Seasonal Monitoring in Namibia

Ad Hoc Report

Severe drought affecting cereal production and pastoral areas in northern and central Namibia

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ACRONYMS USED IN THIS REPORT

FAO – Food and Agriculture Organization
GAUL – Global Administrative Units Layer
GDP – Gross Domestic Product
GIEWS – Global Information and Early Warning System
(G)WSI – (Global) Water Satisfaction Index
JRC - Joint Research Centre of the European Commission
LTA – Long Term Average
MARS – Monitoring Agricultural ResourceS Unit of JRC
NDVI – Normalized Difference Vegetation Index
PROBA-V - small satellite, assuring the succession of the Vegetation instruments on board the French SPOT-4 and SPOT-5 Earth observation missions.
RFE – RainFall Estimates
SPOT VGT – SPOT (Satellite Pour l'Observation de la Terre), Vegetation instrument
TAMSAT - Tropical Applications of Meteorology using SATellite data and ground-based observations
WFP – World Food Programme

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HIGHLIGHTS

- Crop and pastoral areas in the Centre/North have been affected by severe drought starting in December 2014 and extending southwards in January/February. The peak of the drought happened in March following the driest month of February recorded over the last 27 years. Pastoral areas in the Centre/East of the country recovered partially in April, following good rainfall in March.

- This is the second severe drought affecting Namibia in only three years, while many farmers and pastoralists, despite partial recovery in 2014, have not yet fully recuperated from the major drought in 2013.

1. BACKGROUND

Situated between the Namib and the Kalahari deserts, Namibia has the least rainfall of all sub-Saharan African countries. There are typically two rainy seasons: a small rainy season between September and November, and a larger rainy season between February and April. The winter (June – August) is generally dry. Average rainfall varies from almost zero in the coastal desert to more than 600mm in the north-eastern Zambezi Region. Rainfall is also highly variable in time, and droughts are common, as experienced in 2006/2007 for example when rainfall was far below the annual average, or in 2012/2013 which was the driest season over the last 27 years.

Namibian agriculture contributed around 5% to Namibia’s GDP between 2004 and 2009, and about half the population (i.e. around 1 million people) depends on agriculture for its livelihood. The agricultural sector comprises mainly crop farming and livestock rearing. Crops are limited to the north, whilst livestock farming occurs in various areas countrywide. Cattle and goats are more common in the northern and central regions, whilst goats and karakul sheep are more typical in more arid southern regions.

Per capita GDP is five times that of Africa’s poorest countries, but 25 – 40% of Namibians still live in rural areas and rely on subsistence farming and herding. Subsistence farming is mainly confined to communal lands in the north of the country, where roaming cattle herds are prevalent and the main crops are millet, sorghum, maize and groundnut.

Only 2% of Namibia's land receives sufficient rainfall to grow crops; most rivers flow only sporadically, and irrigation is only possible in Orange, Kunene, and Okavango valleys.

In terms of production, the main cereal crops are maize and millet with an average annual production of 58,000 and 52,000 t respectively, followed by wheat and sorghum with about 13,500 and 5,000 t per year respectively, over the period 2005-2013 (Figure 1). In terms of cultivated area, millet is by far the most common crop with 230,000 ha on average over 2005-2013 against 29,000 and 18,000 ha for maize and sorghum respectively. Maize however gives much higher yields, especially since 2005, than millet and sorghum, whose yields tend to stagnate. In terms of crop calendar, maize millet and sorghum are usually sown in November-December and harvested in June (Figure 2). Wheat is cropped during winter from May to October-November by commercial farms on about 2000 ha and is irrigated, which explains an average yield of 6.5 t/ha with a growing trend over 2005-2013.
Administratively, Namibia is divided into 14 regions and subdivided into 121 constituencies (Figure 2).

Figure 1: production (t), harvested area (ha) and yield (t/ha) for the three main cereals cropped by subsistence farmers of Namibia, namely maize, millet and sorghum over the period 1994-2013 (source FAOSTAT).
Figure 2. Regions and limits of constituencies within Namibia, and FAO-GIEWS crop calendar for the main cereal crops.

Figure 3. Potential crop and grass land according to global land use products (source: MARS).
2. CURRENT SITUATION

Tamsat rainfall over the whole country shows that the 2014-2015 season was very dry with total rainfall only marginally different from the totals of the 2012-2013 and 1994-1995 seasons which were affected by very severe droughts (Figure 4). At national level the total cumulated rainfall from September 2014 to May 2015 remained below 150 mm (as compared to the average of ca. 225 mm).

