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Joint Research Centre

Drought in Madagascar June 2026

GDO Analytical Report

PROGRAMME OF THE EUROPEAN UNION

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Contents

Abstract

Drought conditions are quickly deteriorating in Madagascar.

The compound effect of poor precipitation (mainly over north-east) and above average temperatures (mainly over south-west) has been the driver of the drought, with severe dry conditions observed over most of the country.

Temperature anomalies are severely warmer than average over south-western Madagascar further exacerbating the drought conditions in these areas.

Soil moisture is below normal over most of Madagascar, with negative impacts on vegetation and crops.

Continued monitoring is needed to assess the full extent of the damage.

Drought is expected to worsen in most of Madagascar and in particular in the north-eastern regions, with warmer and drier conditions forecasted for the next months. River flow forecast points to low values at the basin scale and extremely low values at the river scale.

Acknowledgements

We gratefully acknowledge the support provided by the Copernicus programme and the Directorate-General for Defence Industry and Space (DG DEFIS), and the Directorate-General for European Civil Protection and Humanitarian Aid Operations (DG ECHO). We thank A. De Jager, A. Hrast Essenfelder, G. Fioravanti, D. Volpi, L. Acquafresca, A. Ficchì, M. Mazzeschi, P. Barbosa for their key contributions to the European and global drought observatories of the Copernicus Emergency Management Service.

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1. Introduction

The Copernicus Emergency Management Service (CEMS[1]), implemented by the European Commission's Joint Research Centre, provides timely and accurate geospatial information on ongoing and forecasted natural hazards and man-made disasters to support decision making and actions. Its products and services support emergency response and disaster management activities, helping to reduce risks and mitigate the impact of disasters and saving lives. CEMS has three components: early warning and monitoring; on-demand mapping; exposure mapping. The early warning and monitoring component focuses on floods, drought, and wildfire.

The European and Global Drought Observatories[2] (EDO and GDO) of CEMS provide drought forecasting and monitoring information, analysis tools and analytical reports. The Observatories aim at detecting, monitoring, and predicting droughts by using a suite of indices and indicators characterising different aspects and phases of drought. In addition, EDO and GDO provide monitoring information and forecasts of warm spells, heatwaves and cold spells. In addition, JRC runs the Anomaly Hotspots of Agriculture system that provides warnings on agricultural drought affecting crops and rangelands[3].

Drought is likely the most complex climate-related natural hazards, due to its spatio-temporal evolution, its cascading impacts on all sectors, including agriculture, public water supply, energy production, transportation, tourism, human health, biodiversity, and natural systems. Drought is a climate extreme characterized by an imbalance in the hydrological cycle. It is due to a deficit in precipitation, that accumulates over time, often compounded by warm spells and heatwaves. It is influenced by land and water use and management. Drought can occur on multiple time scales, from a few weeks to several years, affecting large areas and populations worldwide. The related impacts are both direct and indirect and can persist after its end. Depending on the effect in the hydrological cycle and the impacts on society and environment, different drought phases are commonly distinguished:

1. meteorological drought, characterised by a substantial deficit in precipitation. The deficit is defined with respect to the long-term climatology;

2. agricultural drought, characterised by reduced soil moisture that results from below-average precipitation often compounded by above-normal evapotranspiration;

3. hydrological drought, that occurs when river streamflow and water storages in aquifers, lakes, and reservoirs fall below long-term mean levels.

Due to its complexity, drought monitoring relies on a set of different indices and indicators, representing different components of the hydrological cycle (e.g. precipitation, soil moisture, reservoir levels, river flow, and groundwater levels), as well as specific impacts (e.g. vegetation water stress).

1 https://emergency.copernicus.eu/

2 https://drought.emergency.copernicus.eu/

3 https://agricultural-production-hotspots.ec.europa.eu/

All details of drought indices and indicators used in the Copernicus Drought Observatories are available in the associated factsheets[4] and in the JRC Data Catalogue[5].

This study is part of a series of analytical reports focused on the analysis of drought events affecting Europe as well as the other regions of the world. These studies build on data and information retrieved and processed by the Copernicus Drought Observatories. The information derived from the Observatories is usually complemented with additional sections on impacts, large-scale circulation, and other relevant factors.

4 https://drought.emergency.copernicus.eu/data/factsheet.

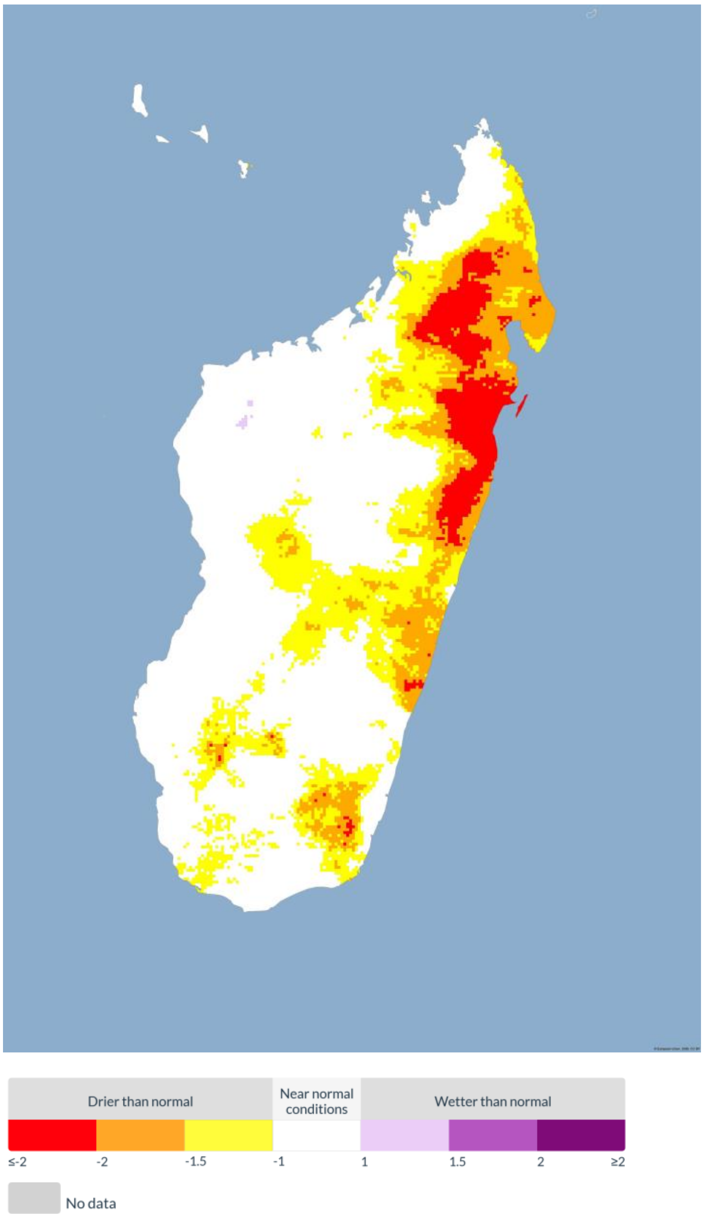
5 https://data.jrc.ec.europa.eu/collection/drought.

2. Standardized Precipitation Index (SPI)

The SPI provides information on the intensity of the precipitation deficit (or surplus) over a defined accumulation period (e.g. from 1 to 48 months). The lower (i.e., more negative) the SPI, the more intense is the drought. SPI can be computed for different accumulation periods. The 3-month period is often used to evaluate agricultural drought and the 12-month (and longer) period for hydrological drought, when rivers fall dry and groundwater tables lower.

Figure 1 displays the SPI-3 (based on CHIRPS (Climate Hazards Group InfraRed Precipitation with Station) data) for Madagascar showing that the north-eastern regions have been affected by a severe and prolonged lack of precipitation. In central and southern regions there are areas affected by negative precipitation anomalies with lower severity.

Figure 1. SPI-3 in early June 2026.

