Drought in the Horn of Africa

Regional analysis

February 2023

REACH Informing more effective humanitarian action

h—h

1. INTRODUCTION

Since late 2020, much of the Horn of Africa region (Map 1.1) has been experiencing severe drought[1]. As of December 2022, many areas are now within their fifth consecutive failed rainy season and **a sixth failed rainy season is predicted for 2023.[2]** These factors have resulted in the **longest and most severe drought the region has experienced in recent history,** surpassing that of 2010-2011 and 2016-17.[3]

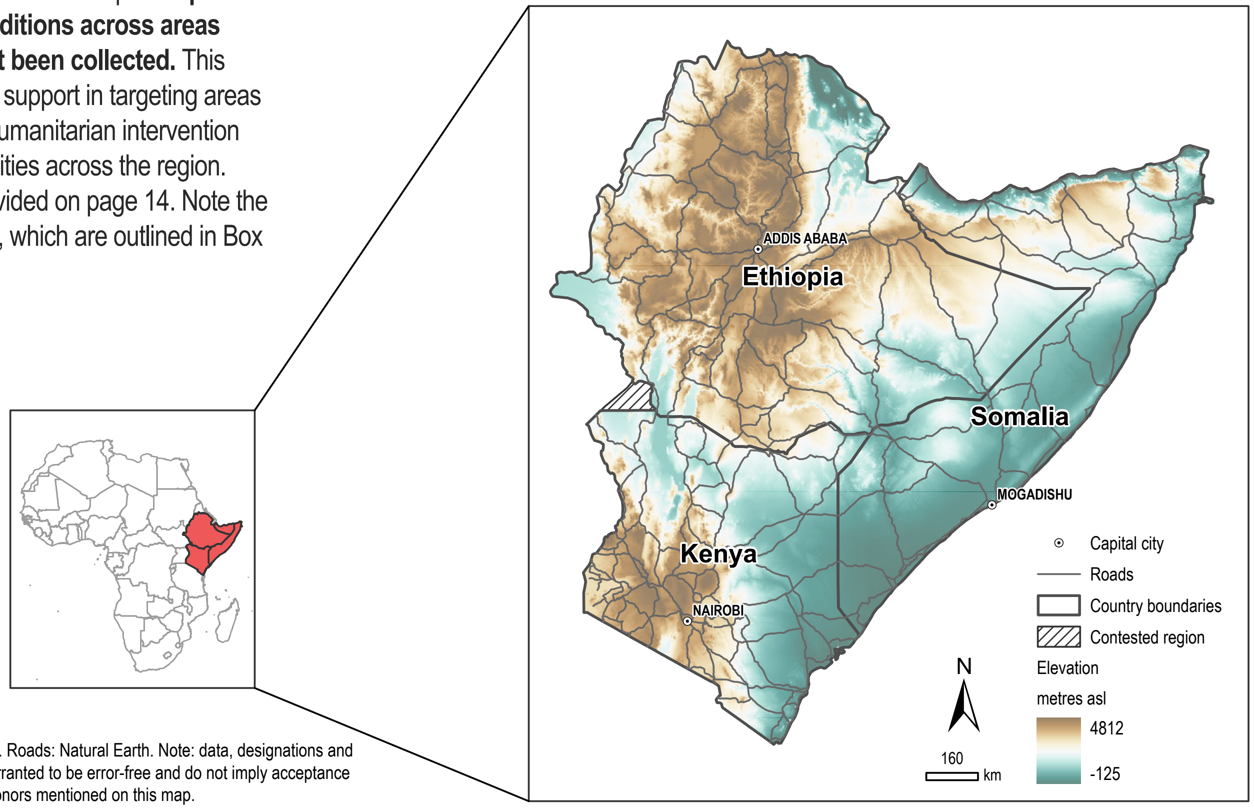
Impacts have been varied and widespread. Around **21 million people were projected to be facing acute food insecurity across the region between October and December 2022,[4]** whilst over **8.9 million livestock have died** across the region.[5] Reduced access to surface water for livestock and human needs, as well as reduced availability of pasture, has affected **pastoralist and agriculturalist communities throughout the region.**

Pastoralists reportedly have to travel further afield in search of food and water for their livestock, which sometimes leads to spikes in conflict between communities.[6] In other areas, agro-pastoralists and agriculturalists experience poor crop yields due to extended crop moisture stress. **Estimates suggest up to a 70% reduction in crop yields in some areas during the 2022 *long rains* season.[7]**

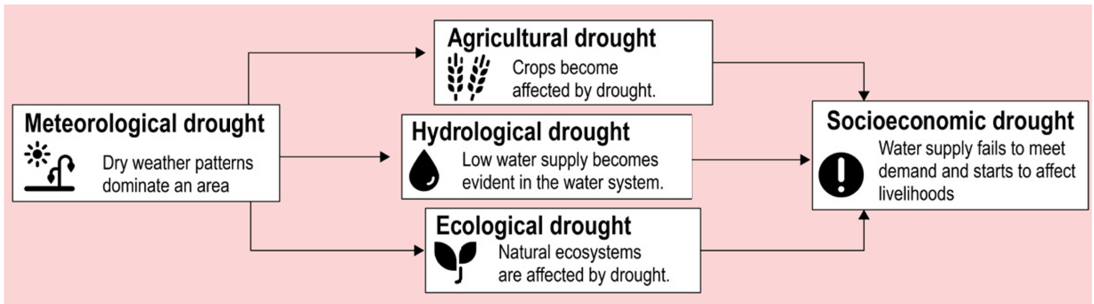
This assessment uses a **combination of remote sensing analysis, primary quantitative data, and secondary data review, to understand climatic patterns and recent drought severity at the local level** across Ethiopia, Kenya, and Somalia. Whilst remote sensing can provide an overview of potential hazards, to understand **real impacts on exposed communities, it is necessary to also compare this with additional data sources.**

REACH conducted various surveys in 2022, including the Humanitarian Situation Monitoring (HSM) assessment in hard-to-reach areas in Somalia, and the REACH Multi-Sector Drought Impact household survey in Turkana and Marsabit counties, Kenya. This data has been compared with remote sensing analysis, both to **triangulate information**, and also to help **extrapolate potential humanitarian conditions across areas where primary data has not been collected.** This consolidated approach could support in targeting areas for further assessment and humanitarian intervention for drought-affected communities across the region. Detailled methodology is provided on page 14. Note the various definitions of drought, which are outlined in Box 1.1.

Map 1.1: location of assessed countries in the Horn of Africa. Capital cities, elevation and major roads are also indicated.



Elevation data source: SRTM DEM. Roads: Natural Earth. Note: data, designations and boundaries on this map are not warranted to be error-free and do not imply acceptance by REACH partners, associates, donors mentioned on this map.



Box 1.1: diagram indicating the various definitions of drought.[8] In general, meteorogical drought can lead to agricultural drought, hydrological drought or/and ecological drought, whilst socioeconomic drought occurs when drought begins to affect livelihoods.

1.1. KEY FINDINGS

- **The Horn of Africa has been experiencing an ongoing drought since late 2020**. As of February 2023, the region had experienced **five consecutive failed rainy seasons**, with rainfall for the upcoming 2023 *long rains* also **expected to be below average.** The greatest rainfall deficiencies were observed in northwest Kenya, southern and central Somalia, as well as southeast Ethiopia.
- In these places, research suggests the 2022 *long rains* were the worst performing rains in over 70 years,[9] including the 2010-11 and 2016-17 droughts. In addition, climatic **data suggests rainfall variability is increasing,** as a result of which **the frequency of both drought, as well as heavy rainfall and flooding, is likely to increase in the future.**
- Primary data collected by REACH in Turkana and Marsabit (northwest Kenya) and hard-to-reach districts in **Somalia indicates the impact of the current drought on food security and livelihoods, as well as access to water, sanitation, and hygiene (WASH) is widespread.** Nearly all HHs interviewed in Turkana and Marsabit **reported drought had been a main challenge** in the 6 months prior to data collection in October 2022, with **reduced access to sufficient food and loss of livestock being the most reported drought-related challenges.** Similarly, in Somalia, drought was reported as a recent shock in the settlement by the vast majority of key informants (KIs) in October.
- **Over half of assessed HHs claimed to have received no assistance in response to the drought, with less assistance reported to be received overall in Marsabit county.** It is likely that communities in hard-to-reach areas, including in Somalia and Ethiopia, might also have been unable to access aid.
- As a result of these challenges, primary data from Kenya suggested **considerable changes in primary income sources** among interviewed HHs since 2019, particularly in relation to livestock, reportedly due to livestock death and lack of pasture, as well as crop cultivation. Drought-related challenges were also the main reported drivers of displacement. In Somalia, nearly all KIs from assessed agropastoral/agricultural settlements reported **the most recent 2022 *Gu* harvest had been much lower for most people compared to the previous years' *Gu* harvest.** Reportedly, there was also a **high reliance on surface water as a primary drinking water source in Somalia, which is particularly vulnerable to drought.**
- Triangulating remote sensing and primary data, **linkages were observed between drought indices such as the VCI and the reported impacts of droughts on livelihoods,** highlighting **the relevance of such indices in providing an indication of potential drought impacts in the region, including areas where no primary data is available.** Moreover, an observed lag (-1 month in Turkana) between reductions in soil moisture and vegetation response highlight **the potential for soil moisture data as proxy for drought early warning.**
- **Although no primary data was collected for Ethiopia, needs are also likely to be high here,** especially as remote sensing data indicates SE Ethiopia in particular has been experiencing considerable rainfall deficiencies as well.