Figure 4. (left) Cumulated rainfall over the whole Namibia for the period September 2014 – May 2015 (red line) compared to the 1989-2014 long term average (grey dashed line), to the 2012-2013 and 1994-1995 seasons (orange and purple dashed lines) and to the historical minimum and maximum dekad rainfall (brown and blue dashed lines). (right) 2015 cumulated rainfall compared to all other years since 1989 for the period November-March.

Rainfall usually starts in October-November with the vegetative part of the crop cycle concentrated mainly over December-March, where rainfall is crucial for crop development and final yield. The 2015 season started normally in terms of rainfall amounts and timing (from November to early December). However, rainfall decreased as from mid-December, resulting in major deficits with respect to the long term average (LTA) in January and February (Figure 5).
Figure 5. Monthly rainfall anomalies in Namibia for the period December 2014 – March 2015 (TAMSAT rainfall estimate); the monthly anomalies are computed as the difference between the monthly cumulated rainfall for 2014-2015 and the corresponding long term average (1983-2014).

In particular, in the Northern regions of Omusati, Oshana, Ohangwena, Oshikoto, Kavango West and East and to a minor extent Kunene, the monthly deficits of both January and February ranged between 70 and 90 mm with respect to the corresponding mean rainfall (peaks of less than 50% of LTA in January and less than 80% of LTA in February). Actually, according to Tamsat rainfall, February 2015 reached a record of low rainfall for the last 27 years (1989-2015) in all the northern regions and was the 2\textsuperscript{nd} or 3\textsuperscript{rd} driest February in the centre-south of the country (Figure 6). As a result, the December 2014 – February 2015 period was ranked as the 2\textsuperscript{nd} driest after 1995 for the northern regions of Oshana, Oshikoto, the Kavango regions, Otjozondjupa and even Khomas in the centre. In all other regions, this same period was ranked as the 3\textsuperscript{rd} or 4\textsuperscript{th} driest trimester of the last 27 years (Figure 7). Rainfall in March was above average in parts of central Namibia, but the seasonal cumulated values remain still far below average and the beneficial effect of the good March rains might have been late for the main crop areas.
Figure 6. Ranking of February 2015 total Tamsat rainfall against the last 27 years for a selection of regions. (NB: Kavango includes West and East and Caprivi stands for Zambezi).
This rainfall deficit has negatively affected the growth of both pastures and crops as shown by satellite-derived measures of NDVI (Normalised Difference Vegetation Index), a commonly used indicator of crops and pastures condition. Figure 8 below shows how the vegetation from January to April 2015 compares to the respective long term averages (1999-2014) according to the SPOT VEGETATION/ProbaV time series.
The first effects of the rainfall deficit appeared in January in the northern regions of Oshana, Oshikoto, the western half of Otjozuntupa, the south-eastern part of Kunene and even in the central part of the country in Khomas and in the eastern part of Hardap. By end of February the drought has worsened and extended into the surrounding areas, and by March, while the core area in the north remains the same, nearly the whole country is affected as well as neighbouring Botswana and Angola (Figure 8). In April, vegetation (mainly grasslands in pastoral areas) appeared to have recovered in the central and eastern parts of the country following above average rainfall in March.

Figure 8. Difference between March 2013 NDVI and the long term average, and May 2013 NDVI and the long term average (SPOT-VGT NDVI, 1999-2012).
3. REGIONAL PROFILES

Figure 9 shows the combined profiles of rainfall and NDVI at region level for both cropland and grasslands; these profiles were extracted according to the masks of Figure 3 and are compared to their respective long term averages.
According to the NDVI-rainfall profiles, the regions can be classified into the following groups:

- The northern regions (Oshana, Oshikoto, the northern and western parts of Otjozondjupa, the south-eastern part of Kunene and the eastern part of Omusati) which overall received very low rainfall over December – February and for which high crop losses can be expected, despite a good season start (as evidenced by above average NDVI in December) and the high rainfall in the last dekad of January;
- The very northern region of Ohangwena and the north of Kavango West and most of Kavango East characterized by a well above average season start followed by a slow decline of vegetation due to lower than average rainfall over December - February and a close to average end of season after the March rainfall;
- The central eastern region (Omaheke, east of Otjozondjupa and up to the wetter Zambezi in the north-east) which also had a better than average start of season followed by a drop of grassland biomass due to the December – February rainfall deficit, drop which was apparently later compensated by the March rainfall;
- The central region (Khomas) and arid southern regions (Hardap and cap) which usually receive less than 20 mm per dekad during the rainy season (between January and March) and also suffered from the low rainfall of December and February; however there also, especially in Khomas, grasslands recovered with the March (and sometimes first dekad of April) rains.