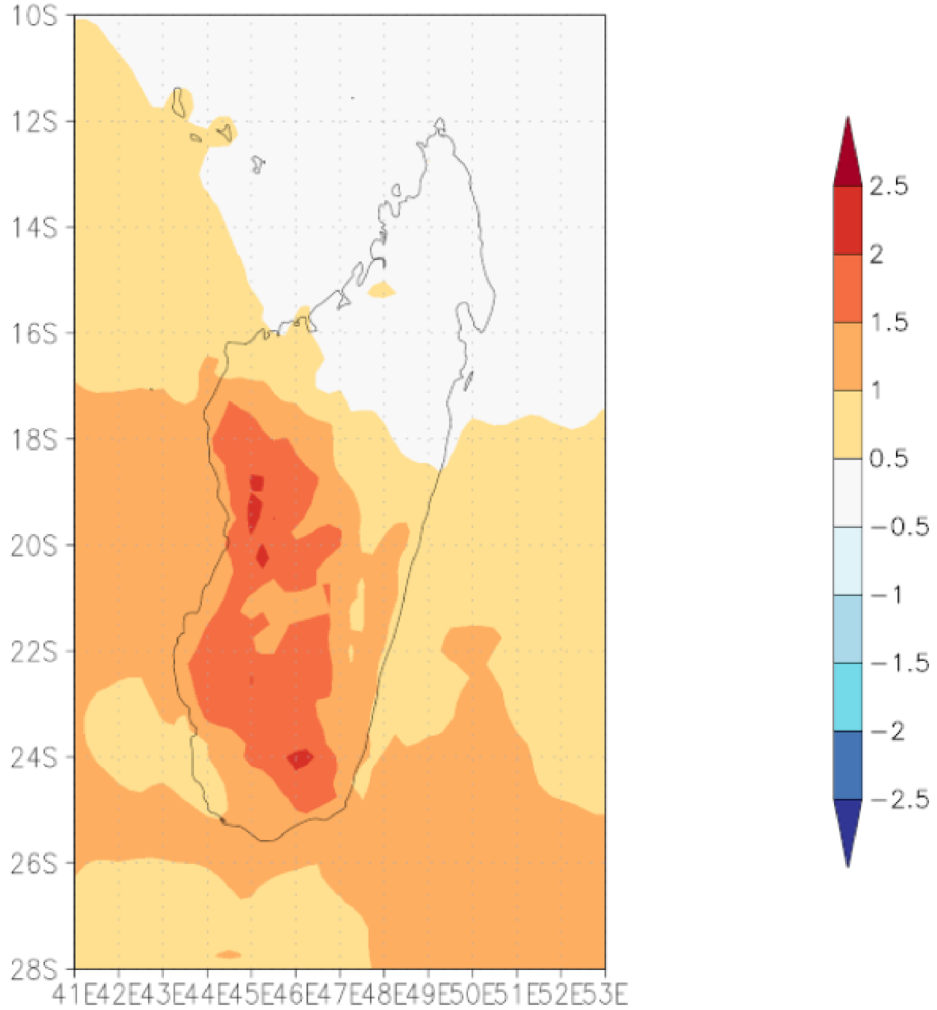


Source: JRC, Copernicus EMS European (EDO) and Global (GDO) Drought Observatory, based on CHIRPS.

3. Temperature

In May 2026, most of central-southern Madagascar experienced above-average temperatures. The positive temperature anomalies affected mostly the central-western and southern regions with anomalies above 1.5 °C.

Figure 2. Average temperature anomalies (data from ERA5, ECMWF European Centre for Medium-Range Weather Forecasts Reanalysis v5, baseline 1991-2020) in May 2026.

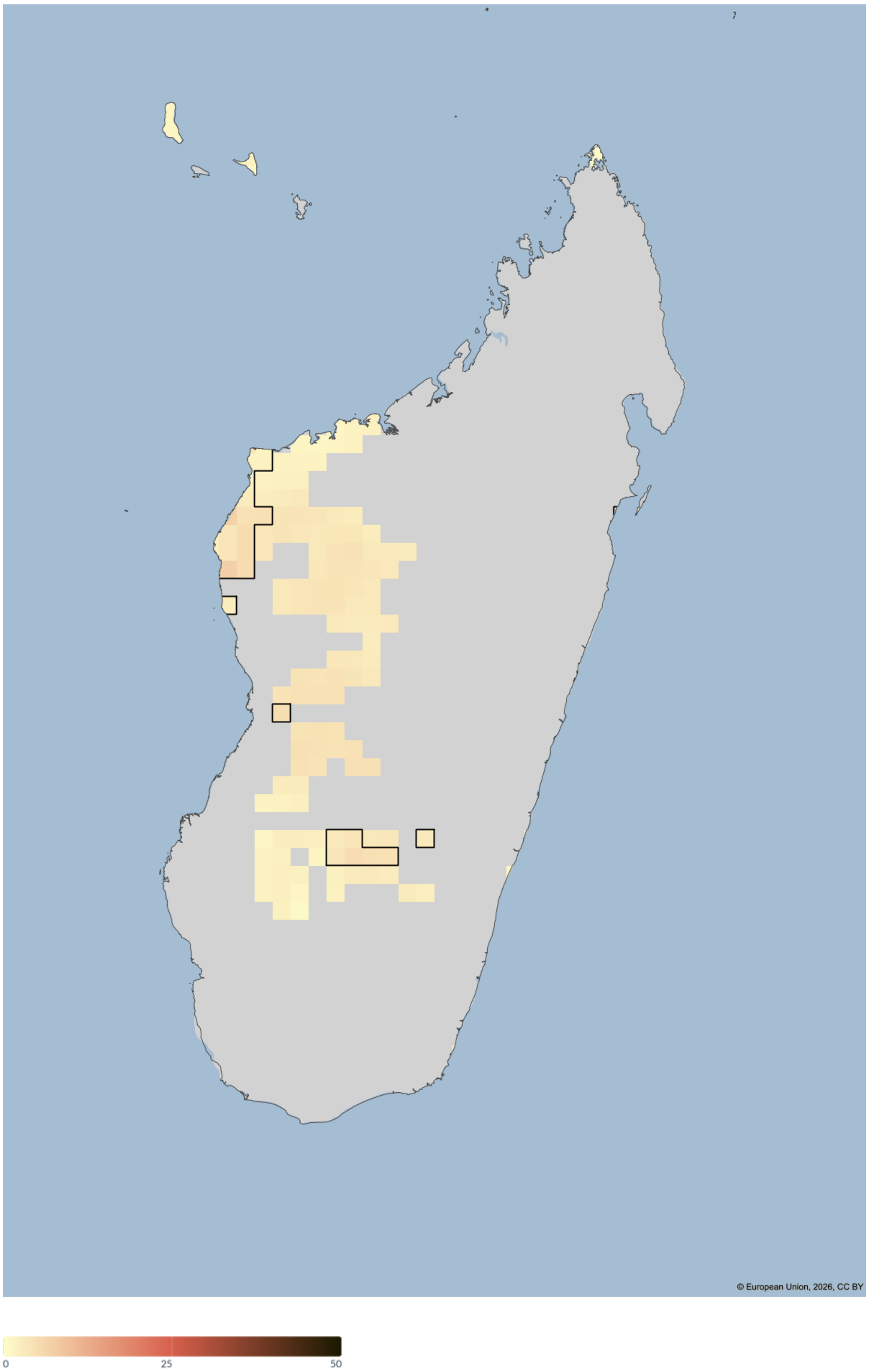


Source: The KNMI (Koninklijk Nederlands Meteorologisch Instituut) Climate Explorer[6].

According to the map of warm spell intensity, the positive temperature anomalies reported for May started with an initial extensive warm spell hitting mainly the central and western regions.

[6] The KNMI Climate Explorer: https://climexp.knmi.nl

Figure 3. Accumulated warm spell intensity in degrees Celsius (°C) during the event (last day here reported: 3 May 2026). Grey contours highlight the areas with warm spell duration greater than 4 days.



Source: JRC, Copernicus EMS European (EDO) and Global (GDO) Drought Observatory, based on ERA5.