1.2. RECOMMENDATIONS FOR FURTHER RESEARCH

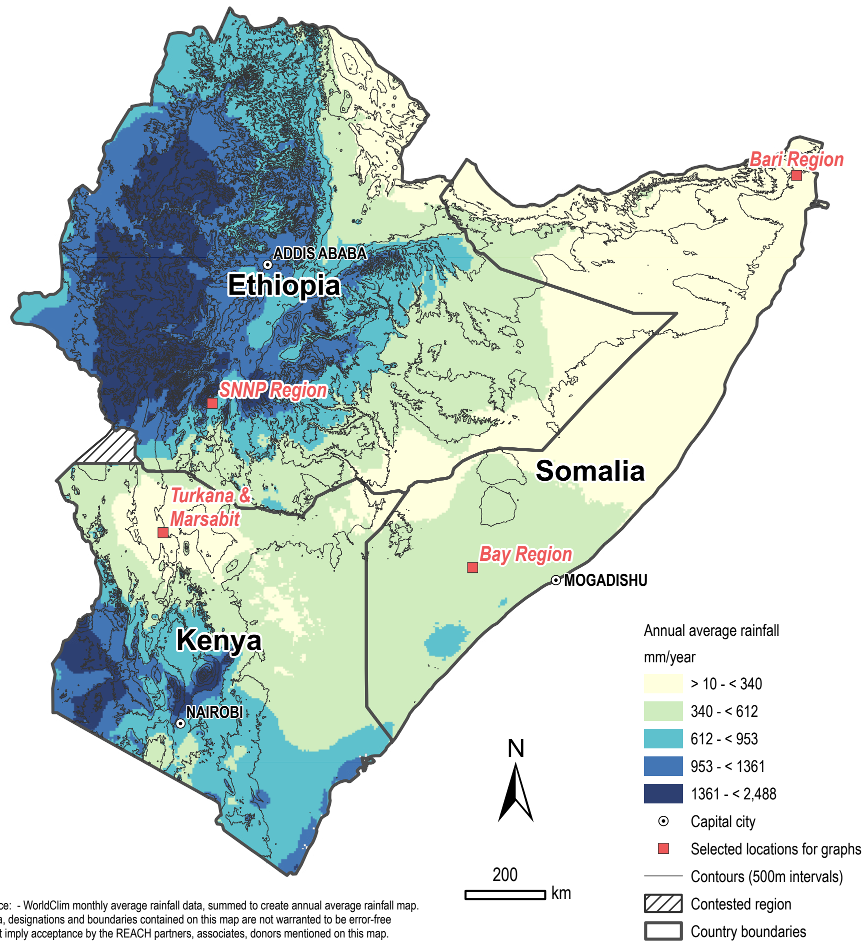
- Conduct further analysis of drought impacts on specific population and livelihood groups to further understand vulnerability, taking a harmonised approach to data collection across all three countries.
- Increase assessment coverage, including in Ethiopia, where primary data collection has been constrained by access and security issues. If these constraints persist, remote data collection and hybrid assessments could be explored in hard-to-reach areas.
- Conduct further investigation into drought-induced livelihood changes and livestock deaths as reported in assessed regions.
- Carry out further research into drought mitigation measures and coping strategies, and their suitability across the region, including for example water harvesting and retention, and groundwater access (boreholes).
- Investigation into adaptive measures of water management, especially in relation to climate change. For example, some research has suggested groundwater may increase in Turkana and Marsabit due to more intense rainfall events, potentially making boreholes and rainfall retention more suitable and sustainable water sources.
- Expand the use of remote sensing analysis to help determine areas where drought may be more severe, and use land cover data and contextual knowledge to help understand where impacts may be greater on different livelihood types.
- Monitor soil moisture trends in relation to vegetation indices to help provide early warning for drought, as trialled here in Turkana.

Data collection for REACH HSM KI survey, Somalia. Photo: REACH, 2022.

Deceased livestock in Baidoa district in Somalia. Photo: REACH, 2022.

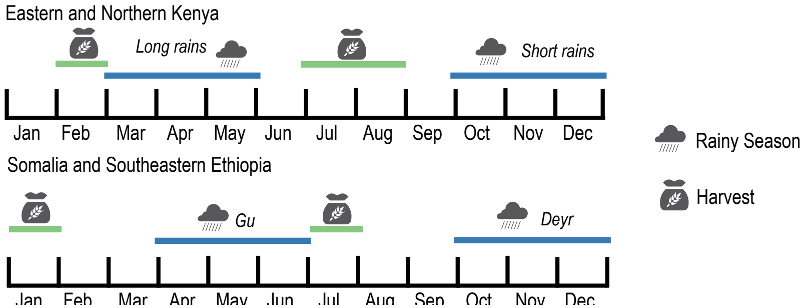
2. CLIMATIC CONTEXT

Map 2.1: annual average rainfall across the Horn of Africa region in mm/year.



Data source: - WorldClim monthly average rainfall data, summed to create annual average rainfall map.
Note: Data, designations and boundaries contained on this map are not warranted to be error-free and do not imply acceptance by the REACH partners, associates, donors mentioned on this map.

Figure 2.1: simplified seasonal calendar for selected regions across the Horn of Africa[14]



The Horn of Africa is characterised by a range of distinct climatic zones. As Map 2.1 indicates, the west of Ethiopia and southern Kenya receive the highest average annual rainfall, whilst Somalia receives the least, particularly the northeast of the country. **Zones of higher rainfall broadly correlate with areas of higher elevation, and are an important determinant of livelihoods**, with agricultural areas broadly aligned to areas of higher rainfall, and pastoralist livelihoods dominating in regions of lower rainfall (see following page).

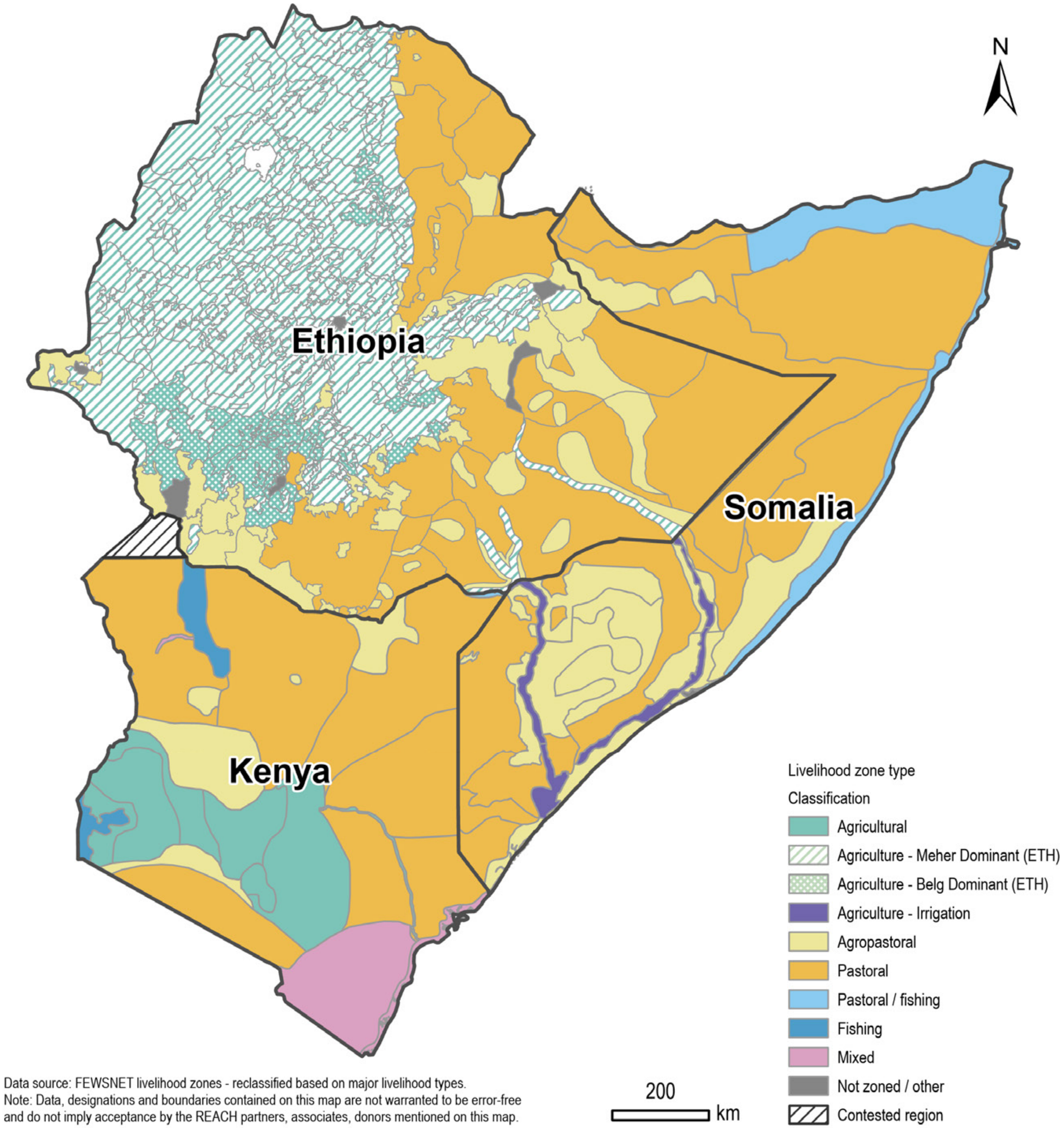
In general, East Africa experiences the *long rains* between March and May, and the *short rains* between October to December, although seasonal rainfall patterns vary across the region.[10] In the **northeast, central, and highlands of the south and east in Ethiopia, the *Belg* rains fall between February and May,** whilst the ***Kremt* season falls between June and September** and is associated with the primary *Meher* agricultural season.[11]

In Kenya, Turkana and Marsabit are some of the driest counties in the country. Generally, the rains fall **between March and May and between October and December.** In Somalia and southeast Ethiopia, the ***Gu* rains fall between late March and June,** whilst the **heavier *Deyr* rains occur between October and November.**[12] Simplified regional rainfall patterns and the main harvests are summarised in Figure 2.1.

Graph 2.1, a-d: rainfall (2021-22) and average monthly rainfall across the Horn of Africa. Locations also shown on map. Locations selected to highlight climatic variability across the region. Source: CHIRPS.[13]

3. OVERVIEW OF LIVELIHOOD ZONES

Map 3.1: livelihood zones across the Horn of Africa region, classified into broad livelihood types.



Data source: FEWSNET livelihood zones - reclassified based on major livelihood types.
Note: Data, designations and boundaries contained on this map are not warranted to be error-free and do not imply acceptance by the REACH partners, associates, donors mentioned on this map.

As defined by the Famine Early Warning Systems Network (FEWSNET),[15] **there is a high diversity of livelihood zones across the Horn of Africa.** The map shows generalised livelihood types, which can broadly be split into **pastoralist, agro-pastoralist, and agricultural zones,** with localised areas where other activities are more dominant. Comparing this map with the mean annual rainfall map on p.4, the dependency of livelihood activities on climate and environment can be observed. **Predominantly agricultural livelihood zones are concentrated in areas of higher rainfall**, which generally correspond to the highland areas of Kenya and Ethiopia.

