GDO Analytical Report

Drought in Somalia, Kenya and Tanzania

January 2022 JRC Global Drought Observatory (GDO) of the Copernicus Emergency Management Service (CEMS) - 28/01/2022

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Executive summary

- A large and long-lasting drought affected coastal regions of Southern Somalia, Kenya and Tanzania. After two poor rainy seasons in October-December 2020 and March-May 2021, the October-December 2021 rainy season has been extremely dry. Severe drought conditions, i.e. lower-than-average rainfall and hot temperatures, affected crops and increased wild and forest fire danger.
- Somalia declared a national emergency in the wake of three consecutive rainy seasons with below average rainfall amounts and accumulating drought impacts. More than 3.2 million people in 66 out of the 74 districts in Somalia are affected, of whom 169,000 people have abandoned their homes in search of water, food and pasture.
- Kenya declared a national emergency and about 2.1 million people in the region were highly food insecure due to low agricultural production as a consequence of the rainfall shortage, and ensuing high food prices.
- A prolonged precipitation deficit in the coastal regions of East-Africa, combined with a severe and wider dry period in November 2021 produced a severe soil moisture deficit and affected vegetation health.
- The precipitation deficit of 2021 is exceptional if compared to the amounts of the preceding years. Despite a slight precipitation improvement forecasted for the next months, and a slight recovery of the soil moisture thanks to the precipitation in December, the drought conditions

in the region require a follow-up monitoring considering the region has a generally low coping capacity and a high sensitivity.

Risk of Drought Impact for Agriculture (RDrI-Agri)

The GDO indicator RDrI-Agri shows the risk of drought impacts, by considering both exposure and socio-economic vulnerability of an area, with a focus on agricultural impacts.

The meteorological conditions illustrated in the following sections triggered high values for the Risk of Drought Impact for Agriculture (RDrI-Agri) at the beginning of December 2021 in a wide region around the coast of Southern Somalia, Kenya and Tanzania (Figure 1). Apart from the meteorological conditions, the high levels of risk are also due to the low coping capacity of the countries involved, where vulnerability is estimated to be high.

The climate of the region is characterized by two main rainy seasons, from April to June and from October to December. If one rainy season fails, a fast precipitation deficit is to be expected till the subsequent rainy season. Impacts could be delayed, but the risk certainly becomes high.

The risk of drought impact (RDrI-Agri) developed and spread over the area relatively fast throughout November and December 2021. The severe drought re-emerged at the beginning of November and reached rapidly its peak at mid-November and already reducing, in meteorological terms, by the end of the year (Figure 2). The estimated high risk conditions are attributable to the extremely dry October and November 2021 but also to the very poor previous two rainy seasons (Oct-Dec 2020 and March-May 2021; see also August 2021 GDO Analytical report[1]). Precipitation in mid-December 2021 partially improved the situation. However, those modest rainfalls were not enough to recover completely from such a severe drought condition considering the high vulnerability of the region and that they occurred at the very end of the rainy season. A close-to-average rainy season in March-May 2022 would be needed to recover from the drought. In addition, another drought event is emerging more to the south in Kenya and Tanzania.

[1] https://edo.jrc.ec.europa.eu/documents/news/GDODroughtNews202108_Sub-Saharan_and_Southern_Africa.pdf

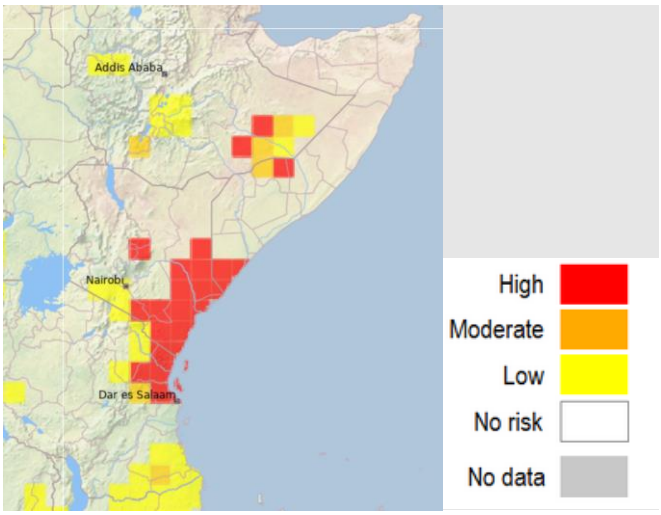

Figure 1: *Risk of Drought Impact for Agriculture (RDrI-Agri) at the level of highest concern – first ten days of December 2021.*

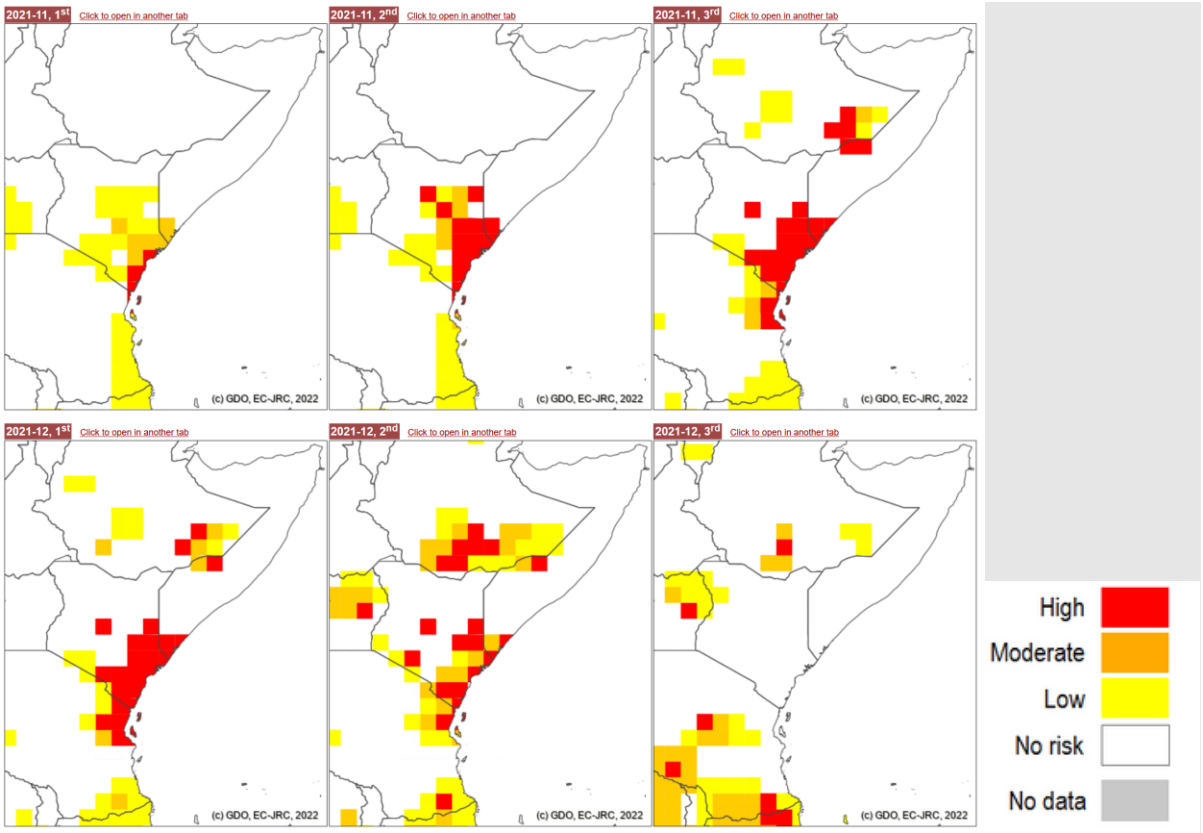

Figure 2: *Risk of Drought Impact for Agriculture (RDrI-Agri) – each ten-day period from November 2021 to December 2021*

We now proceed by analyzing more in details two of the main affected regions: Somalia (Juba Hoose region) in the southern coastal area close to the border with Kenya; Kenya (coastal region) close to the border with Tanzania.

In both the selected regions, RDrI-Agri started to detect risk already in May 2021 with a sharper rise but more fluctuation in Somalia and a more stable situation in Kenya until November when high risk conditions spread quickly over a much wider part of the region (Figures 3 and 4).

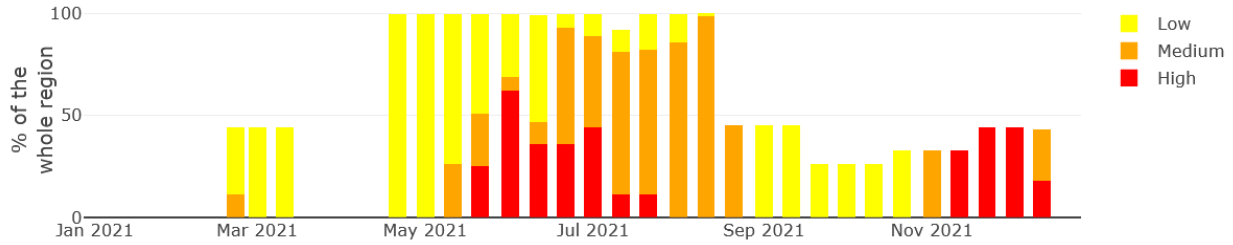

Figure 3: *Risk of Drought Impact for Agriculture (RDrI-Agri) - evolution over time in Somalia (Juba Hoose region) for 2021*

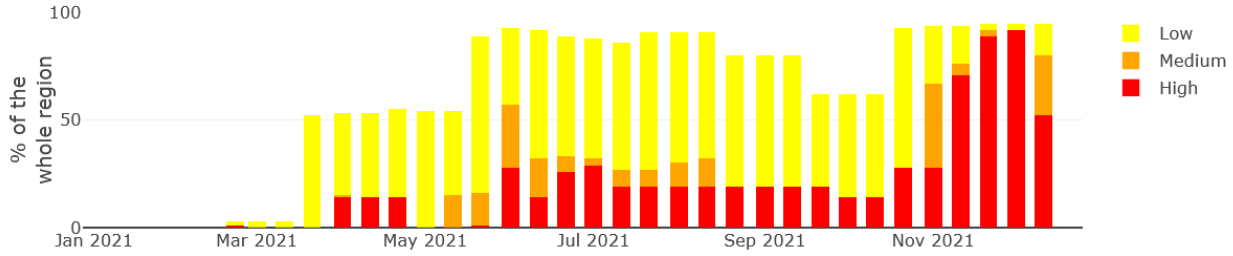

Figure 4: *Risk of Drought Impact for Agriculture (RDrI-Agri) - evolution over time in Kenya (coastal region) for 2021*

Precipitation

Precipitation is measured by total monthly rainfall and is the main component to understand drought events. The climatic patterns of the two regions are similar considering their proximity and are characterized by the main rainy seasons in late spring (April to June) and late autumn (October to December).

