



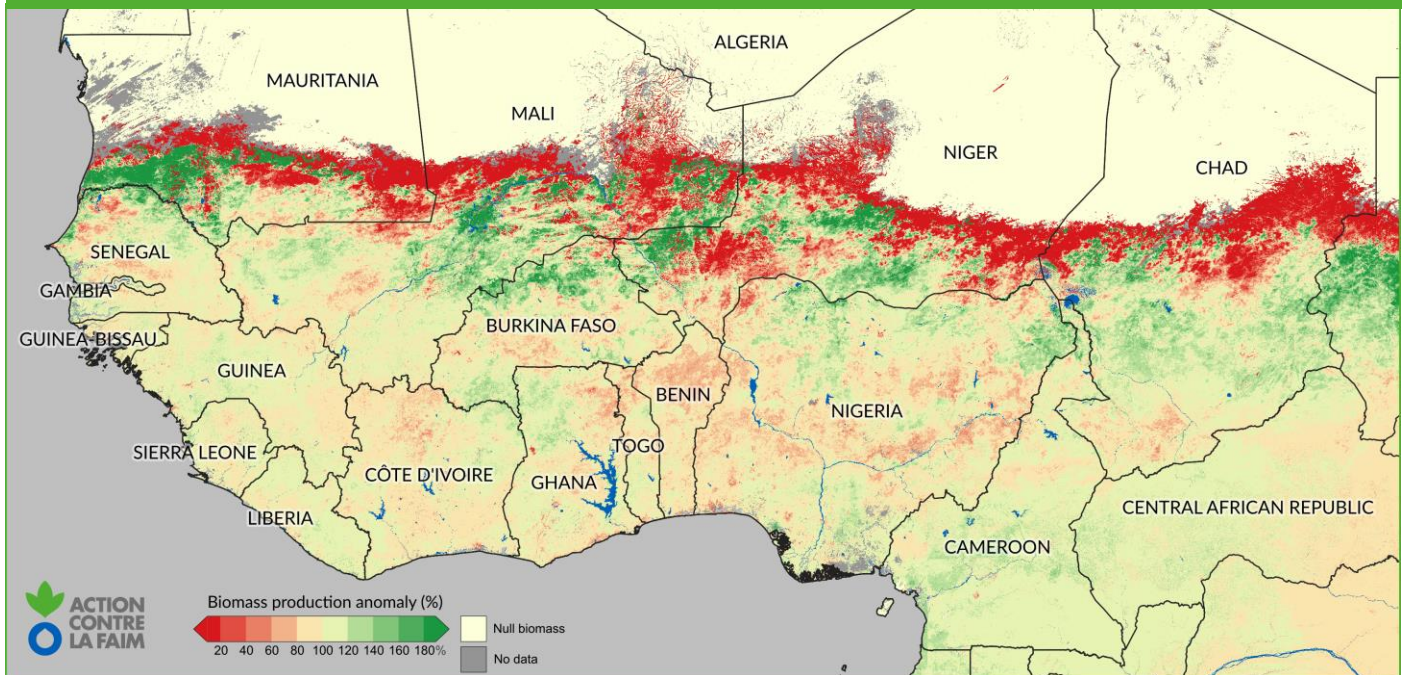
BIOMASS PRODUCTION AT RAINY MID-SEASON 2023

SAHEL REGIONAL BULLETIN

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ERWANN FILLOL**

**ACTION
AGAINST
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MAP 1: ANOMALY OF BIOMASS PRODUCTION AT END OF AUGUST 2023



HIGHLIGHTS

- Rainfall situation ranging from average to good across most of the Sahelian belt
- Occurrence of rainfall breaks and dry spells observed
- Biomass production near average levels throughout West Africa and the Sahel
- Good biomass production in the southern region of Mauritania up to the northern border of Senegal
- Biomass production ranging from average to above normal in the three-border region, except for the Tillabéri zone in Niger
- Low to very low biomass production across the entire northern fringe of the Sahel in areas with very low production
- Irregular growth, early decline, and low to very low biomass production in the Lake Chad region (Chad) and eastern Niger
- Low biomass production along coastal countries, with some localized good production in Nigeria
- Favourable end of the rainy season expected across the entire Sahel
- Probability of limited vulnerability for livestock breeders

INTRODUCTION

This document provides an assessment of the vegetation production in West and Central Africa at the mid-point of the 2023 rainy season, at the end of August.

The 2023 rainy season follows a good to very good rainy season in 2022, covering almost the entire region, although there were areas with low to very low production, particularly in the Central Sahel, especially in the southwest of Niger.

The pastoral populations in the region are becoming increasingly vulnerable due to exposure to the effects of climate change, manifested by ecosystem degradation and extreme weather events.

Additionally, they are facing challenges from the reduction of pastoral lands, often in favor of agricultural production.

The security situation is characterized by institutional instability and the expansion of violence, which is affecting pastoral populations through restrictions on the mobility of herders and increased pressures in relatively secure areas.

While the impact of Covid-19 is now limited, the economic context of the region is still influenced by the Russo-Ukrainian conflict and the unstable geopolitical situation in the region.

DESCRIPTION OF THE SYSTEM

WHAT IS BIOMASS AND HOW IS IT MEASURED?

