IMPACTS OF CLIMATIC SHOCKS ON COMMUNITIES

April 2024 | Kenya

KEY MESSAGES

- **Following 5 failed rainy seasons between 2020-22, rainfall was conversely well above average in 2023, particularly during the short rains when flooding was widespread.** In this report, remote sensing analysis has been triangulated with household-level data on climatic shocks and impacts from May 2023.
- As of May 2023, the data suggests that longer-term impacts of the 2020-22 drought due to factors such as reductions in livestock populations and high food prices still appeared to be adversely affecting food insecurity and livelihoods, despite higher-than-average rainfall. At that time, **35% of households (HHs) in assessed counties were still reporting drought as a major shock affecting them in the 3 months prior to data collection**, reaching 76% in Turkana South and 70% in Turkana East sub-counties.
- Food security was very poor in areas such as Turkana, with almost half of the HHs **(49%) having a poor food consumption score (FCS) in Turkana East**. Turkana was one of the counties worst affected by the 2020-22 drought, and the poor average FCS indicates that the situation may not have improved much as of May 2023. In addition, rainfall was also only slightly above average compared to other counties in 2023. **However, large areas of the county, particularly in Turkana South and East, were significantly drier than average during the 2023 short rains**. Water insecurity was also poor in some areas, with Mandera having the highest proportion of water-insecure HHs (36%).
- **The impacts of flooding that started in October 2023 were also likely exacerbated by the years of drought, degrading the topsoil and increasing runoff**. For example, a high proportion of households in Mandera West and South widely reported both floods and drought as shocks affecting them in the 3 months prior to data collection.
- The **latest seasonal forecast indicates that the 2024 March-May rainy season will be much wetter than normal**, and at the time of writing, further flooding has been seen across the region.

CONTEXT

Introduction

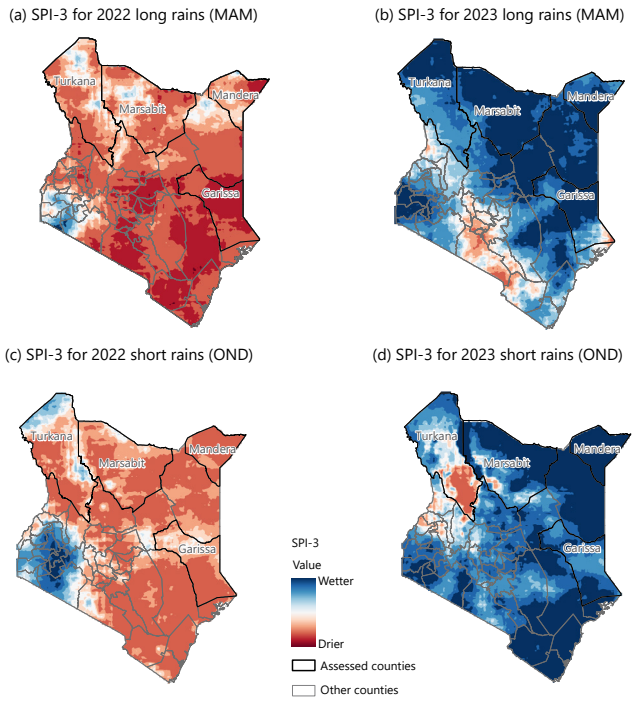
After several years of consecutive failed rainy seasons and protracted drought, much of Kenya was hit by heavier than average rainfall and flooding in 2023, particularly towards the end of the year.[i] These dramatic shifts in rainfall patterns were associated with fluctuations in climatic phenomena such as the El Niño Southern Oscillation (ENSO) and Indian Ocean Dipole (IOD), and further exacerbated by climate change. Whilst the high rainfall observed in 2023 has reportedly led to some improvements in food security across the country,[ii] the prolonged drought also continues to impact livelihoods in much of the arid and semi-arid lands (ASAL), which cover over 80% of Kenya's land area.[iii]

This study investigates climatic patterns throughout 2023 and the impacts of climatic shocks on communities, using both remote sensing analysis and primary data collected from the Multi-Sectoral Needs Assessment (MSNA) conducted in May 2023. The study focusses on Turkana, Marsabit, Mandera and Garissa counties where MSNA data was collected. These counties are some of the worst affected by the prolonged drought, as well as by the flooding which occurred in October 2023.

Climate and situation overview

The ASAL region remains highly vulnerable to floods and droughts,[iv] which scientists say are being exacerbated by climate change across the region.[v] The region experiences two distinct rainy seasons; the long rains between March and May, and the short rains which fall between October and December. Map 1 below shows the Standardised Precipitation Index (SPI) in these two seasons in both 2022 and 2023, and clearly highlights that rainfall was significantly higher than average during both rainy seasons in 2023 across most of Kenya. This is also in stark contrast to the same seasons in 2022, which the maps indicate were significantly drier than usual.

Map 1: SPI-3 for (a-b) March, April, May (MAM) in 2022 and 2023; and (c-d) October, November, December (OND) in the same years. These periods approximately relate to the long rains and short rains in Kenya.



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 (e.g. SPI-3) indicative of seasonal trends, and longer timescales (>SPI-12) relating to groundwater and reservoir storage**. Here, SPI-3 has been used to correlate with the approximate length of the two main rainy seasons in Kenya.

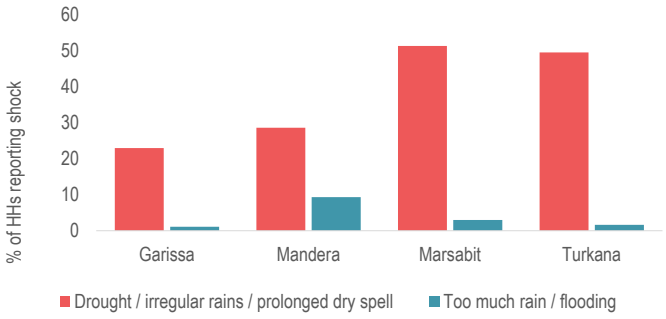
Whilst the favourable rainfall during the 2023 long rains season generally resulted in improved harvests and some improvements to food security, seasonal challenges remained, such as high staple food prices, increased inflation, and flash flooding.[vi] The Integrated Phase Classification (IPC) Acute Food Insecurity (AFI) analysis released in September 2023 indicated that all four focus counties of this study were in Phase 3 (Crisis) between July and September. Garissa was projected to be in Phase 2, while the other three counties were expected to remain in Phase 3 until January 2024.[vii] Note that parts of Turkana East and South again received lower than average rainfall during the 2023 short rains, whilst MSNA data indicated food security was already very poor in these areas as of May 2023, livestock losses had been among the highest.

