to its dependence, the region remains subject to the global geopolitical context. This combination of factors continues to disrupt agricultural systems, with consequences for the food security of agropastoral communities.

SYSTEM DESCRIPTION

WHAT IS BIOMASS AND HOW IS IT MEASURED?

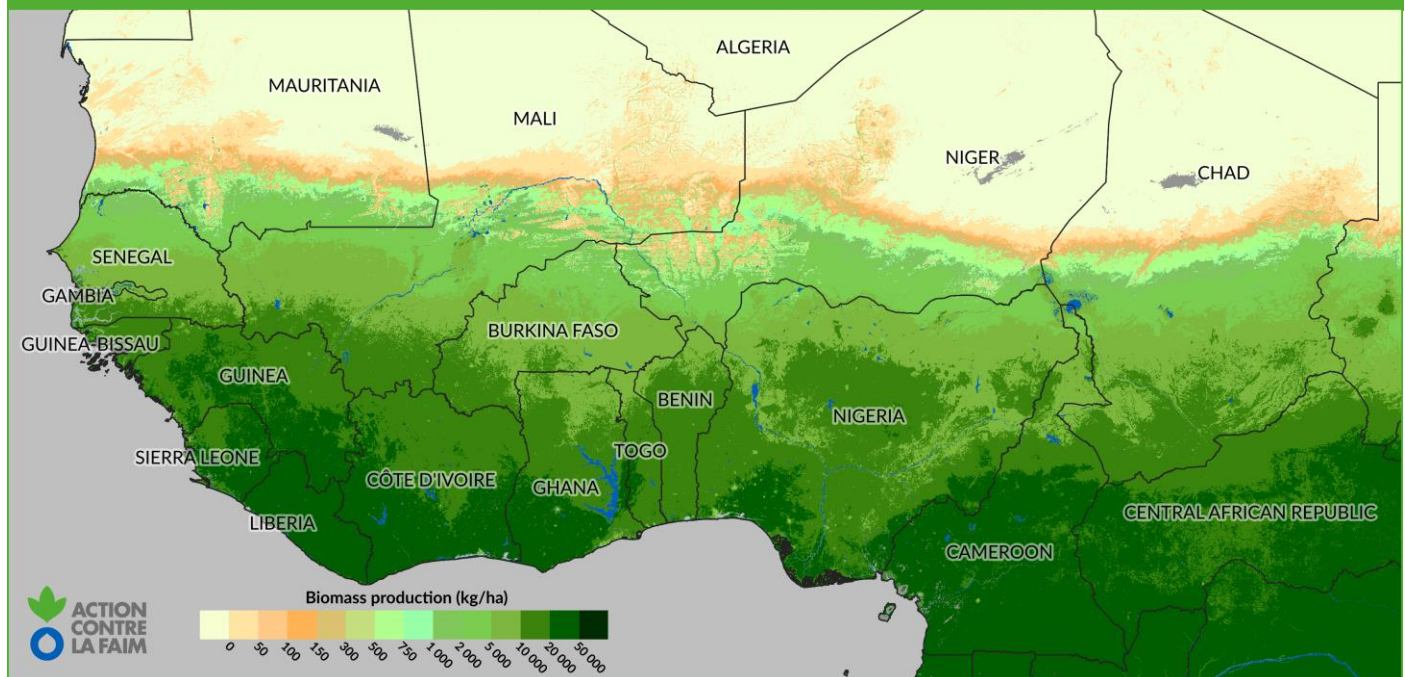
Biomass is the total production of vegetal material measured in kilograms of dry matter MS per hectare kg/ha. The term dry matter is used to describe any form of vegetation above the ground regardless of its water content. For an analysis of the pastoral situation, biomass is an effective way of measuring the availability of fodder resources.

Biomass production is calculated from satellite images collected by the European Space Agency's **SPOT-VEGETATION**, **PROBA-V** and **SENTINEL-3** satellites and supplied as decadal products by the European **COPERNICUS** programme through the Flemish Institute of Technology **VITO**.