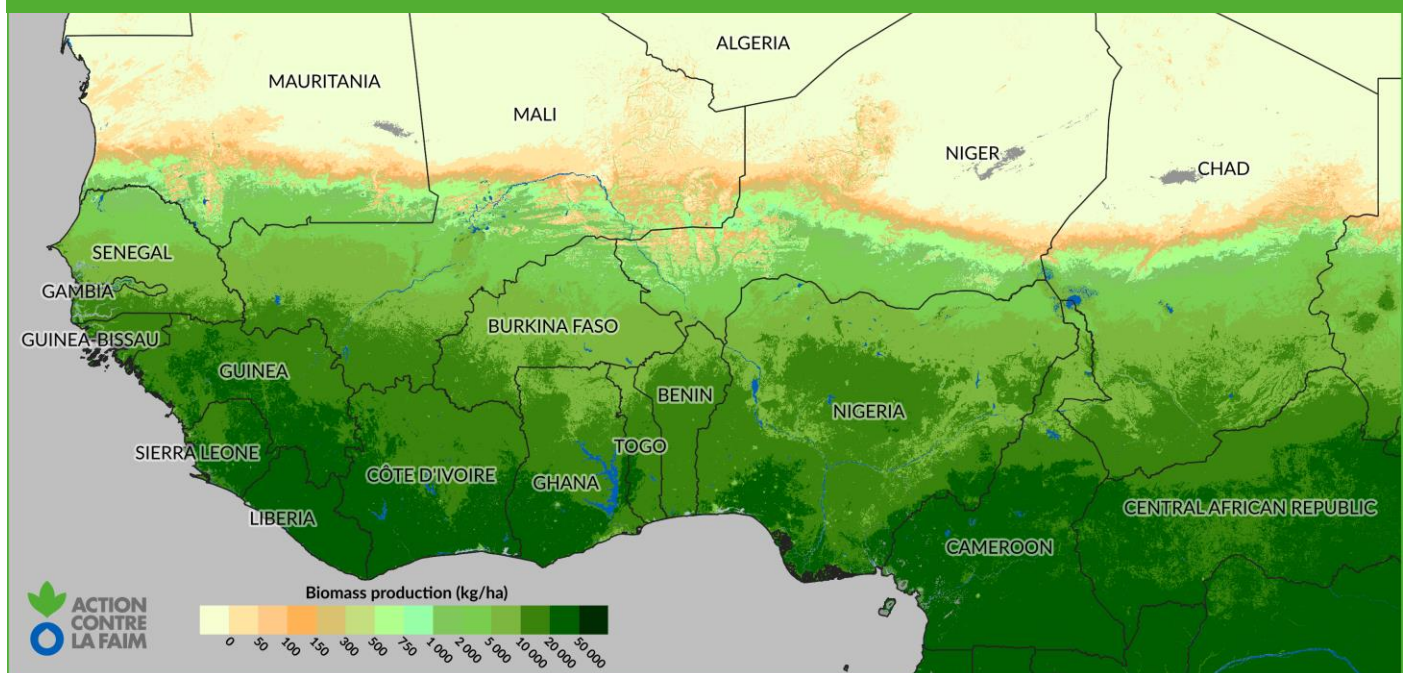
Biomass is the total production of vegetal matter measured in kilograms of dry matter MS per hectare kg/ha. The term dry matter is used to describe any form of vegetation above the ground regardless of its water/moisture content. For an analysis of the pastoral situation, biomass is an effective way to measure 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 provided, in form of 10-day 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 the one of the available satellite archives from 1999 to the present.

MAP 2: AVERAGE ANNUAL BIOMASS PRODUCTION 1999-2022



WHAT ARE THE INDICATORS GENERATED?

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

- **Annual production in kg/ha**

The annual biomass production is compared to the average calculated over all the years since 1998 in order to highlight the anomaly which is represented in two ways:

- **Anomaly expressed as a percentage of the mean value %**
- **Normalised anomaly expressed as the number of standard deviations σ from the mean**

A vulnerability index linked to biomass availability, named « VI » (Vulnerability Index), is calculated recursively by weighting the most recent years in order to take into account the sequence of dry or rainy events:

- **Vulnerability Index VI**

The methods used and details of how BioGenerator works are available at: www.sigsahel.info/index.php/section/tele/

BIOMASS PRODUCTION AT MID-SEASON 2023

MAPPING THE BIOMASS PRODUCTION ANOMALY

Map 1 displays the biomass production anomaly calculated at the mid-point of the growing season in the Sahel, expressed as a percentage of the average and sensitive to absolute variations in the amount of biomass produced. Map 3 shows the same anomaly but expressed in standard deviations (σ) from the mean, referred to as normalized anomaly, with sensitivity to relative variations in the quantity of biomass produced.

These maps indicate that biomass production in the entire Sahelian region is close to the average.

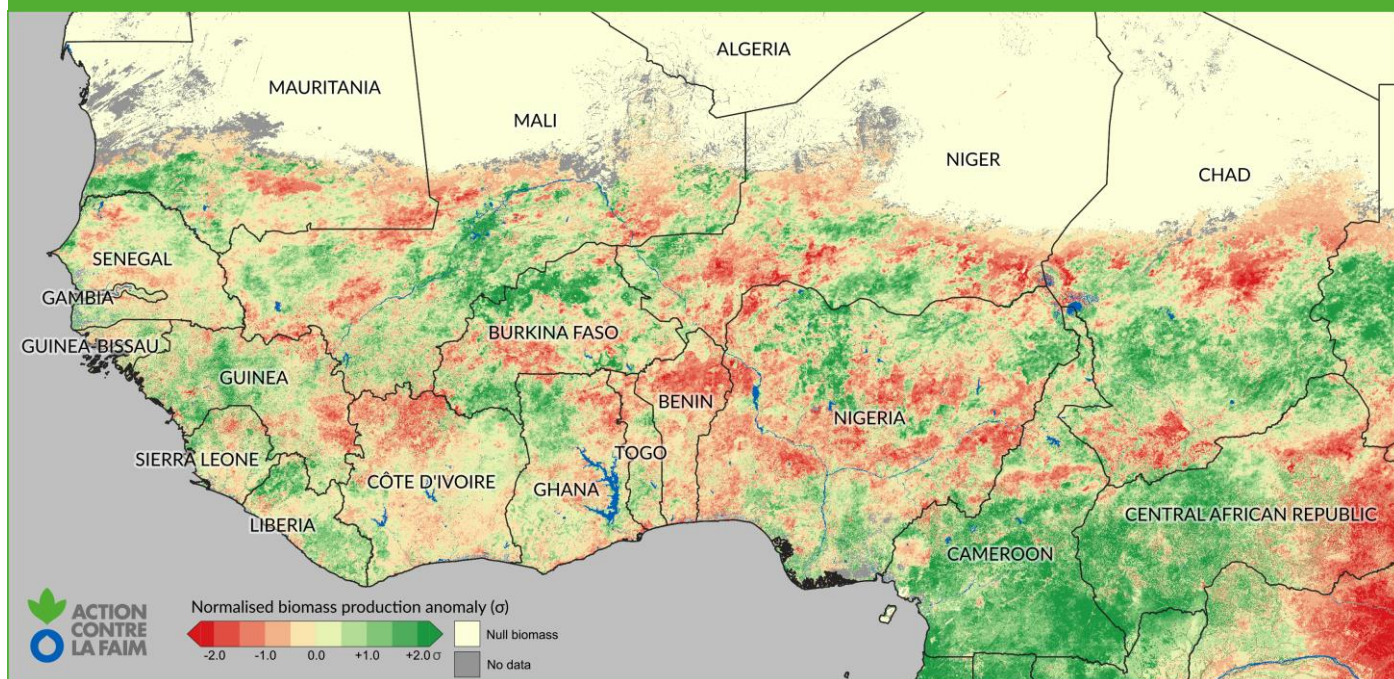
These anomalies highlight good production for the 2023 rainy season but in very localized geographical areas. These areas include the southwest of Mauritania and the northern boundary of Senegal, the belt stretching from the south-central Mali through its border region with Burkina Faso to the southwest of Niger, as well as the central border

region between Niger and Nigeria and the entire central-south of Chad.

The most pronounced deficits are observed in the entire northern boundary of the Sahel. The most significant anomalies are recorded in the southwest of Niger near Tillabéry, the northern part of the sylvopastoral zone of Senegal, parts of central Chad, and the regions surrounding Lake Chad. These negative anomalies reach up to -2σ .

