



2019 BIOMASS PRODUCTION IN THE SAHEL

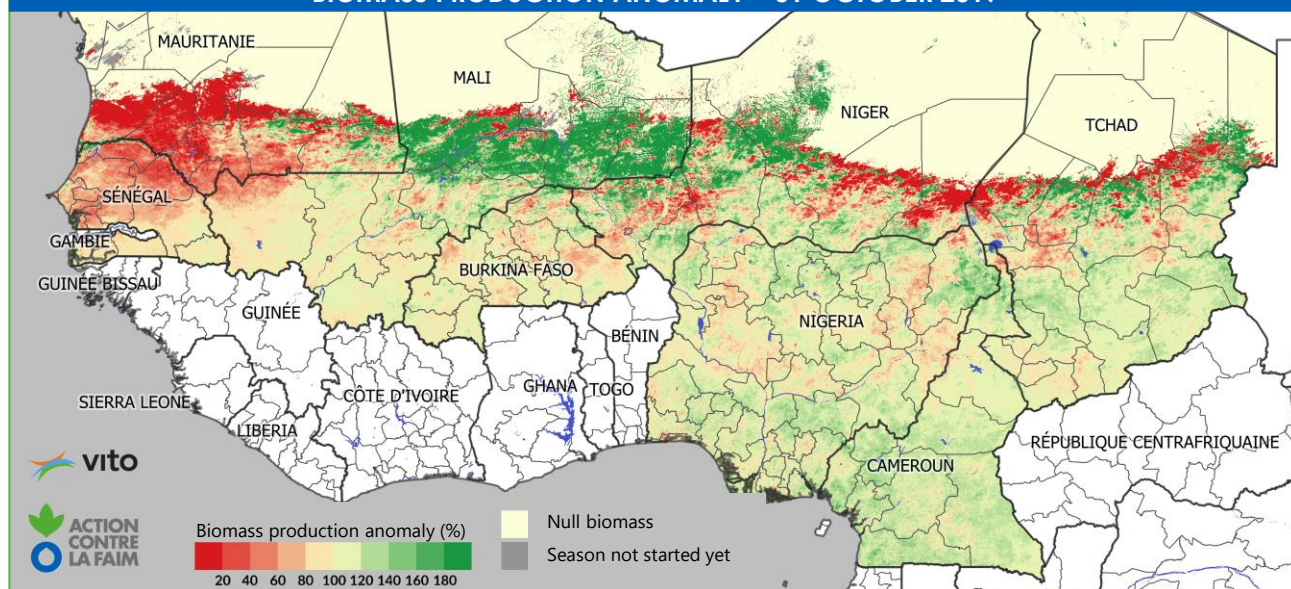
ANALYSIS AND PERSPECTIVES FOR 2020

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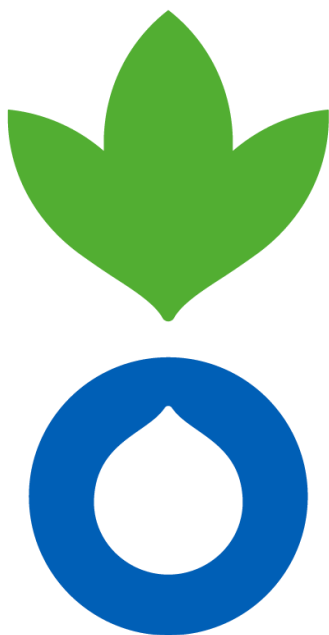
BIOMASS ANALYSIS - SAHEL

BIOMASS PRODUCTION ANOMALY – 01 OCTOBER 2019



KEY POINTS

- **SIGNIFICANT BIOMASS DEFICITS IN PASTORAL ZONES OF SENEGAL AND WESTERN MAURITANIA**
- **RISK FOR EARLY LEAN SEASON IN SENEGAL AND WESTERN MAURITANIA**
- **MODERATE BIOMASS DEFICIT IN NORTHERN PASTORAL ZONES OF NIGER AND CHAD**
- **HIGH BIOMASS PRODUCTION IN NORTHERN MALI**
- **ELSEWHERE, GLOBALLY NORMAL BIOMASS PRODUCTION IN MOST PASTORAL AREAS OF THE SAHEL**
- **NORMAL SURFACE WATER AVAILABILITY GLOBALLY IN THE SAHEL**



Overall, biomass production in the Sahel for the 2019 rainy season shows a marked deterioration over the 2018 high biomass production levels. Serious attention is required for Senegal, Mauritania, northern pastoral zones of Niger and Chad. These areas may potentially be subject to an early and prolonged lean season. In addition to biomass deficits, some of these regions like the south-western of Tagant in Mauritania are also affected by surface water deficits. This is the sixth consecutive year of biomass deficits in the pastoral areas of Senegal and Mauritania.