The method for calculating daily biomass productivity (kg/ha/day) is based on an algorithm integrating biophysical parameters obtained from satellite images as well as climatic parameters of temperature and solar irradiance.

The **BioGenerator** tool developed by ACF integrates all these data to produce an annual biomass production map calculated over the growing season coinciding with the rainy season in the Sahel. The spatial resolution is 1 km, which corresponds to that of the satellite products used. The period covered is that of the satellite archive from 1999 to present.

MAP 2: AVERAGE ANNUAL BIOMASS PRODUCTION 1999-2023



WHAT INDICATORS ARE GENERATED?

The first indicator is the annual biomass production calculated over the growing season:

- **Annual production kg/ha**

The annual biomass production is compared to the average calculated overall years since 1999 in order to compute the anomaly which is represented in two ways:

- **Anomaly expressed as a percentage of the mean value**
- **Standard deviation expressed as number of standard deviations σ from the mean**

A vulnerability index linked to biomass availability, called VI (Vulnerability Index), is calculated recursively by weighting the most recent years to take into account sequences of dry or rainy wintering:

- **Vulnerability Index VI**

Methods and operating details of the BioGenerator can be accessed here: sigsahel.info/index.php/knowledgebase
The data produced can be downloaded here: data.humdata.org/organization/acf-west-africa

BIOMASS PRODUCTION IN 2023

MAPPING OF THE BIOMASS PRODUCTION ANOMALY

Map 1 shows the biomass production anomaly for 2023 over West Africa and particularly the Sahel expressed as a % of the mean, and map 3 shows the same production anomaly but expressed as a number of standard deviations σ from the mean, called the normalised anomaly.

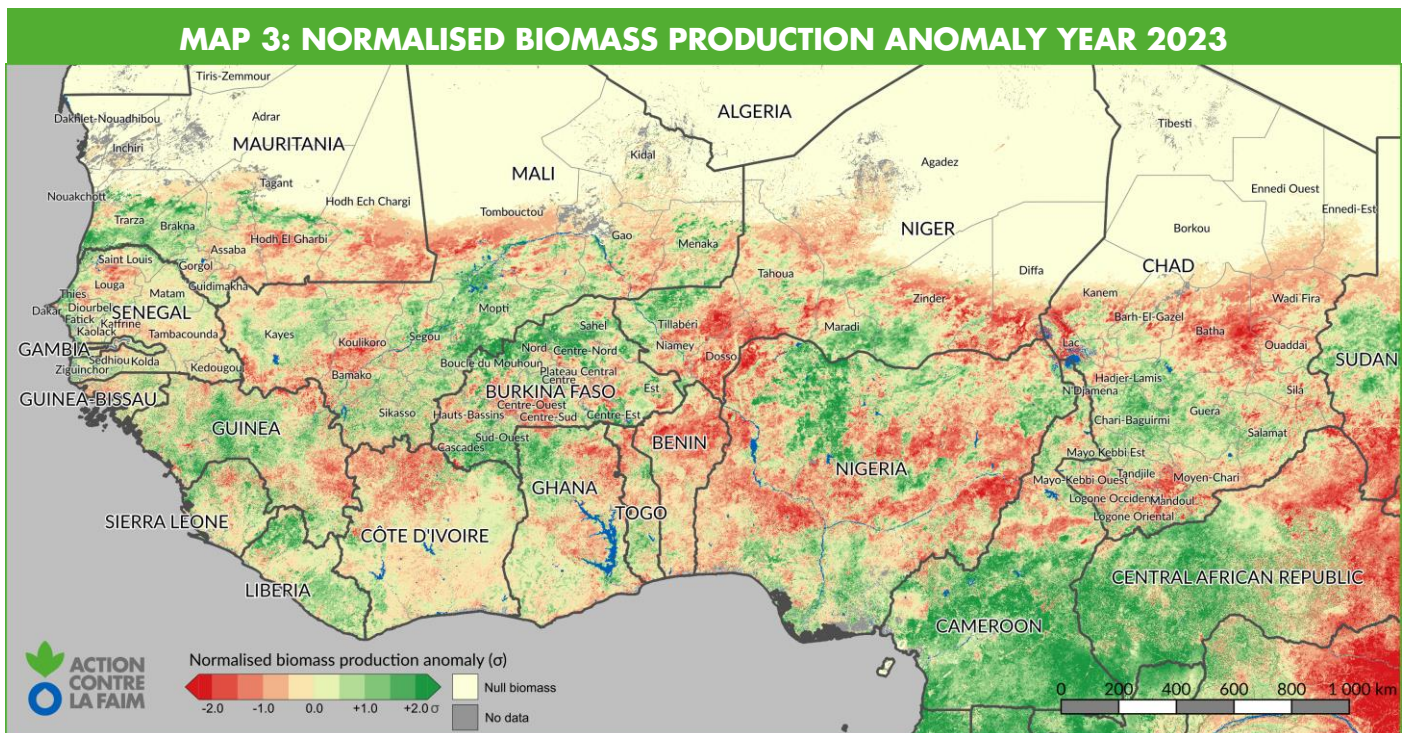
These maps indicate that the overall production at the regional scale is close to or slightly above the normal level but heterogeneous. While there are areas with good production, those with low to very low production are more significant.