Once again, this year, coastal countries report deficit production anomalies, particularly in Benin and western Nigeria. However, the latter records good production, but it is localized in the northern part of the country. These deficits should be closely monitored as they affect areas that serve as destinations for transboundary transhumant populations from Sahelian countries to coastal countries, despite mobility restrictions.

MAP 3: NORMALISED BIOMASS PRODUCTION ANOMALY AT END OF AUGUST 2023



THE 2023 GROWING SEASON

The figure on the following page illustrates the profiles of instantaneous biomass production in a few selected regions (administrative level 1 divisions) chosen as representative.

In Burkina Faso, the Sahel region exhibits a normal start to the season, followed by a good production above the average.

In the Kayes region of Mali, despite a disrupted start, production is close to the average; however, at the mid-season point, the production cycle becomes erratic with a declining trend.

In Niger, the Tillabéri region experienced an early start with growth slightly above average.

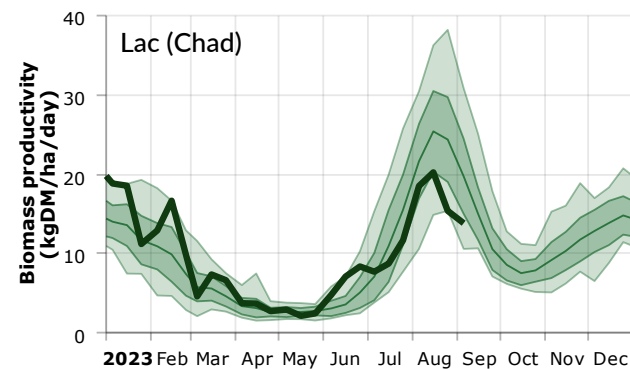
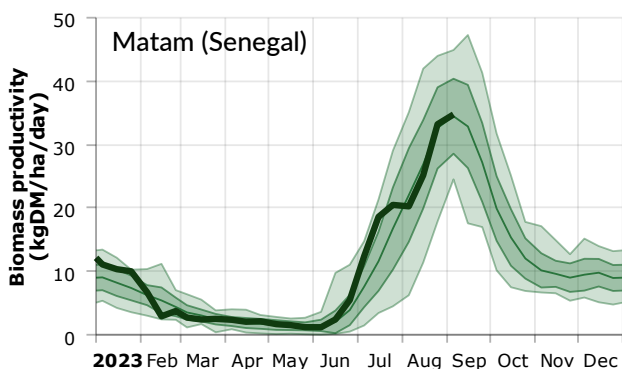
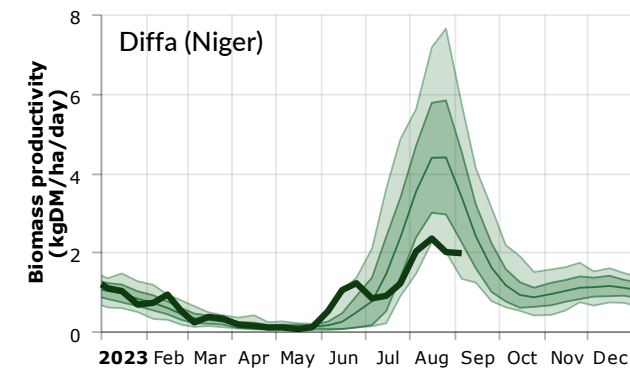
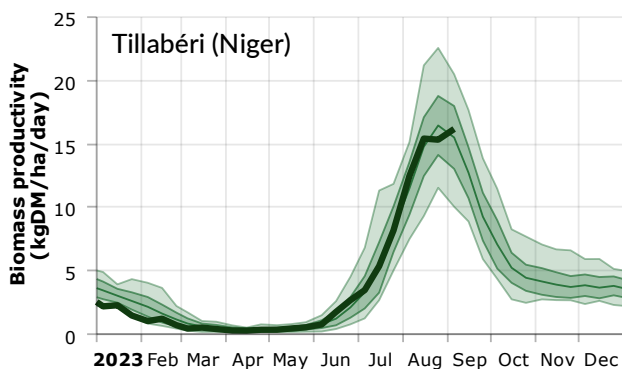
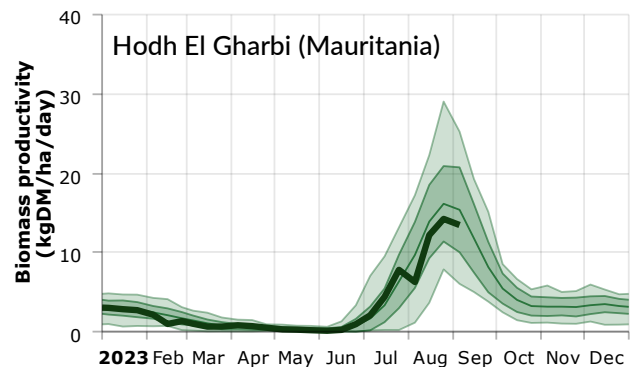
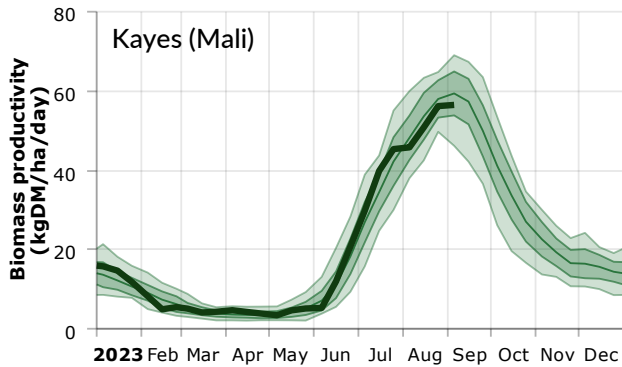
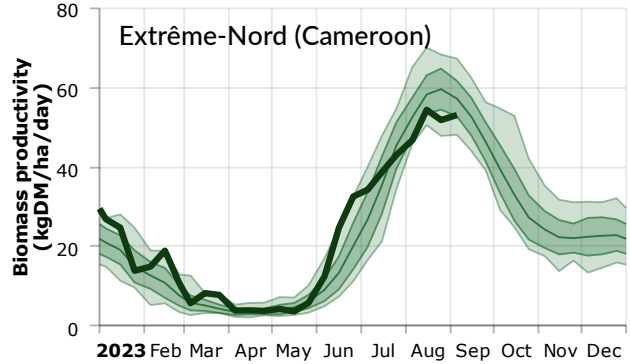
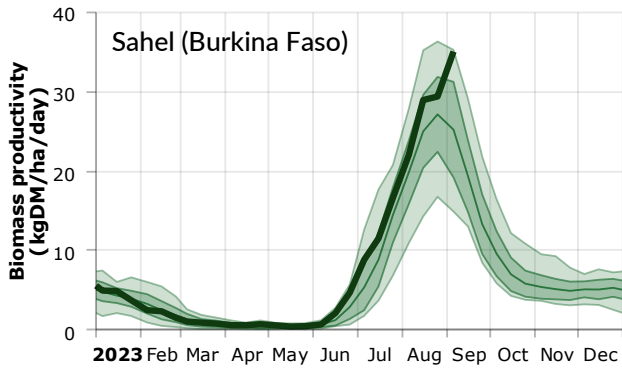
In the Wilaya of Hodh El Gharbi in Mauritania, with a normal start, there is strong growth; however, it is disrupted by a dry sequence, resulting in a downward trend with production below the average.