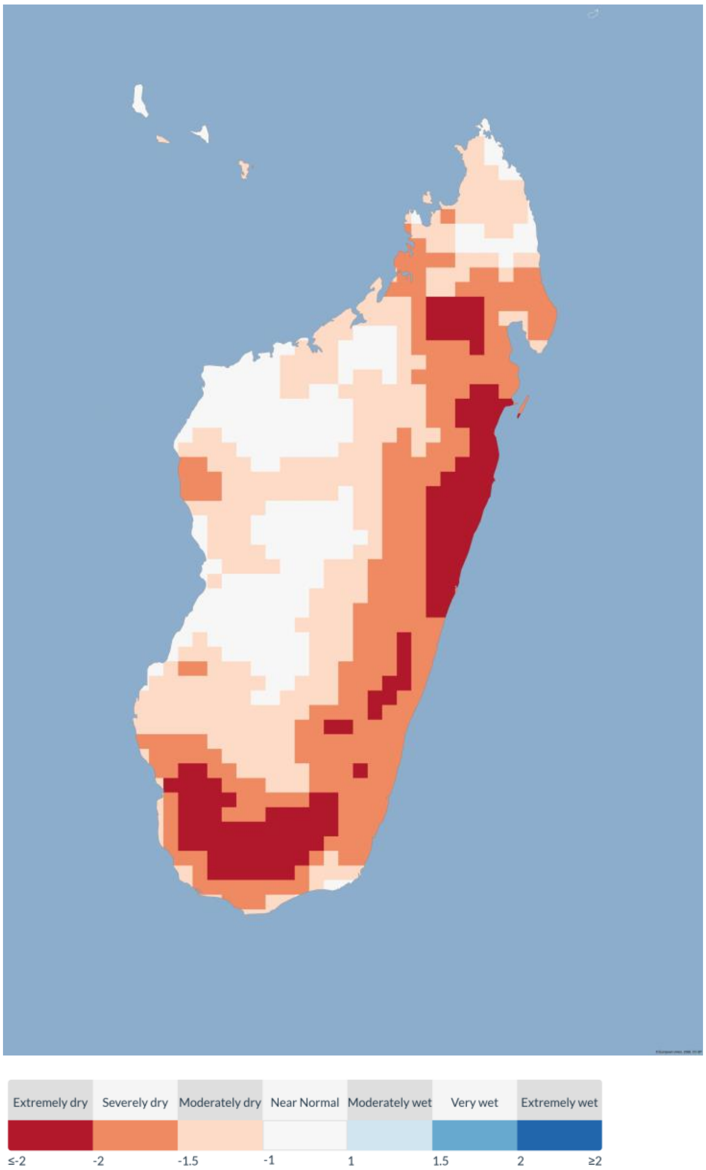
4. Standardized Precipitation Evapotranspiration Index (SPEI)

SPEI accounts for both precipitation and evapotranspiration (potential evapotranspiration, PET, is here computed with the Hargreaves-Samani[7] method) to estimate anomalies of the climatic water balance (precipitation minus potential evapotranspiration) with respect to the climatological average over a given period. Thus, SPEI provides an estimation of the combined effects of precipitation deficit (based on ERA5 data) and warmer-than-usual conditions.

The SPEI, shown in Figure 4, confirms the prolonged drought over the north-eastern regions and additionally takes into account the effect of above average temperature over the southern regions. SPEI-3 well aligns with a combination of SPI-3 and temperature anomalies confirming that the current drought is driven both by precipitation and temperatures.

[7] See Hargreaves, G. H. and Samani, Z. A.: Estimating potential evapotranspiration, J. Irrig. Drain E.-ASCE, 108, 223–230, 1982 and Hargreaves, G. H. and Samani, Z. A. 1985. Reference crop evapotranspiration from ambient air temperature, American Society of Agricultural Engineers, 12 pp., available at: http://libcatalog.cimmyt.org/download/reprints/97977.pdf.

Figure 4. SPEI-3 in early June 2026.



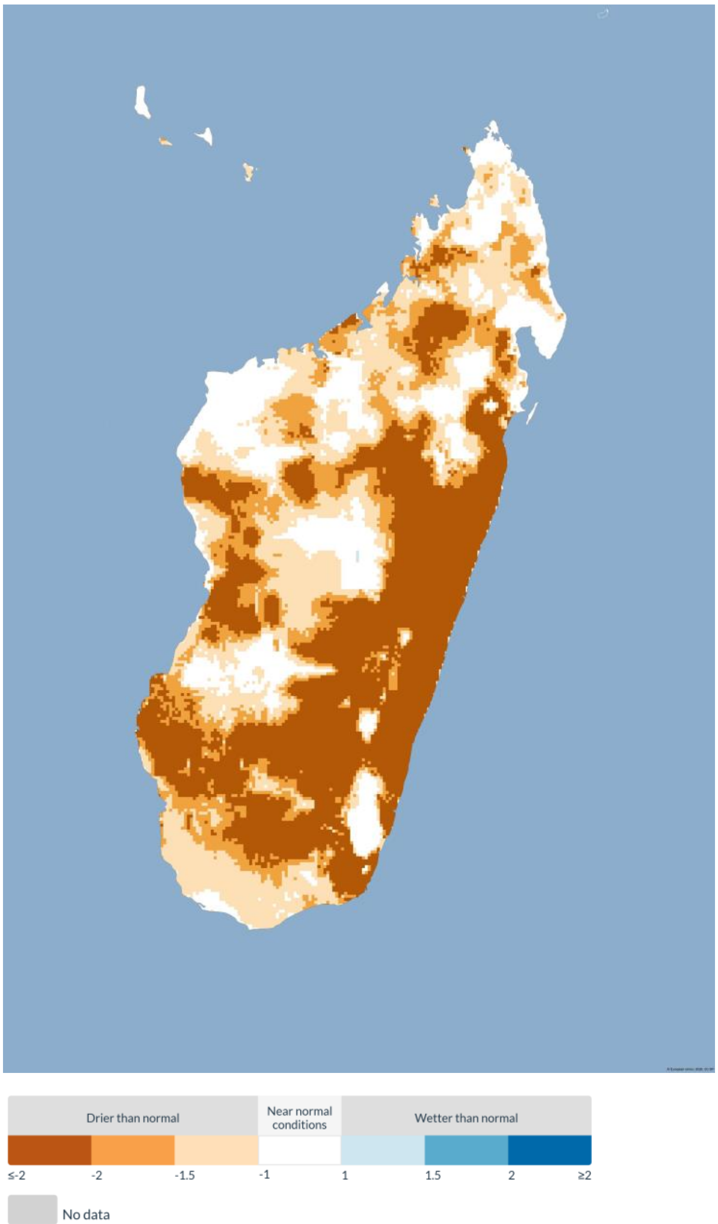
Source: JRC, Copernicus EMS European (EDO) and Global (GDO) Drought Observatory, based on ERA5.

5. Soil moisture

The Soil Moisture Index Anomaly (SMA) is a standardized index that estimates deviations from normal conditions of the root-zone water content. It is an index derived from the hydrological model OS LISFLOOD associated with the difficulty of plants in extracting water from the soil.

The Soil Moisture Index Anomaly shows negative anomalies over most of Madagascar with extreme dry anomalies over eastern and southern regions confirming the compound effect of lack of precipitation and above average temperatures. Less severe anomalies affect the north-western regions.

Figure 5. Soil Moisture Index Anomaly in early June 2026.



Source: JRC, Copernicus EMS European (EDO) and Global (GDO) Drought Observatory, based on OS LISFLOOD hydrological model.