Flooding and long-term impacts of drought

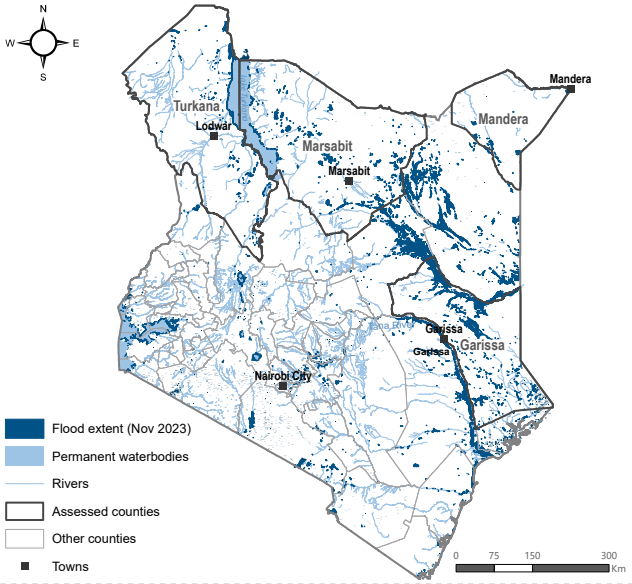
Some flash flooding occurred during the long rains in 2023, although the most severe flooding was observed during the short rains season (Map 2), leading to 174 deaths as of 20th December,[viii] displacing thousands, destroying infrastructure, and resulting in livestock deaths and cropland damage across the region. Northeastern Kenya, including Mandera and Garissa counties, were among the worst affected counties.

Despite the higher rainfall and flooding observed in 2023, the outcomes of the prolonged drought also appear to have remained a significant contributing factor negatively affecting populations across the ASALs. This includes reductions in livestock populations and smaller cultivation areas due to lower purchasing power.[ix] In addition, the effects of flash flooding in 2023 were exacerbated by the dry conditions in the preceding rainy seasons, degrading the topsoil and reducing the ability of the land to absorb water from heavy rainfall.[xii]

Fig 1: Proportion of HHs reporting shocks in the six months prior to June 2023.



Map 2: Flood extent map as of November 2023 based on UNOSAT data[xiii]



Climatic trends and drivers

The climatic trends observed throughout 2023 appear to correlate with fluctuations in the Indian Ocean Dipole (IOD) and El Niño Southern Oscillation (ENSO). Related to sea surface temperature anomalies in the Indian and Pacific oceans respectively, these regional phenomena have global impacts on the climate.[xiv]

The past few years have also been characterised by a positive Southern Oscillation Index (SOI), known as La Niña, and generally related to drier than normal conditions in East Africa. However, this shifted to a negative SOI (El Niño) in 2023, characterised by wetter than normal conditions across the region,[xv] as has been observed. In addition, the IOD, which is currently in a positive phase, has a strong influence on climate variability during the short rains season in particular, generally leading to increased rainfall during this season, as has been observed.[xvixvii]

Finally, the intensity of the flooding and prolonged drought appears to have been further exacerbated and intensified by climate change. Some scientists suggest that increasing sea surface temperatures due to climate change are leading to shifts in ENSO cycles and increasing the intensity of El Niño and La Nina events.[xviii]

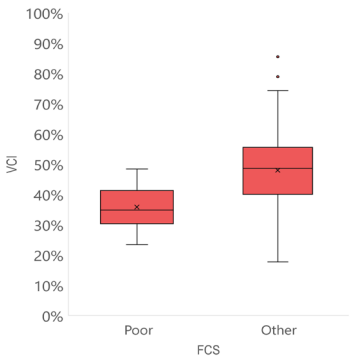
What can remote sensing tell us about potential food security outcomes?

Whilst remote sensing can tell us a lot about the environmental and climatic conditions of a certain location at a specific period of time, it is also important to understand the actual impacts of potential climatic shocks on the humanitarian situation. Correlating remote sensing indices with household (HH) indicators related to food security outcomes, or other variables, can help provide a deeper understanding of how different environmental or climatic indicators relate to humanitarian conditions. In addition, it could also provide useful insights into potential humanitarian conditions across wider areas, and even between data collection rounds or in hard-to-reach areas where data collection is not possible.

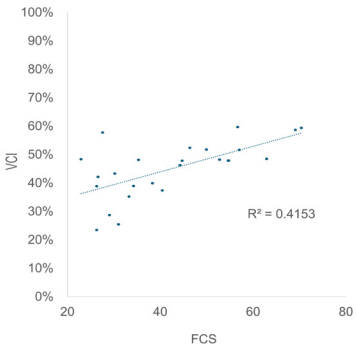
Here, the correlation between food consumption score (FCS) and vegetation condition index (VCI) between April and June is explored for agropastoral HHs. The area was split into a regular grid of 10km-diameter hexagons. FCS was then averaged across all households within each hexagon, whilst VCI was averaged across each hexagon area. The data indicates that despite some outliers, lower VCI, indicative of poor vegetation health, is related to lower FCS, associated with poor food security, especially for agropastoral HHs. Some similar correlations have already been investigated in REACH's 2023 Regional Drought Analysis, and will be further explored in the updated regional analysis to be published later in 2024.