In the Matam region of Senegal, the start is early with very strong growth, but it is interrupted by a dry sequence between June and July. Production is average.

The Extreme-North region of Cameroon had a normal start with very good growth, but it was followed by a decline starting from mid-August.

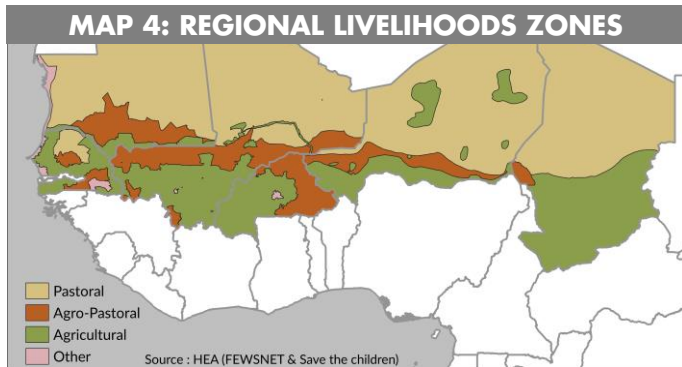
In the Lake Chad region of Chad, as well as in the Diffa region of Niger, although the start was early, growth is irregular after a prolonged pause observed in July.

Across the entire Sahel region, the growth trend is close to the average. This will be confirmed by the behaviour of the end of the rainy season.



INTER-ANNUAL VARIATION IN BIOMASS PRODUCTION

Based on the livelihood zone breakdown (Map 4), it is possible to observe inter-annual variations in biomass production according to land use: Agricultural, Pastoral and Agropastoral (source: Household Economy Analysis HEA / FEWSNET & Save the children).

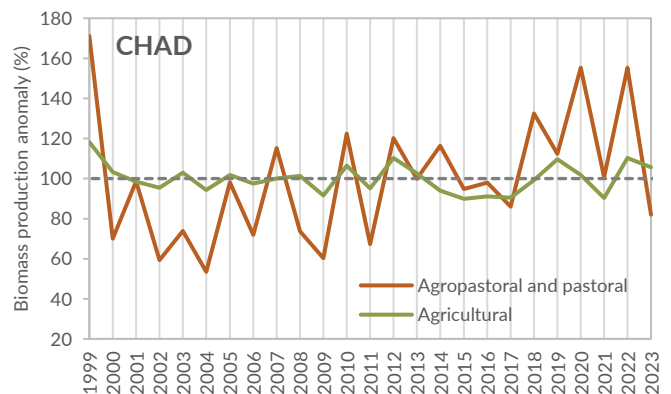
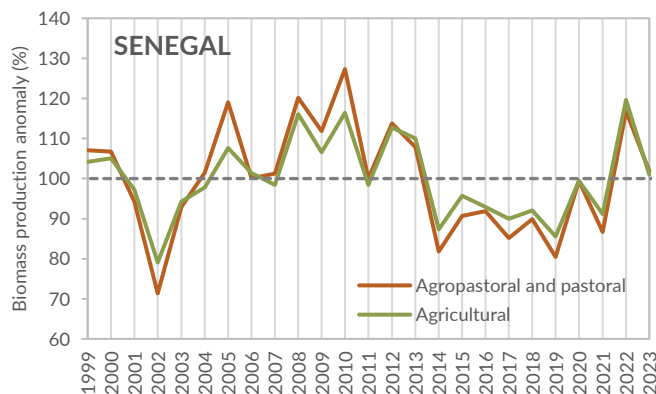
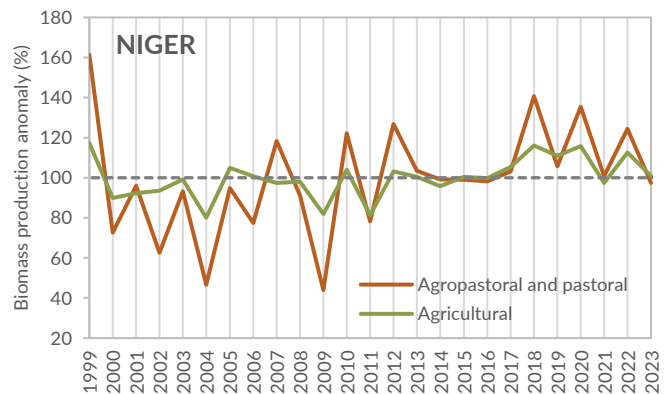
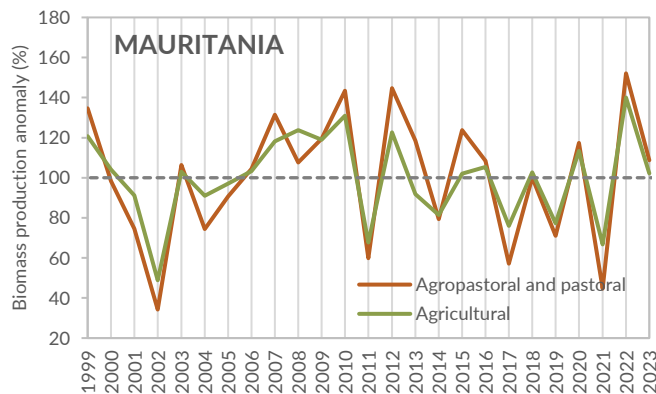
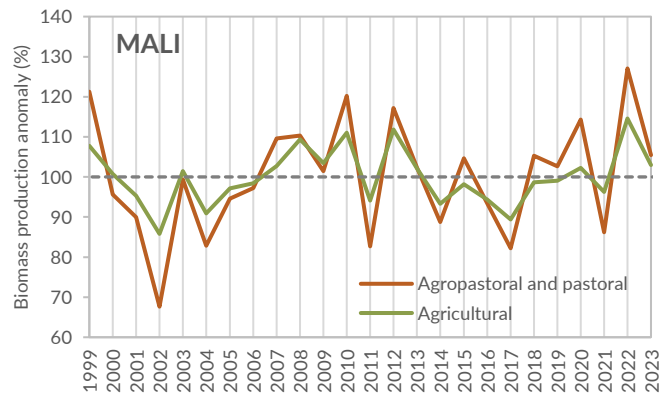
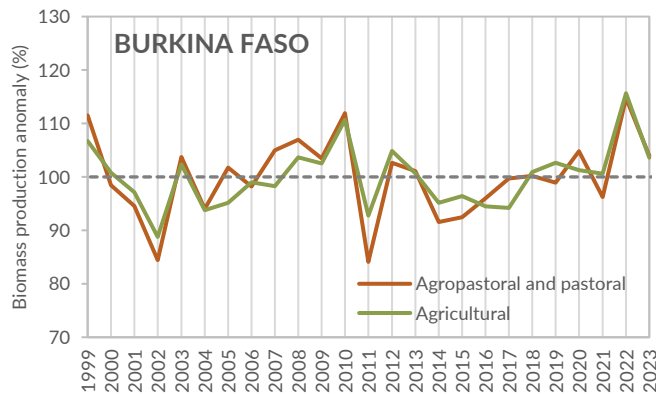


For the elaboration of these comparisons the initial Agropastoral and Pastoral classes are combined to obtain statistic on the complete pastoral use area.