In Somalia both rainy seasons failed in 2021. The autumnal rainy season was very poor also in 2020. A rising severe precipitation deficit is visible from the end of 2020 to November 2021. Only in December higher-than-normal precipitation slightly reduced the deficit but much more contribution is required to guarantee a full recovery (Figure 5).

In Kenya, precipitation remained slightly above the average in 2020, providing a much lower deficit at the start of 2021. Nevertheless, the pattern of precipitation buildup is similar to the one in Somalia for 2021. Here, the December 2021 precipitation contributed to an almost complete recovery of the deficit (Figure 6).

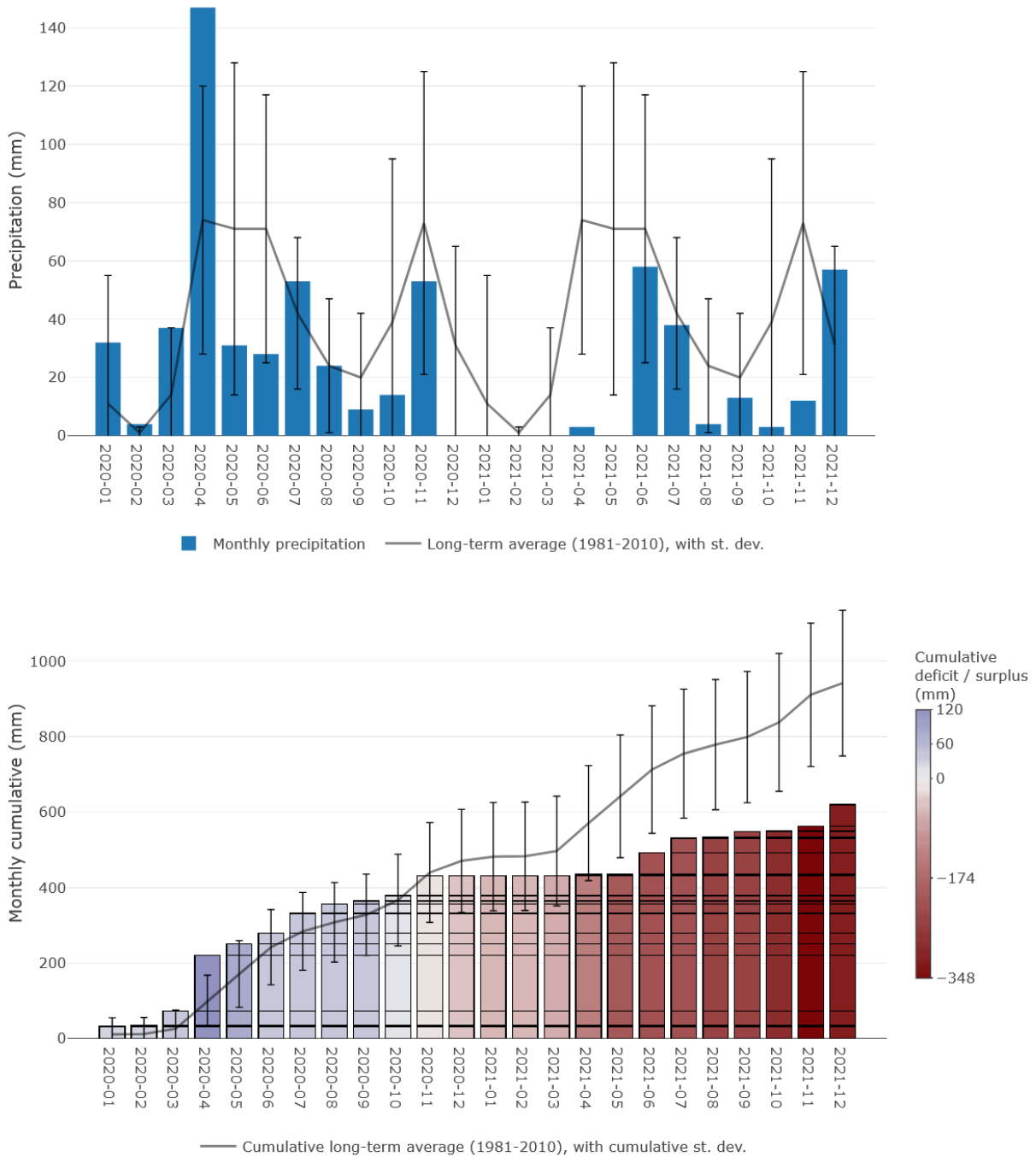

Figure 5: *Monthly total (upper) and cumulative (lower) precipitation - evolution over time in Somalia (Juba Hoose region) (-0.6N, 41.5E) from January 2020 to December 2021*

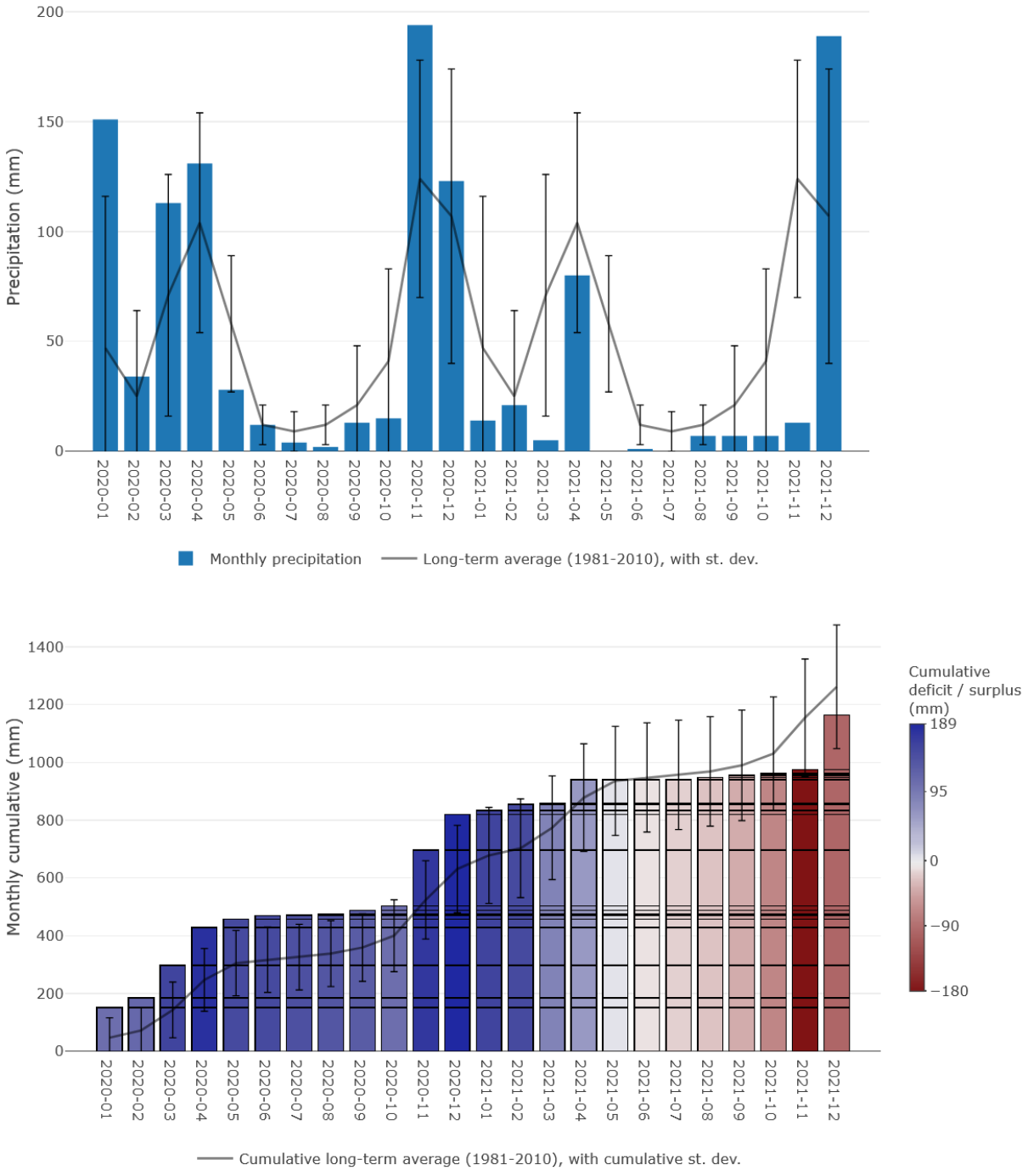

Figure 6: *Monthly total (upper) and cumulative (lower) precipitation - evolution over time in Kenya (coastal region) (-3.4N, 39E) from January 2020 to December 2021*

Standardized Precipitation Index (SPI)

The GDO indicator SPI[2], as one of the driving components of the RDrI-Agri, provides information concerning the intensity and duration of the precipitation deficit (or surplus). By analyzing data for different accumulation periods, the dry conditions of November 2021 over the coastal regions of southern Somalia and Kenya can be attributed to a full year of constant below-average precipitation.