In Ethiopia, cropping areas are split into Belg-dominant and Meher-dominant areas, and are associated with the Belg and Kremt rains respectively (see p.4). The **Belg rains are notoriously unreliable,** and late arrival or failure can significantly impact grain production in areas dependent on these rains.[16]

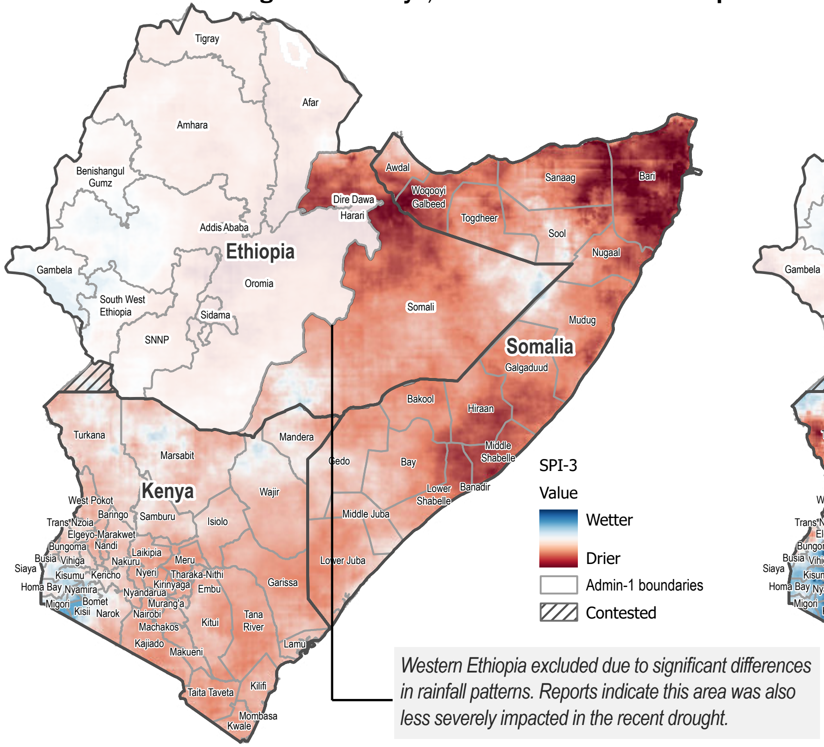
Pastoralist-dominated livelihood zones, meanwhile, are concentrated in semi-arid and arid parts of the region, where rainfall is insufficient or too irregular for crop production. This includes most of Somalia, northern Kenya and eastern Ethiopia. The pastoral zones of Turkana and Marsabit in northwest Kenya, as well as some of the pastoral and agro-pastoral zones of Somalia are analysed in greater detail later. Rainfall in these areas is lower and often localised, and **rainfall deficiencies may limit pasture growth for livestock, as well as water availability for communities and livestock - particularly those relying on surface water.**[17]

Livelihood zones involving fishing are located close to lakes such as Lake Turkana in Kenya, as well as coastal and riverine areas across the region. Riverine zones in southern Somalia are dependent on rains upstream in Ethiopia, where rainfall is higher.[18] Finally, some zones with mixed livelihoods are found in Kenya, such as along the Indian Ocean coastline, where in addition to crop and livestock production, livelihoods associated with casual labour and tourism are also common.[19]

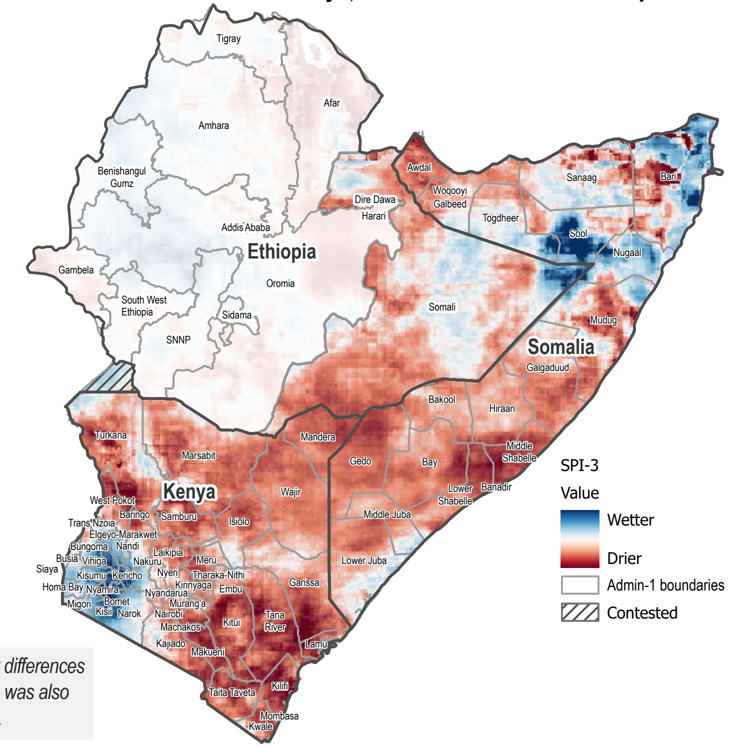
Both agricultural and pastoral livelihoods are particularly dependent on reliable rainfall patterns. Therefore, irregularity or insufficiency in rainfall due to dry spells and drought can result in devastating impacts on the livelihoods and resource access for all households relying on these livelihoods. Other factors, including diversification opportunities, and social and political capital, also affect the resilience of communities to drought. For pastoral communities in Southern Kenya, diversification of livelihoods, which is seen as a climate change adaption strategy, has been observed at an increasing rate.[20] **Much of the region has experienced a severe drought in recent years and is highly prone to this type of climatic shock, as outlined in the next section.**

4. DROUGHT - RECENT PRECIPITATION TRENDS

Map 4.1: SPI-3 for March, April, May (MAM) 2022: generally associated with the *long rains* in Kenya, Somalia and eastern Ethiopia

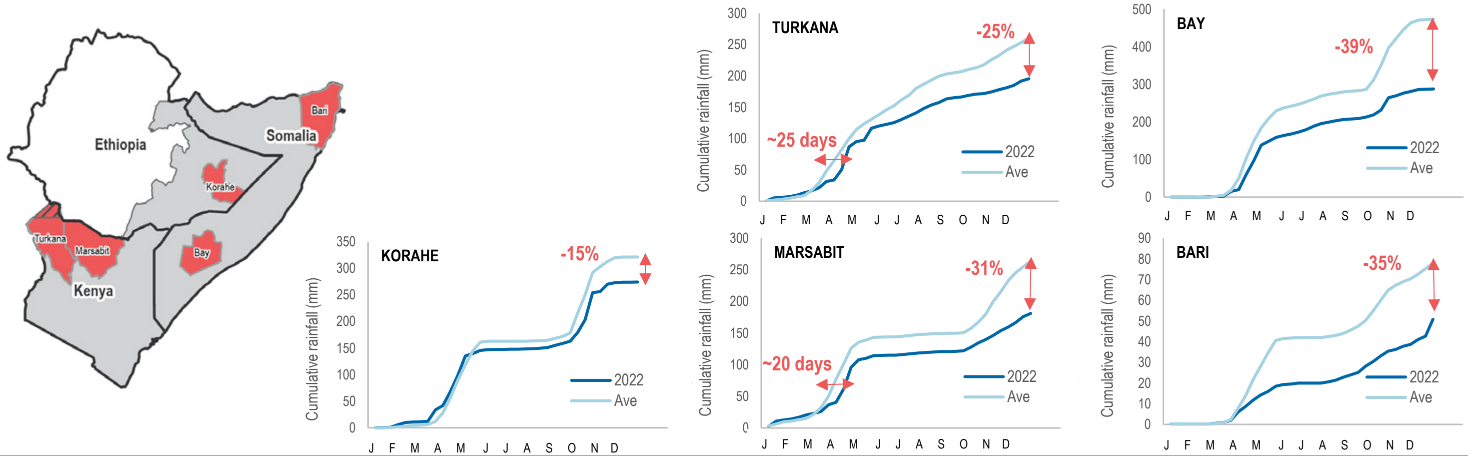


Map 4.2: SPI-3 for Oct, Nov, Dec (OND) 2022: generally associated with the *short rains* in Kenya, Somalia and eastern Ethiopia



SPI calculated in Google Earth Engine using CHIRPS rainfall data. Note: Data, designations and boundaries contained on this map are not warranted to be error-free and do not imply acceptance by the REACH partners, associates, donors mentioned on this map.

Graph 4.1, a-e: cumulative rainfall (2022 and average) for selected locations. Note the lag in onset of the MAM rainy season in Turkana and Marsabit, and overall deficiency in all locations, especially in Somalia (Bay and Bari). Calculated in Google Earth Engine using CHIRPS data[23].



The **Standardised Precipitation Index (SPI) highlights rainfall anomalies for a specified time period.** Negative values (increasingly darker red) are indicative of potential drought, whilst positive values indicate excess rainfall (increasingly darker blue). SPI can be calculated for different timescales (usually 1-24 months), with **shorter timescales (e.g. SPI-1) indicative of soil moisture anomalies, medium timescales indicative of seasonal trends, and longer timescales (>SPI-12) relating to groundwater and reservoir storage.**[24]

Maps 4.1 and 4.2 show the **3-month SPI (SPI-3) for the two main rainy seasons in Kenya, Somalia, and Somali (Ethiopia) in 2022.**[i] Approximately, these correspond to the *long rains* between March and May (MAM), and the *short rains* between October and December (OND). In Somalia and Southeast Ethiopia, these are known as the *Gu* and *Deyr* seasons respectively (see p.4).[21]

The maps indicate **conditions were drier in Somali (Ethiopia) and northern Somalia during the MAM rainy season, whilst Kenya experienced drier conditions during the OND rainy season. Southeast Somalia was very dry during both seasons.** These findings are corroborated in the cumulative rainfall graphs for 2022, which show **rainfall was lower than average in all selected locations, particularly in Kenya (Turkana and Marsabit), and Somalia (Bari and Bay). There was also a notable lag in the MAM rainy season in Turkana and Marsabit, indicating a delay to the start of this rainy season.**

The majority of the assessed region is characterised by pastoralist and agropastoralist livelihoods (see p.5). For livelihoods involving crop cultivation, **dry spells that occur at critical stages of the cultivation season, such as planting, can be particularly damaging to crop health.**[22] For this reason, delays in the start of rainy seasons can cause disruption to crop growth. For pastoralists meanwhile, rainfall deficits often lead to lower water availability and may result in poor pasture health for cattle, as well as atypical migratory movements.