Senegal and Mauritania are still recovering from the successive droughts occurring since 6 years in their pastoral zones. 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 the northern pastoral zone of Niger, particularly in Zinder and Diffa to the East, parts of Tahoua and Tillabery in the West. Similar situation is found in northern Chad. Most of these deficit areas are found near areas of good biomass production. If herd mobility is unimpeded, pastoralists should be able to find pasture. However in areas with conflict or banditry that are amplifying strongly in the Sahel region (Burkina Faso, Niger: Tillabéry, Tahoua, Diffa and Mali: Gao, Mopti), this may be less possible. According to these trends and the important biomass deficit, the pastoral situation should continue to be monitored.

An early response to the pastoral lean season in Mauritania and Senegal should be undertaken without any delay.

See country reports on www.siasahel.info for additional information

An interactive dataset is available at <http://geosahel.info/Viewer.aspx?map=Analyse-Biomasse-Finale#>

DATA USED FOR THE MAPPING 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 (©) ESA and SPOT-VEGETATION (©) ESA



WHAT IS BIOMASS?

Biomass is the total production of above-ground dry matter. In our case, we are referring to Dry Matter Productivity (DMP) measured in Kilograms per Hectare. The higher the value, the drier 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?

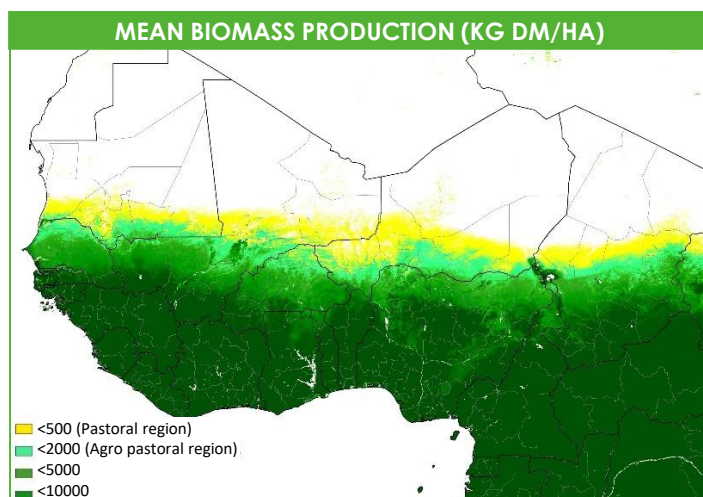
All forms of fodder and vegetation are composed of water and dry matter (DM), but at variable rates. For example, the percentage of dry matter in the hay is much higher than in the green grass. In addition, all the nutrients needed for livestock are in the dry part of the forage (energy, protein, minerals). 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, i.e. 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 kilograms 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 and by SPOT-Vegetation Satellite. 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 its pastoral zone, 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 (1km²) shows that zone's biomass production, compared to every year since 1998.



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 depicted in red and the surplus areas in 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

