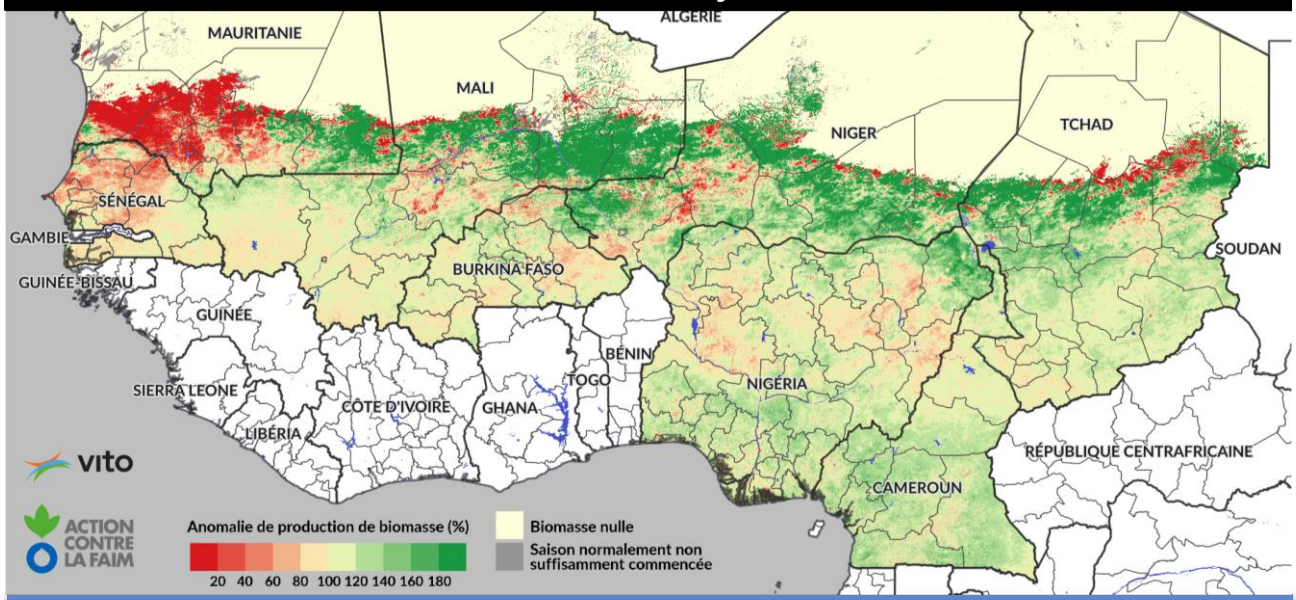
# SAHEL

ACTION AGAINST HUNGER | ACTION CONTRE LA FAIM

## 2018 BIOMASS PRODUCTION ANALYSIS AND PERSPECTIVES FOR 2019

ALEX ORENSTEIN & P. CABANES

**Biomass Production Anomaly: 01 October 2018**




### Key Points

- Significant biomass deficits in Pastoral zones of Senegal and Western Mauritania
  - Potential for early lean season in these areas
- Elsewhere, globally favorable biomass production in most pastoral areas of the Sahel
- Light to moderate biomass deficits in parts of Mali, Burkina Faso and Niger
- Heavy surface water deficits in Senegal but normal to favorable surface water availability elsewhere

Overall, biomass production in the Sahel for the 2018 rainy season shows a marked improvement over the 2017 drought. However, there are still troubling deficit areas in Senegal and Mauritania that require serious attention. These areas may potentially be subject to an early and prolonged lean season. In addition to biomass deficits, there are surface water deficits in these areas. This is the fifth consecutive year of biomass deficits in the pastoral areas of Senegal and Mauritania.

While most of the Sahel is currently experiencing a « good » season, pastoral communities are still recovering from the 2017/2018 drought. Thus, the impacts of biomass deficits will be amplified as decimated herds struggle to find pasture and water.

Elsewhere, moderate deficits of biomass can be found in Eastern Burkina Faso, Central Mali (Mopti) and parts of Tahoua and Tillabery in Niger. Most of these deficit areas are found near areas producing a surplus. If herd mobility is unimpeded, pastoralists should be able to find pasture. However in areas with conflict or banditry (such as Mopti or Tahoua), this may be less possible.

In spite of the marked improvement of conditions since the previous year, the pastoral situation should continue to be monitored. Preparations for the lean season in Senegal and Mauritania should be undertaken without delay.

See country reports on www.sigsahel.info for additional information
An interactive dataset is available at http://geosahel.info/Viewer.aspx?map=Analyse-Biomasse-Finale#

This data was generated by the land service of Copernicus, the Earth Observation program of the European Commission. The research leading to the current version of the product has received funding from various European Commission Research and Technical Development programs. The product is based on PROBA-V data ((c) ESA

# BIOMASS ANALYSIS- SAHEL

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## WHAT IS BIOMASS?

