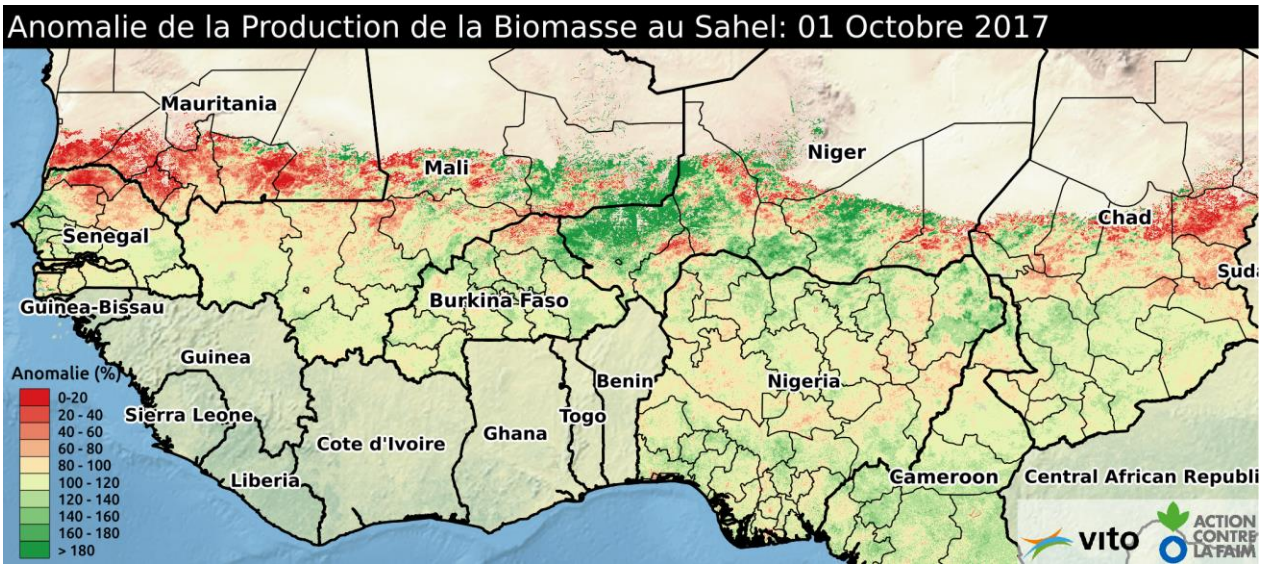
SAHEL

ANALYSIS OF BIOMASS PRODUCTION IN 2017 AND PERSPECTIVES FOR 2018

ALEX MERKOVIC-ORENSTEIN & CHEIKH SAMB



Key points.

- Severe biomass deficits in Senegal, Mauritania and Chad:
  - Very high likelihood of abnormal transhumant movements resulting in agro-pastoral conflicts.
  - Early onset of pastoral lean season is likely
- Pockets of biomass deficits in Niger (Dosso, Tahoua, Diffa) and Mali (Departments of Goundam, Tomboctou, Niono, Ansongo)
- Extreme vulnerability of biomass (negative short-term trends) across entire Sahel belt
- Severe surface-water deficits in Senegal and Mauritania

The biomass anomaly map indicates serious deficits in Mauritania, Senegal and Chad. These areas are likely to have forage deficits and harsh conditions for pastoralists seeking pasture and water for their herds. Poor availability of biomass and water indicates a strong possibility of an early, prolonged and difficult 2018 lean season in these areas. Herds are likely to begin their transhumance early in search of pasture and water, which may exacerbate tensions between agricultural and pastoral communities. Herds will likely be dependant on animal feed for a longer period than normal during the coming dry season. As a result, feed may be less available or more expensive.