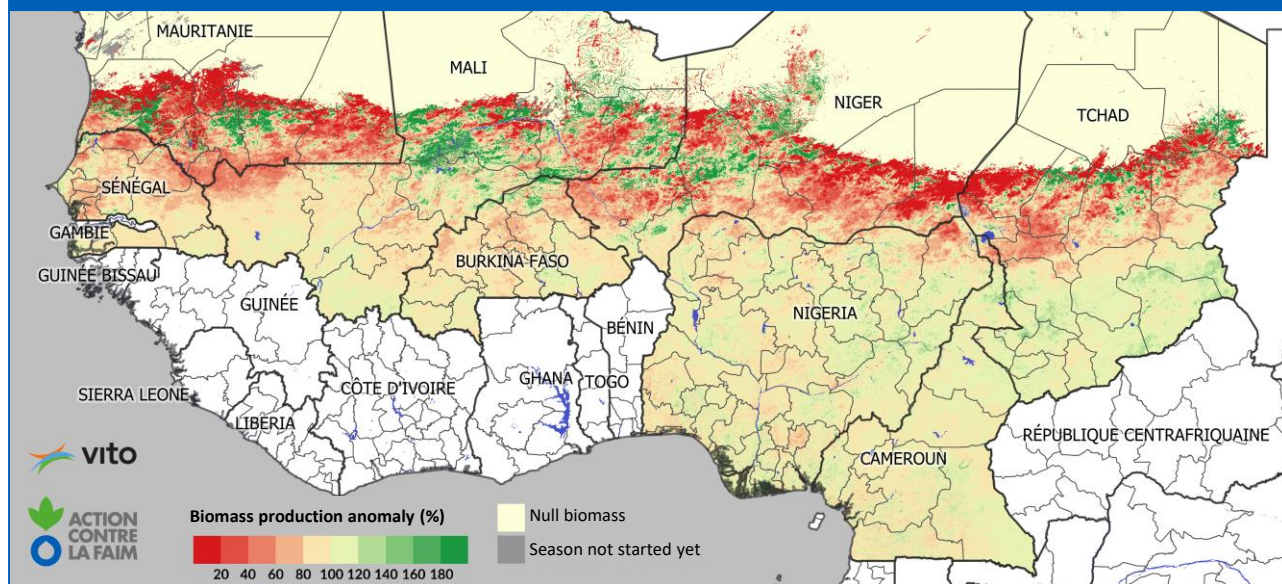
These measurements are particularly adept for measuring forage availability in semi-arid environments, such as the Sahel or the Horn of Africa. The biomass analysis is conducted at the end of the rainy season, when biomass production ends for the year. As the analyses include the totality of production, 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
<http://sigSenegal.info/index.php/knowledgebase/>
Information on dry matter and animal nutrition
<http://equinenutritionnerd.com/2014/05/12/dry-matter/>
Tutorial on remote sensing of vegetation
http://fas.org/irp/imint/docs/rst/Sect3/Sect3_1.html
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BIOMASS PRODUCTION % CHANGE – 2018/2019

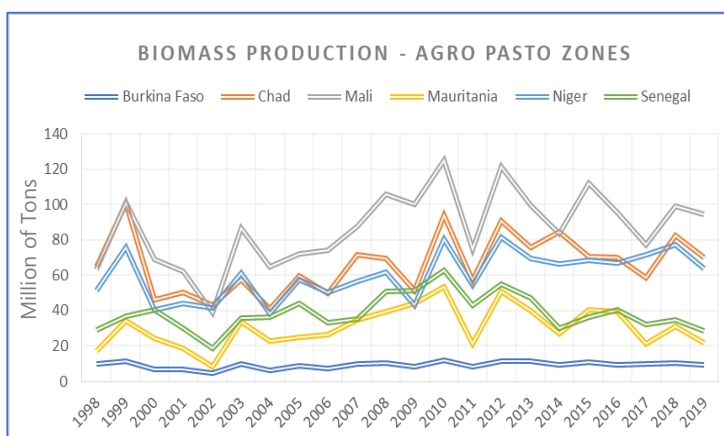
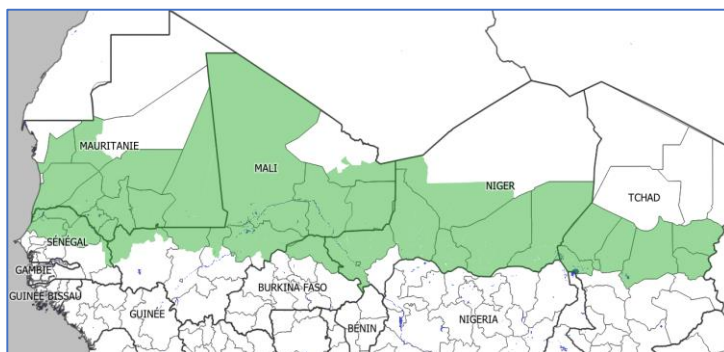


This map compares the biomass production levels in 2019 and 2018, measuring the percent change from last year. Overall, there is a marked deterioration across the region with most areas registering a significant decrease of biomass. This is partly explained by the relative good 2018 production level and by the important biomass deficits observed in 2019 mainly due to late rainfall onset (in the West) and important dry spells. However, some regions (in Mali and Mauritania) feature improvements in biomass production compared to 2018.