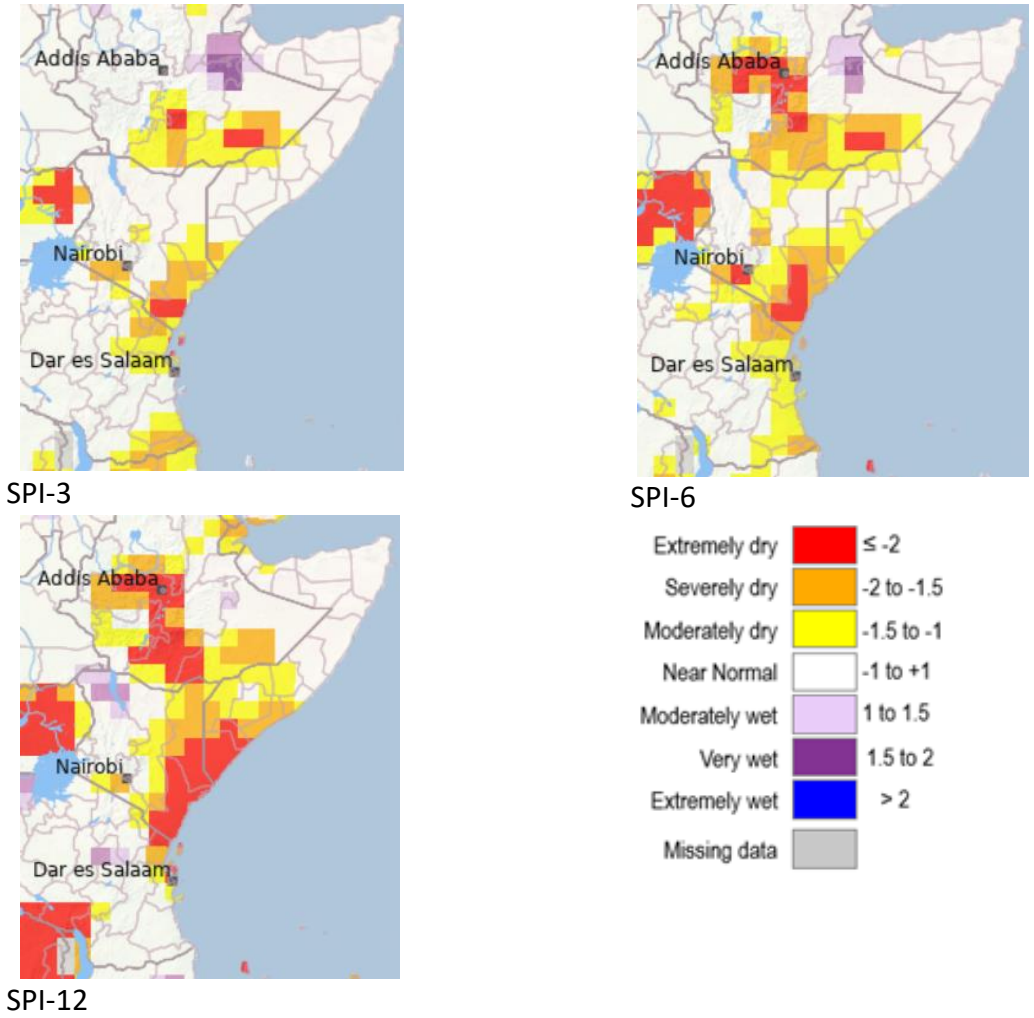

Figure 7: *Standardized Precipitation Index (SPI-3; SPI-6; SPI-12) November 2021*

[2] SPI is used to monitor the occurrence of drought. The lower (i.e. more negative) the SPI, the more intense is the drought. SPI can be computed for different accumulation periods: the 3 months period is often used to evaluate agricultural drought and the 12 month accumulation period can be used for hydrological drought, when rivers fall dry and groundwater tables lower.

By comparing the monthly SPI-3 maps, the onset of the drought event can be located in April 2021. These conditions continued and expanded in the subsequent months, before finally receding in the Northern part of the region at the end of the year, but apparently moving to the southern part of the region (Figure 8).

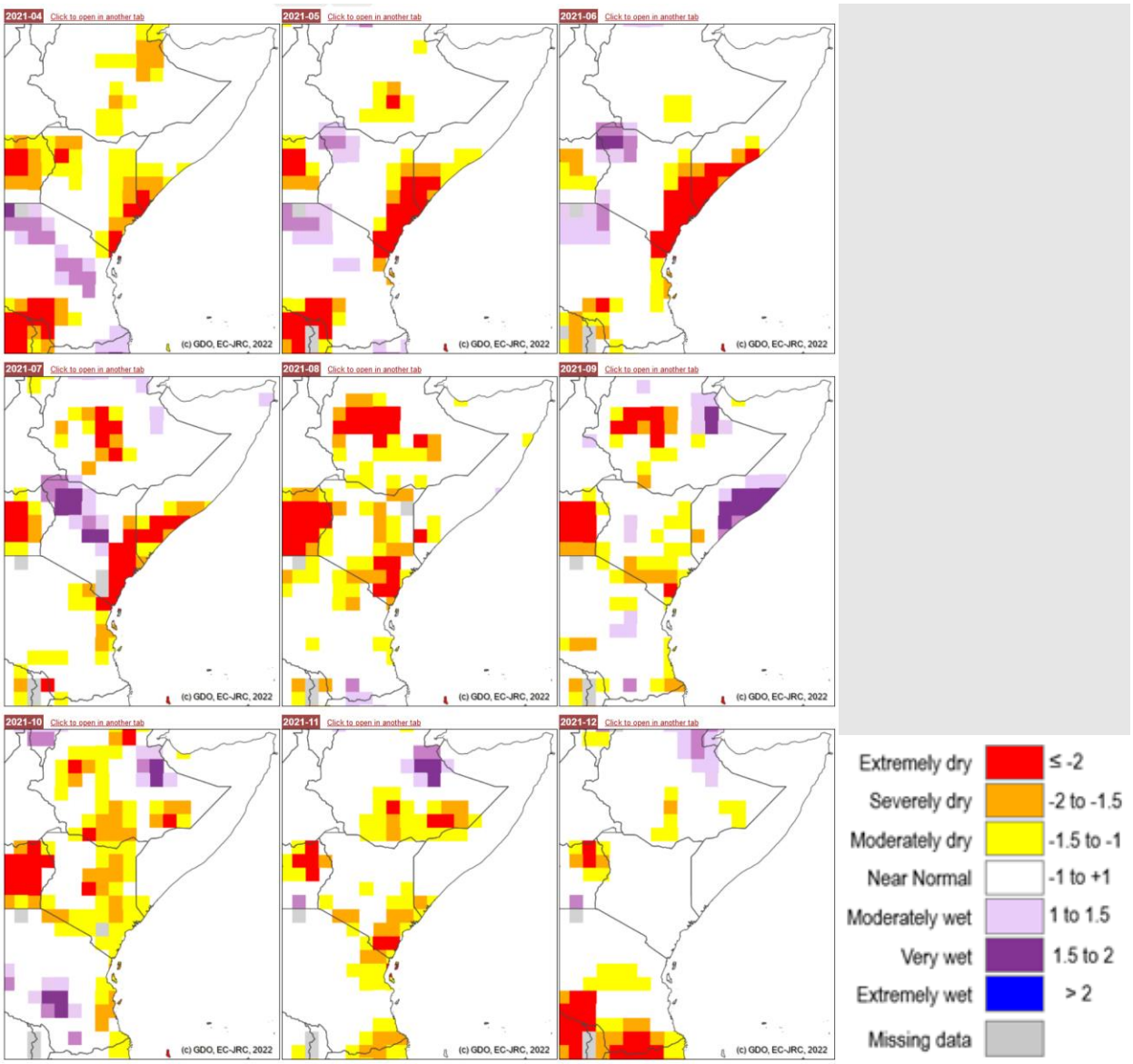

Figure 8: *Standardized Precipitation Index (SPI-3) monthly maps from April 2021 to December 2021*

By looking at the SPI evolution over five years (from 2017 to 2021) in the selected regions, the onset of the extensive drought is quite well defined in late spring (May 2021).

In Somalia, the severity of the events is well depicted by SPI-6 and SPI-12, which feature an extremely dry sequence of values for quite a long period, after about 4 years of conditions without extreme fluctuations. SPI-3 shows at least a reduction on the precipitation deficit in the latest months, indicating a slight meteorological improvement (Figure 9).

In Kenya, a similar pattern is observed with higher fluctuations, shorter duration of the drought starting about one month later and with similar delay in its reduction (Figure 10).