Fig. 2: Correlations between average FCS as of May 2023, and VCI between April and May 2023 within 10-km diameter hexagons

(a) Hexagons with poor average FCS vs VCI



(b) Average FCS vs VCI, agropastoral HHs only, by hexagon



County zoom-in: Garissa

Context and livelihoods

Garissa County is semi-arid, and rainfall varies from 200-500mm/year in the drier western part of the county, up to 700mm/year in the south and east.[xix] The majority of the county lies within the Eastern Pastoral and Southeastern Pastoral livelihood zones, where most inhabitants rely on animal husbandry and livestock production for their income. However, many poorer households also supplement their income with casual labour. In total, over half the population is nomadic or semi-nomadic.[xx]

In contrast, the Tana Riverine Zone, which runs along the southern border of Garissa County, is primarily occupied by fully settled or semi-nomadic households. A range of rain-fed and irrigated crops are produced in this zone during both rainy seasons, both for subsistence and for market sale, whilst livestock keeping is also practiced.[xxi]

Climatic trends and shocks

As indicated by the rainfall graphs (Fig 3a), annual rainfall in 2023 was over 50% higher than the long-term average (1981-2020). It is also interesting to compare these trends with 2022, which was characterised by severe drought conditions in which both rainy seasons showed very poor performance overall.

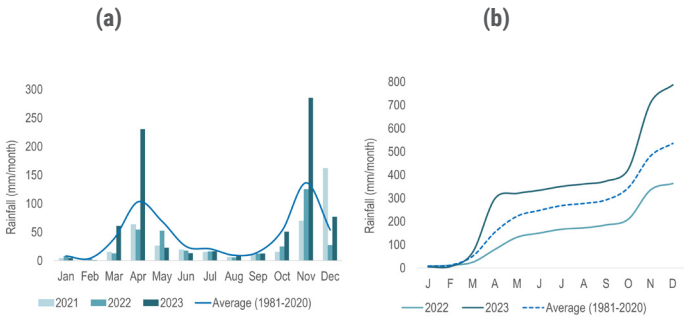
In 2023, April and November saw the highest quantities of rainfall, exceeding double the monthly average. The cumulative rainfall graph (Fig 3b) shows that the long rains began earlier than usual in 2023, with the most rainfall falling towards the start of the season. This is in stark contrast to 2022, where there was a marked delay to the onset of the long rains. Meanwhile, the data shows that the short rains season started approximately on time, although the rainfall far exceeded average in November.

Despite high rainfall in April 2023, MSNA data from May indicated that 19% of HHs reported to have been affected by drought and just 1.3% reported to have been affected by flooding or too much rain as a shock in the 3 months prior to data collection. This indicates that the heavy rainfall experienced at this time had not yet relieved the ongoing impacts of the protracted drought.

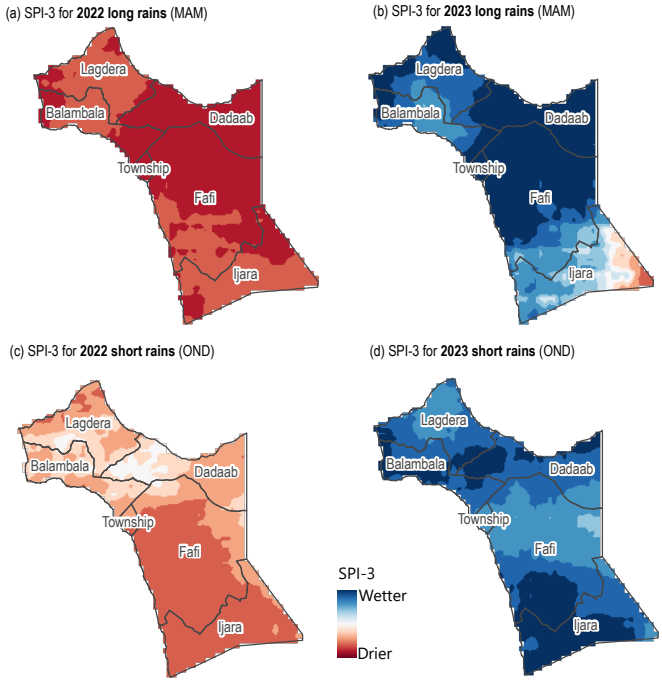
The SPI maps (Map 3) help identify spatial trends in rainfall anomalies across the county and show that both the short rains and long rains were significantly wetter than average across the majority of Garissa County in 2023. Only the southeastern corner of the county saw dry conditions during the long rains. The SPI maps for 2022 highlight the stark difference in conditions, where the entire county was significantly drier than average. This is likely to have degraded the topsoil, reducing its ability to absorb water and thus exacerbating the impact of the flooding in 2023.[xxii]

Despite relatively consistent rainfall anomalies across the county, MSNA data indicated that Lagdera and Dadaab had the highest proportion of HHs (48% and 42% respectively) reporting to have been affected by drought in the 3 months prior to data collection in May 2023, which is significantly higher than the county average of 19%.

Fig. 3: (a) Average monthly rainfall across Garissa County (2021, 2022 and 2023 vs 1981-2020 average); and (b) cumulative monthly rainfall across county in 2022 and 2023 vs 1981-2020 average.



Map 3: (a-b) SPI-3 for March, April, May (MAM) in 2022 and 2023; and (c-d) October, November, December (OND) in the same years



Impacts on livelihoods

Across Garissa County, 46% of assessed HHs reported to own livestock. Of those, 31% HHs mentioned experiencing a minor increase in the number of livestock owned in the 6 months prior to data collection in May 2023. Despite this improvement among some HHs, 25% reported a minor decrease and 30% reported a large decrease. Of those that reported a decrease, 56% reported this was due to disease outbreaks, 41% due to lack of fodder and 37% due to lack of water. These findings suggest continued impacts of the protracted drought were still outweighing the impact of above average rainfall during the 2023 long rains.

On the other hand, just 3.7% of assessed HHs reported to have planted crops during the March-May 2023 rainy season. Of those that reported not to have planted, the most reported reason was lack of land for planting, whilst 22% did not plant because they perceived the rainy season would fail or because of drought, indicating some levels of climate uncertainty at this time among farmers in the county.

Using remote sensing analysis, it is possible to understand the potential impacts of climatic shocks on the environment, which have knock-on effects on populations reliant on it. Specifically, the vegetation condition index (VCI) and rootzone soil moisture has been analysed to help understand impacts of seasonal rainfall performance on environmental regeneration.

Fig 4 shows the monthly change in VCI across the county since January 2020. VCI reached its lowest point just before the 2022 short rains, towards the end of the protracted drought across the region. Whilst vegetation did recover above 2022 levels following the 2023 long rains season, values peaked early in April, returning to very dry conditions again from June.