Biomass production deficits are seen in Mali, including the south of Ansongo, which is normally an important concentration zone for herds. This could lead to irregular transhumant movements. Noticeable deficits are seen throughout the Tomboctou Region and parts of Mopti and Segou. In Burkina Faso, the Sahel region shows significant deficits, reflecting a multi-year trend of chronically poor production. Likewise, negative anomalies are detected in Niger including Tahoua, Maradi and Diffa. Worryingly, the north of Dosso shows a very negative anomaly yet is normally an area with high biomass production. Already urgent humanitarian concerns in Diffa are likely to be exacerbated by negative biomass anomalies.

Please see country reports on www.sigsahel.info for more detailed information
An interactive dataset of the maps in this report are 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

ACTION AGAINST HUNGER | ACTION CONTRE LA FAIM

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.

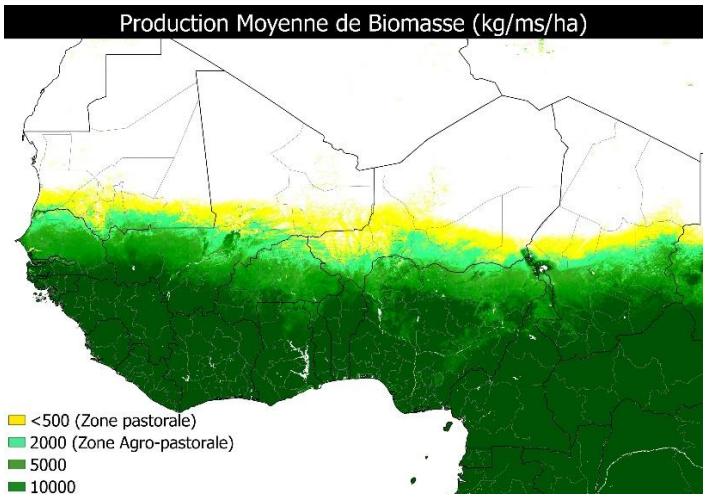
Data on the amounts of DM produced do not inform about their edibility. The type of pasture and its edibility are essential to determine the animal carrying capacity of an area, ie the number of herbivores that can graze. Furthermore, not all forages are identical and may contain different levels of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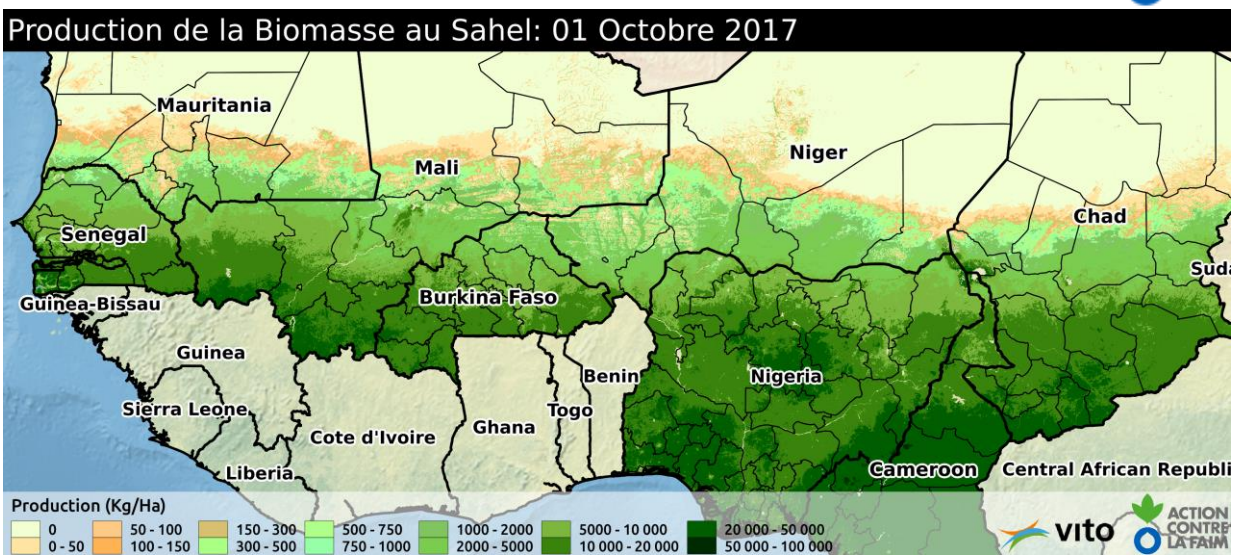
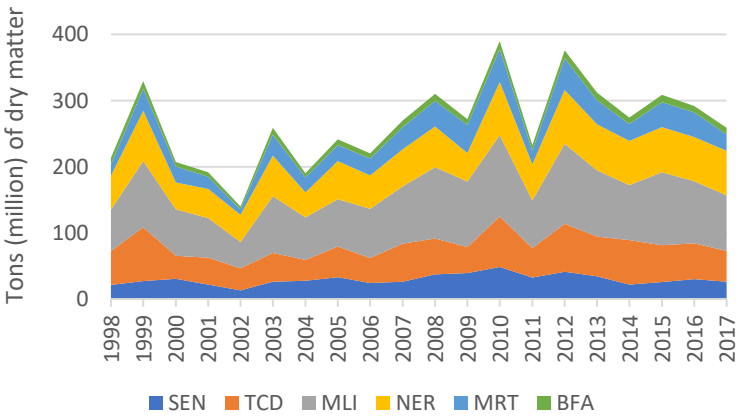
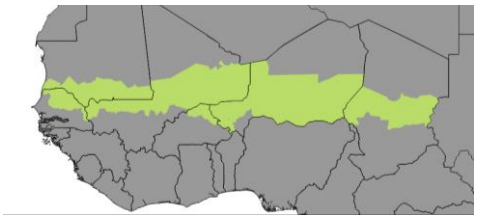