Biomass is the total production of above-ground dry matter. In our case, we are talking about Dry Matter Productivity (DMP) measured in Kilograms per Hectare. The higher the value, the more dry matter produced. The term "dry matter" is used to describe any form of vegetation above the ground without accounting for its water content. For an analysis of the pastoral situation, the DMP is an effective means of measuring the availability of pastoral resources.

## WHY USE DRY MATTER AS A PASTORAL INDICATOR?

All forms of fodder and vegetation are composed of water and dry matter (DM), but at variable rates. For example, the percentage of dry matter in the hay is much higher than in the green grass. In addition, all the nutrients needed for livestock are in the dry part of the forage (energy, protein, minerals). Therefore, livestock feed requirements are generally calculated in terms of DM.

Data on the amounts of DM produced do not inform about their edibility. The type of pasture and its edibility are essential to determine the animal carrying capacity of an area, ie the number of herbivores that can graze. Furthermore, not all forages are identical and may contain different levels of energy, protein and minerals.

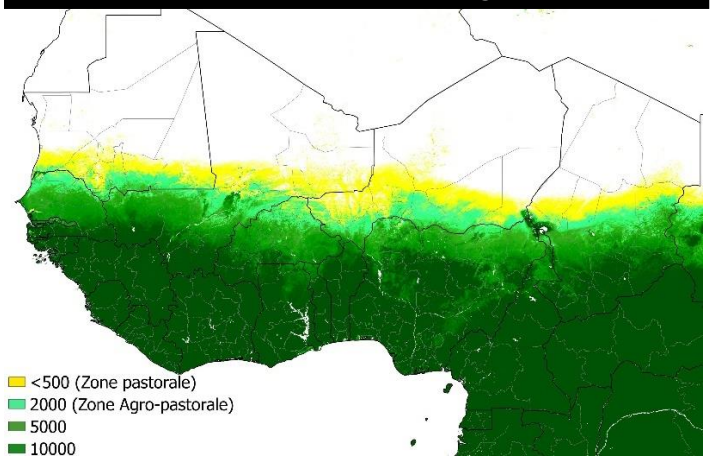
Nonetheless, DMP datasets allow for a high degree of precision in measuring biomass production. The expression of production in kilogrammes per hectare is well-suited to measuring anomalies and trends and provides a useful reference point for agronomists and veterinarians.

## HOW IS IT MEASURED?

Biomass data is gathered every 10 days from satellite imagery generated by the Belgian Satellite Proba-V. The imagery is provided by ACF's scientific partner, the Flemish Institute of Technology (VITO). This is done by measuring the light reflection from the vegetation. The healthier the plant, the more light it absorbs. An algorithm is then used that combines the data on light interception with meteorological data (namely mean temperature and evapotranspiration) to create the estimate of Kg/ha.

The Sahel, and in particular the pastoral zone, is characterized by considerable yearly variations of vegetation growth and rainfall. As a result, it can be difficult to compare DMP using a reference period. An ACF tool called the Biogenerator is used to measure changes in DMP, the data for the current year is measured from the period of 1998 onwards. The calculation creates a map where each pixel (1km$^2$) shows that zone's biomass production, compared to every year since 1998.

Mean Biomass Production (kg DM/ha)




## THE MAPS

Several different maps are offered in this report:

1) Biomass Production: A map showing the production in Kg/Ha
2) Biomass Anomaly: A map of the analysis of the production anomaly which compares the total production of the current year with the average of the period 1998-current year. This anomaly is calculated on a scale of 0 (deficit) to 200 (excess) for each pixel. The most negative anomaly areas are red and the surplus areas are green.
3) The Vulnerability Index: A recursive index that includes anomalies from previous years to establish areas prone to consecutive deficits.
4) Water Accessibility: A map showing availability of water, compared to the period 1998- Current year, measured on a 0-200 scale (like the biomass anomaly)

## USES OF THE SYSTEM

These measurements are particularly adept for measuring forage availability in semi-arid environments, such as the Sahel or the Horn of Africa. The biomass analysis is conducted at the end of the rainy season, when biomass production ends for the year. As the analyses include the totality of production, they are valid for the entire period before the next rainy season. As a result, it's possible to identify potential stress zones, areas to be avoided by herds or areas to restock animal feed.