6. Vegetation and crops

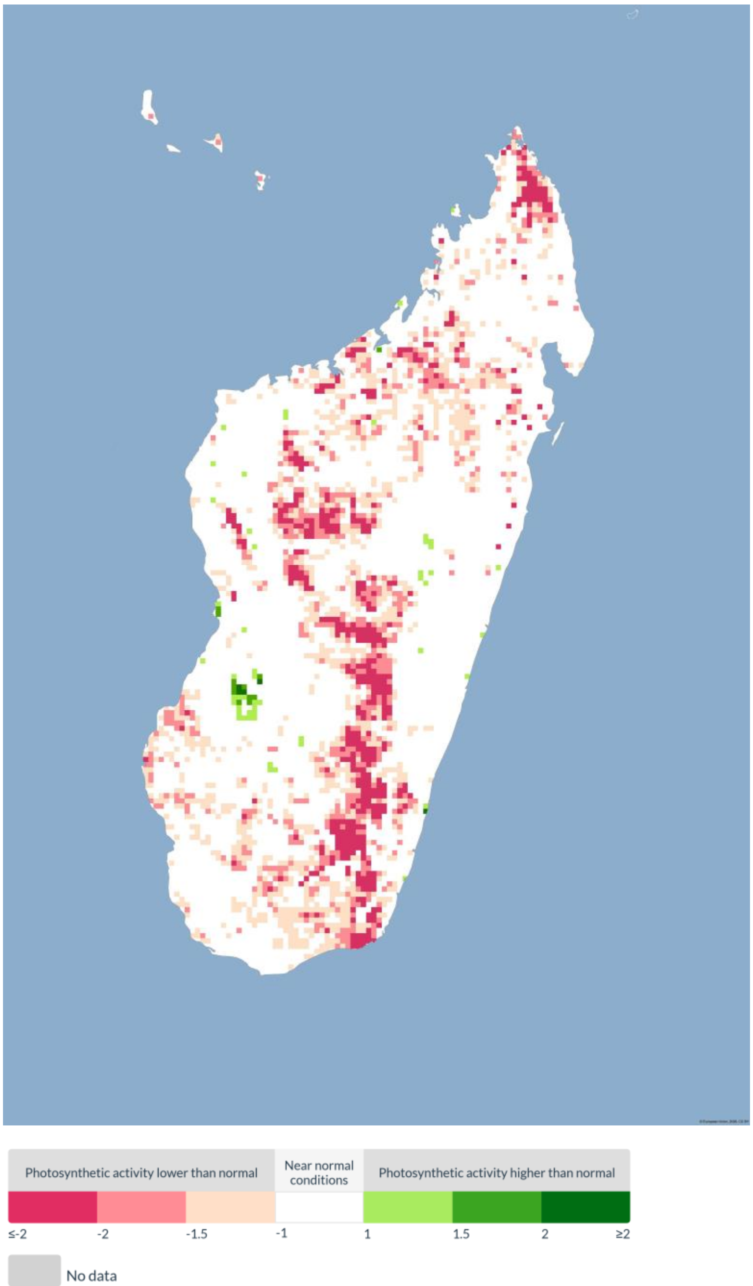
The satellite-based fraction of Absorbed Photosynthetically Active Radiation (fAPAR) represents the fraction of solar energy absorbed by leaves due to photosynthesis. It is a measure of vegetation health and biomass. Negative fAPAR anomalies with respect to the long-term average are associated with a reduction in biomass and often with negative impacts on vegetation.

In early June 2026, the satellite-derived fAPAR anomaly indicator shows sparse worsening vegetation stress over most of Madagascar with the most critical values over central, south-eastern and north-eastern regions. In the rest of the country, conditions are close to normal. The driver of the critical conditions appears to be a combination of precipitation deficit and above average temperature.

Dedicated information on global agricultural production hotspots in countries at risk of food insecurity is provided in the JRC's ASAP (Anomaly Hotspots of Agricultural Production) website[8].

8 https://agricultural-production-hotspots.ec.europa.eu/

Figure 6. VIIRS (Visible Infrared Imaging Radiometer Suite) satellite-derived fAPAR anomalies in early June 2026.

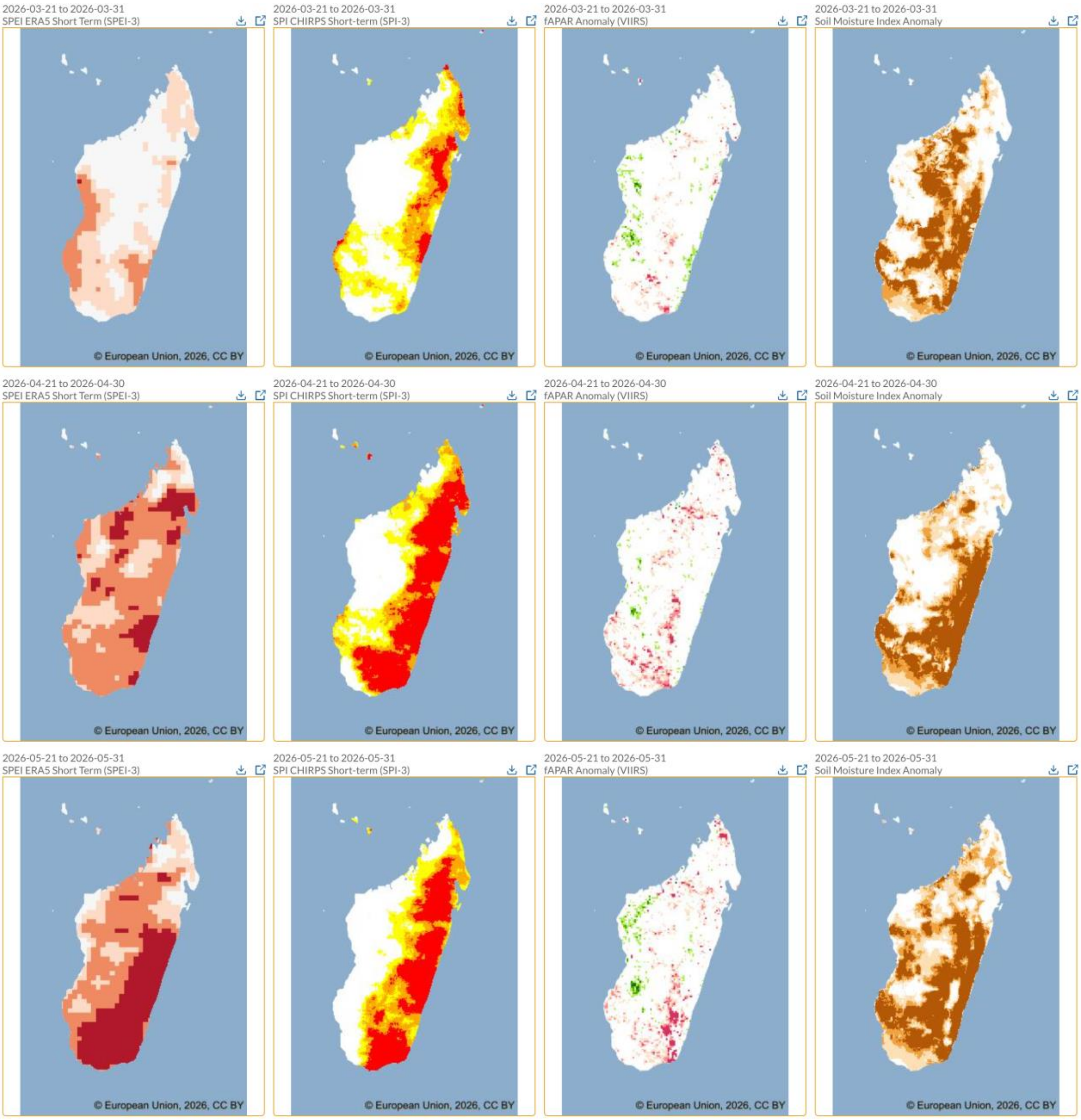


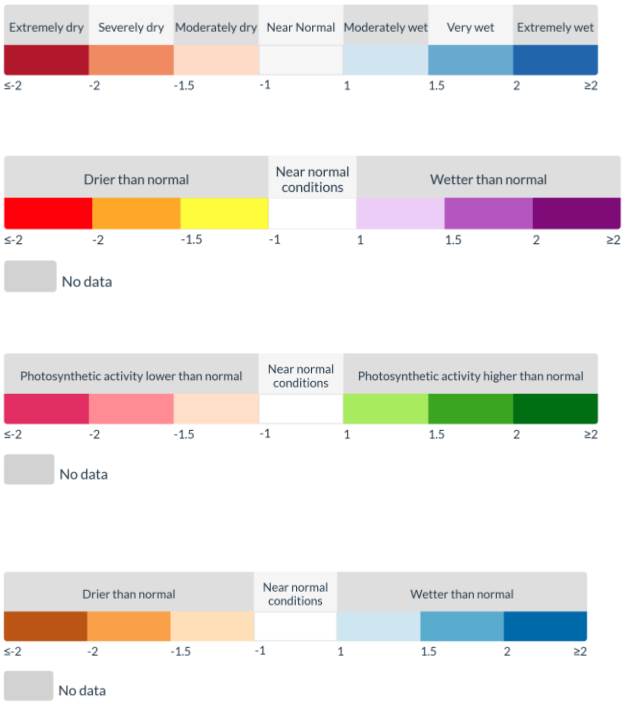
Source: JRC, Copernicus EMS European (EDO) and Global (GDO) Drought Observatory, based on VIIRS.