The map 4 shows that vegetation was dry in some parts of the county such as Balambala, Lagdera and parts of Fafi following the 2023 long rains, most likely due to poorer rainfall during the preceding seasons in these areas, and the cumulative effects of the protracted drought on soil and vegetation degradation. This could have resulted in poor conditions for livestock due to poor pasture regeneration in these areas. Balambala and Lagdera sub-counties also had the highest proportion of assessed HHs with a poor food consumption score (FCS) as of May 2023, at 46% and 41% respectively. This is significantly higher than the county average of 24%.

Despite these findings, there was generally substantial vegetation regeneration compared to 2022, particularly following the 2023 short rains (November 2023-January 2024), aside from some small pockets in Lagdera. However, if the next rainy season shows poor performance, these areas could easily return to drought conditions, with likely negative effects on food security.

Fig 4: Monthly vegetation condition index (VCI) in Garissa County (Jan 2020-23). Values below the red line are considered drought conditions, with values lower than 20% representative of severe drought.

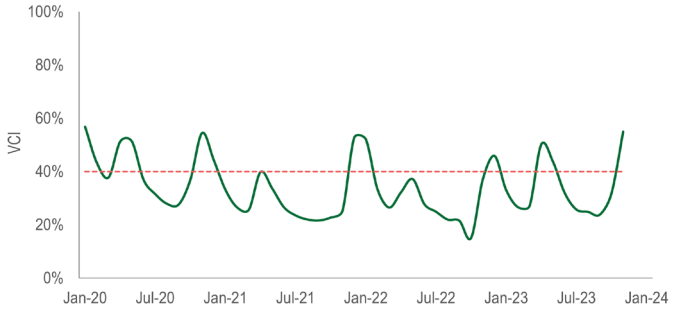
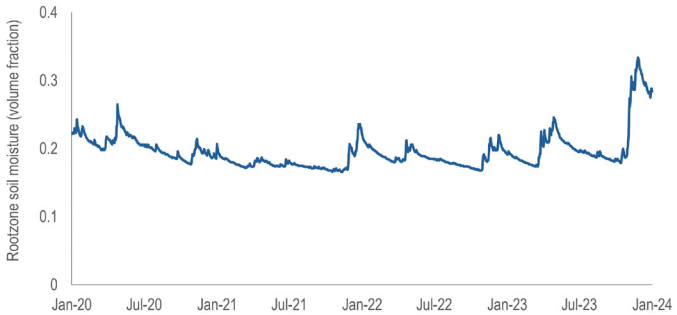
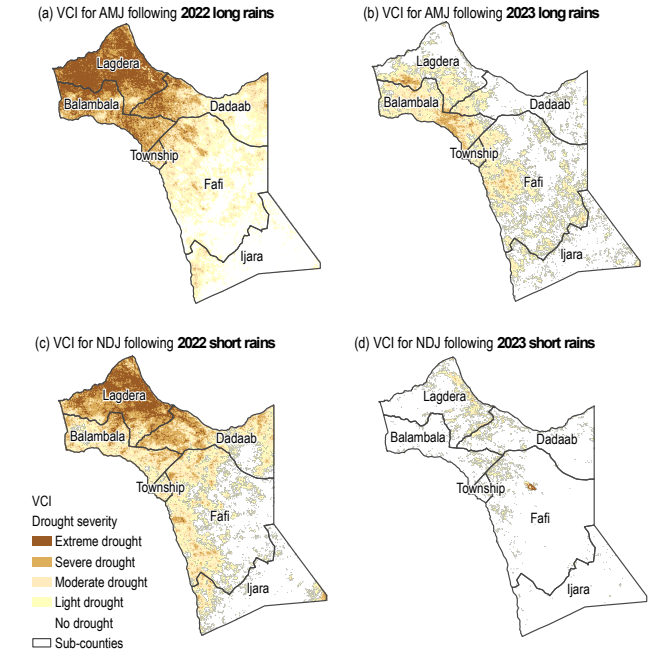


Fig 5: Rootzone soil moisture across Garissa County (Jan 2020-23).



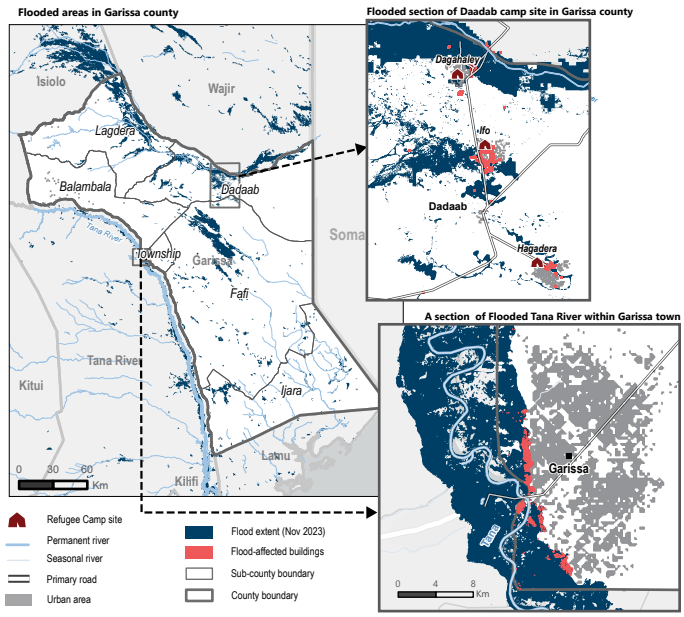
Map 4: Average VCI across Garissa County in April, May, June (AMJ) and November, December, January (NDJ) in 2022 and 2023. These months were selected to account for the slight lag in grassland regeneration from the start of the rainy seasons in March and October.



Flooding in Garissa county

Garissa county was one of the worst affected by flooding in 2023,[xxiii] which was most severe towards the end of 2023. Elevated rainfall during the short rains season led to the Tana River overflowing its banks[xxiv] and inundation in the floodplains to the north and centre of the county (map 5).[xxv] This led to the destruction of major roads,[xxvi] and inundation of thousands of buildings.[xxvii] According to MSF, 16,698 people had been displaced by flooding in Garissa Township alone as of February 2024.[xxviii] Figure 5 shows the rootzone soil moisture, which clearly peaked to very high levels at the end of 2023, reaching a volume fraction of 0.3. This high level of ground saturation would have heightened the susceptibility the area to flooding across the county.