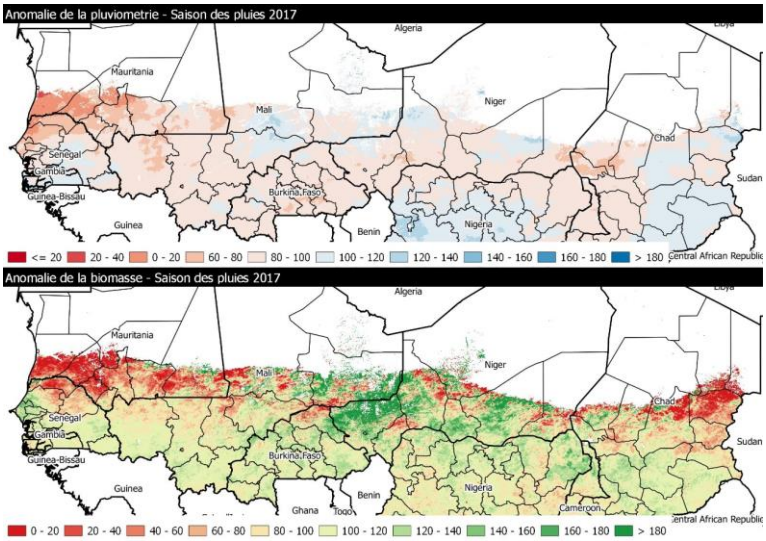
This map shows the production of biomass in Kg/Ha for the entire rainy season of 2017. This year's distribution of production in the Sahel follows the general norm, with areas in the south bordering the sudano-guinean zone showing production levels of 5,000+ Kg/Ha, whereas the pastoral and agro-pastoral areas (See the previous page for reference) are within the 0-2000 Kg margin.