Two geographical areas exhibit good production: the one composed of the southwest of Mauritania and the northern border of Senegal, and the one in the central region of the three borders including the Burkina Faso in its entirety. However, the development of these good productions in the latter area is limited by insecurity. As for the western area, despite good production, there is relatively poor pasture quality, and the livestock concentrations are relatively smaller, resulting in limited exploitation of this resource.

In the rest of the region, the productions appear to be moderate to low and, in some cases, very low. The lowest productions are observed in the east of Mauritania and the border area with Mali, as well as in Niger as a whole, except for the south-central region around Maradi.

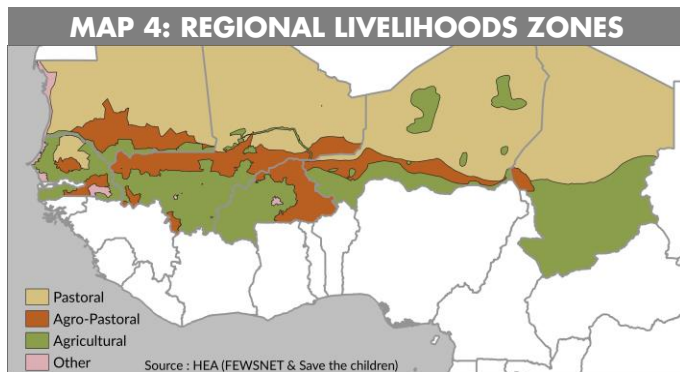
For a more in-depth analysis, this production is expressed as a normalised anomaly (Map 3), which provides a nuanced view of the situation in predominantly pastoral livelihood areas in the northern part of the region. Following the 2023 rainy season, these areas have experienced negative anomalies, with a few very localised variations. Except for the western front in Mauritania, other areas with positive anomalies face constraints related to insecurity, limiting the utilisation of this forage potential by agropastoral and pastoral communities.

In the coastal countries, namely Côte d'Ivoire, Ghana, Togo, Benin, and Nigeria, productions are generally low to very low. Except for the central part of northern Nigeria, production anomalies are negative across most of these countries. The lowest productions are recorded in Benin.



INTERANNUAL VARIATIONS IN BIOMASS PRODUCTION

Based on the breakdown by livelihood zones, it is possible to observe the inter-annual variation in biomass production according to land use: agricultural and agropastoral.