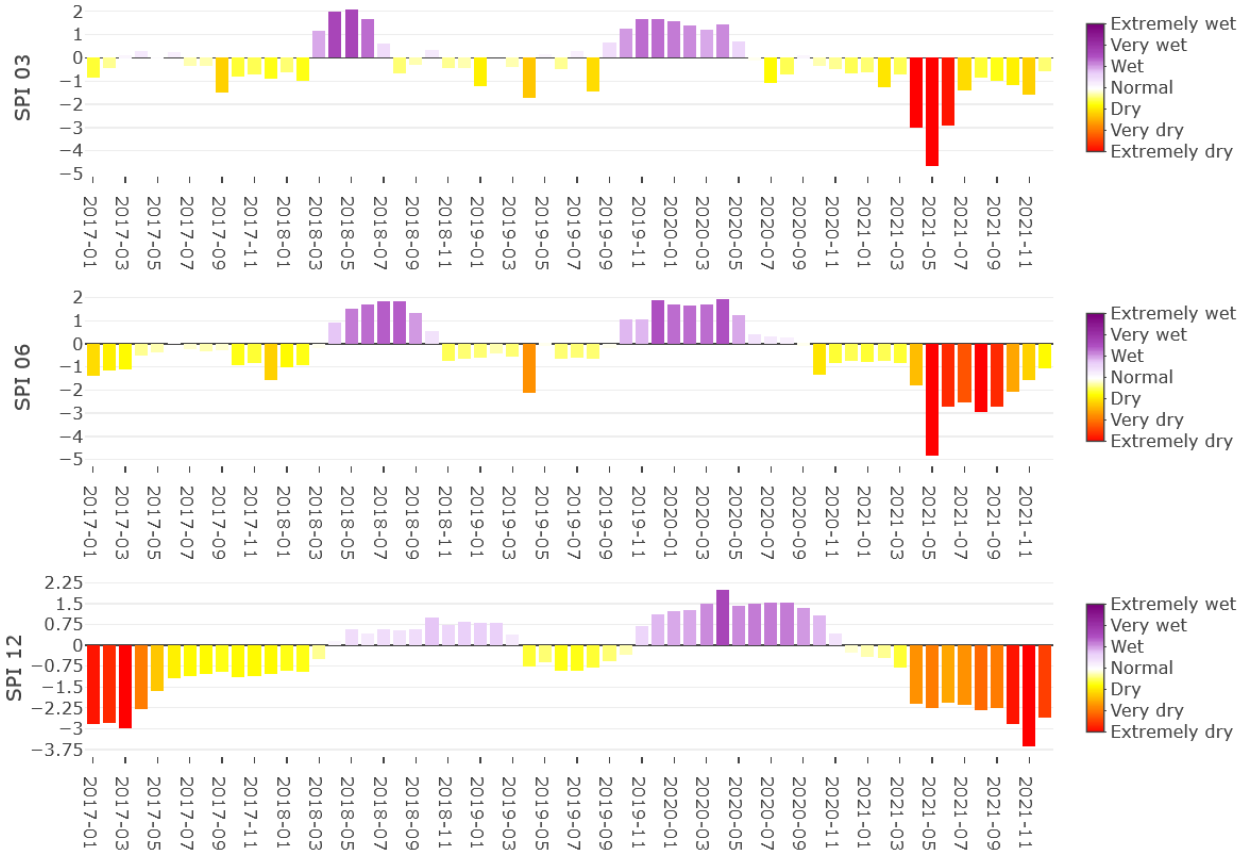

Figure 9: *Standardized Precipitation Index (SPI-3, SPI-6, SPI-12) evolution over time in Somalia (Juba Hoose region) from January 2017 to December 2021*

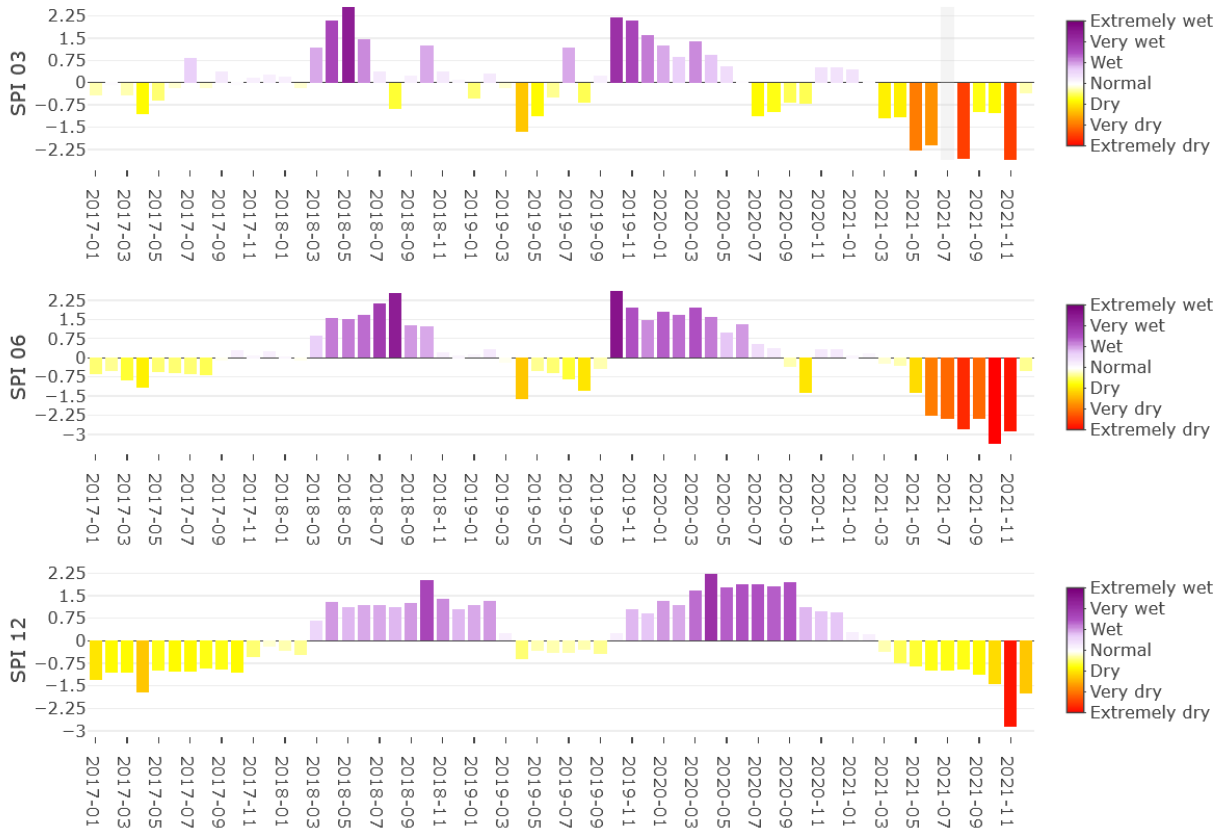

Figure 10: *Standardized Precipitation Index (SPI-3, SPI-6, SPI-12) evolution over time in Kenya (coastal region) from January 2017 to December 2021*

Indicator for forecasting unusually wet and dry conditions

According to the indicator for forecasting unusually wet and dry conditions for January to March 2022 (Figure 11), slightly wetter than normal weather conditions are expected over the eastern coast of Somalia, Kenya and Tanzania. Considering that those are generally three months with scarce precipitation in that region, this may not significantly change the drought situation and it will require a longer time to fully recover from the current drought. It will be necessary to wait for the spring rainy season.

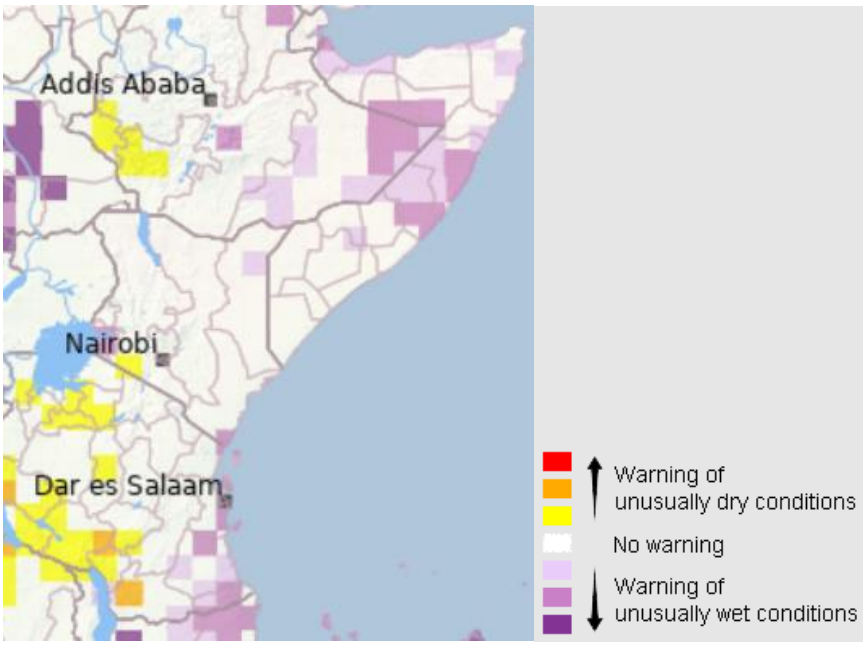

Figure 11: *Indicator for forecasting unusually wet and dry conditions for 3 months, January to March 2022.*

Soil moisture anomaly

The prolonged lack of precipitation is reflected in the reduction of the soil water content. The aim of the GDO soil moisture indicator is to provide an assessment of the topsoil water content, which is a direct measure of drought conditions, specifically regarding the difficulty for plants to extract water from the soil.

During the last 10-day period of November, drier soil moisture conditions (Figure 12) were observed in approximately the same regions where SPI-12 reached the lowest values (Figure 7), confirming that this drought event is mainly due to precipitation scarcity for an extended period.