Actual impacts of drought on livelihoods in specific areas assessed by REACH, is explored in more detail on p.9-12. To understand cumulative deficiencies in rainfall over this period, and to compare with other selected time periods, the next page looks at the SPI-24 over the region, which highlights multi-year rainfall anomalies.

i Western Ethiopia excluded due to significant differences in rainfall patterns. Reports indicate this area was also less severely impacted in the recent drought.

5. DROUGHT - LONG-TERM PRECIPITATION TRENDS

Map 5.1: 24-month SPI (SPI-24) in (a) 2010-11, (b) 2016-17 and (c) 2021-22. In addition to the current drought period, these are the two most recent drought periods to have affected the region. SPI-24 is a good indicator of longer-term rainfall deficiencies. Wetter than normal conditions are represented by progressively darker blues, drier than normal conditions represented by progressively darker reds.

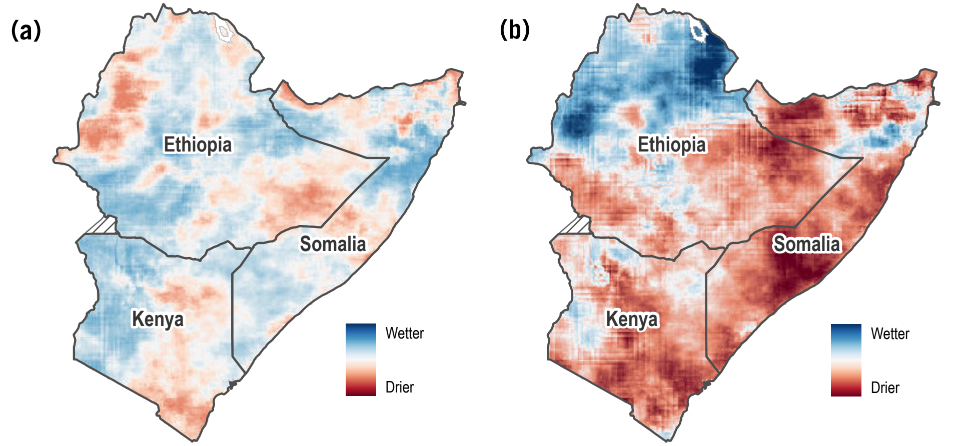


Fig. 5.1: low water levels on river in Dollo Ado, Ethiopia. Photo: ACTED, 2022.

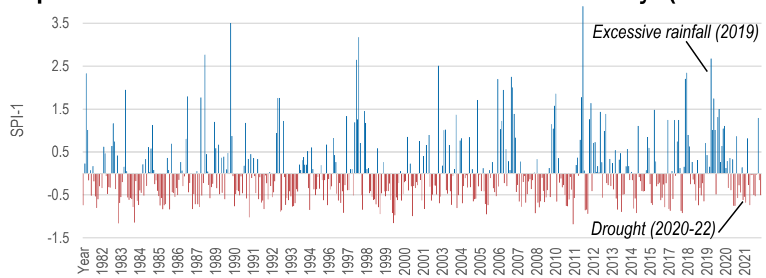
This page investigates the extent and potential causes of recent drought events in the Horn of Africa, as well as longer-term trends and rainfall anomalies over the past decade. Future near-term projections for the region, as well as longer-term drivers related to climate change are also explored. **Maps 5.1 (a-c) above show the SPI-24 for the three most recent drought periods; specifically, 2010-11, 2016-17, and 2021-22.**

The current drought began in late 2020 across much of The Horn, and as of December 2022, many areas were experiencing their **fifth consecutive failed rainy season.**[25] According to NASA Earth Observatory, the drought appears to have been caused by a combination of rising temperatures due to **climate change, and other global drivers such as La Niña.**[26] In fact, strong La Niña years correspond to all three of the most recent drought periods in the past decade.

Increasing rainfall variability

In the long-term, consecutive drought periods can impact soil moisture, surface water availability, and groundwater storage, which can in turn impact local livelihoods and drive displacement (see p.9-12). Recent research suggests that **rainfall across the Horn of Africa drylands is increasing during the *short rains* and decreasing during the *long rains*.**[27] There are also signs of increasing intensity of both heavy rainfall and drought events. For example, **much of Kenya experienced an excess of rainfall immediately prior to the current drought season in 2019** (marked in graph 5.1 above), leading to flooding in at least 25 counties.[28]

Graph 5.1: Ave. SPI-1 for Turkana & Marsabit Counties in Kenya (1982-2021)



← This graph shows the SPI-1 for Turkana and Marsabit counties between 1982 and 2021. SPI-1 was selected here for this graph to highlight the short-term fluctuations in precipitation which may relate to periods of drought or excessive rainfall, whilst also capturing longer-term trends in rainfall.

Rising temperatures and precipitation variability, as indicated by climatic models,[29] will likely contribute to increased severity of **drought periods in the future due to more rapid losses in surface water and soil moisture** through evapotranspiration.[30] Conversely, because of increasing rainfall intensity, recent research has suggested that **groundwater could actually be increasing across the region's drylands, providing potential opportunities for improved sub-surface water access.**[31]

The next pages investiagate some of the impacts of the recent drought in selected locations and may give an indication of how humanitarian conditions could develop in the event of further drought periods.

Box 5.1: Forecasts for the upcoming *long rains* rainy season

Much of the region has now experienced five consecutive failed rainy seasons. Whilst rainfall and other climatic patterns can be difficult to predict, forecasts suggest that the upcoming *long rains* rainy season in 2023 will also be drier than usual.[32] Models run by the Climate Hazard Centre in September 2022 indicated a 62% chance of below average rainfall during the MAM rainy season.[33]

The cumulative impact of continuous poor rainfall is likely to further exacerbate the preexisting and poor food security in many affected areas. Turkana and Marsabit, for instance, were predicted to continue to face Emergency levels (IPC Phase 4) of food insecurity until May 2023.[34] Protracted high levels of food insecurity generally imply that people are more likely to exhaust their consumption and livelihood coping strategies, and are thus likely to erode their resilience to shocks.

6. DROUGHT - IMPACT ON SOIL MOISTURE AND VEGETATION CONDITION

Whilst the previous pages have focussed on meteorological drought, i.e., extended periods of below average rainfall,[35] **this page investigates how protracted rainfall deficits have impacted soil moisture and vegetation across the region.** Such changes may lead to agricultural, ecological, and hydrological drought (see Fig. 1.1). Furthermore, **when drought causes adverse impacts on communities and livelihoods, it may become a socioeconomic drought,**[36] which is explored further following this page.

Vegetation conditions

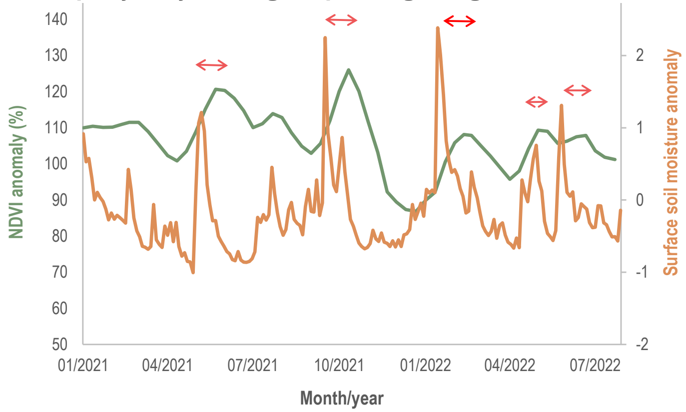
Map 6.1 shows the Vegetation Condition Index (VCI) in July 2022. See Box 6.1 for further explanation. July was selected for analysis because it **follows the *long rains* / *Gu* rainy season and precedes harvests across much of the region** (Fig. 4). The map shows that drought was widespread in July 2022, with the worst affected areas being central and northern Somalia, central and northwest Kenya, and northern Somali, Ethiopia. The **index is useful to determine the impact of rainfall deficiencies on vegetation condition,**[37] **with potential implications for crop and pasture health**, as detailed on the following pages.