7. Drought onset and evolution

The drought started to develop in March 2026 after a period of close-to-normal conditions over the whole Madagascar. The onset of precipitation deficit is detected over central-eastern and north-eastern regions, with a spatial evolution in the whole eastern side of the country. In terms of SPEI also the rest of the country has been hit by above-average temperature, with impacts also on soil moisture anomaly, progressively getting dry over the whole country. The impacts on vegetation slowly emerged over southern regions and got worse, pointing again to the relevance of temperature on vegetation health.

Figure 7. Temporal evolution of SPEI-3 (first column) SPI-3 (second column) fAPAR anomaly (third column) and fAPAR anomaly (fourth column) from March to May 2026.





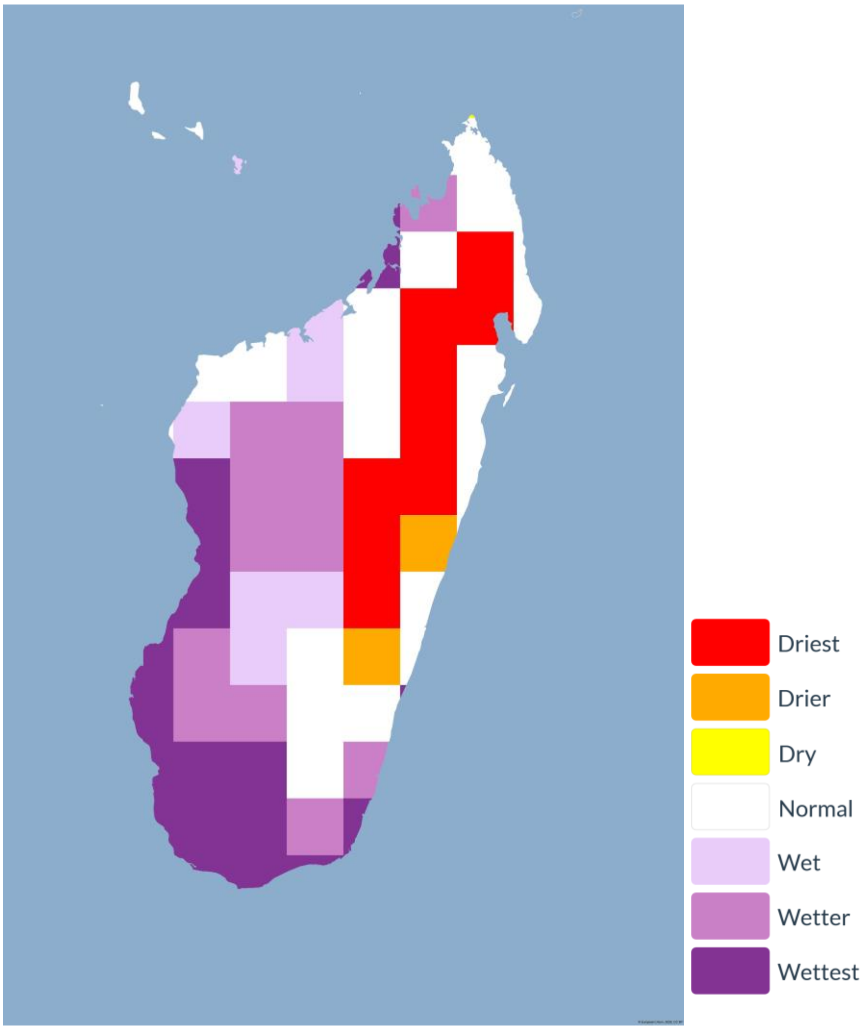
Source: JRC, Copernicus EMS European (EDO) and Global (GDO) Drought Observatory, based on ERA5, CHIRPS, VIIRS and OS LISFLOOD.

8. Seasonal forecast

The Multi-system Indicator for Forecasting Unusually Wet and Dry Conditions provides early risk information at global scale. The indicator is computed from forecasted SPI-1, SPI-3, and SPI-6 derived from eight modelling systems: ECMWF (European Centre for Medium-Range Weather Forecasts), CMCC (Centro Euro-Mediterraneo sui Cambiamenti Climatici), DWD (Deutscher Wetterdienst), ECCC (Environment and Climate Change Canada), Météo France, NCEP (USA National Centers for Environmental Prediction), UKMO (UK Meteorological Office), BOM (Bureau of Meteorology, Australia).

Severely drier than average conditions are forecasted from June to August 2026 by the multi-system ensemble (Figure 8) over central-eastern and north-eastern Madagascar. This follows an already dry period in the same regions, rising concerns for the drought development and consequent impacts. On the other hand, western and southern regions of the country may experience significantly wetter conditions than usual.

Figure 8. Multi-system Indicator for Forecasting Unusually Wet and Dry Conditions, June - August 2026, based on dynamic forecasting systems from 8 centres, issued in June 2026: ECMWF, CMCC, DWD, ECCC, Météo France, NCEP, UKMO, BOM. The baseline period is 1993-2016.