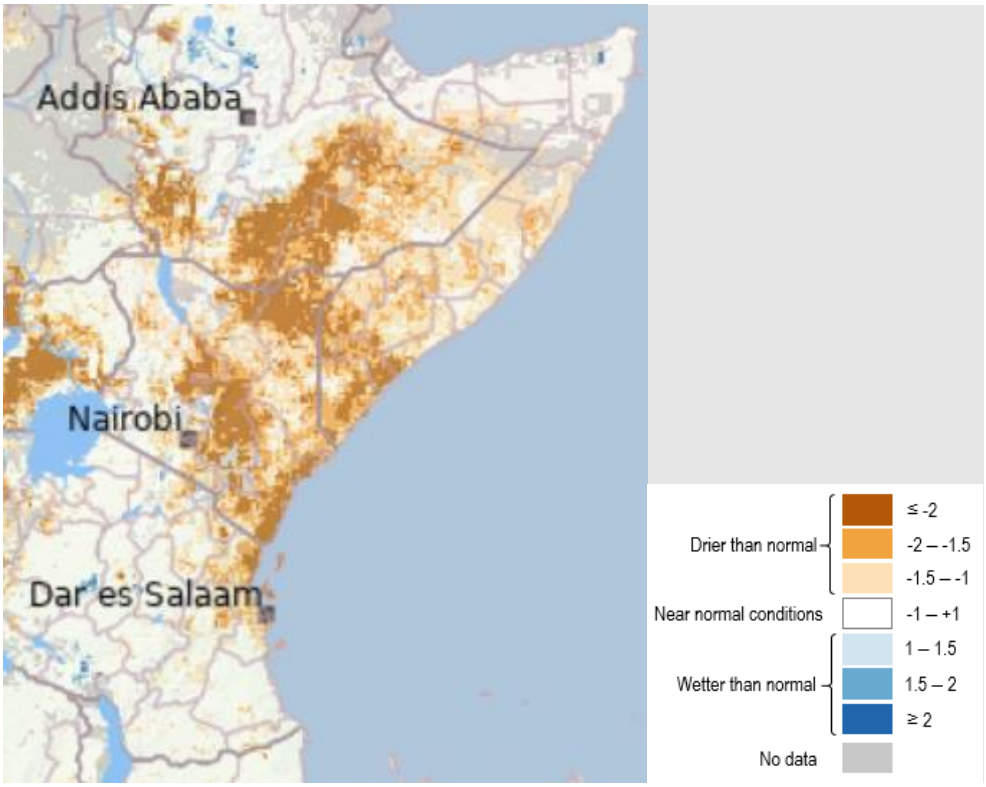

Figure 12: *Soil Moisture Anomaly - last ten-day period of November 2021*

The spring-to-summer period from April to August was characterized by a more localized drought event with a peak in mid-June 2021, affecting soil moisture anomaly only in a narrow region close

to the coast (not shown here, see also August 2021 GDO Analytical report[3]). In November an abrupt and wide extended dryness of the soil came up, however. The temporal evolution of the soil moisture anomaly maps over the last two months of 2021 confirms significantly drier than normal November, and only winter precipitation from mid-December started to slightly recharge soil moisture (Figure 13).

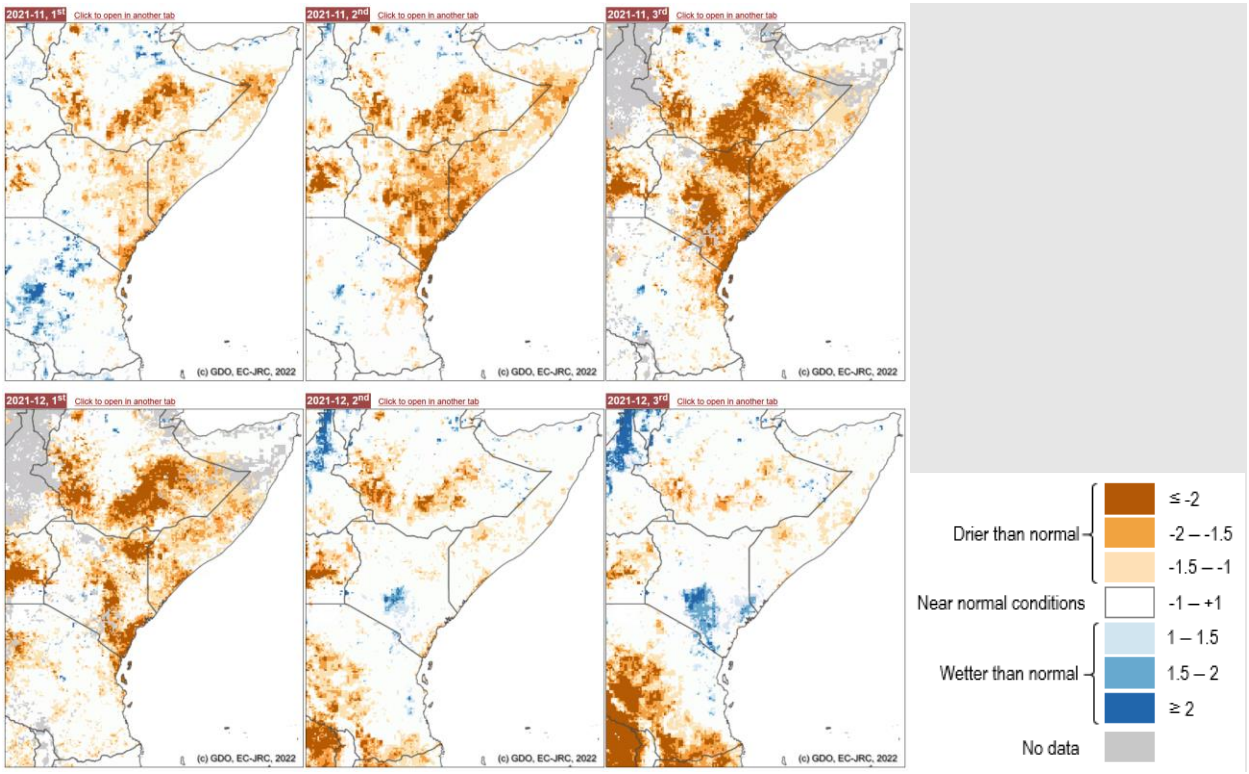

Figure 13: *Soil Moisture Anomaly - each ten-day period from November 2021 to December 2021*

As shown in Figures 14 and 15, a persistent percentage of the regions featuring dry anomalies is clearly visible (on the coastal belt). The negative anomaly peak for June is well visible, and also the almost complete recovery of Somalia in October 2021. November 2021, though, presents a sharp peak of soil moisture anomaly featuring a wider extent and a higher severity, before partially recovering thanks to the mid-December precipitation. The rapidity by which conditions

[3] https://edo.jrc.ec.europa.eu/documents/news/GDODroughtNews202108_Sub-Saharan_and_Southern_Africa.pdf

worsen in November confirms the extremely scarce precipitation and the incomplete recharging of the soil moisture, leaving it sensitive to a subsequent dry period.

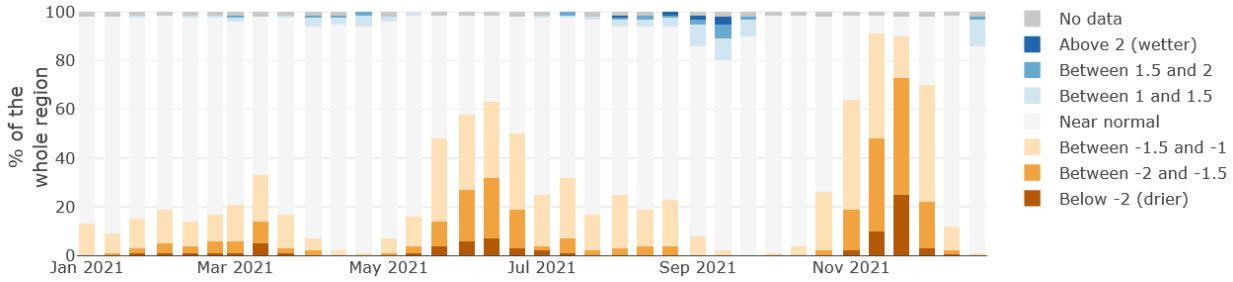

Figure 14: *Soil moisture anomaly evolution over time in Somalia (Juba Hoose region) for 2021*

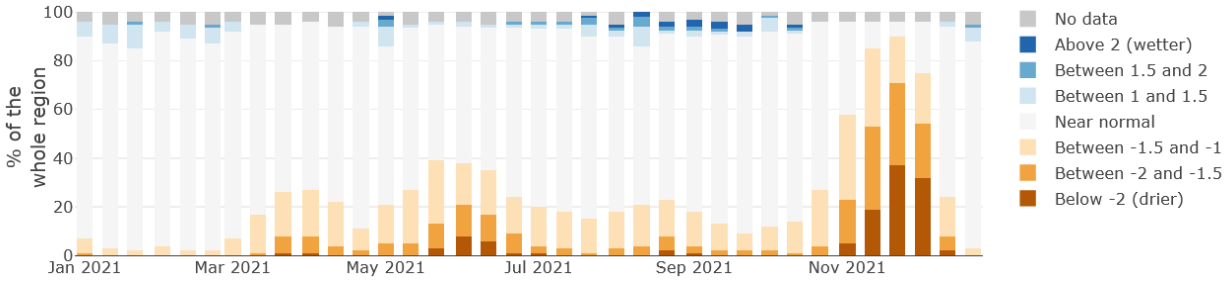

Figure 15: *Soil moisture anomaly evolution over time in Kenya (coastal region) for 2021*

fAPAR anomaly

The satellite based GDO indicator fraction of Absorbed Photosynthetically Active Radiation (fAPAR) represents the fraction of the solar energy absorbed by leaves. fAPAR anomalies, specifically the negative deviations from the long-term average over the same period, are a good indicator of drought impact on vegetation.