## RESOURCES

Guides and Tutorials on biomass analysis
sigsahel,info/index.php/knowledgebase/

Information on dry matter and animal nutrition
equinenutritionnerd.com/2014/05/12/dry-matter/
Tutorial on remote sensing and drought
wamis.org/agm/meetings/amali09/J2_Wardlow-Remote_Sensing_Overview.pdf

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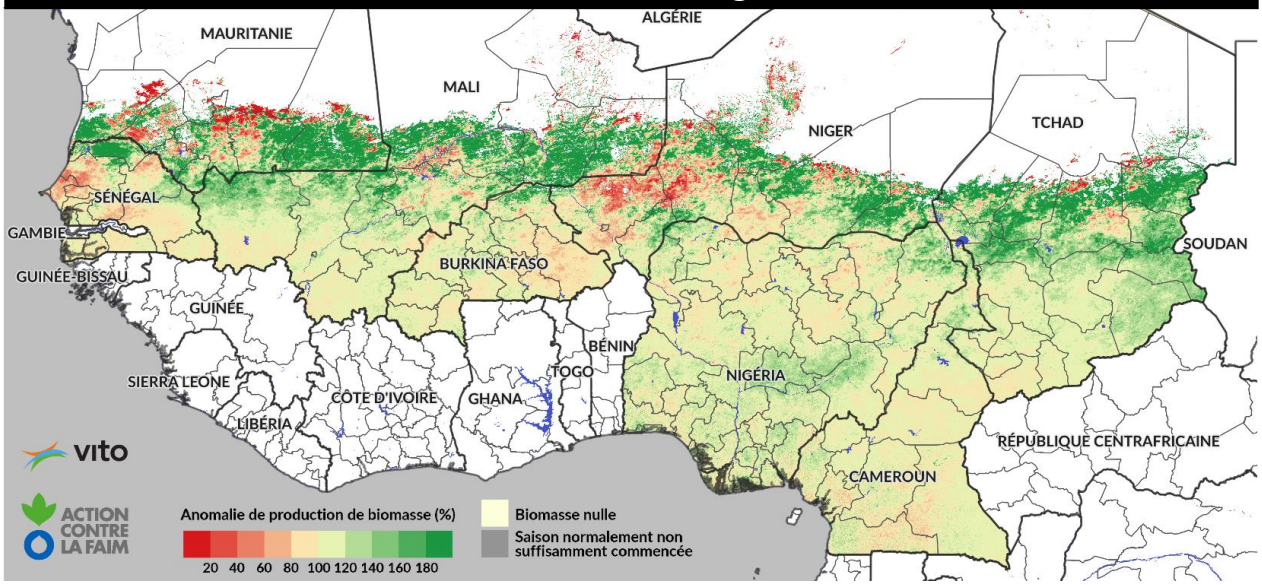
## Biomass Production % Change: 2017/2018

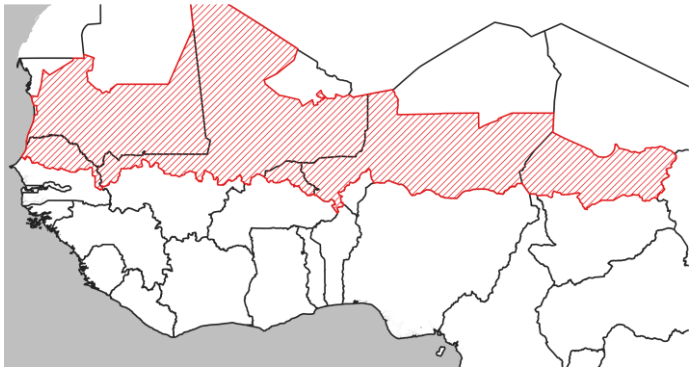



This map compares the biomass production levels of 2018 to 2017, measuring the percent change from last year. Overall, there is a marked improvement with most areas registering a significant increase. This is unsurprising, given that 2017 had the worst production levels since 2011. However, it should be noted that some areas, especially in Senegal and Mauritania are below even 2017 levels.

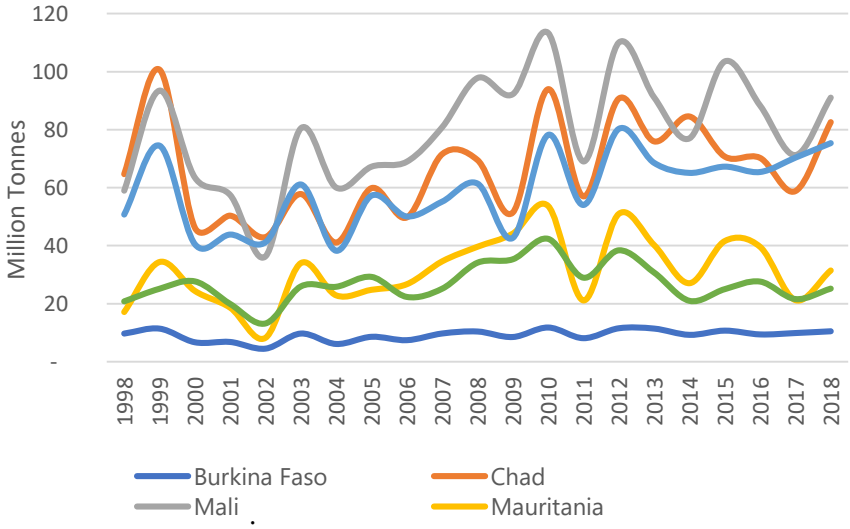
The presence of zones with production under 2017 levels should be cause for concern. For more information on these areas, please consult the individual country reports on sigsahel.info.