Map 5: Flood extent in Garissa County as of November 2023



County zoom-in: Mandera

Context and livelihoods

Mandera County has an arid environment and temperatures average at 20 – 36°, whilst rainfall is erratic and ranges from 200-400 mm per year,[xxix] being wetter to the west and driest to the northeast. Most of the county is located in the Northeast Pastoral Zone which is primarily populated by semi-nomadic (40%) and fully nomadic (30%) HHs. Livestock production is the most significant source of income across the zone, whilst petty trade is also practiced, particularly during times of stress. Due to poor agronomic conditions, most cereals, pulses, and vegetables are purchased in the market. However, wild foods also serve as an important food source.[xxx]

As mentioned, the west of the county receives slightly more rainfall than other parts of the county. This area falls within the Northeast Agropastoral livelihood zone, which supports a small amount of rain-fed crop production. Finally, the northwest corner of the county falls within the Mandera Riverine Zone, which supports a small farming community along the Dawa River. The majority of the population in this zone are fully settled and 60% of HH income comes from food and cash crop production.

Climatic trends and shocks

According to data from the MSNA, the most reported shocks in the 3 months prior to data collection in May 2023 were high food prices (29%), drought (28%), and lack of food (15%). Flooding was also mentioned by 10% of assessed HHs, the highest among all assessed counties, indicating Mandera experienced some of the more significant long rains flooding. However, as with other counties, it is important to note that flooding in 2023 was most severe during the short rains.

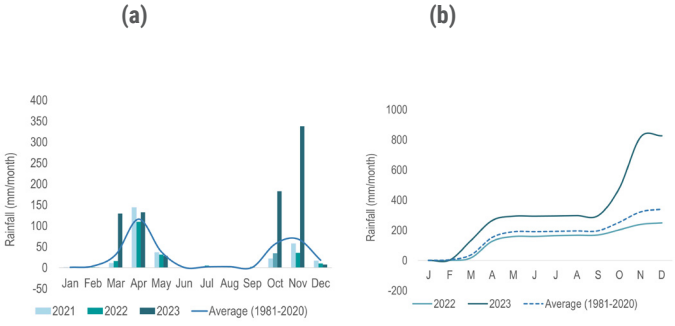
As indicated by Fig 6a and 6b on the next page, rainfall was significantly higher in 2023 compared to the long-term average (1981-2020). During the long rains season, an unusually high amount of rainfall fell at the start of the season in March, whilst the monthly total was close to average for the remainder of the season. However, the highest quantity of rainfall by far fell in October and November, resulting in an annual total 135% above the long-term average by the end of the year (Fig 6b). It is also interesting to compare these trends with 2022, where both rainy seasons showed slightly poorer performance overall.

The SPI maps (Map 6) provide some insights into the spatial variability of rainfall anomalies and show that both the short rains and long rains were significantly wetter than average across the entire county in 2023. However, MSNA data indicated that Mandera West and Mandera South sub-counties were the worst affected by drought in May 2023, with 45% and 32% of assessed HHs reporting it as a shock in the 3 months prior to data collection, compared to 28% average across the county. Floods on the other hand were also most widely reported in these same sub-counties (28% and 21% respectively, compared to average of 10% across the county).

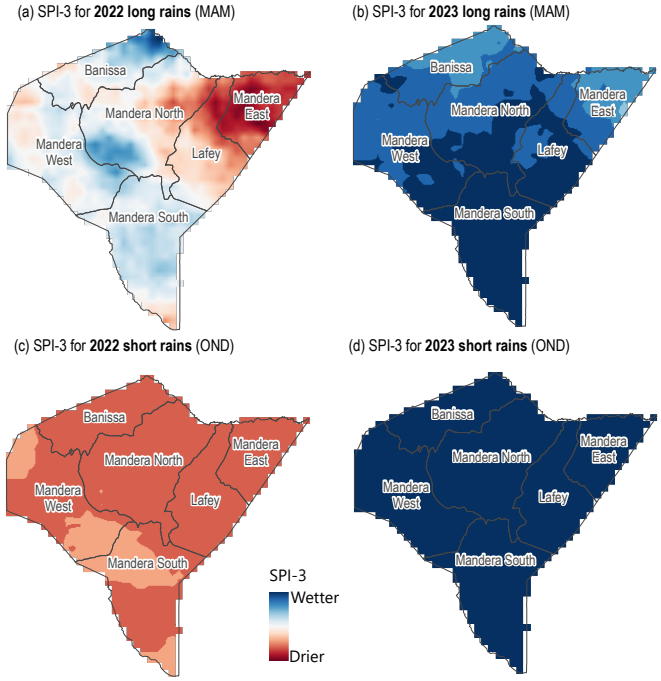
This indicates the exceptionally high susceptibility of these two sub-counties to climatic shocks, and possibly indicates that exceptionally dry conditions during the preceding drought exacerbated the impact of the flooding.

In 2022 on the other hand, the map also shows that the short rains were much drier than average across the entire county. During the 2022 long rains however, in contrast to the graphs which indicate conditions were also drier than average overall, rainfall performance showed considerable spatial variability and much of the county was in fact wetter than average.

Fig 6: (a) Average monthly rainfall across Mandera County (2021, 2022 and 2023 vs 2000-2020 average); and (b) cumulative monthly rainfall across county in 2022 and 2023 vs 2000-2020 average.



Map 6: (a-b) SPI-3 for March, April, May (MAM) in 2022 and 2023; and (c-d) October, November, December (OND) in the same years.



Impacts on livelihoods

According to the MSNA data collected in May 2023, 51% of assessed HHs owned livestock, of which 42% mentioned they had experienced a large decrease in livestock numbers in the past 6 months. On the other hand, 27% reported a minor increase, suggesting some improvements for some HHs. However, there was significant spatial variability, with 89% of assessed HHs in Mandera West reporting a large decrease. The most reported reasons for a decrease in livestock number were lack of water (75%), lack of fodder (68%), and disease (47%).

In terms of agriculture, 27% of assessed HHs reported to have planted crops during the long rains season in 2023. The majority of assessed HHs reported an increase (31%) or large increase (30%) in land area planted. This indicates that above average rainfall performance early in 2023 generally had a positive impact on agriculture.