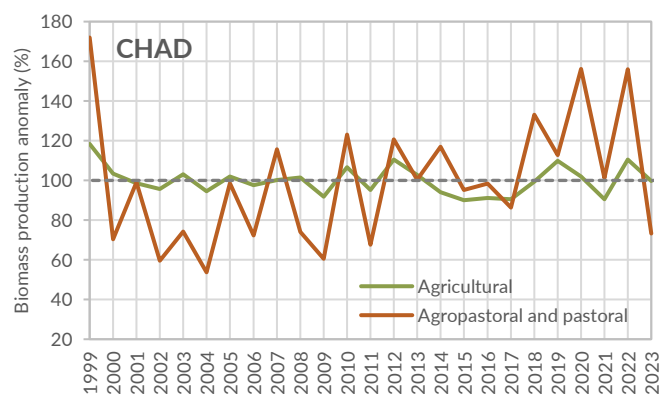
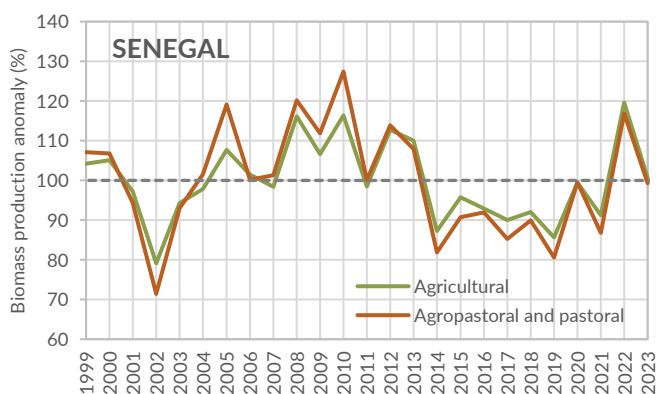
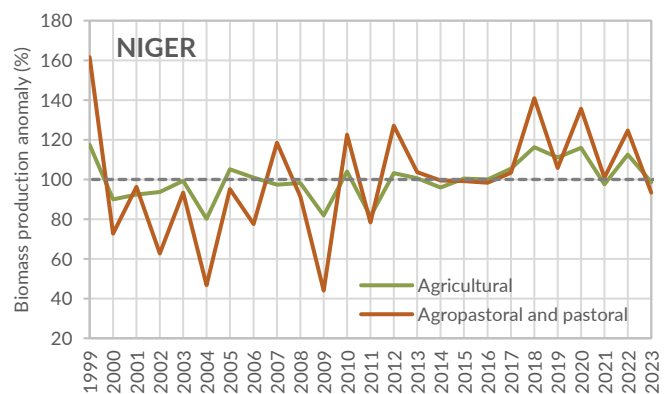
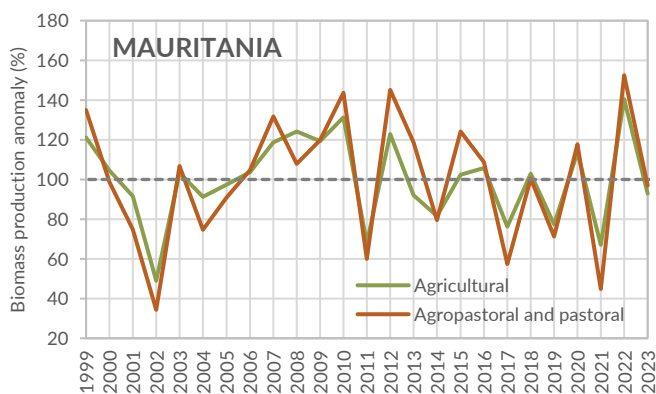
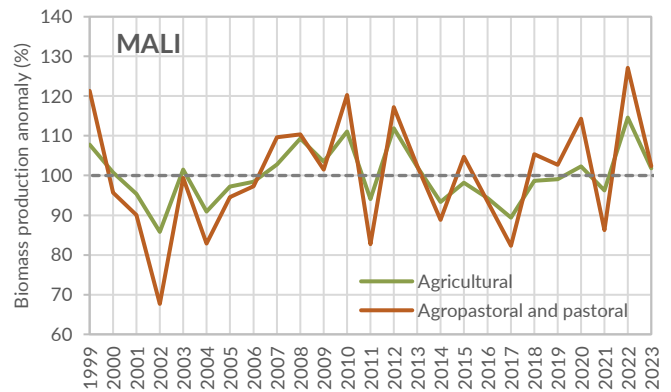
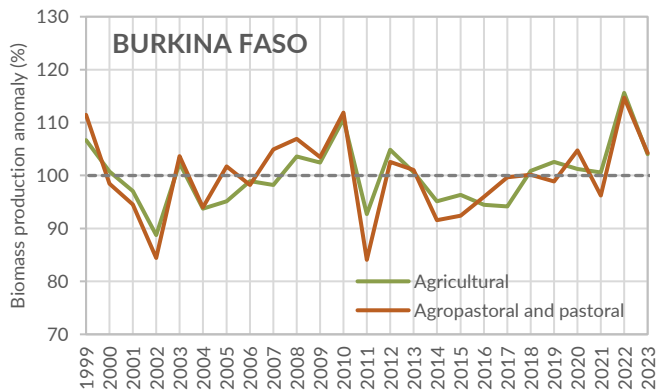