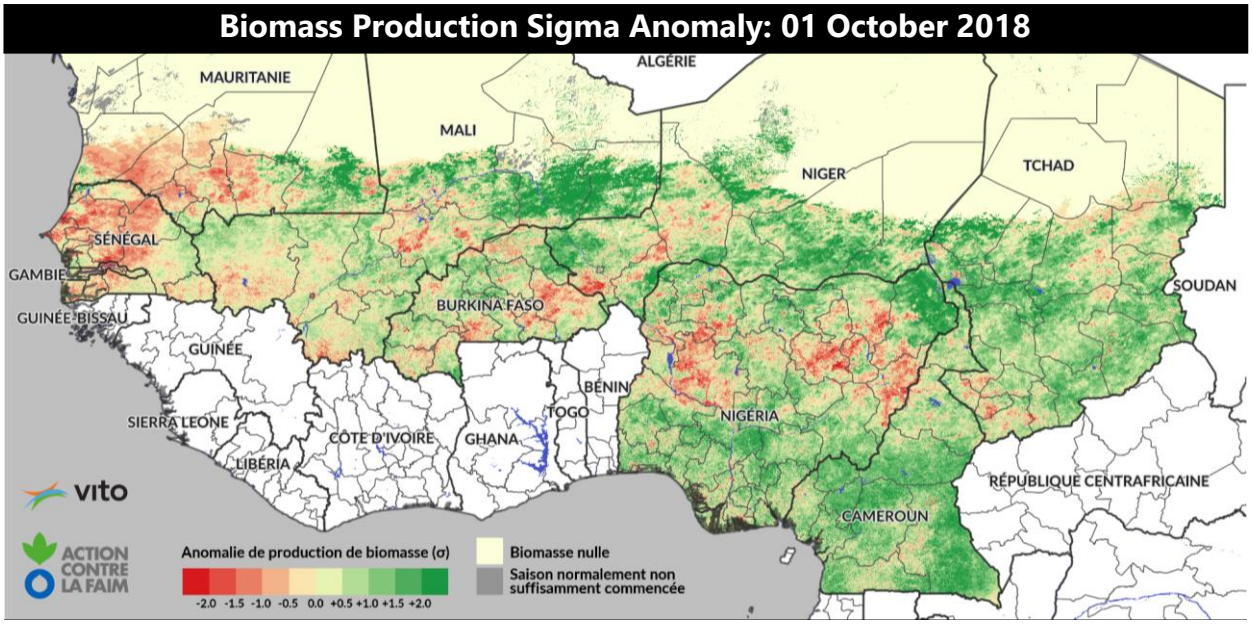
Graph 1 allows for a look at the production of the pastoral and agro-pastoral zones. Forested and agricultural areas have been removed from the analysis as they account for the majority of biomass production in most Sahelian countries and thus can offset an analysis of rangelands. Biomass production has returned to 2015 levels. Significant recoveries from 2017 can be seen in Chad and Mali. Whereas the recovery is less noticeable in Senegal and Mauritania.