PASTORAL + AGRO-PASTORAL ZONE (ADMINISTRATIVE DIVISION)

Details on these important biomass deficits compared to 2018 season, are available on the individual country reports (sigsahel.info).

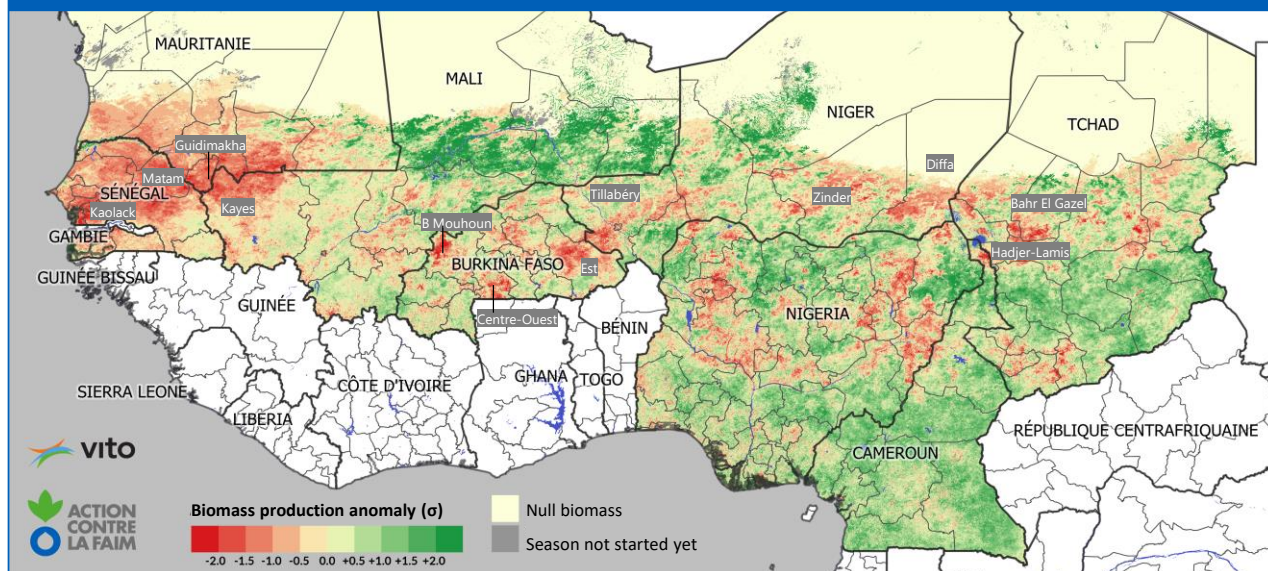
The graph (on the right) shows the biomass production of pastoral and agro-pastoral zones from 1998 to 2019. Forested and agricultural areas have been removed from the analysis as they account for the majority of biomass production in most Sahelian countries and thus can offset an analysis of rangelands. In Mali, Chad and Niger, biomass production decreased from last year but did not reach the low levels recorded in 2017 (except for Niger). Since 2012 Senegal and Mauritania are experiencing a downward trend of biomass that in 2019 have reached the very low biomass levels recorded in 2011 (even lower for Senegal). Burkina Faso is relatively stable.