However, it is interesting to note that 45% of those who did not plant in Mandera West cited flooding as their main reason, showing that high rainfall also resulted in negative impacts in some areas. Overall, 73% of assessed HHs had an acceptable FCS as of May 2023, which is significantly higher than in other assessed counties.

As with Garissa, the VCI and rootzone soil moisture have been analysed to help understand impacts of seasonal rainfall performance, as well as any prolonged impacts of the drought, on regeneration of the environment, on which much of the population depends to sustain their livelihoods. Fig 8 shows the monthly change in VCI across the county since January 2020. VCI was at its lowest between July 2021 and January 2023, when it increased with the 2023 long rains and further with the short rains, peaking at its highest point since before the recent drought at the end of 2023. Map 7 shows that vegetation was healthier than average in the majority of the county following the 2023 long rains, indicating substantial regeneration compared to the same period in 2022. This is stark contrast to 2022, where the majority of the county was very dry during this period.

Mandera was one of the counties worst affected by the flooding following the elevated rainfall during the 2023 short rains. The soil moisture graph (Fig 7) shows that soil moisture peaked to very high levels at the end of 2023, reaching a volume fraction of 0.3. This high level of ground saturation would have heightened the risk of flooding across the county. Again, longer-term impacts of the drought are likely to have reduced the ability of the soil to absorb rainfall normally.

Fig 7: Rootzone soil moisture across Mandera County (Jan 2021 – Dec 2023)

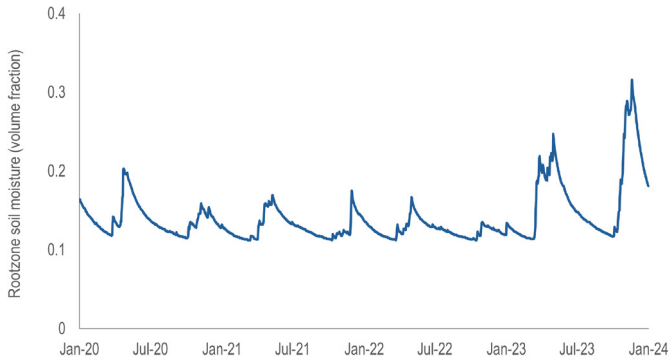
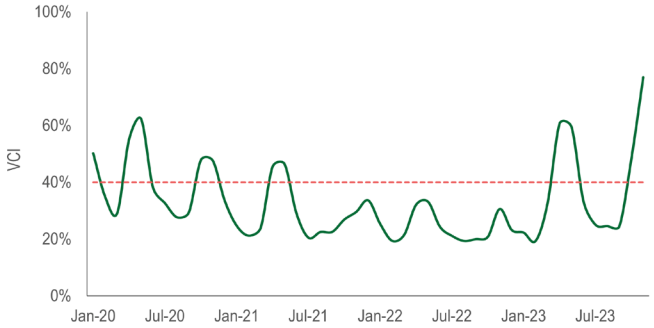
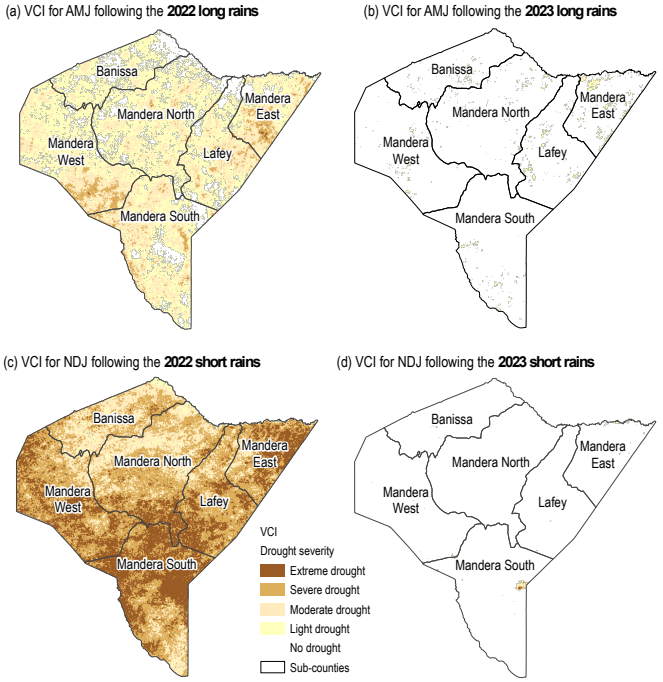


Fig 8: Monthly vegetation condition index (VCI) in Mandera County (Jan 2020 – Dec 2023). Values below the red line are considered drought conditions, with values lower than 20% representative of severe drought.



Map 7: Average VCI across Mandera County in April, May, June (AMJ) and November, December, January (NDJ) in 2022 and 2023. These months were selected to account for the slight lag in grassland regeneration from the start of the rainy seasons in March and October.



County zoom-in: Marsabit

Context and livelihoods

Marsabit County is predominantly a pastoral area, with most of the county area being covered by the Northern Pastoral Zone. Eighty percent (80%) of the inhabitants in this zone are semi-nomadic and a further 10% are occasional nomads. Livestock production constitutes 85% of household income. Whilst animal-derived food products such as meat and milk are mainly sourced from households' own production, the majority of other food items are purchased in the market, whilst wild foods also remain an important food source.[xxxi]

To the southeast of the county, close to Marsabit Town, lies the Marsabit Marginal Mixed Farming Zone, a small agropastoral area in a mountainous pocket. Here, 65% of inhabitants are fully settled. Whilst livestock contribution is the primary contributor to income (65%), cash crop production is important, providing around 30% of household income. Yields are generally poor due to lack of inputs, and as such, staple food production is mostly only consumed within the zone and not distributed outside. Finally, the Lake Turkana Fishing Zone lies along the lake shore and fishing and animal husbandry are the main livelihood activities. Rainfall is generally much higher in this area, reaching 1000 mm/year.[xxxii]