In accordance with the other indicators, a significant impact on vegetation photosynthetic activity is detected from mid-November over the analyzed regions of Somalia, Kenya and Tanzania. The pattern is in strong agreement with the soil moisture anomaly. As in the case of the soil moisture analysis, the strong precipitation deficit in November 2021 clearly affected the vegetation conditions (Figure 16), particularly in the southern and coastal regions of Somalia and Kenya.

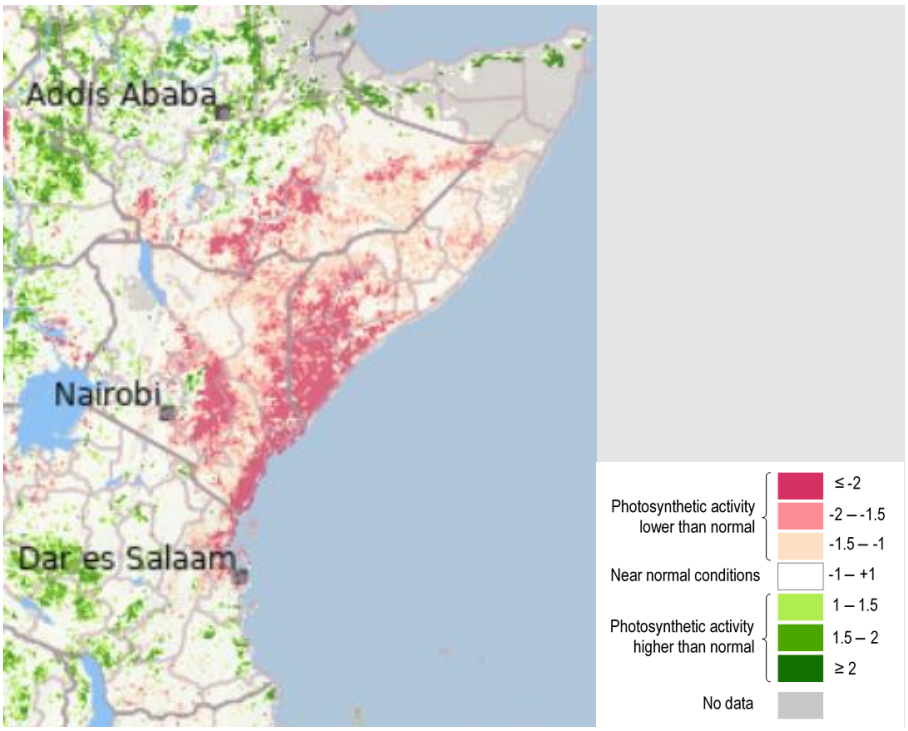

Figure 16: *fAPAR Anomaly - last ten-day period of November 2021*

The temporal evolution of the fAPAR anomaly confirms the quick and severe expansion of the drought and its rapidly changing impact on vegetation conditions during November 2021.

However, by the end of the year vegetation conditions were already starting to slightly improve (Figure 17).

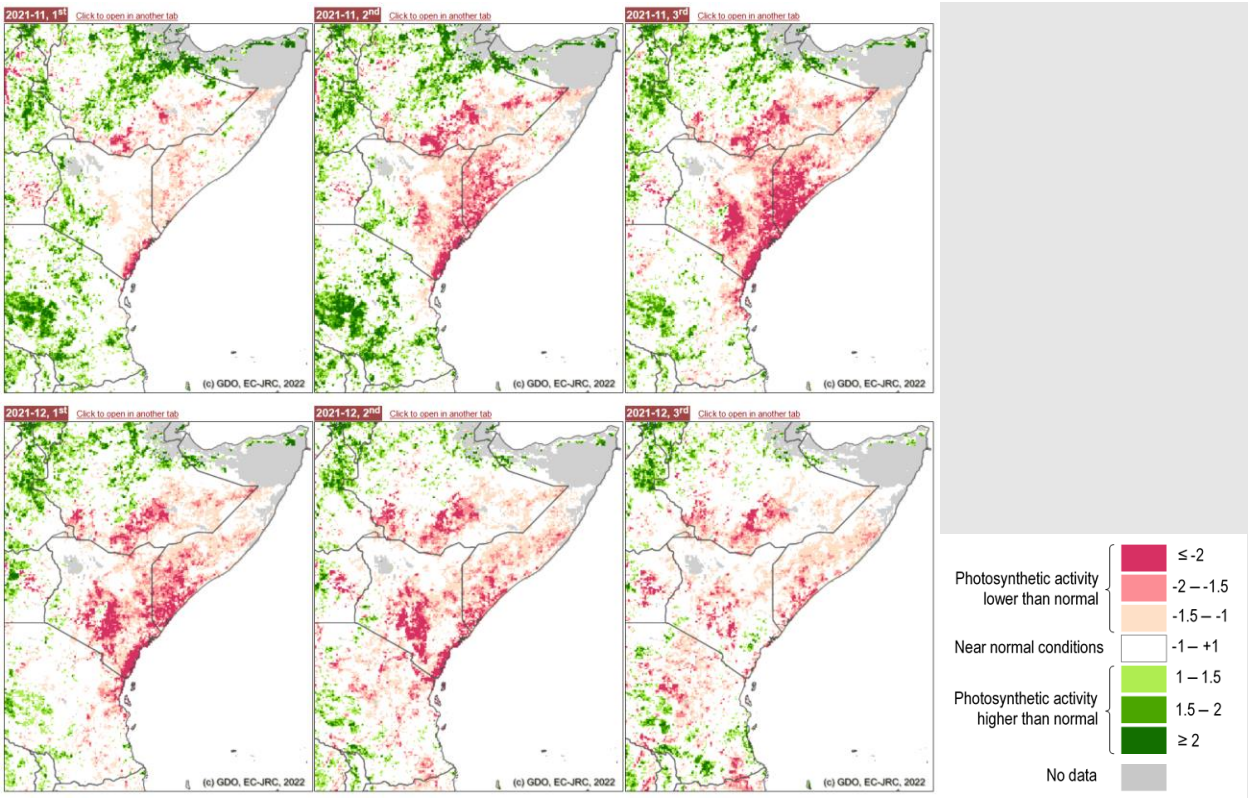

Figure 17: *fAPAR Anomaly - each ten-day period from November 2021 to December 2021*

The evolution of the vegetation conditions in the two selected regions confirms the soil moisture analysis showing a preceding peak of bad vegetation condition starting from May-June 2021 (more severe and evident in Somalia and then the most severe impact on vegetation in November 2021, also here more relevant in Somalia (Figures 18 and 19).

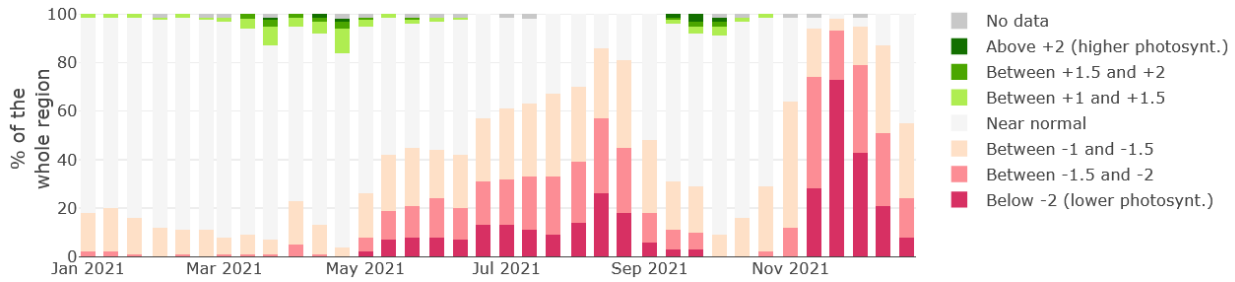

Figure 18: *fAPAR evolution over time in Somalia (Juba Hoose region) for 2021*

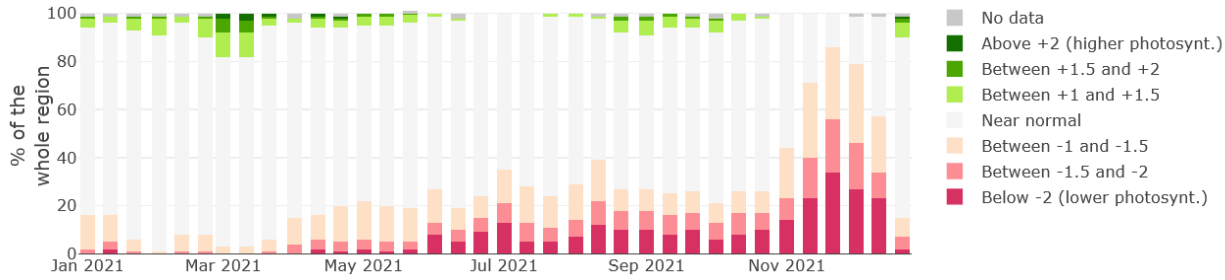

Figure 19: *fAPAR evolution over time in Kenya (coastal region) for 2021*

Temperature anomaly[4]

Temperature is a major driver for drought, together with precipitation deficit. Temperature, together with wind, is the main driver of evapotranspiration, which is the loss of water from soil and vegetation through air. The temperature anomaly in November 2021 made its contribution to the drought resurgence and development in the southern coastal regions of Somalia and Kenya, together with the lack of precipitation. The temperature anomaly quickly regressed in December, contributing to more favorable conditions for soil moisture recovery (Figure 20).