The graphs below illustrate that 2023 has been an overall average year, slightly surpassing the normal values (1999-2022), but consistently lower than the previous year 2022.

An examination at the country level reveals that Burkina Faso and Mali report the best production outcomes, not only in agropastoral and pastoral areas but also in agricultural zones.

In Chad, production in agropastoral areas falls below the norm but remains close to average values in agricultural zones.



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 last few years and highlights the areas with successive biomass deficits.

The index VI calculated at the end of August 2023 indicates neutral values across the majority of West Africa and the Sahel. However, the northern boundary of the Sahel, stretching from Mauritania to

Chad, is experiencing very significant deficits (-0.15) throughout its extent.

On the other hand, the region comprising the southwest of Mauritania and the northeast of Senegal is recording significant to very significant surpluses (+0.10 to +0.15) due to the excellent production in 2022 and the good production in 2023.

MAP 5: BIOMASS VULNERABILITY INDEX END OF AUGUST 2023



The following table shows the biomass production anomalies, expressed as the number of standard deviations σ from the mean and as a % of the mean, for the six countries monitored and according to the administrative level 1 divisions (regions or wilayas).

This table highlights generally slightly positive anomalies for 2023, except for Niger, which has neutral anomalies (100% and 0.0σ) but a negative VI of -0.17 due to a decline in production compared to 2022.

The best production results are observed in the Southwest of Burkina Faso (+1.6 σ (111%), VI +0.02) and in Brakna, Mauritania (+1.6 σ (186%), VI +0.08).

At the country level, production is consistently lower than that of the year 2022. Only Burkina Faso and Senegal show positive anomalies and positive vulnerability indices, while Niger records the most concerning situation, with a significant deterioration compared to the year 2022.

Country	Region/Wilaya	Superficie (km ²)	Anomaly 2019	Anomaly 2020	Anomaly 2021	Anomaly 2022	Anomaly 2023	VI 2023
Burkina Faso	Boucle du Mouhoun	33614	+0.1 σ (101%)	+0.2 σ (101%)	-0.4 σ (097%)	+2.4 σ (118%)	+0.6 σ (105%)	+0.01
	Cascades	18054	+1.1 σ (107%)	+0.5 σ (103%)	+1.3 σ (107%)	+2.9 σ (117%)	+1.2 σ (107%)	+0.01
	Centre	2773	-0.0 σ (100%)	+0.1 σ (101%)	+0.8 σ (107%)	+2.5 σ (123%)	+0.7 σ (106%)	+0.01
	Centre-Est	14234	+1.5 σ (109%)	+0.3 σ (102%)	-0.1 σ (100%)	+1.7 σ (111%)	+0.5 σ (103%)	-0.00
	Centre-Nord	19180	-1.0 σ (088%)	+0.6 σ (107%)	-0.4 σ (096%)	+2.1 σ (125%)	+1.4 σ (117%)	+0.04
	Centre-Ouest	21433	+0.3 σ (102%)	-0.8 σ (095%)	-0.0 σ (100%)	+1.3 σ (108%)	-1.1 σ (093%)	-0.01
	Centre-Sud	11742	+0.6 σ (104%)	+0.2 σ (102%)	+0.5 σ (103%)	+1.9 σ (112%)	+0.1 σ (100%)	-0.01
	Est	46592	-0.6 σ (096%)	+0.0 σ (100%)	-0.6 σ (095%)	+1.4 σ (110%)	-0.1 σ (100%)	+0.01
	Hauts-Bassins	25729	+1.0 σ (105%)	+0.5 σ (103%)	-0.2 σ (099%)	+1.9 σ (111%)	-0.3 σ (098%)	-0.01
	Nord	16421	-0.1 σ (099%)	+0.4 σ (105%)	-0.8 σ (090%)	+2.2 σ (127%)	+1.3 σ (116%)	+0.04
	Plateau Central	8977	-0.4 σ (097%)	-0.1 σ (099%)	+0.2 σ (102%)	+2.3 σ (119%)	-0.2 σ (098%)	-0.01
	Sahel	36088	-0.2 σ (096%)	+1.3 σ (123%)	-0.3 σ (095%)	+1.8 σ (131%)	+0.9 σ (115%)	+0.01
	Sud-Ouest	16327	+0.9 σ (106%)	+0.3 σ (102%)	+0.7 σ (105%)	+2.8 σ (119%)	+1.6 σ (111%)	+0.02
Entire country	272386	+0.2 σ (102%)	+0.4 σ (102%)	-0.1 σ (099%)	+2.5 σ (115%)	+0.6 σ (104%)	+0.01	