For the elaboration of these comparisons, the initial agropastoral and pastoral classes are combined to obtain statistics on the dominantly pastoral use area.

The graphs show that in 2023, the biomass production is lower than in 2022 over the whole region and slightly above the average in Burkina Faso and Mali. However, for the other countries, the productions are close to or lower than the average.

Overall, biomass productions in agricultural areas follow a similar trend to those in pastoral and agropastoral areas. It is worth noting that there is a slightly better biomass production in agricultural areas in Niger and significantly better in Chad, where they are close to the normal levels.

For this year, the best productions are recorded in Burkina Faso, while the least favourable ones are in Chad. In Chad, agropastoral and pastoral productions are below 80% of the normal values.



COMPARISON OF 2023 WITH RECENT YEARS

The vulnerability index VI linked to biomass, represented by Map 5, is sensitive to the variations in production recorded over the most recent years and highlights the areas with repeated biomass deficits.

At the regional scale, vulnerability index values are negative with some local variations. Except for the area consisting of the southwest of Mauritania, combined with the northern border of Senegal with significant surpluses, and the central region of the

three borders with a moderate surplus, the rest of the region is characterized by normal or deficit vulnerability indices. This is primarily due to the decrease in production compared to 2022, which was exceptional overall.

The vulnerable zones consist mainly of the entire northern Sahelian belt. The most significant deficits are recorded in Niger and in the agropastoral zone of Chad.

MAP 5: BIOMASS VULNERABILITY INDEX 2023



The following table shows the biomass production anomalies, expressed as the number of standard deviations from the mean and as a % of the mean by agricultural and agropastoral areas for the six countries monitored.

This table highlights a situation that is slightly negative for the year 2023 with a deterioration compared to 2022. Overall, agropastoral and pastoral areas appear to be more vulnerable than agricultural ones.