BIOMASS ANALYSIS - SAHEL

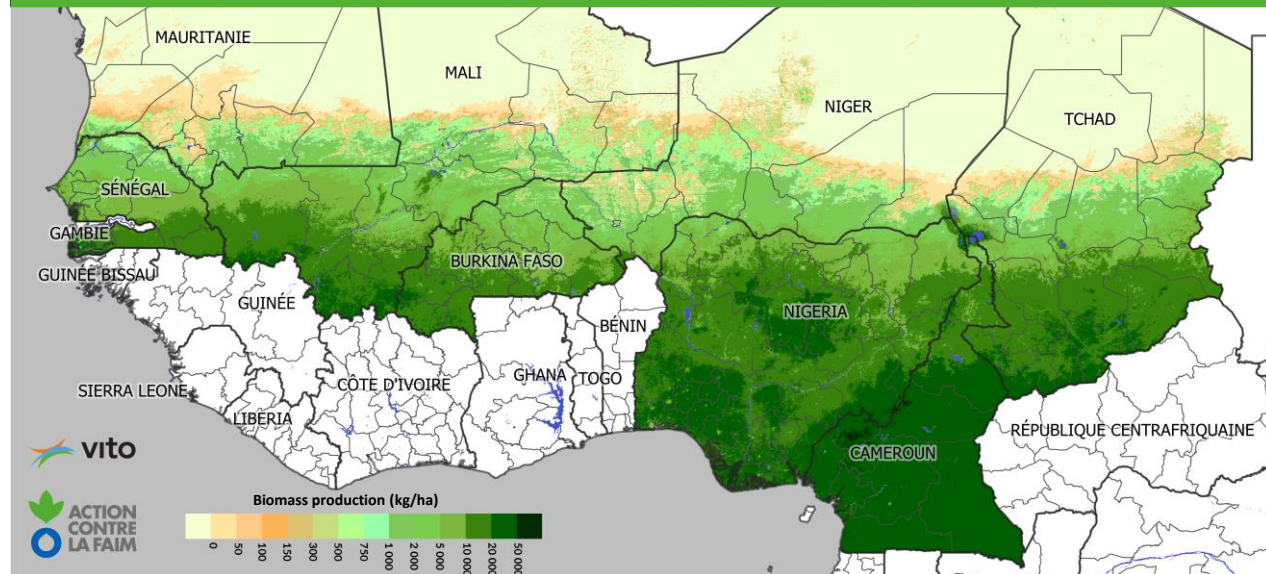
BIOMASS PRODUCTION SIGMA ANOMALY – 01 OCTOBER 2019



This “normalized” map, above, 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 specific spots in Mali (Kayes), Burkina Faso (Boucle du Mouhoun, Est, Centre-Ouest), Niger (Tillabéry, Diffa and Zinder), Chad (Bahr El Gazel, Hadjer-Lamis) and specific small areas in Nigeria. Certain areas of Senegal and Mauritania (especially in Matam, Kaolack and Guidimakha) show anomalies under -2 std.

BIOMASS PRODUCTION – 01 OCTOBER 2019

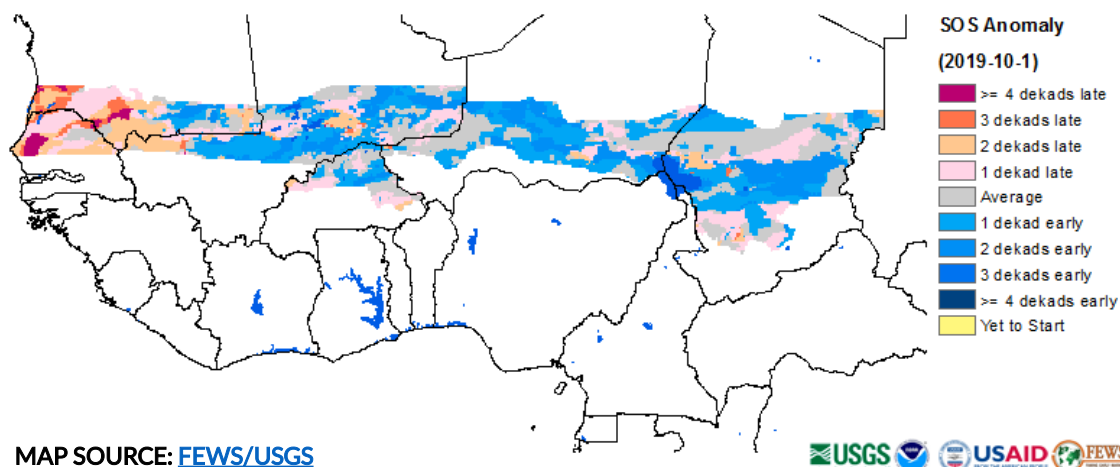


This map shows the production of biomass in Kg/ha for the entire rainy season of 2019. This year's distribution of production in the Sahel follows on average the general norm, with areas in the south bordering the sudano-guinean zone showing production levels of 5,000+ Kg/Ha, whereas the pastoral and agro-pastoral areas (See the previous page for reference) are within the range of 0-2000 K/ha. A particularity of the 2019 season is the wider band of production between 0 and 50 kg/ha relating low production in the northern band of the region. For this report, areas under 50kg/ha are considered desert.



