Seasonal monitoring in Angola

Ad hoc report

Southern Regions of the country hit by drought, in some areas for second consecutive year

Absolute NDVI anomaly between current year and the long term average (1999 - 2012)
(Source: MARS SPIRITS – Images SPOT VGT / May 2013).
1. Agriculture and recent droughts in Angola

Although agriculture accounts only for about 8 percent of Angola’s GDP, it is the main source of employment in the country. Prior to independence (1975), food production was high and the country was a major exporter of maize and coffee. During the years of conflict, agriculture fell to an almost subsistence level in many areas, with little or no marketable surpluses and very limited trade activity. The country’s cropping patterns are varied. In the north (Cabinda, Uige, Kwanza Norte, Zaire, Malange) and the northeast (Lundas area), the principal crops are cassava, beans, groundnuts and maize. In the Planalto Central, maize and beans dominate, and the area of root crops is considerably smaller than in the north. In the south, agro-pastoral systems assume increasing importance; maize quickly gives way to sorghum and millet, complemented by cowpeas and cassava. The south is home to about 95 percent of the country’s livestock, with about one-third of the country’s cattle being found in Cunene Province alone. (FAO 2006, CFSAM report).

In most rural areas in Angola, except in the south where livestock predominates, crop production is the main source of livelihood. In times of inadequate production, the most vulnerable survive by collecting fuel-wood, producing charcoal, and hunting and fishing in inland waters and streams; these are also the main sources of income or food during the lean period.

Crop production is based on a rain-fed main growing season from September to May (planting may vary from September to February). In the South the rainfall pattern normally shows a start in September or October and continues through April or May. Harvest goes from February to June for the first harvest and from July to August for areas with a second harvest mainly in the North (Figure 1).

![Crop calendar for main crops](image1.png)

![Administrative map of Angola](image2.png)

Figure 1. Crop calendar for main crops (source: FAO –GIEWS) (left), and administrative map of Angola (source FAO GAUL)(right)

In 2012 several provinces in central (Western part) and Northern Angola were hit by a severe drought and IFRC estimated that more than 500,000 children were affected by acute malnourishment in the most concerned provinces of Kwanza-Sul, Zaire, Huambo and Bie. Several sources reported a 60% below average rainfall for the 2011 – 2012 rainy season as confirmed by Map 2A and the NDVI anomaly map of June 2012 (map 2B) shows clearly the drought hotspots in
the Western and Northern provinces, but also, to a lower extent in some areas of the South (mainly Cunene and Namibe).

Figure 2 (left) rainfall anomaly for 2012 based on TAMSAT data and (right) NDVI anomaly for the main crop season in 2012.

For the 2013 season again significant parts of the country received clearly below average amounts of rainfall, with hotspots reaching 80 to 100% less rainfall in large areas of the South West along the border with Namibia (Figure 3). The dry area is only the most northern part of a large rainfall deficit area extending of Namibia, Botswana and parts of Southern Africa.

Figure 3. Cumulated Tamsat rainfall estimates from September 2012 to April 2013 (left) and only for the second half of the rainy season from January 2013 to April 2013 (right) showing that the total seasonal deficit is mainly due to negative rainfall anomalies in the second half of the rainy season.
The comparison of the January to April rainfall anomalies of 2013 and 2012 (cf. figures 2 and 3) shows the different location of the 2013 drought as well as its higher severity for the southern provinces (the January to April period being the driest in 25 years for Cunene and Namibe and the second driest for Huila – cf. figure 4).

Figure 4: Ranking of the 2013 rainfall received from January to April (source: Tamsat rainfall estimates); NB: 2012 was the driest year over the same months for Benguela and the 3rd driest for Huila which is again affected by drought in 2013.

The most concerned provinces are Namibe, Cunene, Huila, Cuando Cubango and the South Western part of Benguela.