Countries	Livelihood zones	Anomaly 2019	Anomaly 2020	Anomaly 2021	Anomaly 2022	Anomaly 2023	VI 2023
Burkina Faso	Agricultural	+0.4σ (103%)	+0.2σ (101%)	+0.1σ (101%)	+2.6σ (116%)	+0.7σ (104%)	+0.01
	Agropastoral and Pastoral	-0.1σ (099%)	+0.6σ (105%)	-0.5σ (096%)	+1.9σ (115%)	+0.6σ (104%)	+0.01
Mali	Agricultural	-0.1σ (099%)	+0.3σ (102%)	-0.5σ (096%)	+2.0σ (115%)	+0.3σ (102%)	+0.00
	Agropastoral and Pastoral	+0.2σ (103%)	+1.0σ (114%)	-1.0σ (086%)	+1.9σ (127%)	+0.2σ (102%)	-0.18
Mauritania	Agricultural	-1.0σ (077%)	+0.6σ (114%)	-1.5σ (067%)	+1.8σ (140%)	-0.3σ (093%)	-0.02
	Agropastoral and Pastoral	-0.9σ (071%)	+0.6σ (118%)	-1.7σ (045%)	+1.7σ (152%)	-0.1σ (097%)	-0.10
Niger	Agricultural	+1.1σ (111%)	+1.6σ (116%)	-0.2σ (098%)	+1.2σ (113%)	-0.1σ (099%)	-0.12
	Agropastoral and Pastoral	+0.2σ (106%)	+1.3σ (136%)	+0.0σ (101%)	+0.9σ (125%)	-0.2σ (093%)	-0.24
Senegal	Agricultural	-1.4σ (086%)	-0.1σ (099%)	-0.9σ (091%)	+1.9σ (120%)	+0.1σ (101%)	+0.02
	Agropastoral and Pastoral	-1.4σ (081%)	-0.0σ (100%)	-1.0σ (087%)	+1.2σ (117%)	-0.0σ (099%)	+0.02
Chad	Agricultural	+1.3σ (110%)	+0.3σ (102%)	-1.3σ (090%)	+1.4σ (110%)	-0.1σ (100%)	-0.01
	Agropastoral and Pastoral	+0.4σ (113%)	+1.8σ (156%)	+0.0σ (101%)	+1.8σ (156%)	-0.8σ (073%)	-0.34

RAINFALL CONTEXT

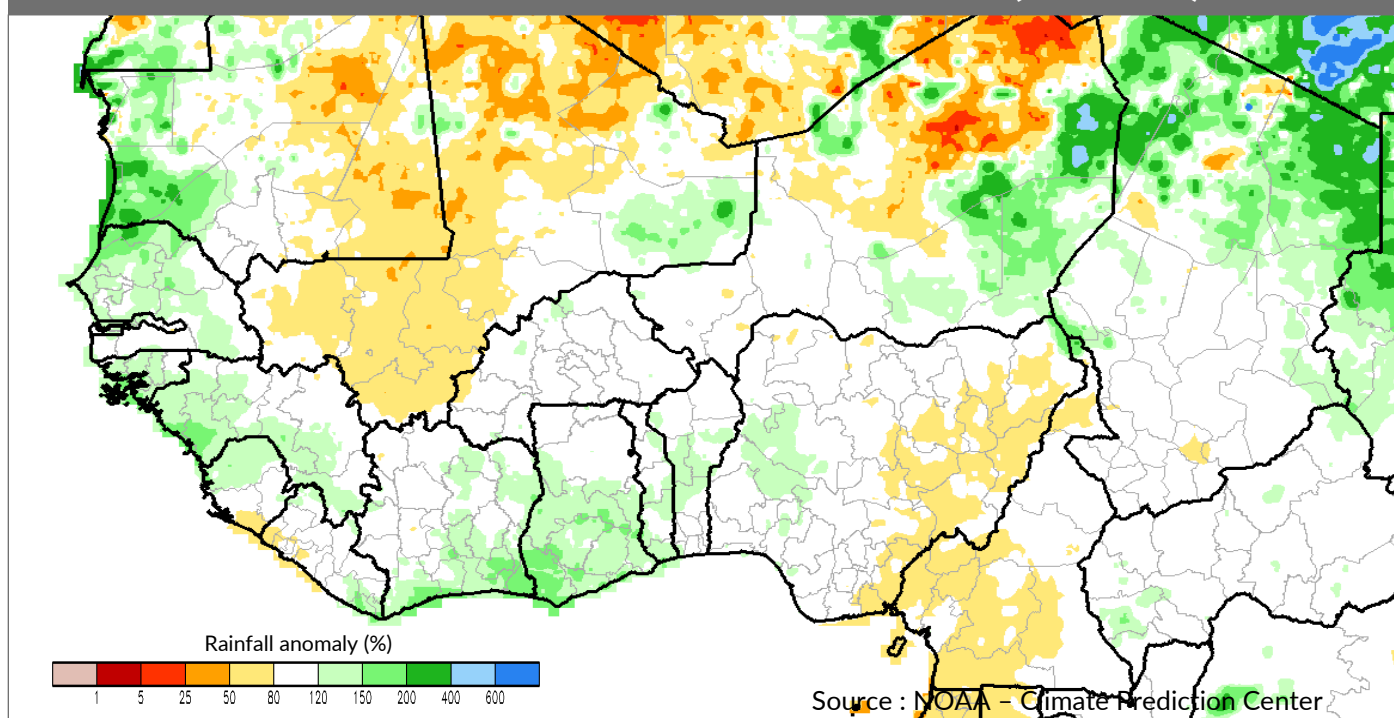
For the Sahel, as for other semi-arid zones, the availability of water and the spatiotemporal distribution of rainfall are two factors determining the annual biomass production balance.