[4] Source: JRC's Monitoring of Agricultural Resources (MARS) – Anomaly Hotspots of Agricultural Production (ASAP) service https://mars.jrc.ec.europa.eu/asap/index.php

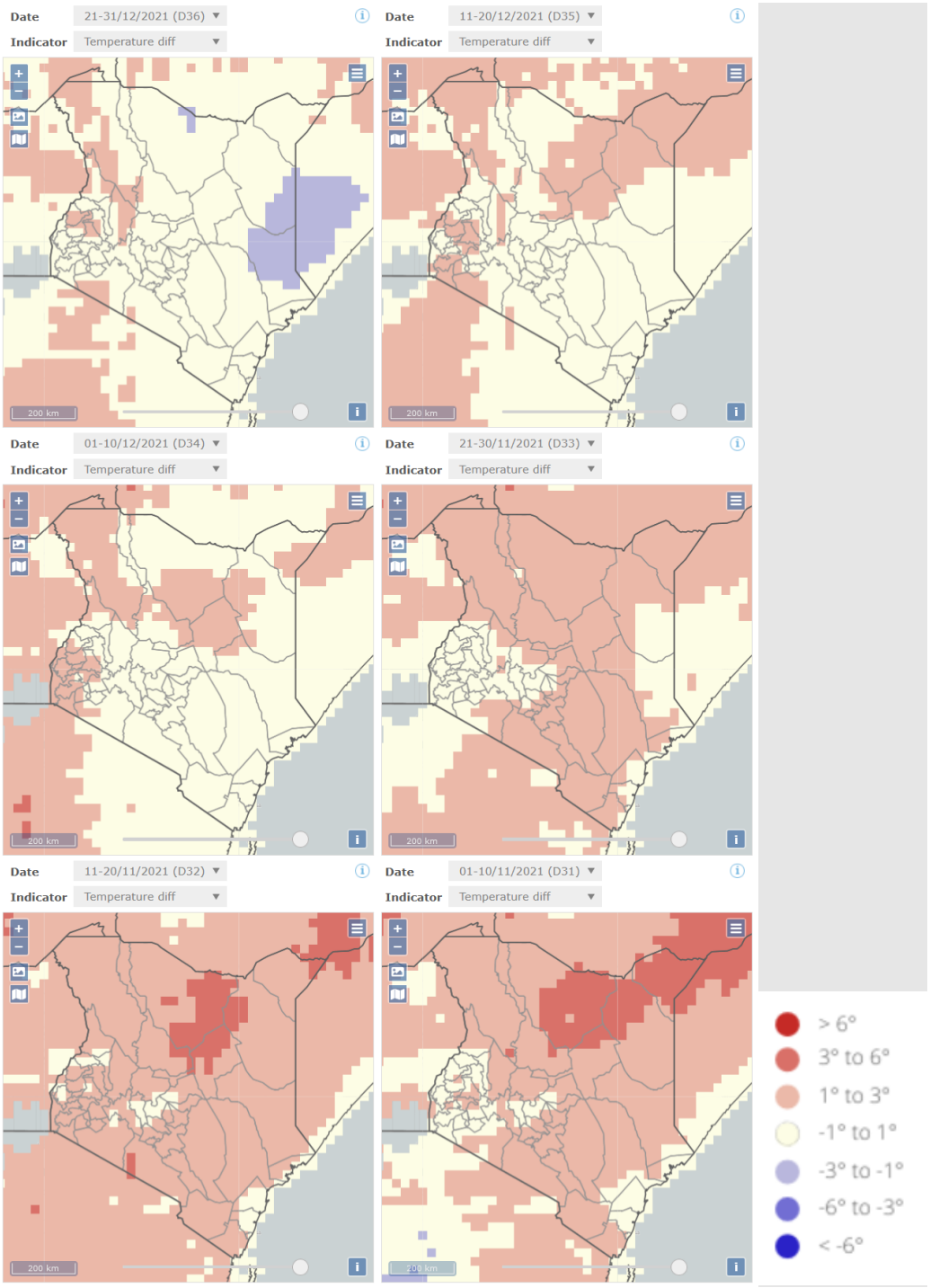

Figure 20: *Temperature Anomaly for four 10-day intervals (from November 2021 to December 2021). Source: JRC's Monitoring of Agricultural Resources (MARS) – Anomaly Hotspots of Agricultural Production (ASAP)*

Fire Danger Forecast[5]

The wildfire hazard is a direct consequence of elevated temperature anomalies and surface dryness, in combination with the availability of fuel (dry litter and wood).

The Global Wildfire Information System (GWIS) provides mapping services of the fire danger forecast all over the world (Figure 21). Almost the whole investigated region and even wider areas are forecasted to be at risk of fires in the coming days. This confirms that the region, even if just partially recovered, needs to be monitored in the coming months to verify the effectiveness of the next rainy season.

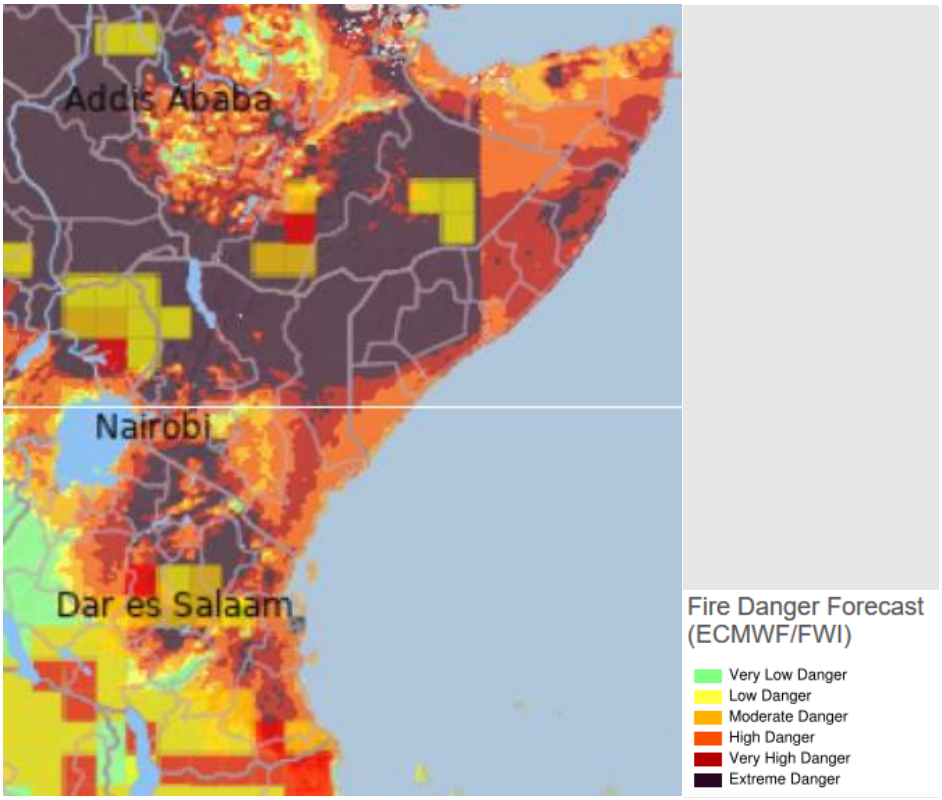

Figure 21: *Fire danger forecast up to 2nd of February 2021 expressed by the Fire Weather Index issued on 26th of January 2021. Source: Global Wildfire Information System, GWIS*

[5] Source: JRC Global Wildfire Information System - https://gwis.jrc.ec.europa.eu/apps/gwis_current_situation/

IGAD[6] Climate Prediction and Applications Centre (ICPAC)[7]

A significant amount of data and analysis tools are available for the regions of interest in the East Africa Drought Watch portal managed by ICPAC.

The Combined Drought indicator confirms, with a higher spatial resolution, the pattern featured by RDrI-Agri previously shown and discussed.

At the beginning of December 2021, alert and warning conditions were mainly detected in the central and southern regions of Somalia and in the coastal regions of Kenya. This reflects the vegetation stress conditions and soil moisture deficit outlined in the previous sections. The coastal and southern regions of Tanzania appear to be under watch conditions, meaning they are affected principally by a precipitation deficit, but not by a significant soil moisture deficit. (Figure 22).

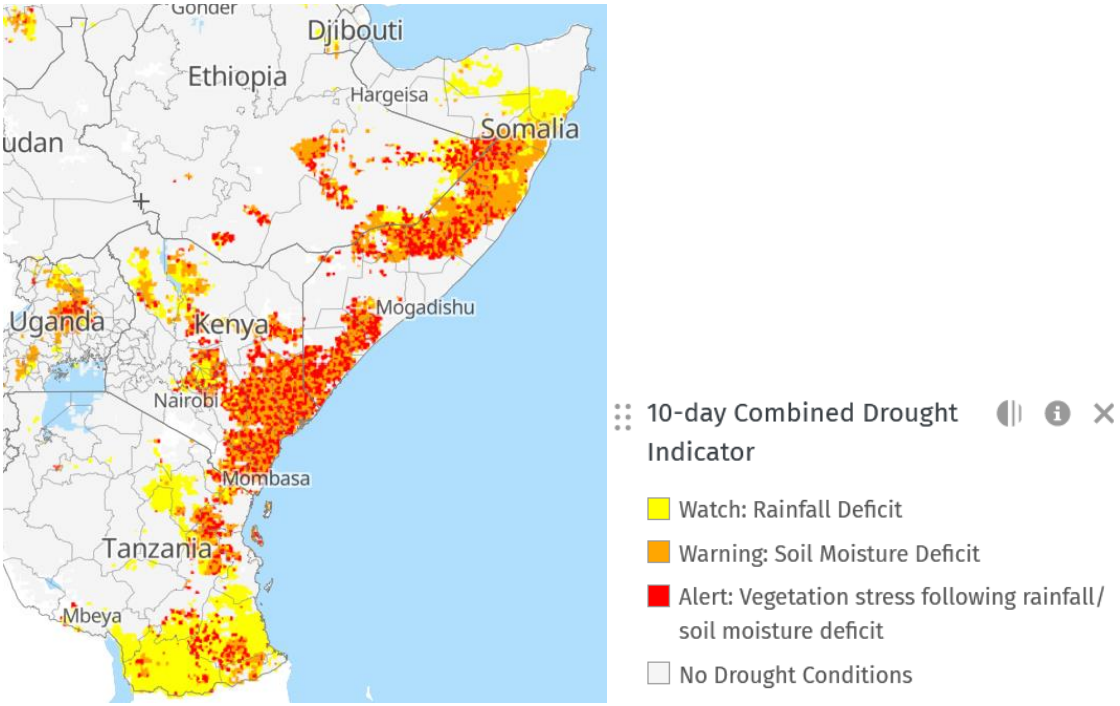

Figure 22: *10-day Combined Drought Indicator first 10-day period of December 2021 (Source:* https://droughtwatch.icpac.net/mapviewer/).