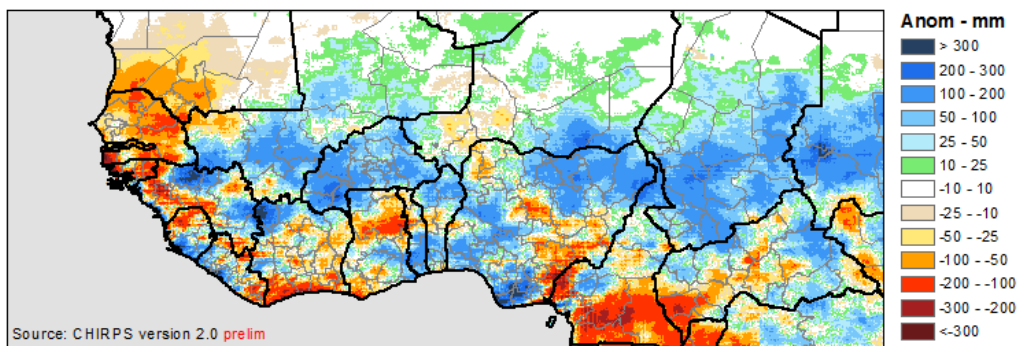
BIOMASS ANALYSIS - SAHEL

Onset of Rains (SOS) Anomaly October 2019 Dekad 1



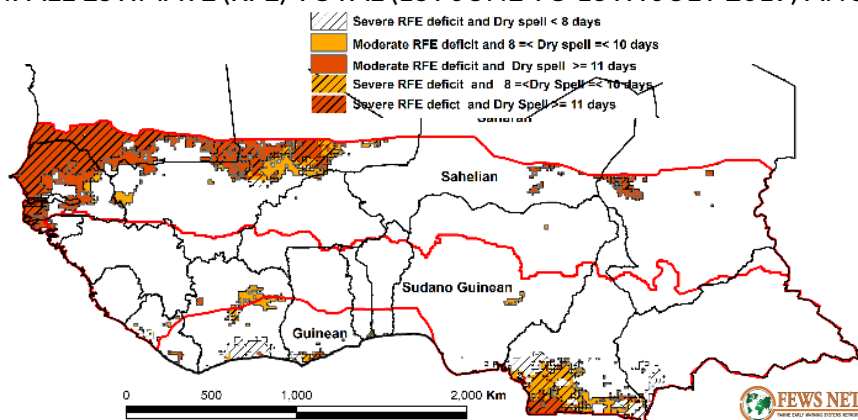
MAP SOURCE: [FEWS/USGS](#)

Seasonal Rainfall Accumulation Anomaly by pentad 2019 season May - Sep (May pentad 1 thru Sep pentad 6) - Average (1981-2010)



MAP SOURCE: [FEWS/USGS](#)

RAINFALL ESTIMATE (RFE) TOTAL (1ST JUNE TO 15TH JULY 2019) ANOMALY AND DRY SPELLS



MAP SOURCE: [FEWS](#)