Maps 6 and 7 display cumulative precipitation derived from satellite imagery for the 2023 rainy season. These maps are derived from two distinct sources: NOAA-Climate Prediction Center and the United States Geological Survey (USGS). While these two precipitation anomaly maps may occasionally diverge in their data, they provide an overview of the progression of the rainy season.

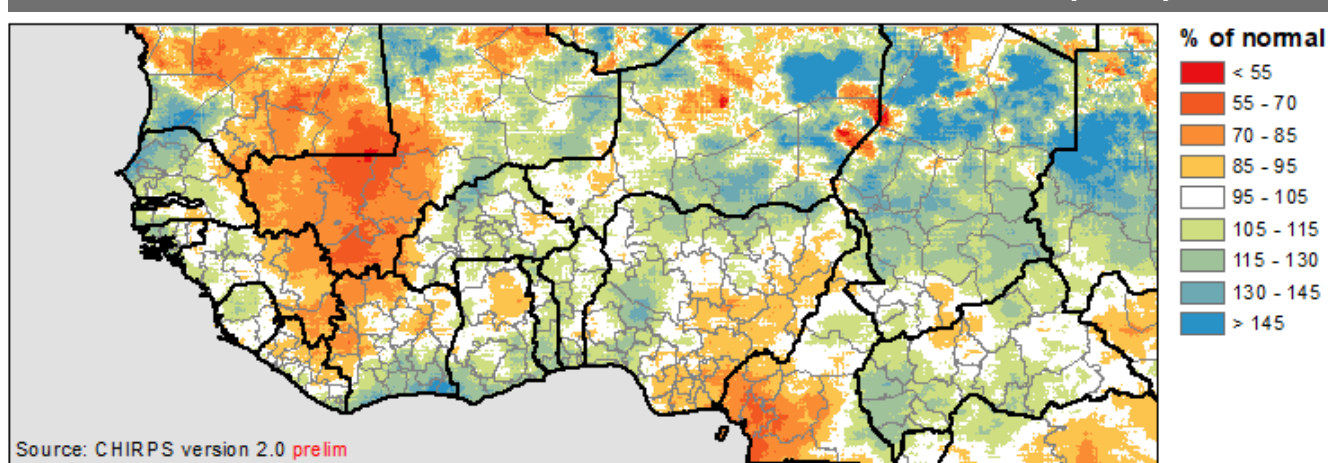
The precipitation balance for the year 2023 is heterogeneous at the regional level. Despite low precipitation recorded in several areas, others have received above-average precipitation. The coastal zone and the northeastern part of the region show positive anomalies, with values reaching up to 200% of normal. However, the central region (Mali and Niger) remains in a negative anomaly.

It is worth noting that in addition to the quantities received, the distribution of rainfall is also an important factor for growth. This rainy season is marked by dry spells and an early cessation in some places, particularly in Niger and Chad.