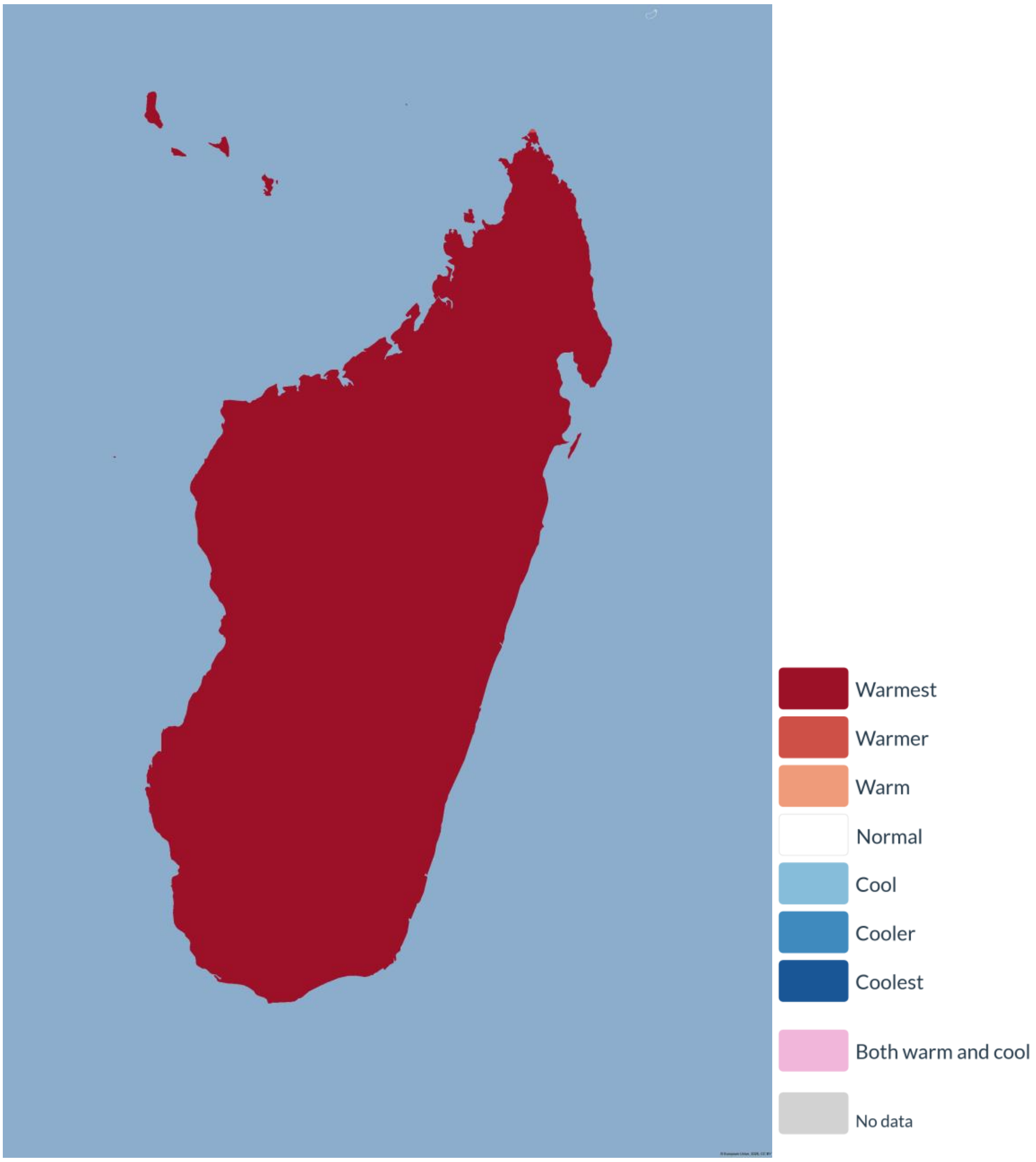


Source: JRC, Copernicus EMS European (EDO) and Global (GDO) Drought Observatory, based on ECMWF, CMCC, DWD, ECCC, Météo France, NCEP, UKMO, BOM.

The individual forecasting systems (not shown here) show broad agreement on the dry anomaly, differing only in spatial extent and severity.

The Multi-system Indicator for Forecasting Unusual Warm and Cool Conditions provides early risk information at global scale, based on the eight forecasting systems mentioned before. As for July 2026, the ensemble predicts extremely warmer than average conditions over the whole Madagascar (Figure 9). This will further exacerbate the current drought.

Figure 9. Multi-system Indicator for Forecasting Unusually Warm and Cool Conditions, July 2026, based on dynamic forecasting systems from 8 centres, issued in June 2026: ECMWF, CMCC, DWD, ECCC, Météo France, NCEP, UKMO, BOM. The baseline period is 1993-2016.



Source: JRC, Copernicus EMS European (EDO) and Global (GDO) Drought Observatory, based on ECMWF, CMCC, DWD, ECCC, Météo France, NCEP, UKMO, BOM.

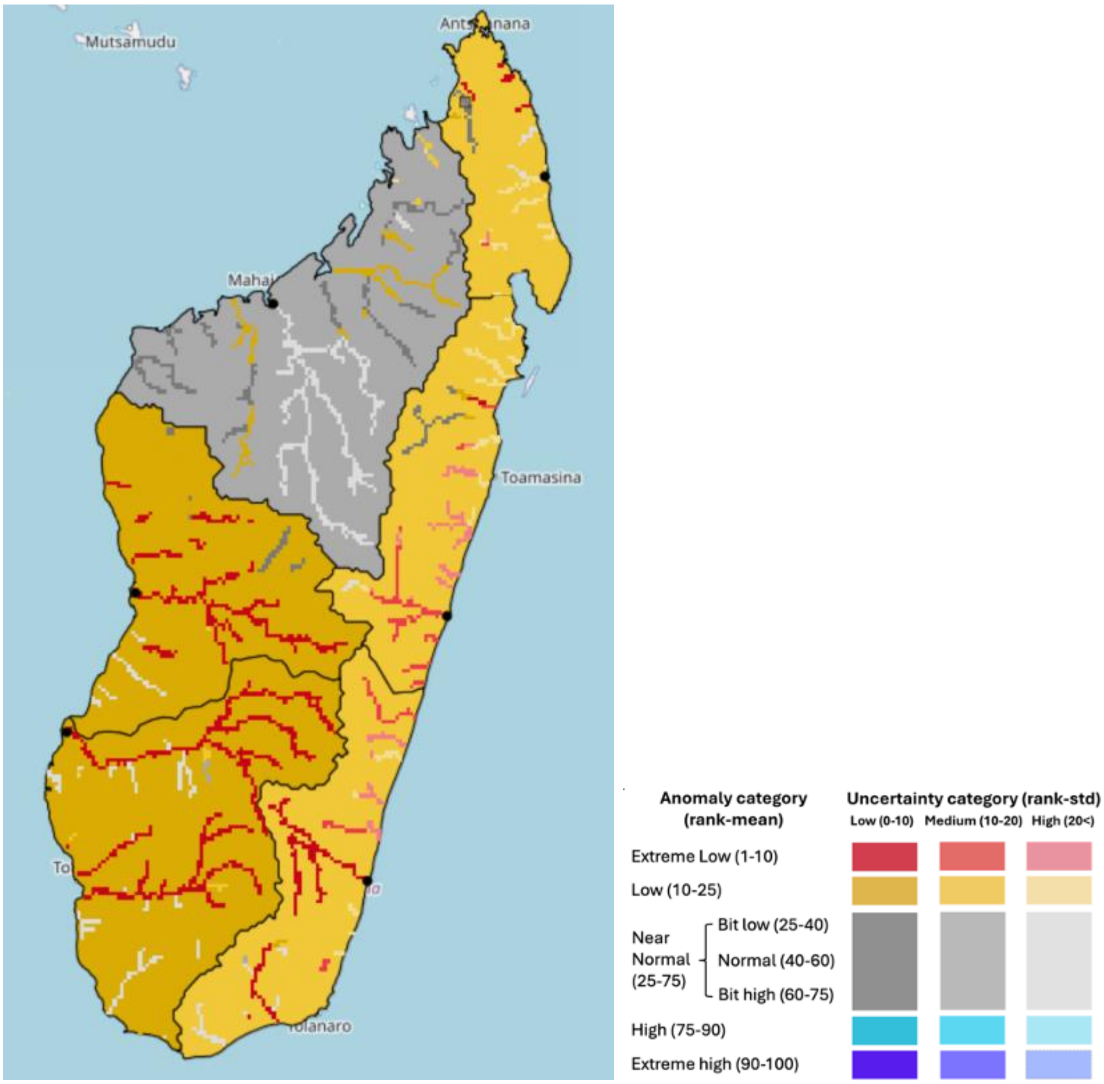
Based on the Copernicus Climate Change Service (C3S) seasonal forecasts[9] (not shown here), warmer than usual conditions are predicted in Madagascar with wetter than usual anomalies in southern regions up to September 2026.

June 2026 river flow forecasts from the Global Flood Awareness System (GloFAS[10], Figure 10) indicate low discharges across most catchments, and extreme low discharge in most rivers in Madagascar, pointing to progressive worsening of drought conditions. Exceptions are the north-western regions, where near normal flows are predicted. The low flow anomaly in the western part of the country is mainly subject to medium uncertainty, while the forecast for the eastern basins affected by low flow conditions has low uncertainty (standard deviation of the ensemble member ranks below 10).

9 https://climate.copernicus.eu/seasonal-forecasts.

10 https://global-flood.emergency.copernicus.eu/react/map.

Figure 10. Seasonal forecast anomaly and uncertainty for June 2026 provided by the 7-month simulation covering July 2026 to January 2027, with information aggregated by basin. Different colours indicate the anomaly category, while the colour intensity shows the confidence level in the anomalies, with the lighter colours associated with higher uncertainty. The anomaly and uncertainty signals are derived by ranking each member of the GloFAS (Global Flood Awareness System) hydrological forecast ensemble, driven by ECMWF SEAS5 (Seasonal Forecasting System 5), against a 99-value percentile climatology; the anomaly category reflects the mean of these ranks, while the uncertainty category reflects their standard deviation. The climatology is generated using ECMWF SEAS5 reforecasts over a 20-year period. [11]



Source: Copernicus EMS GloFAS.

[11] Source: The CEMS Global Flood Awareness System (GloFAS): https://global-flood.emergency.copernicus.eu/react, documentation at GloFAS sub-seasonal and seasonal forecasting - Copernicus Emergency Management Service - CEMS - ECMWF Confluence Wiki. River flow anomalies shown for 942 major basins within the GloFAS domain, delineated semi-automatically against the 3 arcmin OS LISFLOOD river network and based on the hydrological model OS LISFLOOD. Colours indicate anomaly direction and colour intensity reflects ensemble confidence. Results are based on OS LISFLOOD driven by 51 ECMWF SEAS5 ensemble members (De Roo et al., 2000; https://ec-jrc.github.io/lisflood/).