## PASTORAL + AGRO-PASTORAL ZONES
### (ADMINISTRATIVE DIVISIONS)



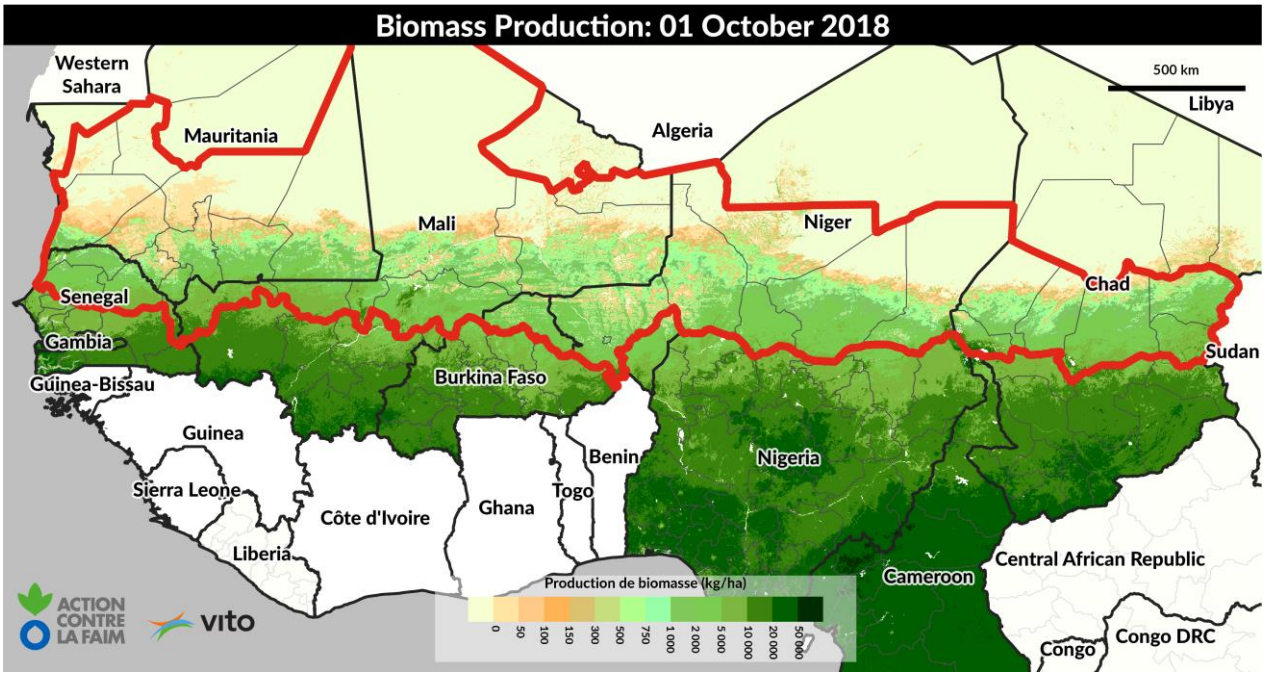
Graph 1: Biomass Production - Pastoral Zones





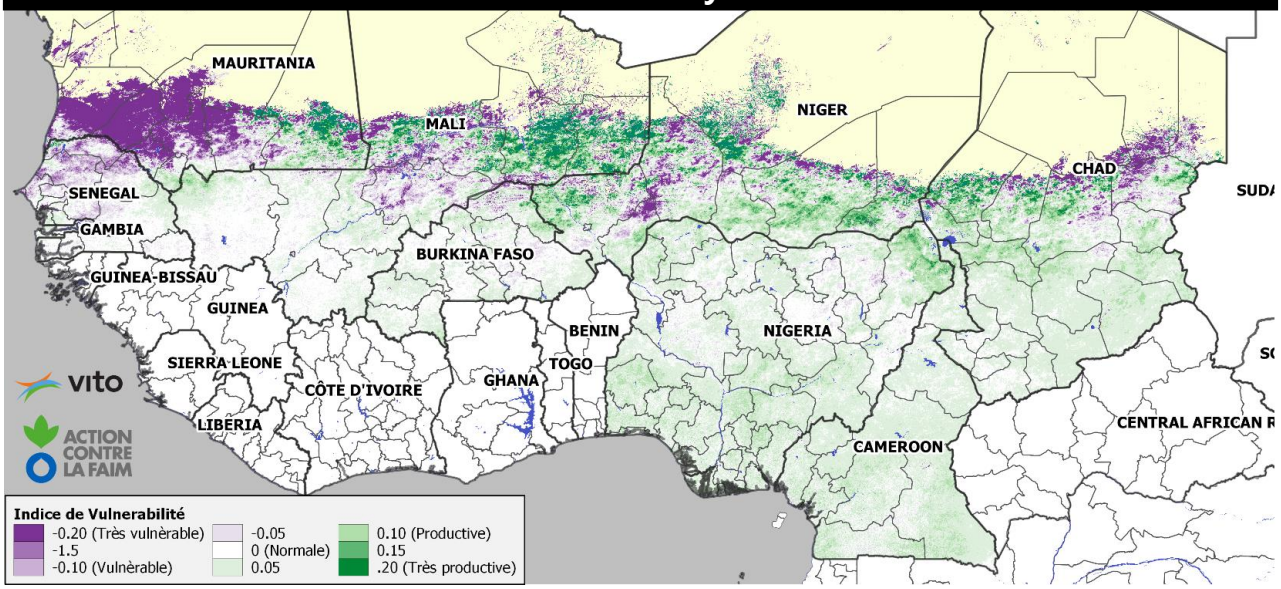

This "normalized" map shows the biomass anomaly in Standard Deviations over the mean. It is an interesting approach, as opposed to the standard "classic" anomaly. As the Sahel has generally volatile inter-annual biomass production, it allows for the identification of extreme anomalies of +/- 1 Standard deviation (std). Any production under -1std is considered abnormally low. Anything close to or under -2 std is significantly lower than anything in the past few years. Because of this, the normalized map is a more effective early warning map than the "classic" anomaly map. The classic anomaly map is used more often because it is more user-friendly.