MAP 6: RAINFALL ANOMALIES MAY-OCTOBER 2023 (NOAA-CPC)



MAP 7: RAINFALL ANOMALIES MAY-SEPTEMBER 2023 (USGS)



CONCLUSION

WINTERING SEASON 2023

The 2023 rainy season recorded overall close to normal rainfall but with dry spells and was slightly deficient on the whole. Biomass production is significantly lower than the exceptional levels seen in 2022 but remains better than that of 2021 or 2019, which had low to very low production.

The areas with good production are limited, primarily encompassing the southwest of Mauritania coupled with the northern border of Senegal, as well as the central region of the three borders and Burkina Faso as a whole.

In the rest of the region, two major patterns emerge: one characterized by very low production, which covers the entire northern Sahelian belt, and the other with moderate to low production, which

includes the remaining parts of the region, encompassing Sahelian and coastal countries.

In recent years, there has been a rapid alternation between positive and negative years. Nevertheless, it is still premature to deduce a pattern for managing crises and disasters related to biomass production deficits.

While biomass is directly utilised from plant production in agricultural areas, it remains a valuable potential for animal production in agropastoral and pastoral areas. Depending on the region, it may be usable by livestock to the extent of 30 to 50%. The utilisation by livestock is decreasing due to accessibility constraints. As an adaptation strategy to the reduced mobility, communities resort to supplementation and reducing livestock numbers.

OUTLOOK FOR 2024

The end-of-season assessment biomass production provides a comprehensive picture of the apparent biomass availability, a crucial resource for managing livestock systems in the sub-region. However, regular monitoring of biomass stocks and herd conditions remains essential to anticipate potential difficulties, especially related to early movements, bushfires, and mobility restrictions.

Looking ahead to the year 2024, three major geographical patterns emerge:

- Areas with good production include a western bloc (Senegal and Mauritania) and the central region of the three borders including Burkina Faso in its entirety. These areas have sufficient stocks for the 2024 season but offer limited potential for exploitation. This is due to the transience of resources in the west and the growing insecurity in the Central Sahel.
- The space with moderate to low productions covers the largest geographical area and is generally characterised by low vulnerability. During the upcoming dry season, pastoral and

agropastoral communities will need to develop resilience strategies in complementarity with transhumance activities for the next pastoral lean period.

- The space with very low production covers the entire northern limit of the Sahelian belt, the region of the three borders, and the Lake Chad basin area. In addition to the high vulnerability characterized by significant deficits, this area has been influenced in recent years by ecological disruptions and increasing insecurity. An early and challenging lean period for pastoral communities is expected.

At the regional level, in addition to the low productions recorded during this rainy season in some area, the 2024 dry season will expose pastoral and agropastoral communities to high vulnerability. These communities will have to contend with the multiple consequences of increasing insecurity and disruptions in mobility, which limit geographical complementarities. Institutional instability and the global geopolitical situation are exacerbating factors.

RECOMMENDATIONS

- Follow the general recommendations in favour of pastoral and agropastoral sectors:
 - Advocate for the recognition of the importance of transhumant livestock for the functioning of the Sahelian agrarian system
 - Facilitate pastoral mobility, especially cross-border transhumance
 - Develop services for livestock and herders (animal health, vaccination...)
 - Improve pastoral infrastructure, considering it a priority for the stability and socio-economic development of countries
 - Strengthen support for the sector and preventive actions
- Establish monitoring of pasture stock throughout the dry season and monitor the impact of bushfires
- Conduct regular monitoring during the offseason in vulnerable targeted areas, especially in the northern limit of the Sahelian belt, the region of the three borders, and the Lake Chad basin area
- Integrate support for the pastoral sector at the core of intervention strategies in the sub-region

The data used for the calculation of biomass production comes from the data generated by the COPERNICUS land service, the European Commission's Earth observation programme. The research that led to the current version of the product was funded by various European Commission research and technical development programmes. The product is based on data from the SENTINEL-3, PROBA-V and SPOT-VEGETATION satellites of the European Space Agency ESA.

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