Graph 1: Biomass Production in the Pastoral Zone of the Sahel



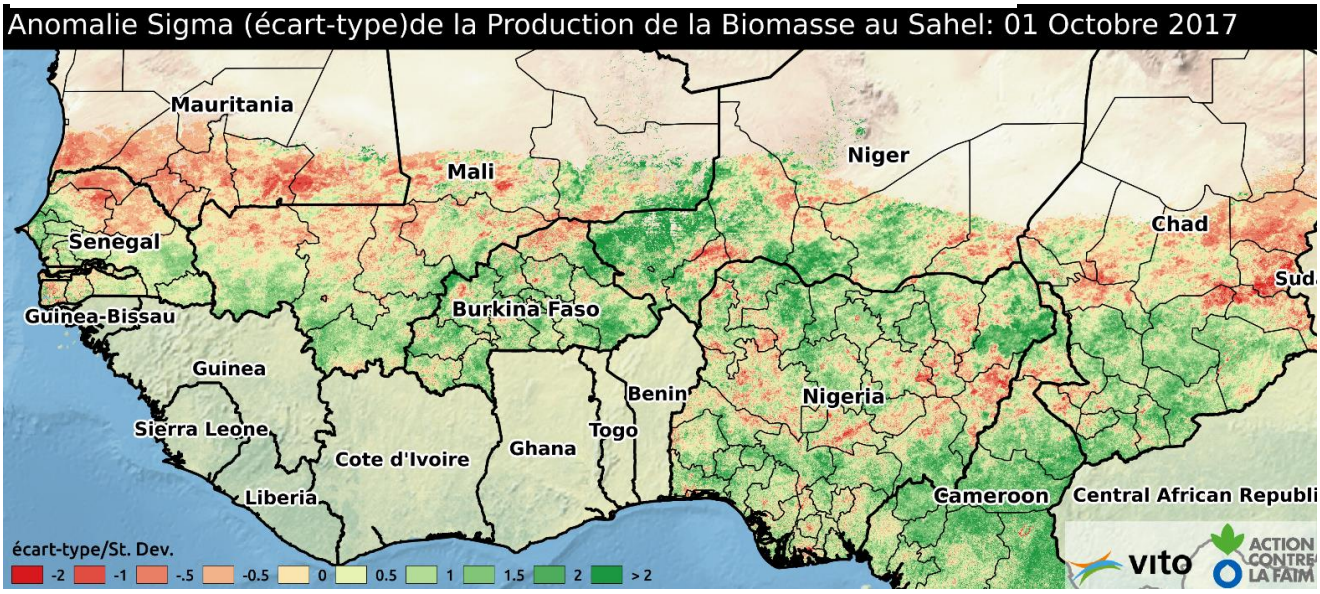


Graph 1 allows for a look at the production of the pastoral and agro-pastoral zones (highlighted in green above this paragraph). Overall, production levels have declined for this area. This is the second consecutive year that production has declined.