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Country	Region/Wilaya	Superficy (km ²)	Anomaly 2019	Anomaly 2020	Anomaly 2021	Anomaly 2022	Anomaly 2023	VI 2023
Mali	Bamako	200	-1.4σ (078%)	-1.0σ (084%)	-1.1σ (083%)	-0.9σ (086%)	-0.7σ (090%)	+0.03
	Gao	100820	+1.2σ (149%)	+1.1σ (144%)	-0.3σ (086%)	+1.0σ (142%)	-0.2σ (090%)	-0.23
	Kayes	121931	-0.7σ (093%)	-0.1σ (099%)	-1.1σ (089%)	+1.5σ (115%)	+0.2σ (102%)	+0.02
	Kidal	148391	+1.5σ (249%)	+3.7σ (480%)	+0.5σ (147%)	+0.8σ (179%)	-0.1σ (089%)	-0.37
	Koulikoro	89917	-0.1σ (099%)	+0.5σ (105%)	-0.7σ (093%)	+1.8σ (117%)	-0.3σ (098%)	-0.01
	Menaka	77489	+1.4σ (173%)	+1.7σ (193%)	+0.6σ (133%)	+0.4σ (123%)	+0.4σ (123%)	-0.28
	Mopti	79584	+0.3σ (106%)	+1.3σ (124%)	-0.4σ (094%)	+2.1σ (138%)	+1.3σ (123%)	+0.03
	Segou	61972	+0.1σ (102%)	+1.0σ (112%)	-0.4σ (095%)	+2.0σ (125%)	+0.7σ (109%)	+0.01
	Sikasso	71877	+0.1σ (101%)	-0.2σ (099%)	-0.3σ (099%)	+2.2σ (111%)	+0.4σ (102%)	+0.01
	Tombouctou	498297	+1.5σ (156%)	+1.5σ (155%)	-0.7σ (074%)	+1.6σ (158%)	+0.2σ (106%)	-0.19
Entire country	1257151	+0.0σ (100%)	+0.6σ (106%)	-0.7σ (093%)	+2.0σ (118%)	+0.4σ (104%)	-0.09	
Mauritania	Adrar	220687	-0.1σ (089%)	-0.5σ (020%)	-0.6σ (007%)	+0.6σ (203%)	+0.1σ (111%)	-0.02
	Assaba	35239	-1.2σ (066%)	+0.5σ (113%)	-1.8σ (050%)	+2.2σ (163%)	+0.1σ (103%)	-0.03
	Brakna	32734	-1.1σ (044%)	+0.2σ (108%)	-0.9σ (054%)	+1.3σ (166%)	+1.6σ (186%)	+0.08
	Dakhlet-Nouadhibou	37920	-0.3σ (016%)	-0.3σ (004%)	-0.3σ (004%)	-0.1σ (085%)	+0.0σ (100%)	-0.02
	Gorgol	13812	-1.4σ (056%)	+0.0σ (101%)	-0.9σ (071%)	+1.5σ (148%)	+0.4σ (113%)	+0.04
	Guidimakha	10914	-1.3σ (072%)	+0.3σ (107%)	-1.2σ (073%)	+2.5σ (154%)	+0.7σ (114%)	+0.07
	Hodh Ech Chargi	182159	+0.1σ (102%)	+0.8σ (128%)	-1.3σ (055%)	+0.9σ (132%)	-0.4σ (085%)	-0.23
	Hodh El Gharbi	50287	-1.2σ (066%)	+0.4σ (112%)	-2.1σ (041%)	+1.5σ (143%)	-0.2σ (094%)	-0.08
	Inchiri	31504	-0.1σ (075%)	-0.4σ (011%)	-0.4σ (000%)	+0.2σ (148%)	-0.0σ (100%)	-0.03
	Nouakchott	1137	-0.5σ (029%)	-0.5σ (032%)	-0.6σ (015%)	-0.2σ (067%)	+0.0σ (107%)	+0.05
	Tagant	99789	-0.8σ (034%)	+0.4σ (134%)	-1.0σ (019%)	+1.5σ (221%)	+0.3σ (126%)	-0.14
	Tiris-Zemmour	258552	-0.3σ (000%)	-0.3σ (000%)	-0.3σ (000%)	-0.3σ (000%)	-0.0σ (099%)	-0.07
	Trarza	66032	-0.9σ (069%)	+0.6σ (122%)	-0.4σ (084%)	+1.2σ (144%)	+1.4σ (151%)	-0.01
	Entire country	1040397	-1.0σ (074%)	+0.6σ (116%)	-1.7σ (055%)	+1.7σ (147%)	+0.2σ (106%)	-0.08
	Niger	Agadez	622088	+1.7σ (202%)	+2.0σ (216%)	+0.5σ (132%)	+0.4σ (121%)	-0.0σ (099%)
Diffa		145423	+0.3σ (107%)	+1.5σ (136%)	+0.4σ (109%)	+2.0σ (147%)	-0.9σ (079%)	-0.29
Dosso		30935	+1.5σ (114%)	+1.6σ (114%)	-0.7σ (093%)	+0.5σ (104%)	-1.2σ (089%)	-0.06
Maradi		38874	+0.8σ (113%)	+0.6σ (111%)	-0.4σ (093%)	+1.2σ (122%)	+0.7σ (112%)	-0.01
Niamey		506	-1.7σ (072%)	-0.3σ (095%)	-1.3σ (077%)	-1.1σ (081%)	-0.0σ (099%)	+0.02
Tahoua		107482	+0.5σ (113%)	+1.5σ (138%)	+0.1σ (101%)	+0.3σ (108%)	-0.4σ (091%)	-0.14
Tillabéri		91413	-0.4σ (095%)	+1.2σ (114%)	-0.5σ (094%)	-0.3σ (096%)	+0.1σ (102%)	-0.07
Zinder		146807	+0.4σ (108%)	+1.0σ (124%)	+0.1σ (102%)	+1.5σ (134%)	+0.4σ (109%)	-0.14
Entire country		1187491	+0.6σ (109%)	+1.4σ (122%)	-0.1σ (098%)	+1.1σ (116%)	-0.0σ (100%)	-0.17
Senegal	Dakar	606	-1.5σ (076%)	-0.2σ (097%)	-0.2σ (097%)	-0.1σ (098%)	-0.5σ (092%)	+0.01
	Diourbel	4586	-0.9σ (085%)	+0.4σ (105%)	-0.9σ (086%)	+1.6σ (125%)	-0.3σ (095%)	-0.01
	Fatick	7080	-1.7σ (080%)	+0.3σ (104%)	-0.4σ (096%)	+2.4σ (127%)	+0.3σ (104%)	+0.02
	Kaffrine	10878	-1.6σ (076%)	-0.1σ (098%)	-1.0σ (085%)	+1.4σ (121%)	-0.4σ (094%)	+0.01
	Kaolack	5541	-1.6σ (080%)	+0.3σ (103%)	-0.9σ (089%)	+2.6σ (131%)	-0.2σ (097%)	+0.01
	Kedougou	16821	-0.8σ (094%)	-0.4σ (097%)	-0.6σ (096%)	+1.5σ (111%)	+0.0σ (100%)	+0.01
	Kolda	13778	-1.4σ (087%)	-0.5σ (096%)	-1.0σ (091%)	+1.6σ (115%)	-0.2σ (099%)	+0.02
	Louga	25653	-0.6σ (089%)	+0.9σ (116%)	-0.7σ (088%)	+0.9σ (115%)	-0.1σ (099%)	-0.00
	Matam	28560	-1.6σ (067%)	-0.3σ (094%)	-1.1σ (077%)	+1.2σ (125%)	+0.5σ (110%)	+0.07
	Saint Louis	19615	-1.0σ (077%)	+1.0σ (123%)	-0.1σ (097%)	+0.6σ (114%)	+0.9σ (121%)	+0.05
	Sedhiou	7398	-1.5σ (088%)	-0.5σ (096%)	-0.6σ (095%)	+2.5σ (119%)	+0.4σ (103%)	+0.02
	Tambacounda	43144	-1.3σ (084%)	-0.3σ (097%)	-1.0σ (087%)	+1.5σ (119%)	-0.1σ (099%)	+0.02
	Thies	6924	-0.8σ (090%)	+1.0σ (113%)	+0.2σ (103%)	+2.0σ (126%)	+0.8σ (111%)	+0.01
	Ziguinchor	7592	-1.5σ (089%)	-0.2σ (098%)	+0.8σ (106%)	+2.8σ (121%)	+1.0σ (107%)	+0.03
Entire country	198320	-1.4σ (084%)	-0.0σ (100%)	-0.8σ (091%)	+1.7σ (119%)	+0.2σ (102%)	+0.03	
Chad	Barh-El-Gazel	49876	+0.2σ (107%)	+1.3σ (140%)	-0.7σ (079%)	+1.7σ (152%)	+0.4σ (111%)	-0.11
	Batha	90543	+0.7σ (117%)	+1.4σ (134%)	-0.0σ (100%)	+2.0σ (149%)	-0.4σ (089%)	-0.15
	Borkou	149318	+0.2σ (117%)	+2.0σ (288%)	+0.5σ (145%)	+1.3σ (221%)	-0.8σ (029%)	-0.33
	Chari-Baguirmi	46298	+1.5σ (116%)	+0.6σ (106%)	-0.7σ (093%)	+1.6σ (116%)	+1.3σ (113%)	+0.03
	Ennedi Ouest	123959	+0.7σ (159%)	+1.2σ (203%)	+0.3σ (129%)	+0.6σ (153%)	-0.8σ (028%)	-0.43
	Ennedi-Est	83306	+1.3σ (214%)	+2.1σ (289%)	+0.3σ (125%)	+0.8σ (170%)	-0.7σ (040%)	-0.42
	Guera	60921	+0.9σ (108%)	+0.1σ (101%)	-1.0σ (090%)	+1.3σ (112%)	+1.2σ (111%)	+0.03
	Hadjer-Lamis	29085	+0.7σ (112%)	+1.5σ (123%)	-0.3σ (095%)	+2.1σ (133%)	+0.9σ (113%)	+0.01
	Kanem	72851	-0.0σ (099%)	+1.7σ (154%)	-0.7σ (078%)	+2.1σ (168%)	+0.2σ (106%)	-0.24
	Lac	21746	+0.7σ (109%)	+1.6σ (120%)	+0.8σ (110%)	+2.5σ (132%)	-0.4σ (095%)	-0.09
	Logone Occidental	8640	+0.9σ (106%)	-1.4σ (091%)	-2.0σ (087%)	-1.4σ (091%)	-1.0σ (094%)	-0.00
	Logone Oriental	23840	+1.5σ (106%)	-0.6σ (097%)	-1.9σ (092%)	+0.1σ (100%)	-0.4σ (098%)	+0.00
	Mandoul	17388	+0.8σ (104%)	-0.6σ (097%)	-1.8σ (092%)	+0.5σ (102%)	-1.4σ (093%)	-0.01
	Mayo Kebbi Est	18395	+1.4σ (111%)	-1.1σ (092%)	-2.0σ (084%)	+0.3σ (103%)	+0.6σ (105%)	+0.03
	Mayo-Kebbi Ouest	12551	+1.6σ (111%)	-1.8σ (088%)	-2.3σ (084%)	-0.0σ (100%)	-0.2σ (099%)	+0.01
	Moyen-Chari	40810	+1.1σ (106%)	-0.6σ (097%)	-1.5σ (092%)	+1.4σ (108%)	+0.0σ (100%)	+0.01
	N'Djamena	471	+0.8σ (112%)	+0.6σ (109%)	-1.2σ (082%)	+0.4σ (106%)	+0.8σ (112%)	+0.03
	Quaddai	29689	+0.9σ (116%)	+1.1σ (120%)	-0.1σ (098%)	+2.1σ (137%)	+0.6σ (110%)	-0.02
	Salamat	68151	+0.7σ (107%)	-0.3σ (097%)	-1.7σ (084%)	+0.4σ (104%)	+1.2σ (111%)	+0.04
	Sila	36285	+1.6σ (118%)	+0.5σ (106%)	-0.9σ (090%)	+1.1σ (113%)	+1.4σ (116%)	+0.04
Tandjile	17850	+1.1σ (107%)	-1.1σ (093%)	-2.1σ (086%)	-0.7σ (095%)	-0.1σ (099%)	+0.01	
Tibesti	210958	+4.6σ (694%)	-0.1σ (082%)	-0.6σ (026%)	-0.7σ (015%)	-0.0σ (099%)	-0.17	
Wadi Fira	52068	+0.5σ (119%)	+1.6σ (158%)	+0.2σ (108%)	+1.3σ (146%)	-0.3σ (089%)	-0.20	
Entire country	1272128	+1.2σ (110%)	+0.5σ (104%)	-1.2σ (091%)	+1.5σ (112%)	+0.6σ (105%)	-0.08	