The normalized map shows large swaths of Senegal and Mauritania registering abnormally low production, as well as a significant portion of the eastern region of Burkina Faso (Gnagna and Komondjari provinces). Certain areas of Senegal (especially in Louga and Kaffrine) show anomalies under -2 std.

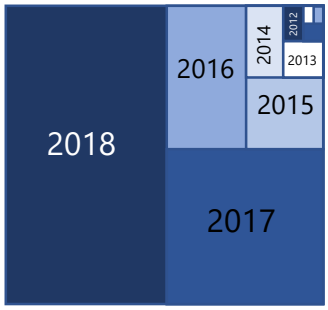



This map shows the production of biomass in Kg/Ha for the entire rainy season of 2018. This year's distribution of production in the Sahel follows the general norm, with areas in the south bordering the sudano-guinean zone showing production levels of 5,000+ Kg/Ha, whereas the pastoral and agro-pastoral areas (See the previous page for reference) are within the 0-2000 Kg margin. For this report, areas under 50kg/ha are considered desert.

## Biomass Vulnerability Index: 2018

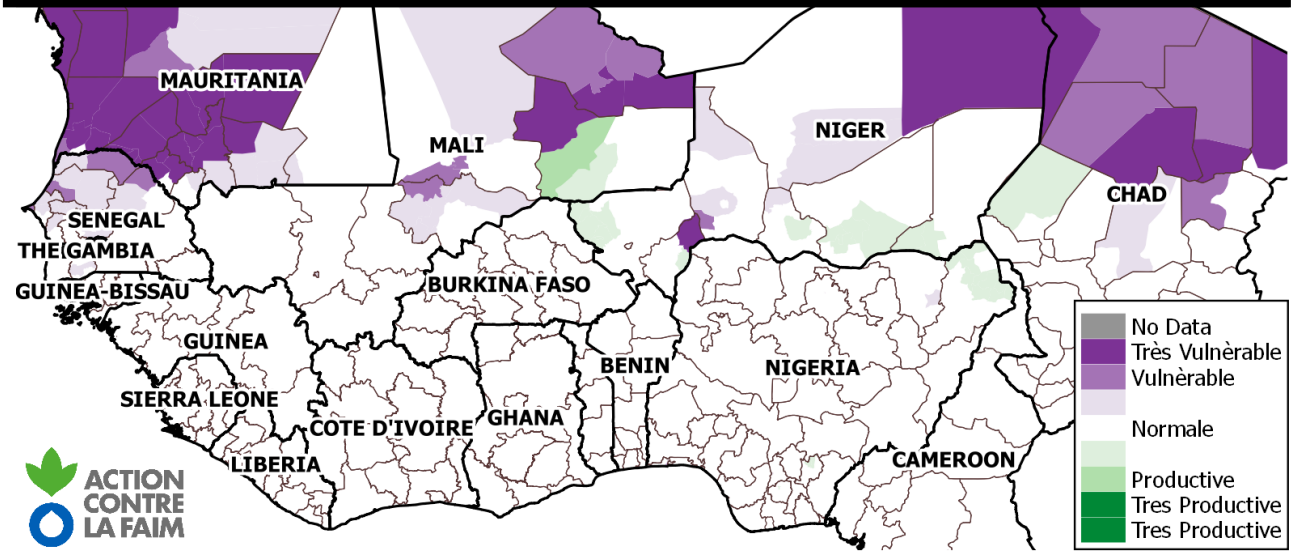



The Vulnerability Index (VI) is a recursive indicator, meaning that anomalies of previous years are factored into the index. The more recent years are weighted more heavily. The figure to the right indicates the makeup of the VI. 50% of the index's value consists of the current year. 25% the previous year, 12,5% the year before that, etc. The inclusion of multiple years allows us to isolate pastoral areas prone to consecutive years of weak production. Pastoralists are particularly vulnerable to multiple years of forage deficits, as sustained periods of deficits (and thus, poor animal nutrition) cause significant damage to the health and productivity of herds




Areas with a VI of -2, which have seen several consecutive years of drought can be found in Senegal and Mauritania. Isolated areas of vulnerability can also be found in Mali, Niger and Chad. However the situation in these cases is less worrying, given the current production surplus. The map below shows the aggregate vulnerability index for each Admin 2 area of the Sahel. See the individual country reports for more information on these areas, including time-series analyses of long-term trends.