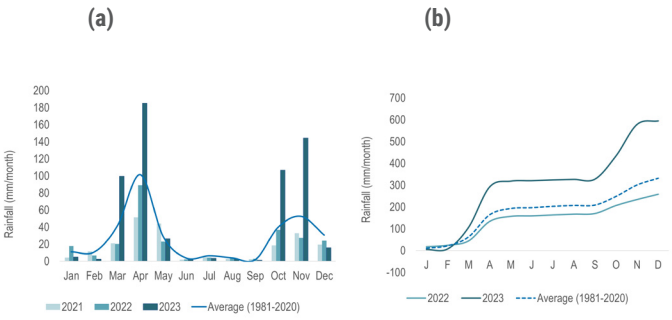
Climatic trends and shocks

As indicated by the rainfall graphs below (Figs 9a and 9b), rainfall was significantly higher in 2023 compared to the long-term average (2000-2020). During the long rains season, an unusually large amount of rainfall fell, especially towards the start of the season in March and April, whilst the monthly total was close to average in May. On the other hand, according to MSNA data from May 2023, high food prices were the most widely reported shock (65%) in the 3 months prior to data collection across Marsabit County, followed by drought (51%) and high non-food item (NFI) prices (30%). Flooding meanwhile was only reported by 3% of assessed HHs. This suggests that the ongoing impacts of the drought were still having a considerable impact on livelihoods during this time despite the high rainfall.

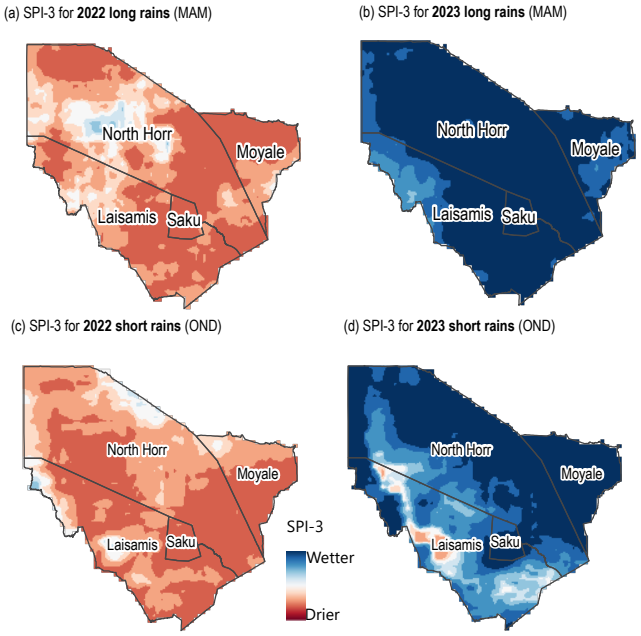
Rainfall was also higher than average during the 2023 short rains, with the majority of rain falling in October and November. By the end of the year, the annual total was 76% above the long-term average (Fig. 9b). It is also interesting to compare these trends with 2022, where both rainy seasons showed slightly poorer performance overall due to the prevailing drought across the region.

The SPI (Map 8) shows that besides a few localised areas, the majority of the county was significantly wetter than normal during both rainy seasons in 2023, and much drier than normal during the same seasons in 2022. There was not much spatial variability in the proportion of HHs reporting drought across all sub-counties. Flooding on the other hand was most widely reported in Laisamis sub-county (9%), which is significantly higher than the county average of 3%.

Fig 9: (a) Average monthly rainfall across Marsabit County (2021, 2022 and 2023 vs 2000-2020 average); and (b) cumulative monthly rainfall across county in 2022 and 2023 vs 2000-2020 average.



Map 8: (a-b) SPI-3 for March, April, May (MAM) in 2022 and 2023; and (c-d) October, November, December (OND) in the same years.



Impacts on livelihoods

MSNA data from May 2023 indicated that 53% of assessed HHs owned livestock, of which 78% experienced a large decrease in the 6 months prior to data collection. This figure was even higher (92%) in Laisamis sub-county. Of those HHs that experienced a decrease in livestock numbers, lack of fodder was the most widely reported reason (89%), followed by lack of water (79%). This indicates the ongoing impacts of the extended drought on livelihoods at this time.

In terms of agriculture, 36% of assessed HHs reported to have planted crops during the March-May rainy season in 2023. Of those who normally plant, 44% did not plant because they lacked land for planting, whilst 24% perceived that the rainy season would fail, indicating some climate uncertainty among farmers in the county following several consecutive failed rainy seasons.

Map 10 gives some insight into the conditions in agricultural areas in the Marsabit Mixed Farming Zone prior to harvests following the 2023 long rains. The map indicates that much of this area still remained in drought conditions, despite some improvements compared to the same time in 2022.

Marsabit County was also affected by flash flooding in 2023, the impacts of which were exacerbated by the effect of the prolonged drought on reducing the ability of the ground to absorb runoff. More livestock deaths occurred,[xxxiii] whilst roads were cut off, including major routes such as the Isiolo-Marsabit – Moyale route as rivers such as the Malgis in eastern Laisamis sub-county overflowed their banks. As mentioned previously, Laisimis sub-county also had the highest proportion of assessed HHs reporting drought in the 3 months prior to data collection. As of November 2023, eastern Laisimis sub-county and the southern areas of North Horr sub-county were the worst affected by flooding.[xxxiv]

Overall, 15% of assessed HHs had a poor FCS, whilst the sub-counties with the highest proportion of HHs with a poor FCS were North Horr (20%) and Laisamis (18%). The Household Water Insecurity Experiences (HWISE)[xxxv] indicators meanwhile showed that 27% of assessed HHs were water insecure, the lowest of assessed counties. However, Saku sub-county had a larger proportion of water insecure HHs (40%).

As before, the vegetation condition index (VCI) and rootzone soil moisture have been analysed to help triangulate information on the impacts of seasonal rainfall performance, as well as any prolonged impacts of the drought on the environment and populations reliant on it. Fig 11 shows the monthly change in VCI across the county since January 2020. Following the 2020 long rains, VCI remained very low across Marsabit County, reaching its lowest point at the end of 2022. Very little vegetation regeneration can be observed following the rainy seasons during this period, particularly in 2022 where the county remained in severe drought throughout the entire year. Some vegetation regeneration was finally observed following the 2023 short rains and further still during the 2023 long rains.