RAINFALL CONTEXT

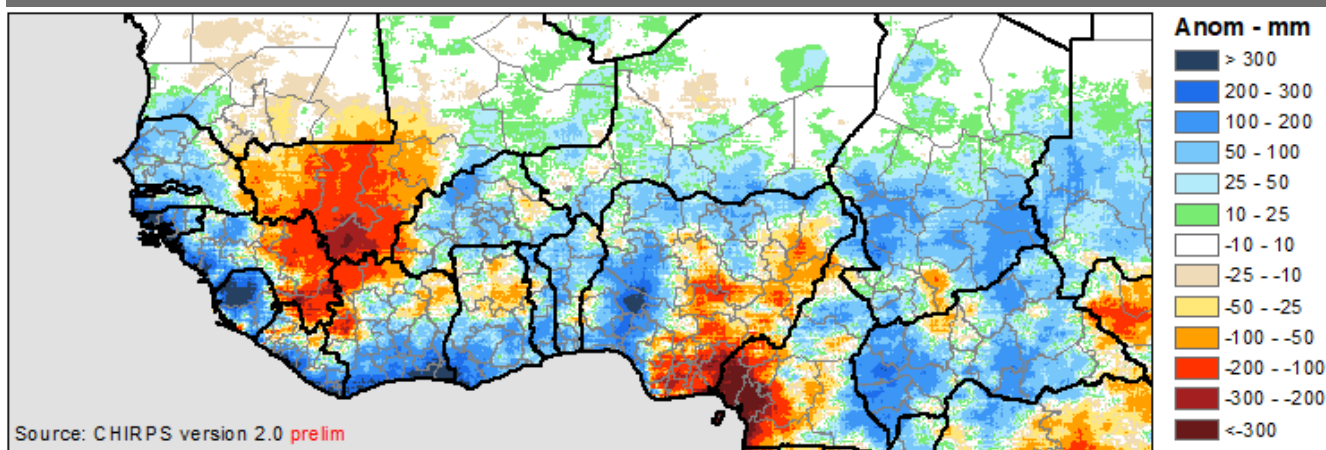
Although water availability is the limiting parameter for vegetation growth in the Sahel, it is the distribution of rainfall over time that is crucial and will determine the annual production of biomass. The annual accumulation cannot alone explain the anomaly in biomass production.