[6] Intergovernmental Authority on Development

[7] www.icpac.net

As for Kenya, December marked the end of the short rainy season October-November-December. Isolated storms occurred in the coastal regions towards the end of December with some of the coastal counties recording above normal rainfall (e.g. Kilifi). The state of water sources and pasture conditions recorded slight improvement[8]. While these rains have resulted in slight improvements due to the persistent drought conditions that have affected the region since early 2021, the observed rainfall is not enough to ensure complete recovery.

Concerning Somalia, towards the end of December, there was above normal rainfall over the southern coastal regions as shown by SPI-1.

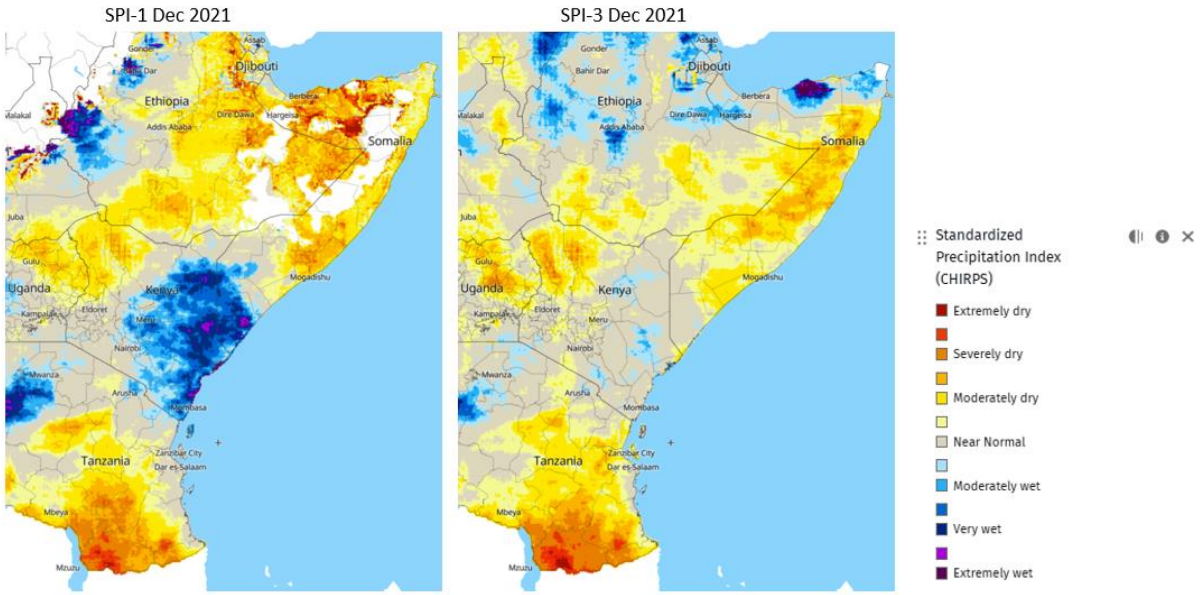

Figure 23: *SPI-1 (left panel) and SPI-3 (right panel) (CHIRPS) for December 2021 (Source ICPAC)*

It should be kept in mind as a general consideration to evaluate the impacts that the high sensitivity to drought over these regions is also due to the low coping capacity of the countries involved.

[8] *Kenya Drought Management Authority Kilifi County December 2021 Report* *https://www.ndma.go.ke/index.php/resource-center/early-warning-reports/send/19-kilifi/6332-kilifi-december-2021*

Reported impacts

Late and below average rainfall amounts, combined with above average temperatures resulted in extreme drought conditions in southern Somalia in November 2021, and a national emergency has been declared. This drought causes poor crop production prospects and poor rangeland conditions for livestock grazing. Southern cropping areas have been affected for about 40% of the annual average output. An almost complete dryness in the Lower Shabelle Region in October and the first half of November affected the main maize producing areas. The below-average rainfall in the Bay Region or 'Sorghum belt' affected the main sorghum producing areas. Due to the rainfall deficit in central, eastern and coastal Kenya, pasture and drinking water for livestock have been scarce. The combination of climate and socioeconomic stressors led to an increased risk of food insecurity in the eastern and central dryland areas and in the southern and coastal marginal agricultural areas. [9] According to the IPC[10] September 2021 report, about 3.5 million people in Somalia face high acute food insecurity in late 2021, due to the shortage of rains, low agricultural production, and high food prices. Over 1.2 million children are likely acutely malnourished.[11]

Water scarcity is the worst in 40 years in some parts of the country and boreholes and shallow wells are running dry. More than 3.2 million people in 66 out of the 74 districts in Somalia are experiencing the cumulative impacts of three consecutive rainy seasons with below average rainfall amounts, nearly 245,000 people of whom forced to abandon their homes in search of food, water and pasture, especially in the central and southern regions of the country. Deteriorating drought conditions in Somalia could displace over 1 million people by April if urgent action is not taken[12]. According to FEWSNET[13]/FSNAU[14], the 2021 October-December rainy season has largely failed across most of Somalia. This has led to the worst seasonal harvests on record, excess livestock losses and exceptionally high cereal prices. According to data collected across five states - Galmudug, Hirshabelle, Jubaland, Puntland, and Southwest – access to water has diminished as the boreholes and shallow wells in most locations have dried up. Water prices

[9] JRC's Monitoring of Agricultural Resources (MARS) – Anomaly Hotspots of Agricultural Production (ASAP) https://mars.jrc.ec.europa.eu/asap/index.php

[10] Integrated Food Security Phase Classification (IPC)

[11] https://www.ipcinfo.org/ipcinfo-website/resources/resources-details/en/c/1155103/

[12] https://www.iom.int/news/intensifying-drought-threatens-displace-over-1-million-people-somalia

[13] Famine Early Warning Systems Network

[14] Food Security and Nutrition Analysis Unit

have spiked, with eastern and central parts of Galmudug state, Jubaland and Southwest states reporting the highest water prices. Distances to functioning water wells have increased, to about 100 km in some places. Many families have lost their means of livelihood. At the same time, prices of basic commodities, including food, have significantly risen beyond the reach of most families. As a coping mechanism, families have reduced the frequency and quantity of meals, including for children. Over 80 per cent of interviewees had exhausted all their food stocks. Pastoralists reported that the scanty pasture resources are getting depleted. Most areas reported a shortage of livestock feed, with current fodder stock only able to sustain livestock for less than one month. Livestock is dying, and prices of essential food commodities are unaffordable for most people. Resource-based conflicts over pasture and control of water sources were reported in Galmudug. In addition, pastoral migration in search of food, water and pasture is on the rise, including across the border into Ethiopia and Kenya. Livestock deaths were reported, and the market value for livestock has reduced as many animals are sick or dying. Crop production has declined by more than 80 per cent due to lack of rain compared to normal times. [15]

The worst affected areas in Somalia include Lower-Juba, Middle-Juba, Gedo, Mudug, Nuugal, Bari, Toghdheer, Bakool, Galguduud, and Sool regions which are currently experiencing severe water shortage for domestic as well as agricultural and pasture production. Pasture and water resources are getting depleted in most of the affected pastoral areas already leading to death and migration of livestock and communities. Currently, the water levels of Juba River are to some extent closer to the normal level, while levels along Shabelle River are slightly below average. The levels in both rivers are expected to decrease further as no rains are foreseen in the coming two weeks.[16]

According to the National Drought Management Authority (NDMA) of Kenya the vegetation condition index in most of the Arid and Semi-Arid counties was either severe or extreme deficit even for the coastal and eastern sector that received above average rainfall in the month of December. This is attributed to late onset and poor performance of rainfall in the month of November. The pasture and browse condition in most of the arid and semi-arid counties was generally fair to poor except in Taita-Taveta that reported good browse condition attributed to the minimal rainfall showers. Overall, the current body condition of most livestock is below normal in comparison to similar periods during a normal year.[17]

[15] Somalia: Drought Situation Report No.2 (As of 21 December 2021) https://reliefweb.int/report/somalia/somalia-drought-situation-report-no2-21-december-2021

[16] Ministry of Humanitarian Affairs & Disaster Management, The Federal Republic of Somalia Jan. 2022

[17] https://www.ndma.go.ke/

GDO indicators versioning:

The GDO indicators appear in this report with the following versions:

Ensemble Soil Moisture Anomaly 2.3.0
fAPAR (fraction of Absorbed Photosynthetically Active Radiation) Anomaly 1.3.1 Indicator for forecasting unusually wet and dry conditions 1.0.0
Precipitation (GPCC) 1.2.0
Risk of Drought Impact for Agriculture (RDrI-Agri) 2.3.2
Standardized Precipitation Index (SPI, GPCC) 1.2.0

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