By looking at the seasonally cumulated profiles in Figure 5 of rainfall in these provinces, again Cunene is clearly the most seriously concerned, with rainfall after March below the historical minimum (for each 10-daily period) for all years since 1989.
Figure 5 cumulated Tamsat rainfall profiles of 2013 (orange) for the Southern Provinces of Angola as compared to the historical average (grey), the historical minimum (green) and the maximum (blue). The long term average used is from 1989 to 2012 and the minimum and maximum are computed for every 10-days (dekad) in this period.

The cumulated rainfall evolution from September 2012 to May 2013 shows that the situation in Namibe is similar to the one in Cunene and close to the minimum of all recorded 10-daily rainfall values since 1989. In both Cunene and Namibe, the negative rainfall anomaly started in December, followed by continuously below average rainfall from January to March. In Huila and Cuando Cubango, although total cumulated rainfall is also below average, the drier than normal period started only in March and previous rainfall was normal or close to normal.

As a result of the negative rainfall anomaly described above, the vegetation index reflects the drier than normal conditions in the Southern provinces of Angola with the impact of the rainfall deficit...
becoming well visible in April and extending to large parts of the South West in May 2013 (Figure 6).

![NDVI anomalies for April 2013](image1)
![NDVI anomalies for May 2013](image2)

**Figure 6.** Spot VGT NDVI anomaly in April and May 2013 showing the increasing extent of vegetation affected by water stress.

### 2. Impact analysis for main cereal crops based on the water satisfaction index model

The JRC is running a Water Satisfaction Index (WSI) model at global scale for 7 cereal crops based on rainfall estimates from different sources (ECMWF at the global scale and TAMSAT for the African continent). Figures 7, 8 and 9 show the TAMSAT based WSI for the 3 main cereals grown in Angola (Maize, Sorghum and Millet). The same model also computes the planting date (based on rainfall thresholds) as well as the planting date anomalies as compared to the average.

In May 2013 the main maize areas have been already harvested and show no water stress with the exception of small areas in the South of the Huila province and in the North of Namibe. In Huila, maize planting had been slightly delayed (1-2 dekads), but the final water stress conditions is most likely linked more to the large rainfall deficit from January to February than to the slight initial delay in planting (Figure 7).
Figure 7. Water satisfaction index and season start anomaly for the main maize areas in Angola.

For Sorghum a clear water stress situation is visible at the end of the crop cycle, and the season is marked by a clear delay in planting in Cunene province and in the Southern part of Huila. There are significant spots with WSI < 50% which is commonly defined as crop failure. Sorghum crops in Cuando Cubango at the border with Namibia were also affected by water stress, but to a slightly lower extent than in Cunene (Figure 8).

Figure 8. Water satisfaction index and season start anomaly for the main sorghum areas in Angola.

A very similar situation can be observed for Millet, although due to higher drought resistance the areas with crop failure are more limited than for Sorghum (Figure 8).
3. Temporal analysis of NDVI and rainfall estimates profiles at municipality level

The temporal analysis of rainfall and vegetation index of the current season as compared to the long term average can be refined by distinguishing a predominantly crop growing land use from a mainly pastoral one. Figure 10 shows a crop and a pastoral vegetation layer derived from the GLOBCOVER project (crop layer adapted by JRC). The 2 layers are not mutually exclusive since many areas have both crops and crops and differently from the masks used for the WSI analysis they are not crop specific.

Figure 9. Water satisfaction index and season start anomaly for the main millet areas in Angola.

Figure 10. Cropland and grassland according to remote sensing land cover products
Based on these land use layers, combined graphs for NDVI and rainfall have been computed for all municipalities in Southern Angola. A selection of the most affected municipalities is shown below, while the same graphs for all municipalities in the 5 affected provinces are provided as jpg files attached to this report.