Drought early warning

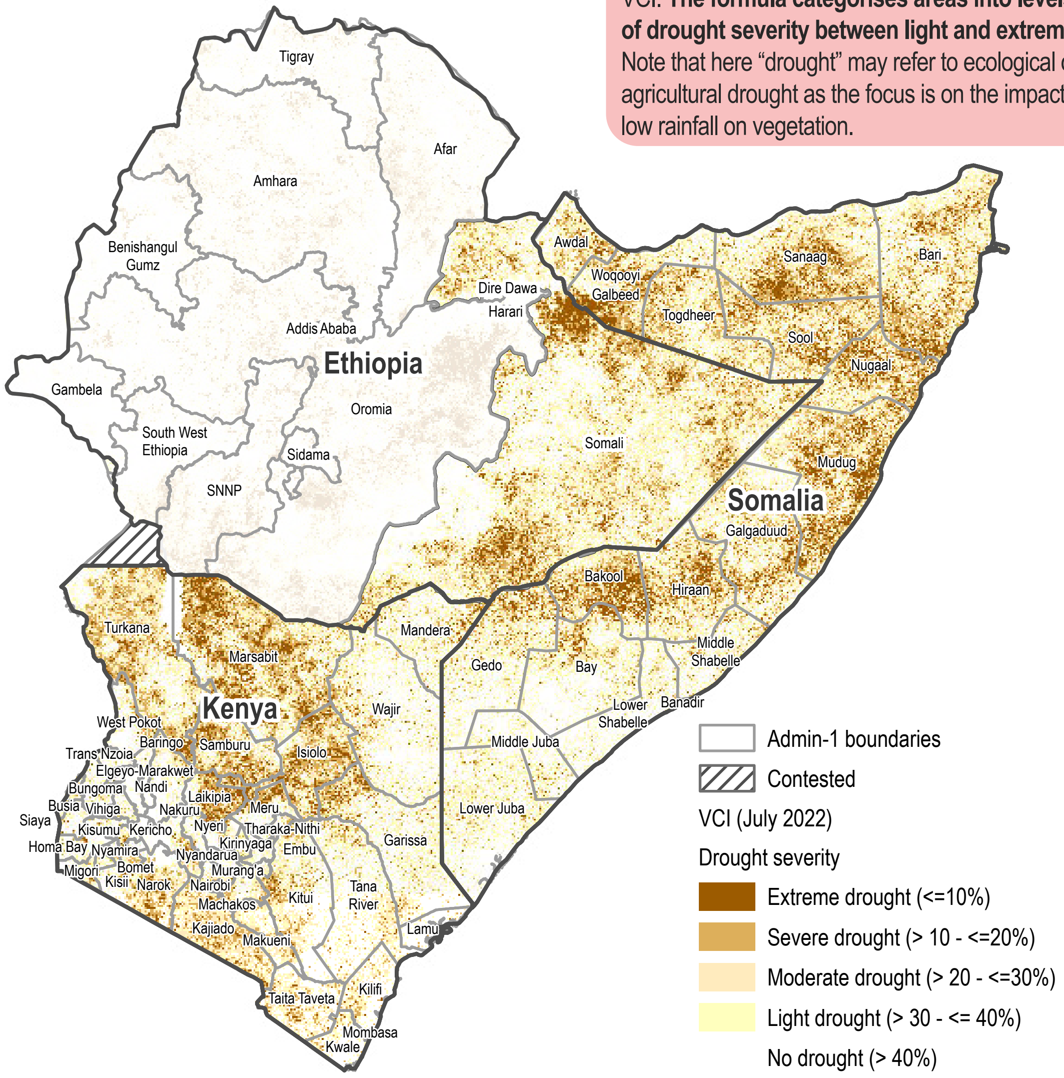
The link between rainfall, soil moisture and vegetation greenness (i.e. density and health) can be seen as a causal process. In addition to factors such as temperature, soil type and vegetation cover,[38] **rainfall patterns impact soil moisture conditions, which in turn affects vegetation greenness.**[39] As such, vegetation indices such as NDVI and EVI have been observed to correlate with both rainfall and soil moisture, following a lag period which varies depending on soil type and depth.[40] This highlights the **utility of this relationship to provide a proxy early warning system for drought conditions.**[41]

Graph 6.1 indicates the relationship between surface soil moisture anomaly[42] and NDVI anomaly[43] in Turkana county, Kenya. Soil moisture at the near-surface level responds rapidly to precipitation and drying events,[44] and **drops in this index clearly precede drops in NDVI by around 30 days or less,** as marked. For Turkana, soil moisture response at the subsurface level is more delayed and less pronounced but shows a similar pattern.[45] Note that the specific response and lag time will vary by region.

Graph 6.1: NDVI anomaly and surface soil moisture anomaly for Turkana County, Kenya (Jan 2021 - July 2022). Note there is a delay of <=1 month between soil moisture and NDVI peaks, making it a useful proxy early warning of upcoming drought conditions.



Map 6.1: VCI in July 2022, focussing on Kenya, Somalia and Somali region, Ethiopia. July was selected because it allows for a delay in vegetation response following the *long rains*, and precedes harvests across the region.



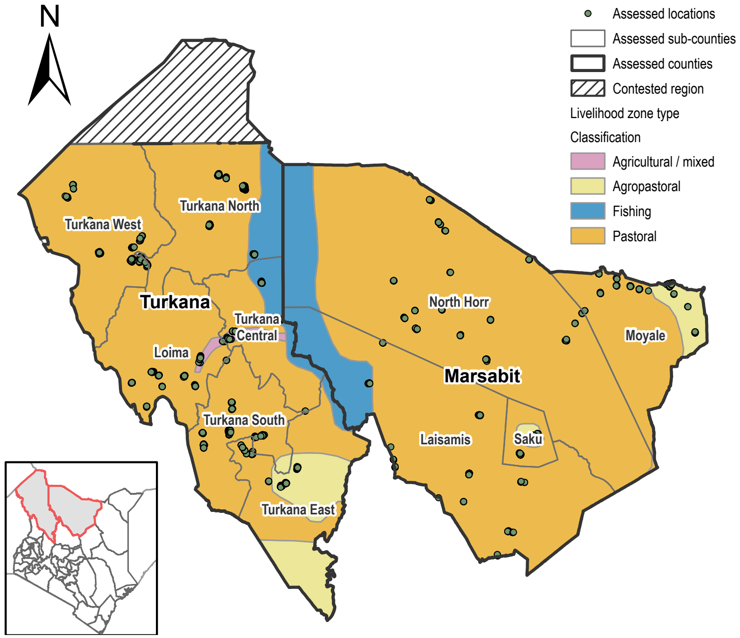
SPI calculated in Google Earth Engine using CHIRPS rainfall data. Note: Data, designations and boundaries contained on this map are not warranted to be error-free and do not imply acceptance by the REACH partners, associates, donors mentioned on this map.

Box 6.1: Vegetation Condition Index (VCI)

VCI highlights impacts of meteorological drought on vegetation condition through comparing vegetation greeness (from NDVI/EVI) in a specified time period (e.g. a month/season) with the average long-term value for that location. **The lag between rainfall and vegetation response should be considered** when selecting a time period to calculate VCI. **The formula categorises areas into levels of drought severity between light and extreme.**[46] Note that here "drought" may refer to ecological or agricultural drought as the focus is on the impact of low rainfall on vegetation.

7. KENYA ZOOM-IN - TURKANA AND MARSABIT

Map 7.1: Turkana and Marsabit counties indicating livelihood zones and assessed locations in the REACH Multi-Sectoral Impact of Drought Assessment (Oct 2022).



97% of assessed HHs reported having experienced drought challenges in the 6 months prior to data collection (Sept 2022)

Chart 7.1: Among HHs reporting experiencing drought challenges in the six months prior to data collection (Oct. 2022), the most reported challenges were:

Given the high severity of drought in these counties, and the availability of data from the Multi-Sectoral Impact of Drought HH assessment undertaken by REACH in Oct. 2022, this page focusses on Turkana and Marsabit counties in northwest Kenya. Primary data referenced on pages 9-11 is from this assessment. See *p.14 for more info on methodology.*

Map 7.2: % of assessed HHs reporting using surface water as their primary drinking water source, by sub-county, as of Oct. 2022.

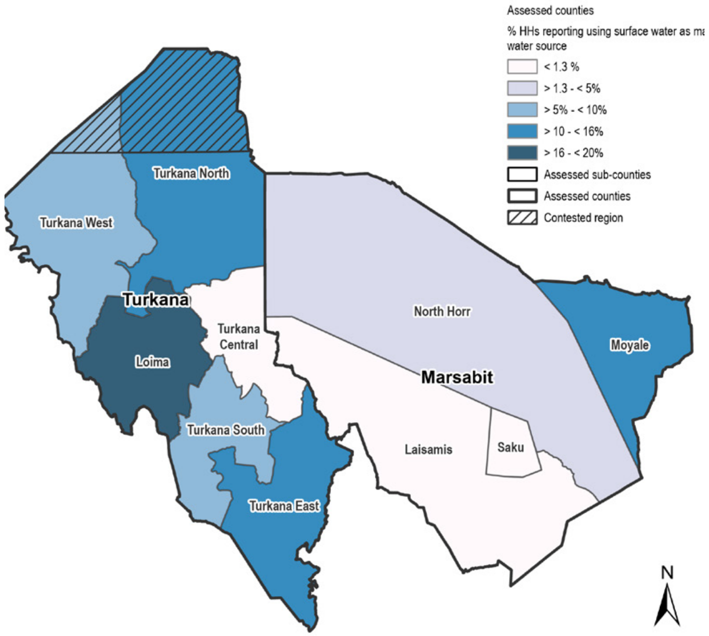
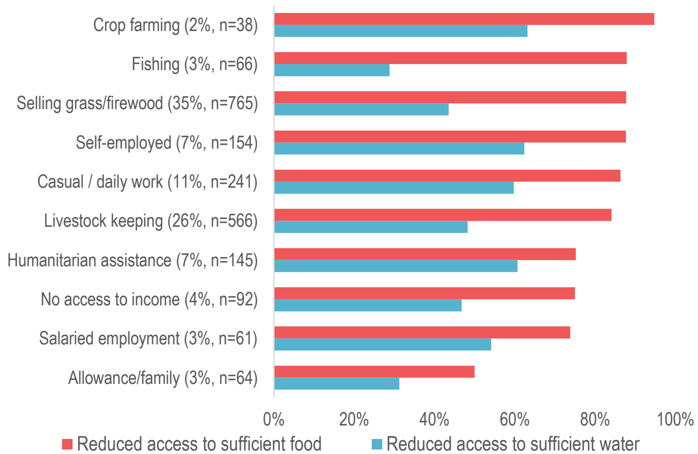


Chart 7.2: of those HHs reporting experiencing drought challenges in the 6 months prior to data collection (Oct. 2022), % reporting reduced access to sufficient food and reduced access to water, by current primary source of income:[i]



i Note: main food source varies by income source; e.g. those with salaried employment most likely to purchase food from market which may be affected by decreased production. Subset size shown in brackets after each income source.