For a zoom at sub-region level, NDVI-rainfall profiles for cropland areas of a selection of constituencies are given in Annex 1.
4. Impact analysis for main cereal crops based on the water satisfaction index model

The JRC runs a Global Water Satisfaction Index (GWSI) model for rain-fed maize, sorghum and millet. The higher the water stress (i.e. the difference between the crop water requirements and the available water from rainfall summed along the crop season), the lower the value of the water satisfaction index (WSI). Figure 10 below shows the TAMSAT based WSI for the three crops, which are the main crops grown in Namibia, at the end of the 2nd dekad of June. At this date, WSI provides a good overview of the season for the three crops usually harvested in June.

According to the GWSI model, all three crops have suffered from severe water stress with less than 50% of the millet and sorghum water requirements satisfied over their whole season in the northern regions of Namibia (Omusati, Oshana, Oshikoto, Ohangwena, Kavango West and East) and less than 35% for maize in Oshikoto and Otjozondjupa (Figure 10). Zambezi in the far NE appears to have had better conditions for millet and sorghum with WSI between 60 and 70%. Major yield reductions can be expected for the three crops and especially maize due to the rainfall deficits reflected both by the NDVI and the crop model (figures 7 to 10).

A WFP report from April 2015 assumed a 33% crop production decrease relative to last year, which was a good year. The WSI suggests a similar decrease compared to the long term average, but it is only referring to rainfed agriculture.
Figure 10. Tamsat based water satisfaction index for the main maize, sorghum and millet areas of Namibia.

5. Conclusions

Rainfall estimates and vegetation indices for both cropland and grassland areas and output from a water balance model for maize, millet and sorghum were analysed to identify drought stricken areas. At the end of May 2015, nearly the whole country and especially the crop and pastoral areas in the northern regions appear to have been affected by severe drought. According to the JRC water satisfaction model, less than 50% of the millet and sorghum water requirements and less than 35% of the rainfed maize requirements over their whole cycle were met. Cereal production is expected to drop to less than 30% of last year with a clear negative impact on food security.

The 2014-2015 season started well with timely rains in October-November and above average biomass observed in the central northern to eastern parts of the country, but rainfall deficit in December and especially February, which in all northern regions was the driest in the last 27 years, caused a strong decrease in vegetation greenness in March. As a result, high crop and pastures losses can be expected in Oshikoto, Oshana, the northern and western parts of Otjozondjupa, the south-eastern part of Kunene and the eastern part of Omusati. Only the very northern regions of Ohangwena, the northern part of Kavango regions and Zambezi seem to have had fair conditions with respect to the long term average.

Pastures production in centre-south of the country (Khomas in February and Hardap in February-March) also declined as a result of the rainfall deficit, but good rainfall in March favoured a partial recovery of grasslands. A similar recovery also occurred in the east of the country (Tsumkwe at the east of Otjozondjupa, Omaheke, Zambezi).

This is the second severe drought affecting Namibia in only three years, while many farmers and pastoralists, despite partial recovery in 2014, have not yet fully recuperated from the major drought in 2013.

These findings are based on the analysis of low resolution satellite imagery and rainfall estimates (TAMSAT), as well as on modelled crop water requirements, and should be validated by ground observations. It is recommended that detailed field surveys are carried out in the most affected regions and constituencies for a quantitative impact assessment. For instance, in addition to the lack of grassland biomass in February-March, cattle may also have suffered from depletion of rivers and water bodies. Seasonal NDVI and rainfall profiles for all constituencies are available at JRC on request, for instance to plan and prioritise field visits.
References:
FAO 2009 FAO/WFP CROP AND FOOD SUPPLY ASSESSMENT MISSION TO NAMIBIA
FAO 2015 GIEWS country brief for Namibia (11 March 2015)
JRC 2013 Seasonal Monitoring report for Namibia June 2013
WFP 2015 SOUTHERN AFRICA SEASONAL ANALYSIS –2014/2015, End of season status
Annex 1: selection of NDVI/rainfall profiles for the constituencies with cropland according to the MARS crop mask of figure 3.
The objective of this report is to give an overview of the climatic seasonal developments and vegetation conditions in Namibia for the 2014 - 2015 crop season as of June 2015. The analysis of satellite-derived rainfall estimates and vegetation indices, and outputs from a water balance model, identified severe drought areas where crops yields and pastoral biomass production are expected to be critically low: these include the main crop production and pastoral areas in the North and Centre of the country. In these areas good initial rainfall in late 2014 was followed by a quickly increasing rainfall deficit culminating in February 2015 and showing negative effects on vegetation from March to May 2015. This is the second severe drought affecting Namibia in only three years, while many farmers and pastoralists, despite partial recovery in 2014, have not yet fully recuperated from the major drought in 2013.
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