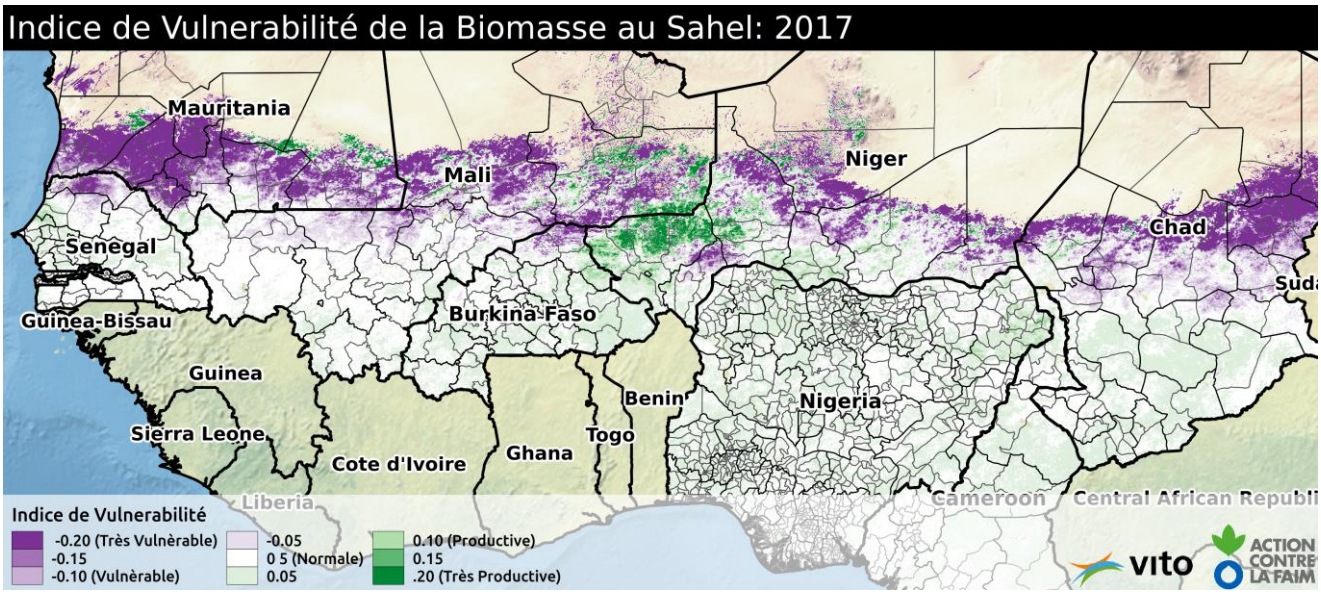


Rainfall for the sahel region was unfavorable to pasture growth in many areas. The map to the left shows a comparison of rainfall and biomass growth. Both maps are measured over the same period and compared to the mean of 1998-2017. While we see that rainfall and biomass deficits overlap, the relationship is not completely linear. For instance, while an area's rainfall may have the cumulative average for the season, it could have fallen in short , intense bursts followed by long dry spells. This indicates that cumulative rainfall alone is not a sufficient indicator to track pastoral conditions. It is important to likewise examine the spatio-temporel distribution of rain.