As of January 2023,[47] **Marsabit and Turkana counties were classified by the Kenya NDMA to be under the Alarm drought phase**[i], because of the failure of four consecutive rainy seasons and the delayed onset of the 2022 OND *short rains* (see p.6-7).[48] As described on p.5, Turkana and Marsabit are located in **Kenya's arid and semi-arid land (ASAL) region** and are dominated by **(agro-)pastoral livelihood activities, with pockets of fishing and agricultural livelihoods (Map 7.1).**

As outlined on p.5, considering the **cumulative impact of five failed rainy seasons and projected failure of the 2023 *long rains,*** both counties were expected to **remain in IPC Phase 4 (Emergency) levels of food insecurity until May 2023 due to lack of food availability.** In addition, these areas are reportedly "at risk" of deteriorating further into **IPC Phase 5 (Catastrophe) should conditions continue to worsen, and without large scale-up of humanitarian assistance.**[49]

Findings from the REACH Multi-Sector Drought Assessment (October 2022) indicate the drought had a large impact on communities; **97% of HHs reported having experienced drought-related challenges in the 6 months prior to data collection.**

As is visible from chart 7.2, **reduced access to food was widely experienced, regardless of the HHs' main sources of income.** While HHs engaged in crop farming most commonly reported having experienced reduced access to food as a drought-related challenge in the 6 months prior to data collection, even HHs with livelihoods that appear less directly linked to rainfall, such as salaried employment and allowances/family, commonly reported having experienced a decline in their food access, indicating **the far-reaching impact of drought on local economies.**

In terms of population movement, **a very small proportion of assessed HHs (<1%) in Turkana county reported having moved to their current location within the 6 months** prior to data collection. **In Marsabit county, the number was 7%,** and highest in Laisamis and Moyale sub-counties. **HHs who had been displaced reported the lack of access to water, pasture, and/or food to have been the key displacement triggers.** Similarly, IDP, returnee, and refugee HHs interviewed in Sololo village, who had recently migrated from Ethiopia, also reported a **lack of food and water had driven their decision to cross the border into Kenya.**

i NDMA classifies drought severity into four categories; ranked from least to most severe, these are: normal, alert, alarm, emergency.

7. KENYA ZOOM-IN - IMPACTS ON WATER ACCESS

This page explores the **impacts of the current drought on water access**, based on the REACH Multi-Sectoral Impact of Drought assessment conducted in October 2022 and presented on the previous page, plus remote sensing data on surface water availability.

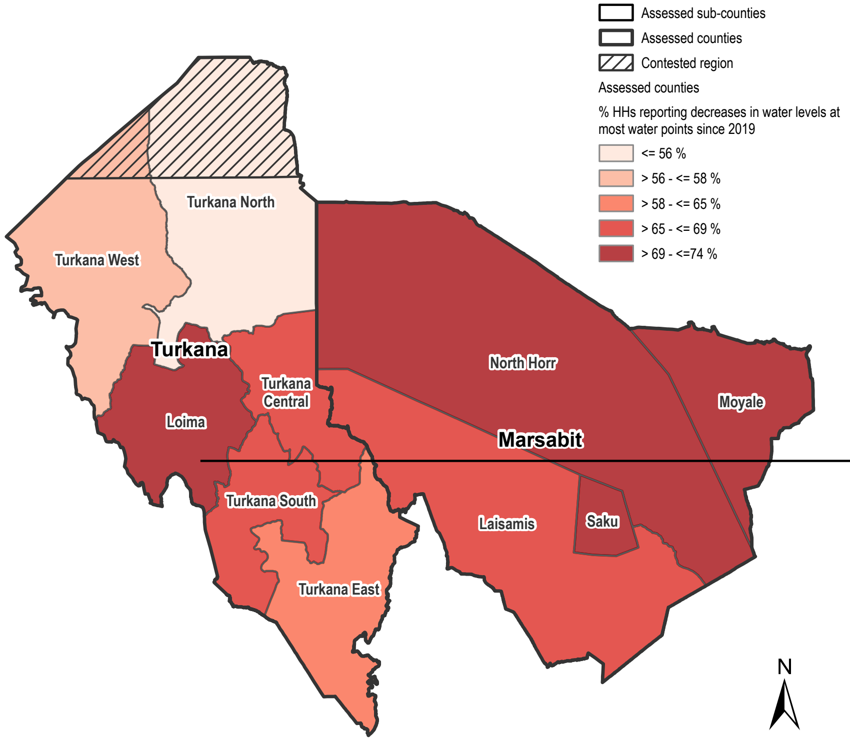
As Graph 7.3 indicates, **the highest % of HHs expressing reduced access to water as a drought-related challenge were found in among Sololo village IDPs, and in Moyale.** Map 7.3 to the right indicates the % of HHs reporting that water levels at most water points had decreased at the time of data collection in October 2022, since before the start of the ongoing drought in 2019. As shown, findings suggest **water decreases were most widely experienced by HHs in Loima (Turkana), as well as North Horr, Saku, and Moyale (Marsabit).**

Loima sub-county also had the highest proportion of HHs reporting relying on surface water as their main drinking water source (Map 6.2). As highlighted by Graph 7.4, HH data suggests **surface water might be a source that is particularly vulnerable to drought, with more than three-quarters of HHs relying on surface water reporting having experienced decreases in water availability since the start of the drought.**

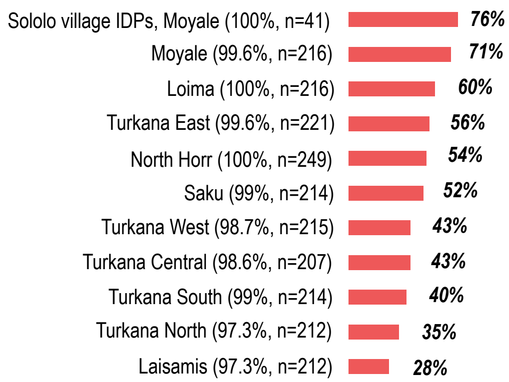
These HH-level findings from Loima seem to be triangulated by the normalised difference water index (NDWI), which indicates that **surface water availability in Loima had reduced in the past two years,** likely impacting livelihoods and forcing communities to travel further in search of water. See Box 7.1 for more information.

Fig. 7.1: new IDP camp in Baidoa, Somalia, where people were displaced due to recent drought. Photo: REACH, 2022.

Map 7.3: % of assessed HHs reporting that water levels at most water points had decreased since before the start of the ongoing drought (2019), by sub-county



Graph 7.3: Among those HHs reporting having experienced drought challenges in the 6 months prior to data collection, % reporting reduced access to water, by sub-county[i]

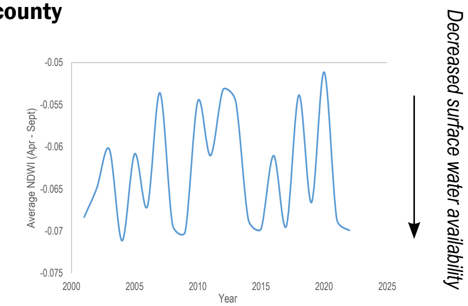


i Subset size (HHs who indicated they had experienced drought challenged) indicated in brackets

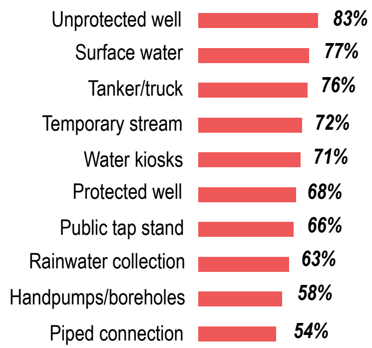
Box 7.1: Potential impacts on communities relying on surface water

At the time of the REACH Multi-Sector Impact of Drought assessment in October 2022, Loima sub-county had the highest proportion of HHs reporting relying on surface water as the main HH water source. HHs in Loima also commonly reported having faced reduced access to water as a challenge experienced during the drought. These findings can be further triangulated with the normalised water difference index (NDWI), an index used to quantify surface water availability. As shown in Graph 7.5 below, low NDWI values are clearly visible in 2021-2022, indicating reduced availability of surface water. Note that the graph shows annual average NDWI between April and September as they align with the recall period of the 2022 HH data collection and roughly correspond to the dry season.

Graph 7.5: Average NDWI (Aug-Sept), Loima sub-county

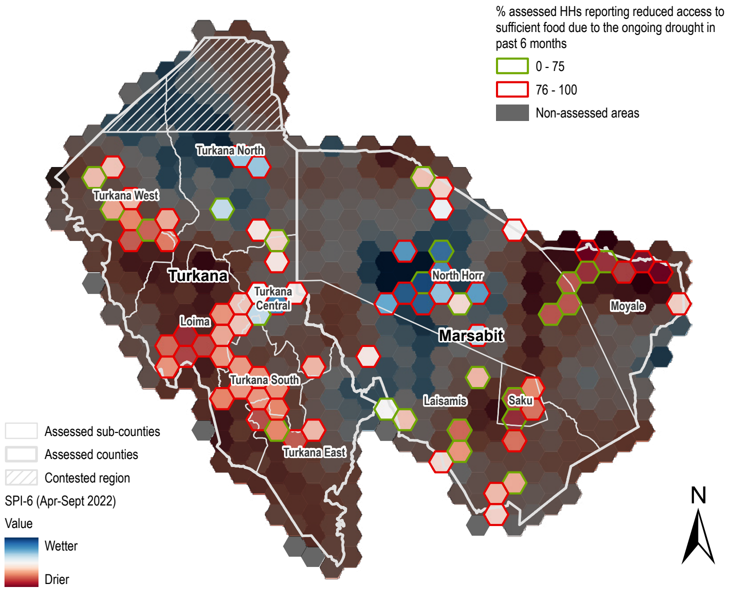


Graph 7.4: % of assessed HHs reporting decreases in water availability since 2019 (since the start of the ongoing drought), by main source of water

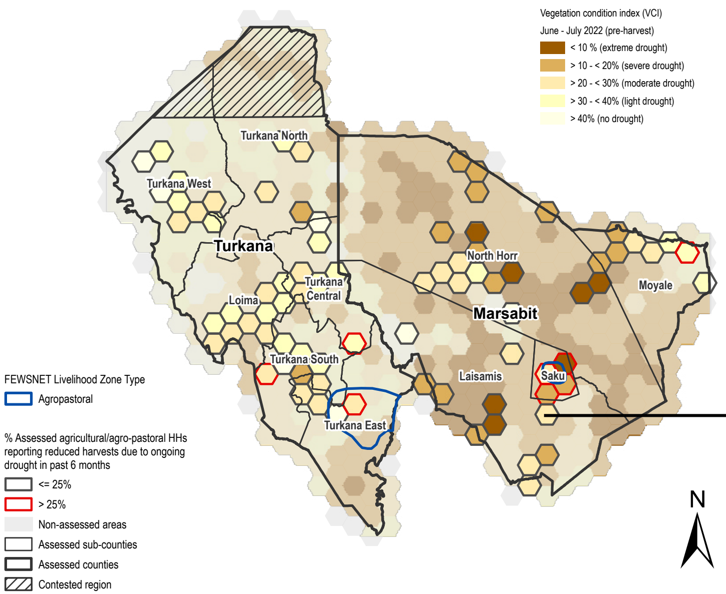


7. KENYA ZOOM-IN - IMPACT ON FOOD SECURITY AND LIVELIHOODS

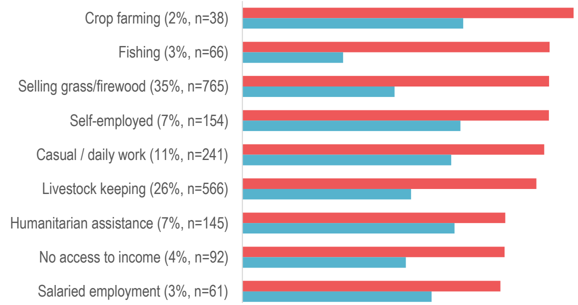
Map 7.4: Six-month SPI (SPI-6) for Apr - Sept 2022, and % assessed HHs indicating reduced access to sufficient food due to drought challenges in 6 months prior to data collection (Oct 2022)



Map 7.5: VCI in June-July 2022, preceding long rains harvest. VCI indicates vegetation health compared to average. % assessed HHs reporting reduced harvests due to drought also shown (Oct 2022).