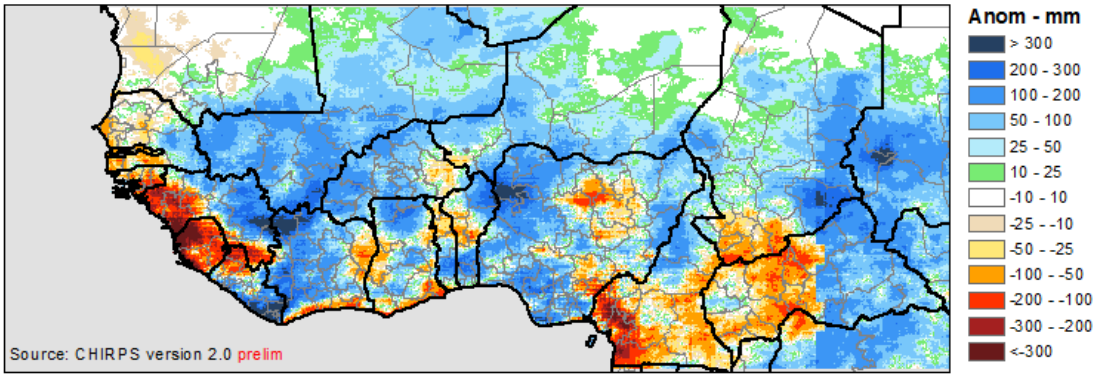
## Biomass Vulnerability Index by Department (Admin Level 2): 2018



## Seasonal Rainfall Accumulation Anomaly by pentad

**2018 season May - Sep**

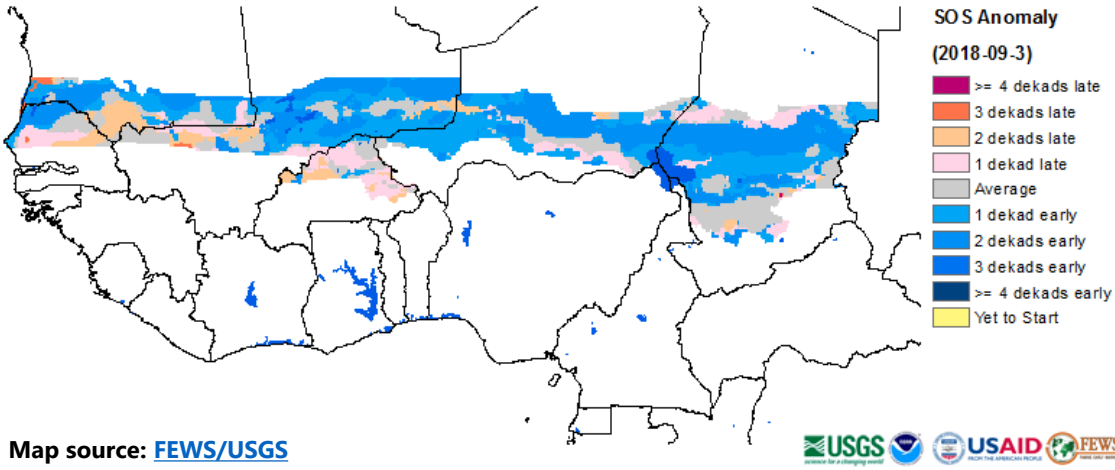
**(May pentad 1 thru Sep pentad 6) - Average (1981-2010)**