Map 6 shows the cumulative rainfall derived from satellite imagery over the 2022 rainy season (May to August) by the United States Geological Survey (USGS). It shows a favourable rainfall situation during the first half of the rainy season across the majority of the Sahelian belt, with anomalies ranging from +200 to +300mm. However, two large areas exhibit negative precipitation anomalies. The first area encompasses the entire southern Mali, the eastern

and southeastern regions of Guinea, the northwest of Côte d'Ivoire, and parts of southwestern Burkina Faso, with a peak at -300mm centred on Sikasso in Mali. The other zone is located along the southern border between Nigeria and Cameroon in the coastal region.

Map 7 displays precipitation forecasts for September 2023 provided by the Climate Prediction Center (CPC) of the National Oceanic and Atmospheric Administration (NOAA). This map indicates a positive anomaly in the 2023 rainy season's conclusion across the entire Sahel, with good rainfall prospects suggesting a positive biomass production by the end of the season.

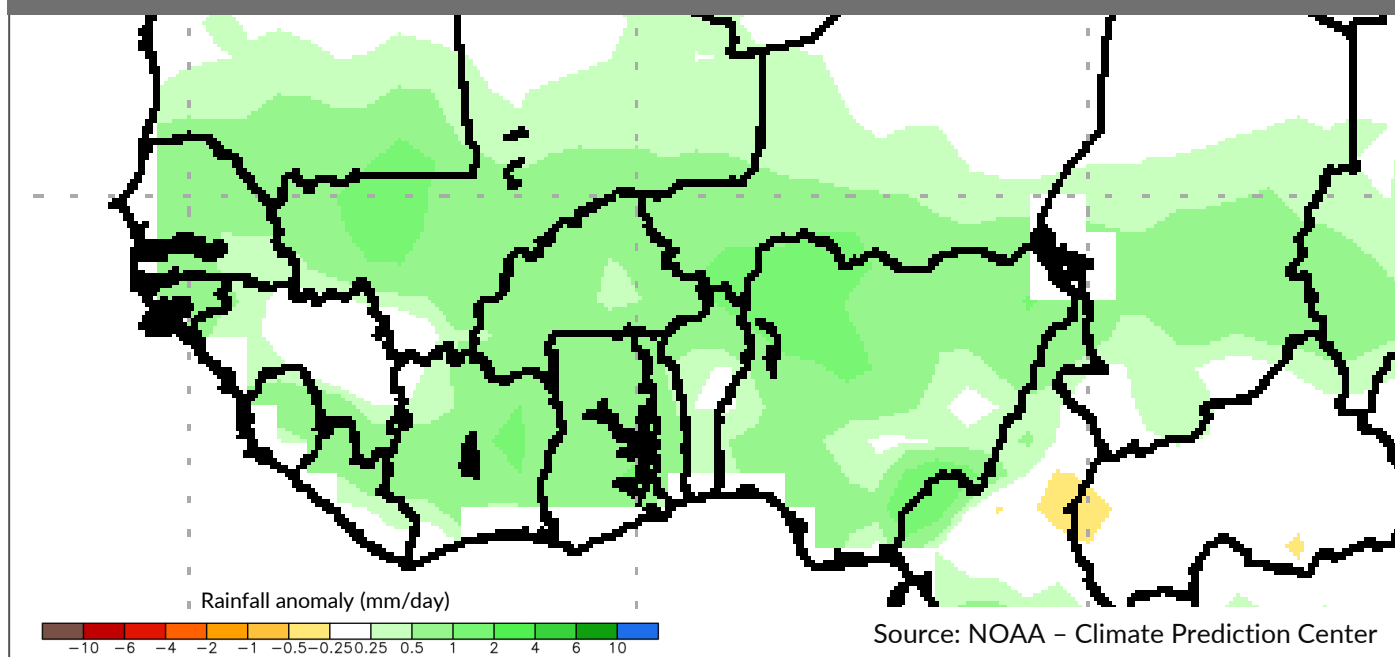
MAP 6: RAINFALL ANOMALIES MAY-AUGUST 2023 (USGS)



Map produced by USGS/EROS



MAP 7: RAINFALL FORECAST FOR SEPTEMBER 2023 (NOAA-CPC)



CONCLUSION

WINTERING SEASON 2023

At mid-season, biomass production for the 2023 wintering season appears to be close to the average for West Africa as a whole, despite some contrasts observed in the central Sahel. At the regional scale, the anomaly in biomass production is slightly positive overall.

Areas with good biomass production are located in the southern part of Mauritania and the northern border of Senegal, as well as in the region of the three borders.

Areas with low biomass production are mainly the regions bordering Lake Chad, including the Lac region in Chad and the Diffa region in Niger, which exhibit fluctuating production cycles. The Extreme-North region in Cameroon is spared, with a normal to slightly positive situation.

Also experiencing a significant deficit is the southern and eastern part of the Tillabéri region in Niger, extending to the western part of the Tahoua region. This situation is even more alarming as these areas were already experiencing deficits in the two previous years.

Coastal countries, especially Benin and the central part of Nigeria, as well as the northern parts of Togo, Ghana, and Côte d'Ivoire, have biomass production below the average. While the vulnerability of these coastal countries to a deficit in biomass production is usually lower, this situation should still be monitored because these areas serve as host regions for transboundary transhumants.

For this year, at mid-season, river flows are slightly above the average of the past two decades. Floods are limited, despite some overflow situations in Senegal and coastal countries, particularly in Benin and Nigeria. The impacts on pastoral and agropastoral production are limited.

The behavior of the late rainy season will be crucial in accurately assessing biomass production. Forecasts indicate a positive trend across the region as a whole, marked by a late end to the season and above-average rainfall.

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 agricultural system
 - Facilitate pastoral mobility
 - Develop services for livestock and herders (animal health, vaccination, etc.)
 - Improve pastoral infrastructure, which should be considered a priority for the stability and socio-economic development of the countries affected by the monitoring system
- Consult the Early Warning Guide on Biomass available at www.sigsahel.info
- Conduct regular monitoring during the late rainy season in the targeted areas located at the northern boundary of the Sahel region, especially in Chad
- Facilitate transhumance, especially cross-border transhumance, to reduce the vulnerability of pastoral communities due to biomass production deficits and the security context
- Establish a system for anticipation and rapid interventions for agropastoral communities in the region of the three borders
- Follow the specific recommendations that will be formulated during the end-of-rainy-season analysis in the regional report and the national reports expected in November 2023

The data used for the calculation of biomass production comes from the data generated by the COPERNICUS ground 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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