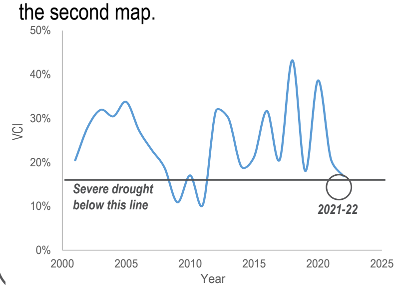
Graph 7.5: change in primary income source between 2019 (before ongoing drought) and during ongoing drought (October 2022).

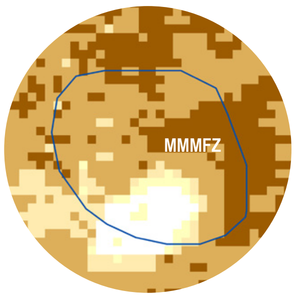


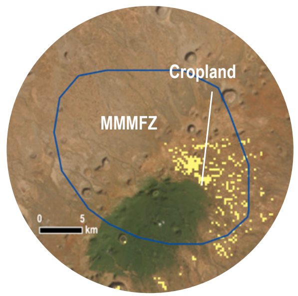
Graph 7.6: Primary reason for change in main income source, by % of assessed HHs who reported their main income source had changed since 2019 (40%, n=905).

Box 7.2: Potential impact of drought on crop yields in agricultual communities

The VCI map indicates that many areas were in severe and extreme drought in June-July 2022 (immediatley prior to main harvest). Graph shows VCI for June-July in the Marsabit Marginal Mixed Farming Zone (MMMFZ), Marsabit County. This is a small agropastoral zone where a high proportion of assessed HHs reported reduced harvests in the 6 months prior to data collection. Low VCI values are also clear between 2021-2022. Map insets show VCI and land cover[53] around the MMMFZ (outlined in blue). Cropland is shown in yellow in the second map.







* Livestock prices due to poor livestock body conditions

Turkana and Marsabit were classified in Phase 4 ("Emergency") during the IPC Acute Food Insecurity Analysis in July 2022, with **half of the population being considered food insecure and in need of urgent assistance.**[50] During the aforementioned REACH Multi-Sector Drought assessment in **October 2022, 59% of HHs reported not having received food assistance in the six months prior to data collection.** Meanwhile, water assistance was reportedly received by just 10% of HHs, multipurpose cash assistance by 24%, and livestock assistance by 15%. **Overall, receipt of any type of assistance was less reported by HHs in Marsabit than in Turkana.**

HHs in Turkana and Marsabit reportedly **purchase most food commodities from markets, and cereals and vegetables are mainly bought with cash or credit. Livestock products also play an important part in meeting food needs and contributing to HH income**, especially for better-off households[51].

As a primarily pastoral region with a semi-arid climate, most communities are nomadic or semi-nomadic, and herders must migrate with their **livestock during the dry season in search of water and grazing pastures.**[52] As Graph 7.5 indicates, **there were considerable changes in primary income source** between 2019 (before the ongoing drought) and the time of data collection. For example, **whilst 63% of HHs in Marsabit reported livestock was their primary income source prior to the ongoing drought, only 19% reported it at the time of data collection** (Oct. 2022). Graph 7.6 shows that the most reported **reason for these changes was livestock death.**

Map 7.4 shows SPI-6[i] between Apr- Sept 2022, along with the % of assessed HHs indicating they had reduced access to sufficient food due to drought challenges in the past six months, as of Oct 2022. **Some correlation can be observed between these indicators, particularly in western Turkana county.**

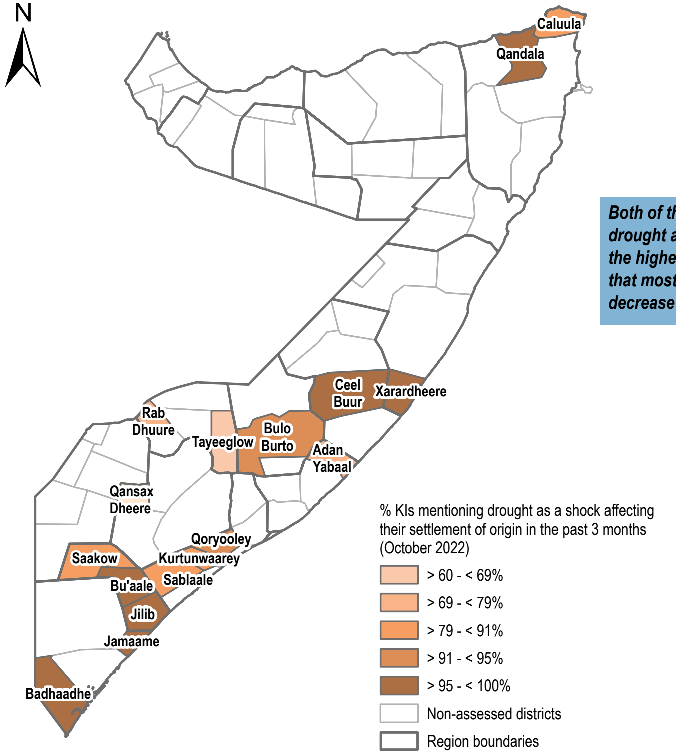
There are a number of small agro-pastoral zones scattered throughout the region. This type of **rain-fed agriculture practiced in these regions is particularly vulnerable to climatic fluctuations, with good harvests relying on regular rainy seasons with sufficient amounts of rainfall.** Therefore, the timings of the rains are also important. Rainfall irregularity and insufficiency (see also Graph 4.1) might be behind the considerable decrease in HHs engaged in crop farming indicated by Graph 7.2. See Box 7.2 for mini zoom-in on one of these agropastoral zones.

i As mentioned previously, the standardised Precipitation Index (SPI) is a useful tool to understand rainfall variability. SPI-6 is useful for showing seasonal variability, and long-term rainfall deficiencies that could affect ground and surface water availability.

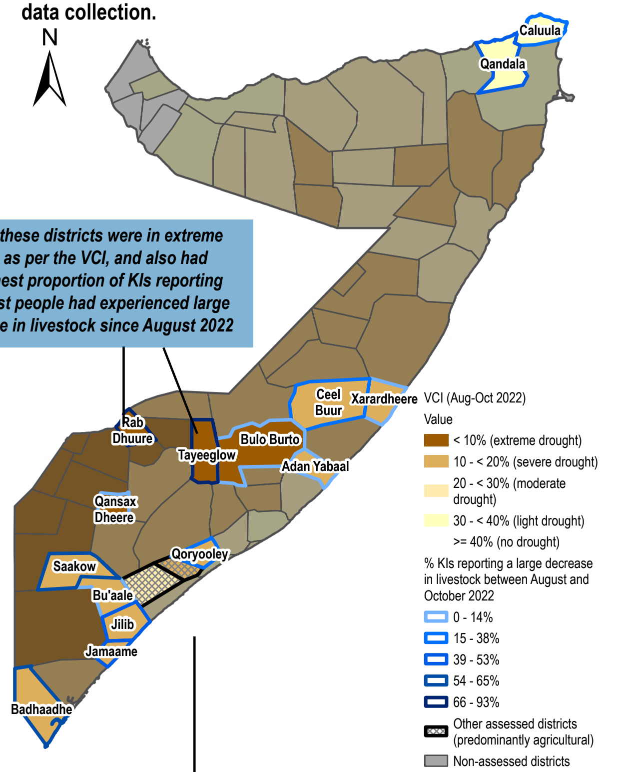
8. SOMALIA ZOOM-IN - DROUGHT IMPACTS BY LIVELIHOOD TYPE

Districts assessed during the REACH Humanitarian Situation Monitoring (HSM) survey in hard-to-reach areas (October 2022). Findings express % of KIs reporting on the situation in a hard-to-reach settlement they have updated knowledge about. *See p.14 for more info on methodology.*

Map 8.1: % of KIs reporting drought was a shock that had affected their settlement in the 3 months prior to data collection.[i]



Map 8.2: Average VCI (Aug- Oct 2022), and % KIs in assessed predominantly pastoral/agro-pastoral districts reporting most people had experienced a large decrease in livestock in the 3 months prior to data collection.



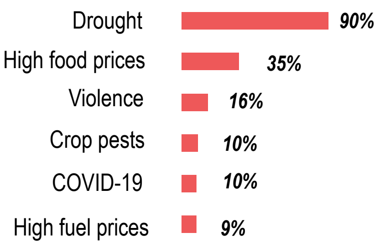
Map 8.1 shows assessed districts, as well as % of KIs expressing drought as a shock affecting their settlement in the 3 months prior to data collection. Regarding those who had migrated from assessed settlements since August 2022, **63% of KIs reported that drought was the primary push factor.** Almost half of KIs (43%) also reported that **surface water, which is particularly vulnerable to drought, was the main water source used by most HHs in assessed districts.**

Maps 8.2 and 8.3 aim to represent the impacts of the drought on specific livelihood types by utilising both remote sensing (VCI) over relevant timescales, and quantitative data from the HSM survey. **Between June and October 2022, districts with the highest % of KIs reporting that most HHs had experienced large decreases in livestock generally also had lower VCI**, indicating more severe drought (Chart 8.3).