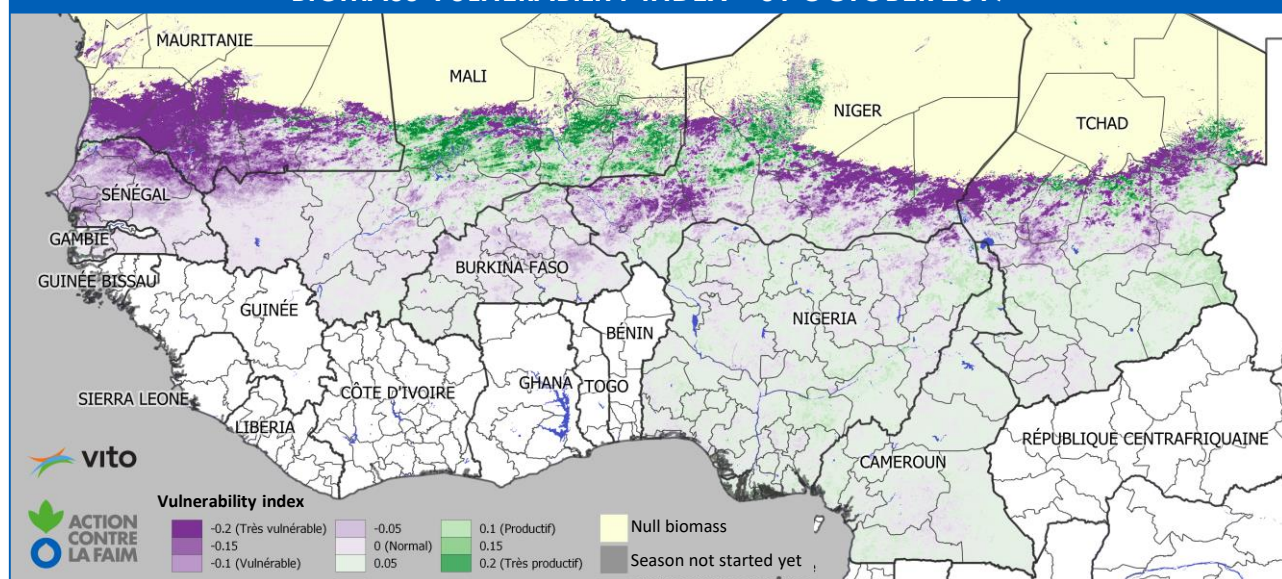
Rainfall is the key determinant of biomass production in the Sahel, particularly the timing of the season. Late rains or longer dry spells can heavily impact biomass production, even if the cumulative annual rainfall are above average.

The maps above, borrowed from USGS/FEWS show the onset of the rainy season and the occurrence of dry spells in early stages of the season (until 15th July). These maps confirm the late onset of rains in Senegal and western Mauritania. Besides, the presence of dry spells in Senegal and Mauritania also affect the growing of vegetation and have amplified the biomass deficits. The cumulative rainfall from May to September was much lower in Senegal and Mauritania than the 29 years average. Nevertheless unusual late rain events (October) were recorded in Senegal and to some extent in Mauritania and could improve cumulative annual rainfall anomaly. However, impacts of dry spells and delays in the start of the season will never be catch-up.

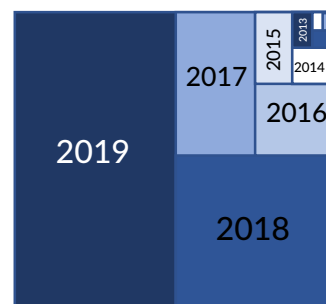


BIOMASS ANALYSIS - SAHEL

BIOMASS VULNERABILITY INDEX – 01 OCTOBER 2019

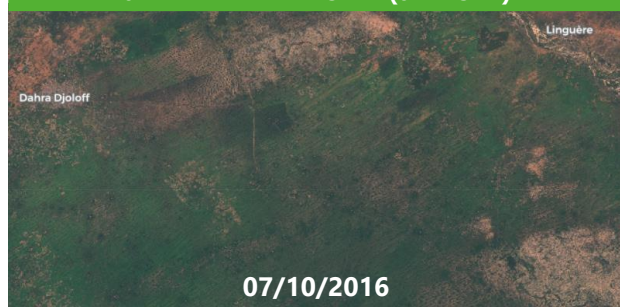


The Vulnerability Index (VI) is a recursive indicator, meaning that anomalies of previous years are factored into the index. The more recent years are weighted more heavily. The figure to the right indicates the makeup of the VI. 50% of the index's value consists of the current year. 25% the previous 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 -0.2, which have experienced several consecutive years of drought can be found in Senegal, Mauritania, northern strips of Niger and Chad. The huge “patch” of vulnerability in Mauritania and Senegal is very worrying especially because herders will have to walk huge distances to reach biomass. Other isolated areas of vulnerability can also be found in Mali. However the situation in these cases is less worrying, given the local phenomenon.