BIOMASS ANALYSIS-SAHEL

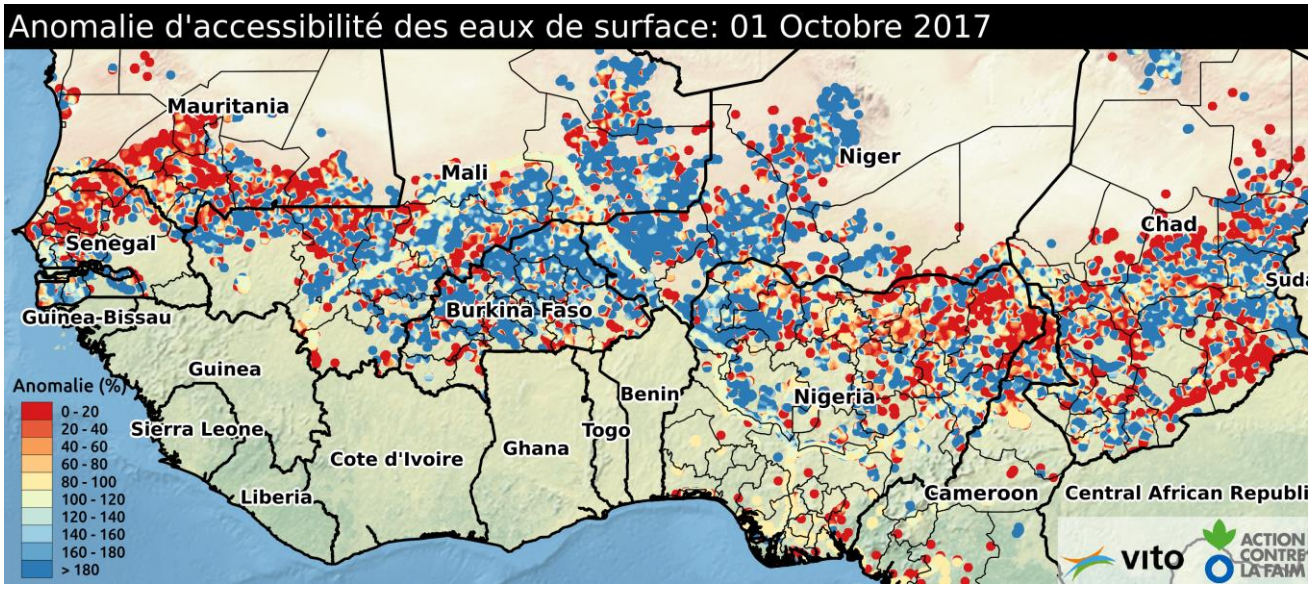


This map shows the biomass anomaly in Standard Deviations over the mean. It is an interesting approach, as opposed to the standard anomaly. As the Sahel has generally volatile inter-annual biomass production, it allows for the identification of extreme anomalies(+/- 1 Sigma). Senegal, Mauritania and Chad are clearly subject to abnormal deficits. Whereas Tillabery (West Niger) is uncharacteristically green.



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 consists of the current year. 25% the previous year, 12,5% the year before that, etc 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

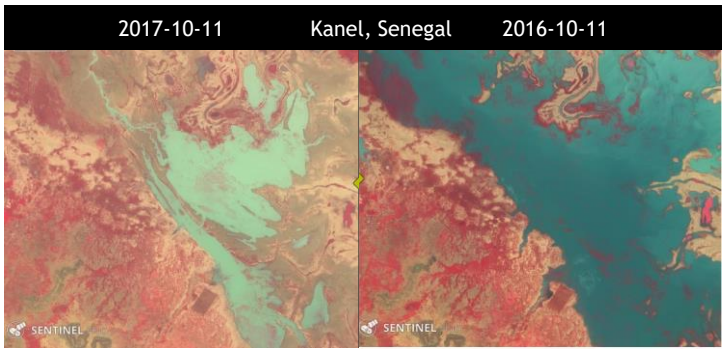
The current VI shows some overlap and differences with the other anomaly maps of this report. The northern part of the Sahel shows a very high degree of vulnerability, indicating multiple years of negative anomalies. The only countries with significant positive trends can be found in Mali (Menaka) and Niger (Tillabery). The entire pastoral bands of Mauritania and Chad are highly vulnerable. The VI for Senegal shows a very vulnerable pocket of Podor. Yet the remainder of the country is more neutral, showing that this year's deficit does not follow short-term trends. Such high vulnerability indicates potentially worrying outcomes for pastoral livelihoods in the sahel.



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.

For the current year, a severe deficit in surface water can be seen in Senegal and Mauritania. This post-rainy period is normally replete with lakes and ponds. However there is a near total absence of detected water points in this area. This matches the rainfall map on page 3, which showed unfavorable rainfall for this area, preventing lakes from filling. Other significant deficits can be seen in Chad and Nigeria. This is a particularly alarming data-point. The lack of surface water in pastoral areas will most likely engender an early transhumance. Herd migrations are likely to start earlier than normal and in many cases, may make non-typical paths. This could lead to increased agro-pastoral tensions if herds move into agricultural areas.

The satellite images to the right show comparisons of several important lakes at the same period last year and this year. The stark differences between the two periods shows how extensive the loss of water is for these areas.