Notably, of assessed districts, **Rab Dhurre and Tayeeglow had the lowest VCI, as well as the highest % of KIs reporting large decreases in livestock.** This supports the notion that drought indices such as VCI can **help predict potential humanitarian conditions in areas with no primary data if basic livelihood information is known.**

As shown in map 8.3 below, in agricultural/agro-pastoral districts, KIs commonly reported **crop yields had been lower for most people in the settlement in the most recent *Gu* harvest compared to the previous one.** Particularly in Jamaame, all KIs (100%) who reported farming was a main livelihood source in the hard-to-reach settlement they were reporting on **(24%), perceived the harvest yields to have been much lower than in 2021. This district also had the highest proportion of surface area in severe or extreme drought as per the VCI**. Note that the % of KIs who reported crop cultivation as a main livelihood source was highest in Kurtunwaarey (71%); here, too, nearly all KIs reported perceiving much lower yield for most people. **Overall, the link between VCI and primary data suggests the relevance of VCI as a proxy indicator of potential livelihood impacts in hard-to-reach areas.**

Chart 8.1: Reported shocks experienced in the settlement since August 2022, by % of KIs.



i In all assessed districts, the majority of KIs reported drought had been a shock, the lowest being 60% in Qansax Dheere

Chart 8.2: Reported main water source used by most HHs in the settlement in the month prior to data collection, by % of KIs

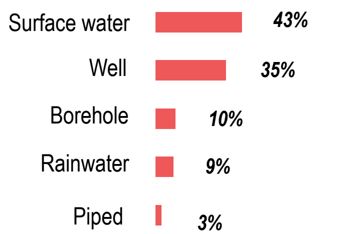
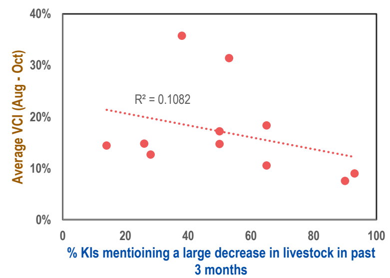
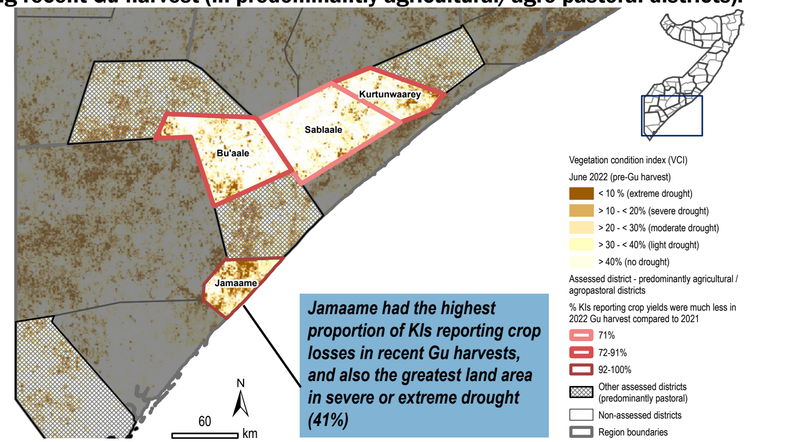


Chart 8.3: average VCI (Aug-Oct) vs KIs reporting most people had experienced large decreases in livestock in 3 months prior to data collection.



Map 8.3: Average VCI (June-July 2022, preceding *Gu* sorghum harvests in agricultural and agro-pastoral zones), and % KIs reporting most HHs experienced crop losses during recent *Gu* harvest (in predominantly agricultural/agro-pastoral districts).[i]



i Subset of those KIs that reported agriculture as a main livelihood source in the hard-to-reach settlement

9.1. CONCLUSIONS

Since late 2020, much of the region has been affected by the worst drought in decades, with five consecutive failed rainy seasons as of January 2023 and a sixth one predicted for the upcoming 2023 *long rains* season. This report has used both quantitative data and remote sensing analysis with the objective to better understand timing, frequency and severity of drought across the Horn of Africa, as well as the impact it has had on different communities.

Remote sensing data indicates that the **present drought has been more severe than the two other most recent droughts in 2010-11 and 2016-17,** whilst research indicates the 2022 long rains were the worst in >70 years. Primary data collected by REACH in northwest Kenya and hard-to-reach districts of Somalia indicates that impacts have been widespread, with **pronounced shifts in rainfall-dependent livelihoods and increased challenges accessing food and water.**

Another objective of the study was to understand if and how remote sensing data could be used to compliment primary data collection and provide any indications of potential humanitarian conditions in areas not covered by primary data collection. With some knowledge of the livelihoods in the area, using indices such as VCI over specific timescales, e.g. immediately prior to harvests, should give some indication of potential crop health or pasture condition. These connections were made regarding the *Gu* harvest in parts of Somalia for example. However, further knowledge of the vulnerabilities of different populations should not be underestimated and users should be aware of the limitations of remote sensing. **Overall, findings suggest remote sensing can be used as a tool to provide indicative information to support prioritisation of areas for further, more granular analysis.**

Given the increasingly erratic weather patterns that are becoming more apparent due to climate change, increased flooding could also occur in the future, as in northwest Kenya in 2019. Predicted heavier rainfall events could in fact increase groundwater availability in some areas, and adaptive measures, such as tapping into these sources or rainfall retention, could help build resilience to future droughts. In addition, the analysis hinted at the **potential of comparing soil moisture and vegetation conditions to support drought early warning.** When applied to specific areas in the Horn of Africa, this might provide **a useful additional tool to help improve community preparedness to droughts.**

9.2. METHODOLOGY

This report uses a combination of remote sensing analysis, analysis of primary quantitative data collected from HH and KI surveys in selected locations across the region, and secondary data review.

Remote sensing analysis

The remote sensing component of this assessment utilises a range of data sources including Climate Hazards Group InfraRed Precipitation with Station (CHIRPS) rainfall data,[54] Moderate Resolution Imaging Spectroradiometer (MODIS) Enhanced Vegetation Index (EVI) data,[55] and MODIS Normalised Difference Water Index (NDWI).[56] These data sources were accessed through Google Earth Engine (GEE), with further analysis of the CHIRPS and EVI data performed on this platform to create Standardised Precipitation Index (SPI) and Vegetation Condition Index (VCI) data respectively.

When calculating SPI, the full period of CHIRPS rainfall data availability, from 1981 to present, was used as a baseline. The index then calculates the anomaly from this baseline for a specific time period (usually a period of 1, 2, 3, 6, 12 or 24 months), and can be a useful indicator of potential drought conditions or excess of rainfall.[57] In addition, surface soil moisture anomaly was taken from the Soil Moisture Active/Passive (SMAP) dataset extracted from GEE,[58] as it has been identified as a proxy early warning for drought conditions.[59] Finally, VCI data was used, which helps to understand the impacts of drought on vegetation greenness, and calculates anomalies in vegetation indices to provide a standardised classification of drought severity.[60] This was developed based on a baseline of average MODIS EVI between 2001 and 2021. Further details of how these indices were developed and how to interpret them are provided in the respective sections.

Primary data on drought impacts and humanitarian needs

The primary quantitative data referenced in this report was collected by REACH for selected regions of Kenya and Somalia. For Kenya, household (HH)-level data was collected in Turkana and Marsabit under REACH's Multi-Sectoral Impact of Drought HH survey conducted in October 2022. The objective of this assessment was to better understand the impact of the drought on HHs and their needs across relevant sectors including food security and livelihoods (FSL); water, sanitation and hygiene (WASH), health, and nutrition. HHs were selected through a stratified simple random sampling technique, whilst recent arrivals in Sololo village, Marsabit county, were treated as an isolated strata. These IDPs are from Ethiopia and reportedly settled here in response to the drought in the country. In total, 2241 HH interviews were conducted and the data has a 95% confidence interval with a 7% margin of error. See methodology note for more details.

In Somalia, data from REACH's Humanitarian Situation Monitoring (HSM) survey conducted in October 2022 in hard-to-reach districts of the country was utilised. A total of 17 districts were assessed remotely through the "Area of Knowledge" methodology, which involves use of key informant (KI) interviews to provide information on humanitarian needs and conditions in target settlements. KIs who could testify to have sufficient knowledge of the target settlement; for example, if they had been recently displaced from or regularaly travel to target districts, were identified through purposive and snowballing sampling methods. Note that findings are indicative only. See methodogy note for more details. Unfortunately no data was collected in Ethiopia due to access issues.

9.3. LIMITATIONS

Remote sensing is an invaluable tool for understanding climatic and environmental conditions over large areas and long timescales. In addition, it allows spatial and temporal comparison of these conditions, which can be important for the humanitarian and disaster risk management community to support prioritisation of interventions and aid delivery to most affected areas.

In terms of the remote sensing analysis conducted, SPI is limited by the fact it does not account for temperature and potential evapotranspiration. One alternative would be the SPEI which also accounts for temperature variability and extremes.[62] However, this is more complex to calculate. Regarding VCI, this analysis has used relatively low resolution (500x500m) data to speed up processing. However, this might not capture details in larger scale maps. An alternative would be to use Sentinel 2 imagery (10x10m resolution).

There are limitations to the accuracy and interpreability of remote sensing data alone when investigating impacts of droughts on livelihoods and the environment. This is why this data should always be cross-checked with other primary or secondary socioeconomic data sources where possible.

Primary data was only collected in specific locations across the region, hence findings might not represent the situation in non-assessed areas in the Horn of Africa. Due to security and access-related constraints, no primary data could be collected in Ethiopia.

Moreover, data from the REACH HSM assessment in Somalia is not generalisable with a known level of precision and should be considered indicative of the situation only in the assessed hard-to-reach settlements. Moreover, while HH data from the H2H survey in Kenya was representative at the county level, findings related to subsets of the total sample are not generalisable either.

Lastly, the sampling, methods, and survey tools used in Somalia and Kenya were inherently different, and findings can thus not be directly compared.

ACRONYMS

EVI: Enhanced Vegetation Index
HH: Household
HSM: Humanitarian Situation Monitoring
IPC: Integrated Phase Classification
KI: Key Informant
NDMA: Kenya National Drought Management Authority
NDVI: Normalised Difference Vegetation Index
NDWI: Normalised Difference Water Index
SPI: Standardised Precipitation Index
VCI: Vegetation Condition index

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