**Table 1** Seasonal profiles of NDVI and rainfall estimates for crops and grassland in selected municipalities of the 5 drought affected provinces (Cunene, Namibe; Cuando Cudango, Huila and Bengala)

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<th>CROPs</th>
<th>GRASSLAND</th>
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<td>Cunene</td>
<td><strong>NDVI and rainfall for Cropland in Cunene - Curoca</strong></td>
<td><strong>NDVI and rainfall for Grassland in Cunene - Curoca</strong></td>
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<tr>
<td>Namibe</td>
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<td><strong>NDVI and rainfall for Grassland in Namibe - Bibala</strong></td>
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<td><img src="image6" alt="NDVI and rainfall for Grassland in Namibe - Bibala" /></td>
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<td>Cuando Cudango</td>
<td><strong>NDVI and rainfall for Cropland in Namibe - Temba</strong></td>
<td><strong>NDVI and rainfall for Grassland in Namibe - Temba</strong></td>
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<td><img src="image8" alt="NDVI and rainfall for Grassland in Namibe - Temba" /></td>
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Thanks to these graphs it is possible to examine the temporal evolution of the crop and grassland vegetation between August 2012 and May 2013.

It is interesting to observe for example that in Cunene, the drought conditions are more severe for the South Eastern municipality of Curoca, with a sharp drop in vegetation activity in January, as opposed to the South Western municipality of Namacunde, which had a good start and a drop of NDVI starting only in March. In both municipalities the situation is very similar for crops and grasslands.

In Namibe, crops in the North East of Bibala show a clear water stress in January followed by a partial recovery and an early senescence in March April. The same pattern is even more
pronounced for grassland. In the Southern Municipality of Tombua, both crop and grasslands show a very negative anomaly due to rainfall deficits starting in January and continuing until April.

In Cuando Cubango the situation is generally much better as compared to the previous 2 provinces and again improves going from East to West, although the Cuangar municipality in the South East had a good and anticipated start of the vegetation season.

The Gambos municipality in the South of Huila is also clearly affected by rainfall deficits starting as early as November and both crops and grasslands show a rapid decline in March.

In Benguela the Baia Farta municipality is also concerned by a lower than average crop and grassland growth following rainfall deficits from November onwards. The municipality has a clear bimodal pattern and the second crop cycle starting in February was heavily affected by water stress both in terms of growth intensity and cycle length.

4. Conclusions

Following the analysis of rainfall estimates and vegetation indices provided by low resolution satellite images as well as a water balance model, it can be concluded that 5 provinces in Southern Angola are directly affected by a severe rainfall deficit starting in late 2012 and showing a strong impact on agricultural and natural vegetation in April-May 2013. The most affected provinces are Cunene and Namibe, the South Western municipalities of Huila, the Baia Farta municipality in Benguela and to a lower extent the Southern municipalities of Cuando Cudango.

While maize crops are concerned only in limited areas in the South West of the Huila province, according to the WSI, most Sorghum crops in Namibe, Huila, Cunene and in the South Western part of Cuando Cudango are clearly affected and a complete crop failure cannot be excluded in large parts of these provinces. Even the more drought resistant Millet has probably failed in Cunene province.

These findings are based on the analysis of low resolution satellite images and on rainfall estimates (TAMSAT) as well as on modelled crop water satisfaction and should be validated by ground observations, such as measured meteo data and ground surveys. The Global Water Satisfaction Index model run by JRC is experimental and largely dependent on the quality of the rainfall estimates used as input data. It is recommended that detailed field surveys are carried out in the most affected municipalities for a quantitative impact assessment.

The additional seasonal NDVI and rainfall estimates profiles for all municipalities in the South provided together with the report can be used for a prioritisation and planning of field visits.

References:

FAO 2006 FAO/WFP CROP AND FOOD SUPPLY ASSESSMENT MISSION TO ANGOLA

FAO 2013 GIEWS country brief for Angola

IFRC 2012 Emergency appeal Angola: Food Insecurity
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*MARS stands for Monitoring Agricultural Resources

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