9. Reported impacts

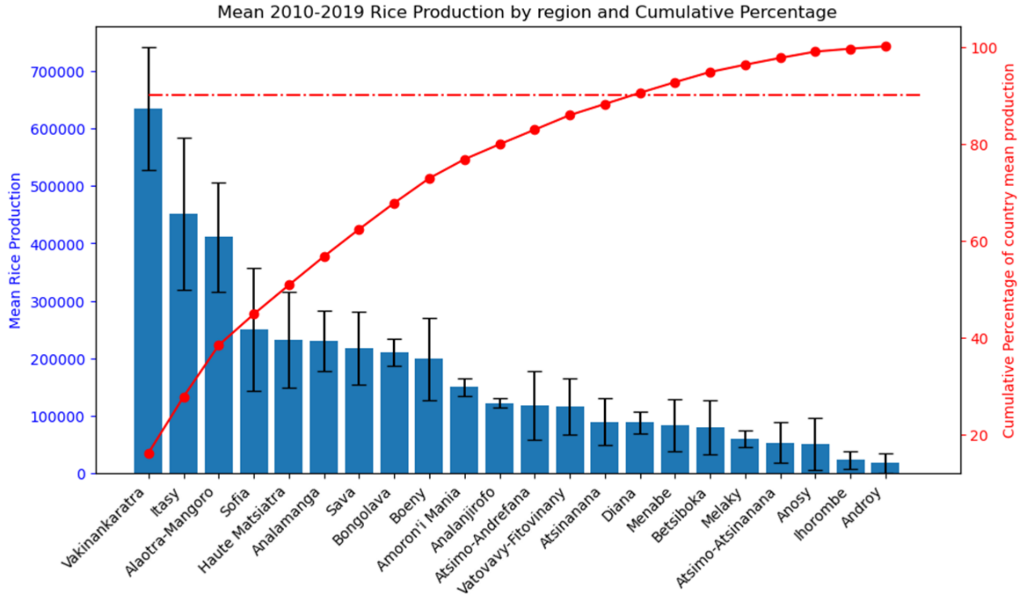
Rice is by far the main crop in Madagascar with 2 million ha planted in 2024 (FAOSTAT data), followed by cassava (320,000 ha) and maize (150,000 ha). According to the JRC ASAP (Anomaly Hotspots of Agricultural Production[12], prospects for the ongoing harvest of rice and maize in Madagascar are near average levels at the national scale, largely due to varied crop conditions across different regions. Specifically, looking at the main rice producing regions, crop biomass is above average in the regions of Vakinankaratra and Alaotra Mangoro, close to average in Itasy and Analamanga, and slightly below average in Sofia, potentially as a consequence of cyclone Fitya's impact at the end of January (Figure 12). The rice cultivation season started in November, benefiting from satisfactory rainfall up until January. In February, rainfall conditions started to deteriorate, reaching particularly poor levels in March, fortunately at the end of the rice season in most areas. An acceleration of rice senescence, which is likely to result in reduced rice output, is visible in the southern part of the central highlands (see early decline of FPAR profile in Haute Matsiatra - Figure 12). In the Grand South region, the season started with close to average rainfall till the end of January, after which below average rainfall and approximately 2 °C above average temperatures accelerated crop senescence, resulting in below average crop biomass (Figure 13). As a result of this early cessation of the rainfall season especially in Anosy and Androy, prospects are below average for cereals and legumes output in this region prone to drought. According to the latest Integrated Phase Classification (IPC) analysis, the region is anticipated to face significant food insecurity challenges, with approximately 1.8 million individuals projected to be in acute food insecurity (IPC Phase 3 and above). This dire situation is a cumulative result of previous droughts (in 2020, 2021, and 2022), the impact of cyclones, poor socio-economic conditions, and a reduction in aid.

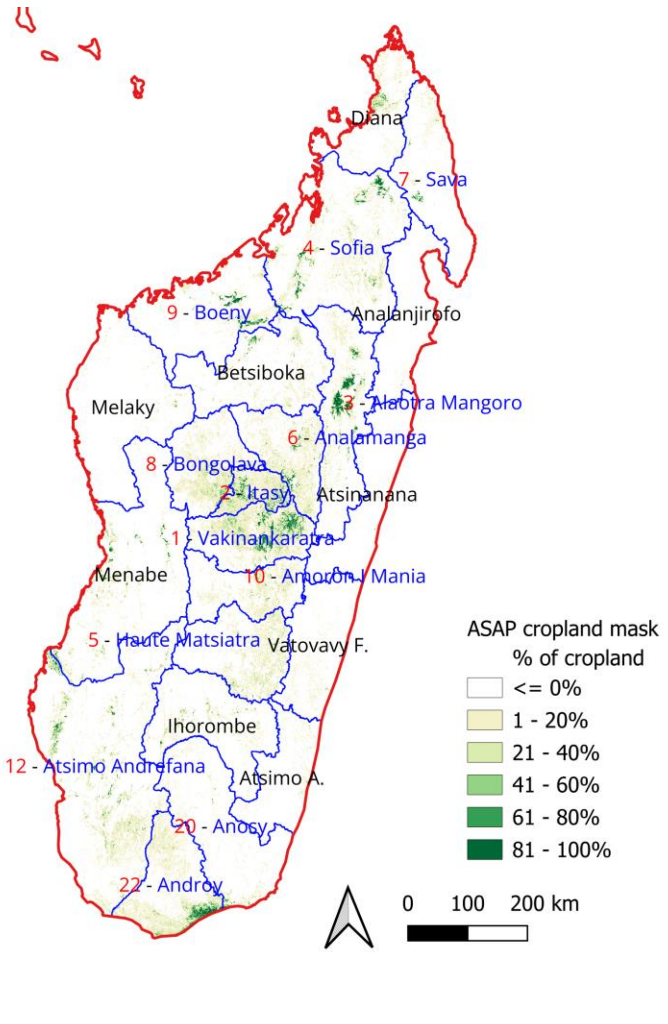
The drought conditions in Madagascar have also been assessed by the Crop Monitor for Early Warning[13], which reports that the harvesting of main season cereals is complete or nearing completion. The production is expected to be near average, except in the south, where poor seasonal rainfall performance and high temperatures have resulted in poor yield outcomes. Overall, the drought has mainly affected the agricultural production of the southern region of Madagascar, and it is expected to have a negative impact on the food security of this vulnerable region.

12 https://agricultural-production-hotspots.ec.europa.eu/index.php

13 GEOGLAM (Group on Earth Observation Global Agricultural Monitoring) https://www.cropmonitor.org/crop-monitor-for-early-warning