SENTINELLE-2 IMAGERY (SENEGAL)



07/10/2016



09/10/2019

SENTINELLE-2 IMAGERY (MAURITANIA)



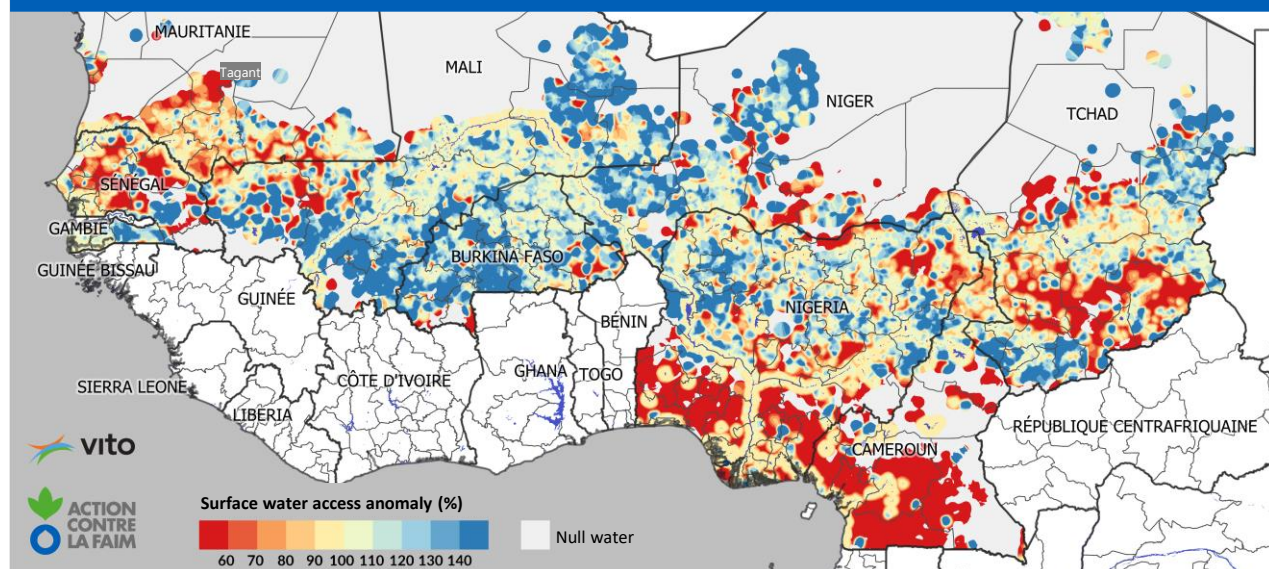
13/09/2015



14/09/2019



SURFACE WATER ACCESSIBILITY INDEX – 01 OCTOBER 2019



Water is an indispensable resource for pastoralists in the Sahel. The above map measures the accessibility of water along the same principles as the biomass anomaly map. Satellite imagery provides a map of the water points available for the current period, in our case October 1st, 2019. This is measured against the average number of water points detected by the satellite for the same period every year from 1998 to 2019. The red spots represent areas that are supposed to have water at this period but are either dry or not 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 more concentrated surface water deficits are found in Senegal, Mauritania and Chad. Late significant precipitation that have occurred in Senegal and Mauritania could minimize the negative impacts of water deficit. Besides, Mauritania's surface water is quite stable (except in south-western Tagant where water deficit are important), in contrast to its noticeable deficits in biomass. Important deficits in southern Nigeria and Cameroon are not critical due to important annual rainfall receive in those areas. Please refer to individual country reports for more information.

CONCLUSION

The 2019 rainy season is on average much less productive than the 2018 season (which was a good year across Sahel except in Mauritania and Senegal). The presence of important biomass surplus in northern Mali is promising. However strong biomass deficit in Senegal and Mauritania in 2019 come on top of 3-years biomass deficits. This indicates that pasture resources may deplete earlier than normal causing an early lean season in 2020 in these two countries. Moderate deficits in northern Niger, northern Chad, in parts of Burkina and Nigeria should be examined further.

Despite the relative « good » 2018 season, the subregion is again suffering from important biomass deficits, Action is required more than ever to guarantee the livelihoods of pastoral communities.

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RECOMMENDATIONS

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

- 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 and Senegal to potentially include the following interventions
- Reinforcement of state livestock services and pastoral organisations
- Animal feed distributions
- Livestock Restocking/Destocking
- Veterinary support and livestock vaccination
- Cash transfers