CONCULSION

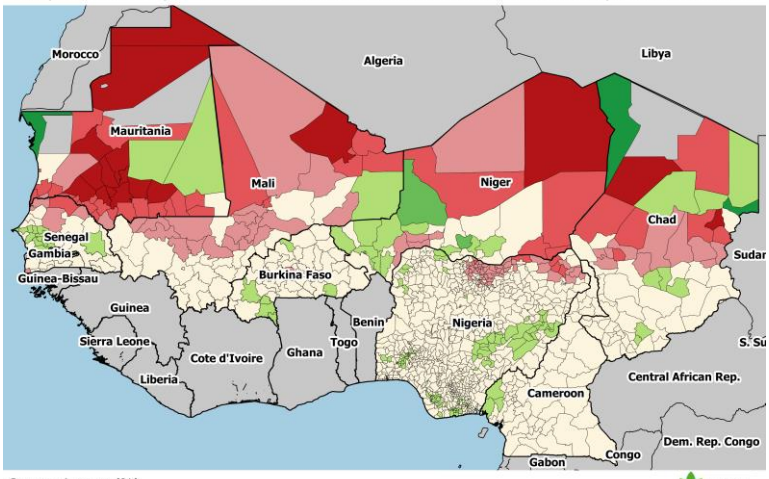
The 2017 rainy season has resulted in severe biomass deficits in a number of pastoral areas. Production levels in many parts of Mauritania and Senegal are near or under those of the 2011/2012 season, which was a significant drought. Likewise, significant surface water deficits in the same zones are likely to have negative effects for herds.

The high degree of biomass vulnerability (as noted on page 4) across the Sahel is likely to compound the deficits and endanger pastoral livelihoods across the Sahel.

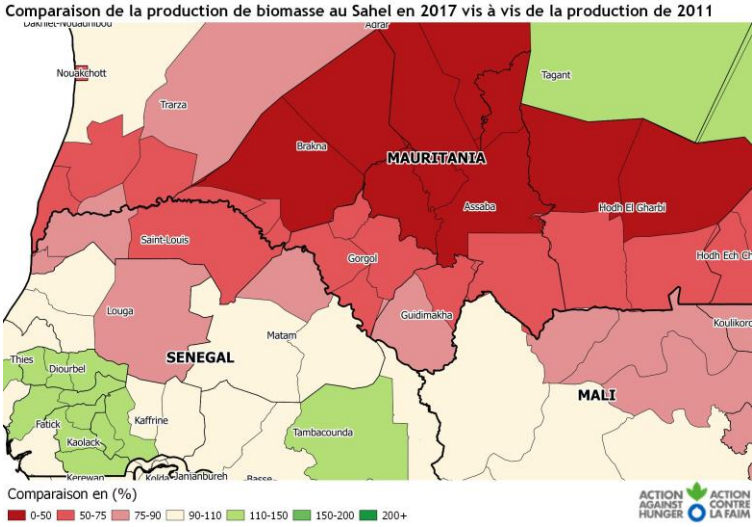
Pastoral areas with biomass deficits are likely to see negative ancillary effects in livelihoods, food security and nutrition. Animal mortality and a rise in demand for animal feed may trigger market shocks in these areas. Likewise, irregular transhumant movements (the key adaptation strategy of pastoralists) may inflame agro-pastoral tensions.

State and humanitarian actors need to begin preparations to mitigate the effects of the oncoming lean-season.

Comparaison de la production de biomasse au Sahel en 2017 vis à vis de la production de 2016



Comparaison de la production de biomasse au Sahel en 2017 vis à vis de la production de 2011



Recommendations

Note: A guide has been prepared on using biomass data to plan early warnings and interventions. It is available at https://tinyurl.com/alerte-precoce

- Reinforce datacollection mechanisms. Field data is needed to complement satellite data when planning an intervention. Data on pasture availability, terms of trade , water availability, brush fires and animal diseases should be collected regularly to monitor the onset of the dry season.
    - If regular data collection is not possible, engage in rapid participatory surveys using the LEGS or PCVA methods.
- Monitor prices of animal feed closely and plan ahead for distribution of feed stocks.
- Closely monitor food security and nutritional indicators in affected areas.
- Begin preparations to reinforce pastoral organisations and state technical services in affected areas. As the lean season is likely to come early this year, interventions will need to be ready before March 2018.
- Reinforce services that provide pastoralists with information on pasture and water availability.
- Check sigsahel.info and geosahel.info regularly for updates