**Map source:** FEWS/USGS

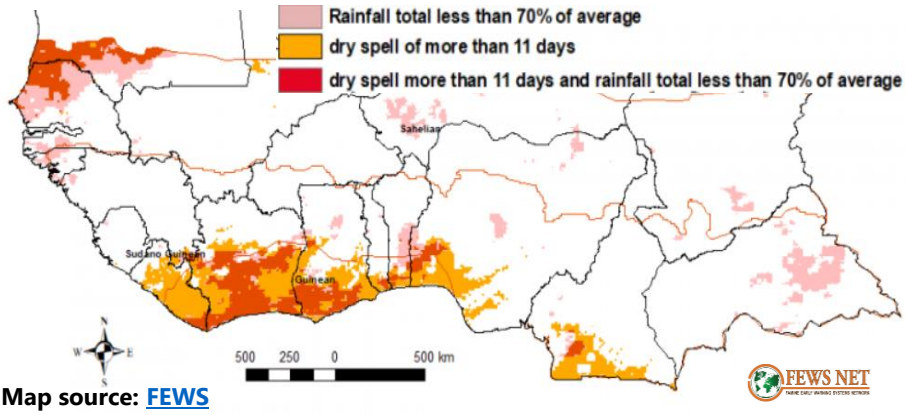
## Onset of Rains (SOS) Anomaly

**September 2018 Dekad 3**




**Map source:** FEWS/USGS

## Dry spells from 21 July to 20 August 2018



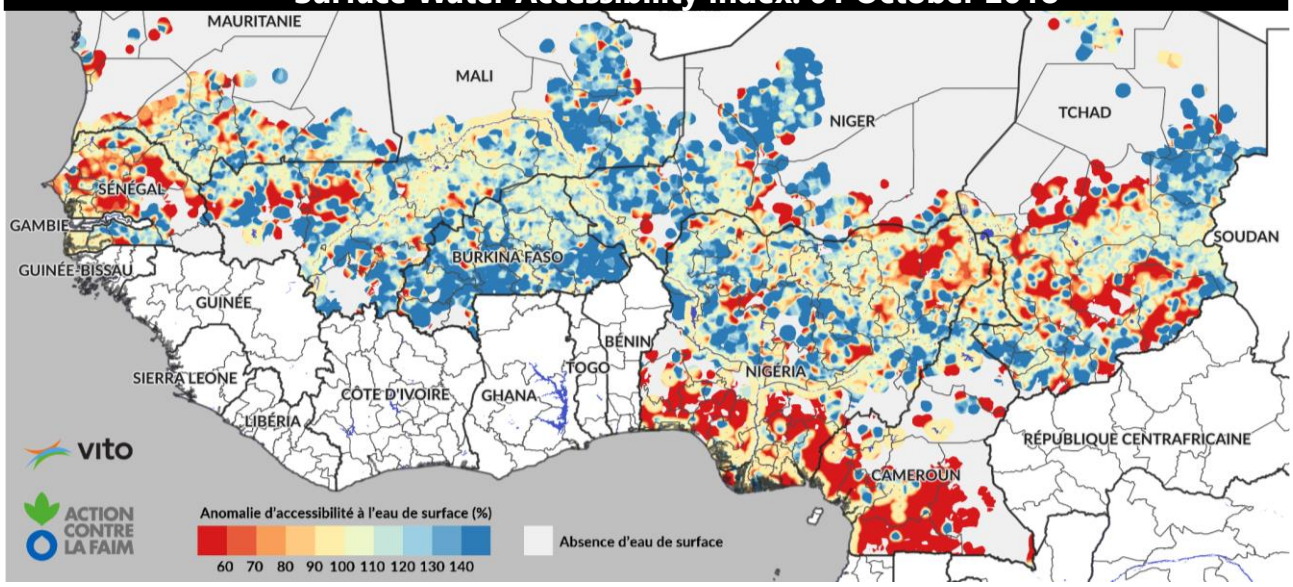

**Map source:** FEWS

Rainfall is the key determinant of biomass production in the Sahel, particularly the timing of the season. Late rains or dry spells can heavily impact biomass production, even if the cumulative levels of rainfall are above average.

These maps, produced by USGS/FEWS show the onset of the rainy season and the presence of dryspells during the first half of the season. The presence of dryspells in Senegal and Mauritania corresponds to the areas with biomass deficits. The cumulative rainfall in many of the deficit zones was close to, if not above, the 29 year average. This points to the importance of monitoring the timing of the rainfall, rather than simply the cumulative precipitation, as is often the norm for early warning systems in the region.

# ANALYSE DE LA BIOMASSE - SAHEL

**Surface Water Accessibility Index: 01 October 2018**




Water is an indispensable resource for pastoralists in the Sahel. The above map measures the accessibility of water along the same principles as the anomaly map. Satellite imagery provides a map of the water points available for the current period, in our case October 1 2017. This is measured against the average number of water points detected for the same period every year from 1998 to 2017. The red spots represent areas that are supposed to have water at this period, but it is not present or detected (early drying up). The yellow areas, usually concentrated around rivers, are at their normal levels. The blue spots are areas with more water points than usual.

The most concentrated surface water deficits are found in Senegal, with some isolated pockets in Northern Chad and the West of Mali. Mauritania's surface water is quite stable, in contrast to it's noticeable deficits in biomass. Please see individual country reports for more information,

**Conclusion**

The 2018 rainy season is a considerable improvement over 2017 and is generally favourable across the Sahel. The presence of strong biomass surpluses in Mali, Niger and Chad is promising. However, the presence of significant biomass deficits in Senegal and Mauritania indicates that pasture resources may deplete earlier than normal. Likewise, moderate deficits in Mali (Mopti), Niger (Tahoua & Tillabèry) and Burkina Faso (Région de l'est) should be examined further.

The subregion is still reeling from the 2017 drought and any biomass deficits will be felt several times over by pastoral communities. An improvement in ecological conditions over last year should not be a justification for inaction.

**Recommendations**

Consult the ACF Biomass Early Warning Guide available at **tinyurl.com/alerte-precoce**

- Conduct rapid assessments in deficit areas to determine community needs
- Government + Humanitarian Actors: Adjust response plans and contingency arrangements to account for a potential early pastoral lean season in Mauritania & Senegal to potentially include the following interventions:
  - Reinforcement of state livestock services and pastoral organisations
  - Animal feed distributions
  - Restocking/Destocking
  - Veterinary support and livestock vaccination
  - Cash transfers

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