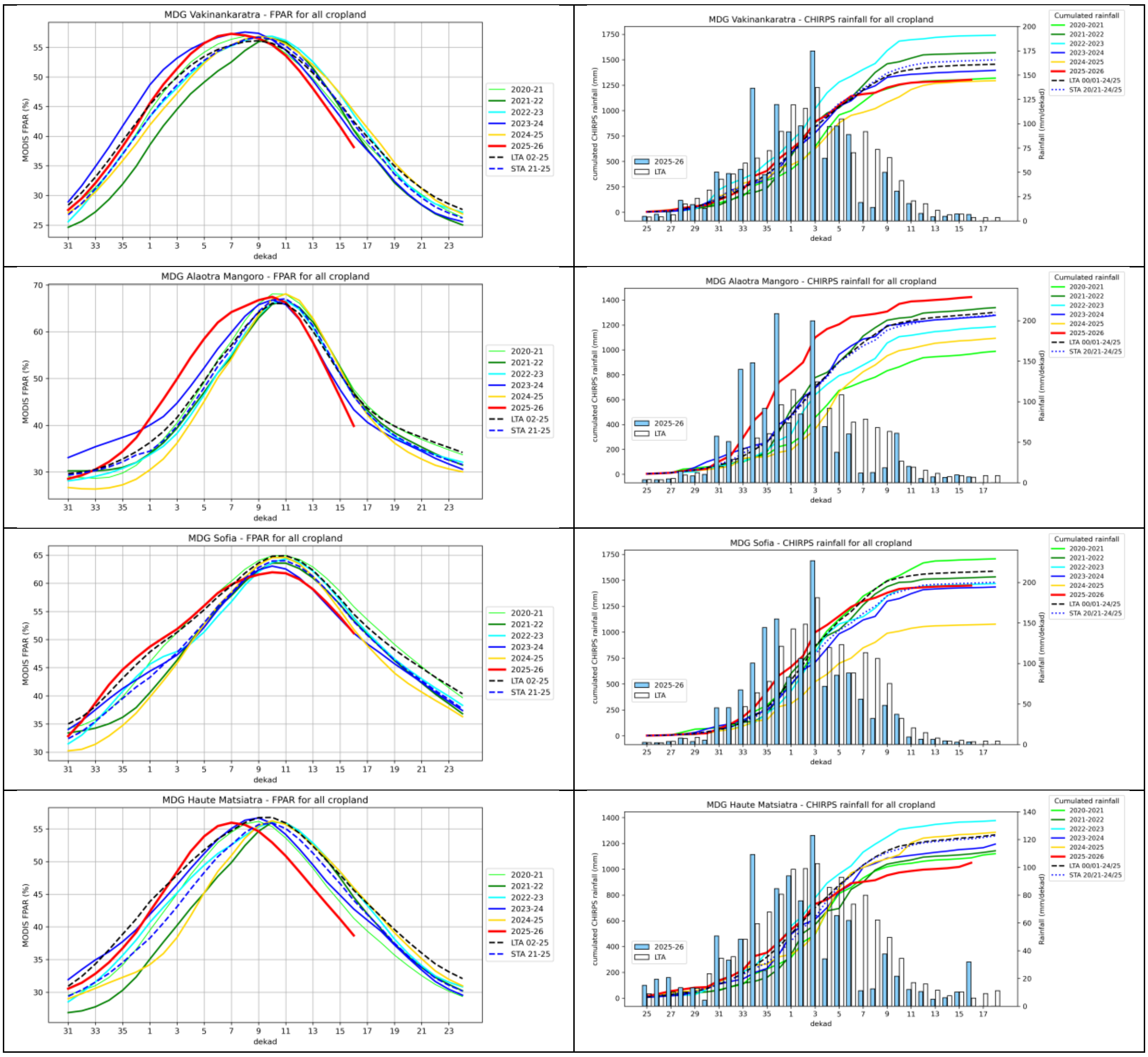
Figure 11. Main rice producing regions derived from the Ministry of Agriculture rice production statistics available till 2019 (top) and map of Madagascar regions (bottom - the 10 main rice producing regions and the three regions of the Grand south are in blue with their rank in red)





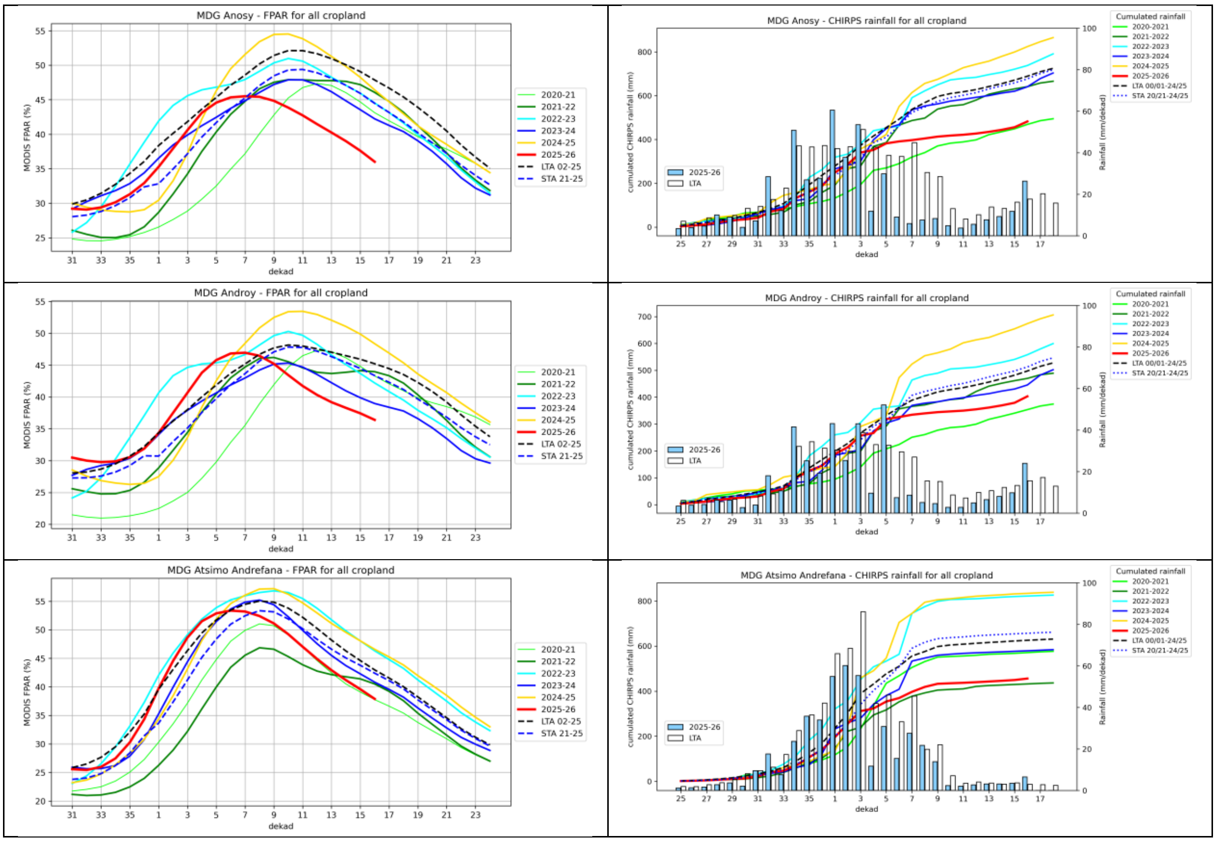
Source: JRC ASAP (Anomaly Hotspots of Agricultural Production).

Figure 12. fAPAR and rainfall profiles in 4 of the 5 main rice producing regions in the North and Central Highlands



Source: JRC ASAP (Anomaly Hotspots of Agricultural Production).

Figure 13. fAPAR and rainfall profiles of the 3 regions of the Grand South



Source: JRC ASAP (Anomaly Hotspots of Agricultural Production).

List of abbreviations and definitions

Abbreviations	Definitions
ASAP	Anomaly hotSpots of Agricultural Production
BOM	Bureau of Meteorology, Australia
C3S	Copernicus Climate Change Service
CEMS	Copernicus Emergency Management Service
CHIRPS	Climate Hazards Group InfraRed Precipitation with Station
CMCC	Centro Euro-Mediterraneo sui Cambiamenti Climatici
DWD	Deutscher Wetterdienst
ECCC	Environment and Climate Change Canada
ECMWF	European Centre for Medium-Range Weather Forecasts
EDO	European Drought Observatory (Copernicus Emergency Management Service, CEMS)
ERA5	ECMWF Reanalysis v5
EU	European Union
fAPAR	Fraction of Absorbed Photosynthetically Active Radiation
GDO	Global Drought Observatory (Copernicus Emergency Management Service, CEMS)
GloFAS	Global Flood Awareness System
IPC	Integrated Phase Classification
JRC	Joint Research Centre
KNMI	Koninklijk Nederlands Meteorologisch Instituut
NCEP	National Centers for Environmental Prediction (National oceanic and Atmospheric Administration, NOOA)

Abbreviations	Definitions
OS LISFLOOD	grid-based hydrological rainfall-runoff-routing model
PET	Potential Evapotranspiration
SEAS	Seasonal Forecasting System
SMA	Soil Moisture Index Anomaly
SPEI	Standardized Precipitation Evapotranspiration
SPI	Standardized Precipitation Index
UKMO	United Kingdom Meteorological Office
VIIRS	Visible Infrared Imaging Radiometer Suite

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