Whilst the maps (Map 9) show that vegetation was healthier than average in much of the county following the 2023 long rains, there were still large areas remaining in drought conditions, particularly in Laisamis and eastern North Horr sub-counties. Despite this, there was substantially more vegetation regeneration compared to the same period in 2022, where much of the county was in severe or extreme drought. The soil moisture graph (Fig 10) on the other hand shows that soil moisture peaked to elevated levels following both the short rains and long rains seasons in 2023, reaching a volume fraction of 0.25. This high level of ground saturation would have heightened the risk of flooding across the county.

Fig 10: Rootzone soil moisture across Marsabit County (Jan 2021 – Dec 2023)

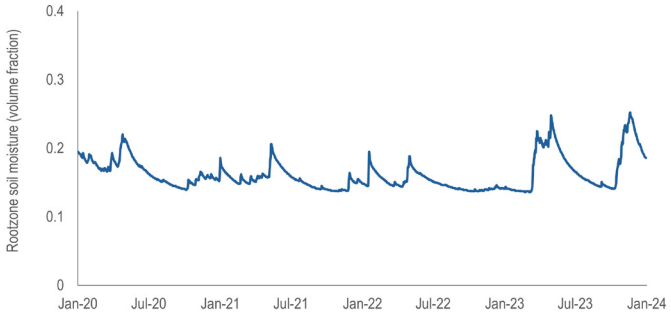
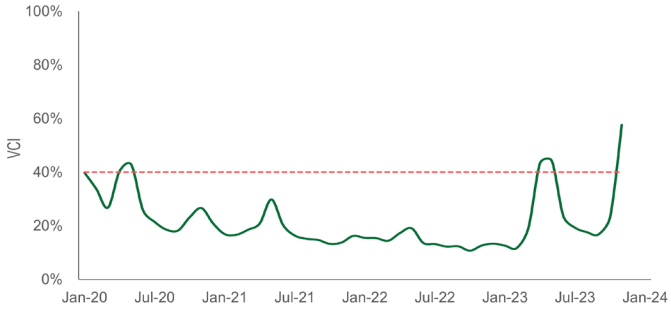
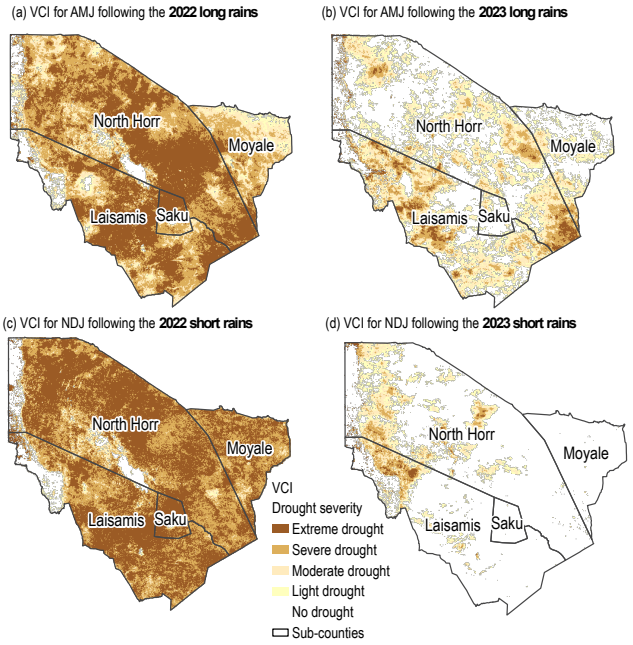


Fig 11: Monthly vegetation condition index (VCI) in Marsabit County (Jan 2020 – Dec 2023). Values below the red line are considered drought conditions, with values lower than 20% representative of severe drought

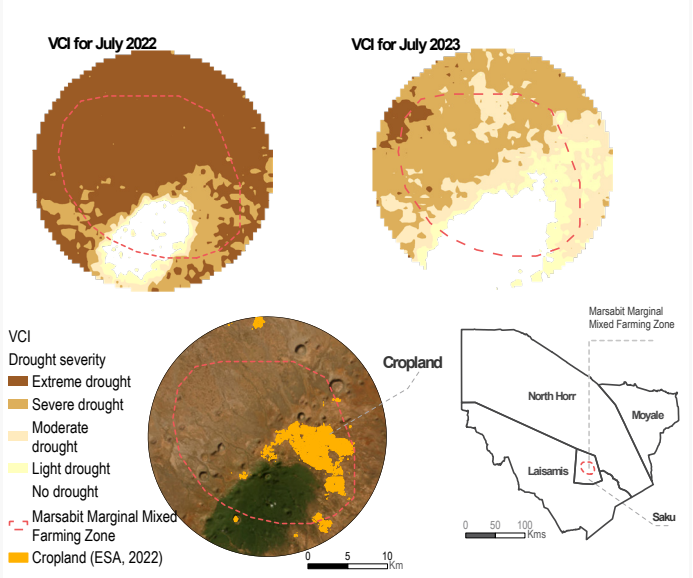


Map 9: Average VCI across Marsabit County in April, May, June (AMJ) and November, December, January (NDJ) in 2022 and 2023. These months were selected to account for the slight lag in grassland regeneration from the start of the rainy seasons in March and October.



Climate shocks and agriculture

Map 10: Average VCI in July 2023, i.e. prior to the long rains harvest, in the Marsabit Marginal Mixed Farming Livelihood Zone. Whilst a considerable improvement in vegetation condition can be observed in 2023, much of the agricultural zone remained in drought conditions.



County zoom-in: Turkana

Context and livelihoods

Turkana County has an arid environment, with annual rainfall averaging around 300-400mm year, and rain generally falling in brief violent storms which often lead to flooding. Note however that some mountainous areas across the county receive significantly higher rainfall. Pastoral livelihoods dominate across the county, with the Northwest Pastoral Zone covering the majority of the county area. Ninety-five percent (95%) of the inhabitants of this zone are nomadic, relying on livestock husbandry, as well as trade and hunting. Wild foods are an important food source across the zone. However, aid dependency is very high across the county and the area remains insecure due to cattle raiding and conflict with neighbouring communities.[xxxvi] Due to the severe impacts of climate change, pastoralism has become increasingly unsustainable in the county. With the support of NGOs, some inhabitants have developed kitchen gardens which provide sufficient food for their households, and sometimes an excess which can be sold in the market.[xxxvii]

There are a number of small agropastoral zones across the county, such as along the Turkwell River, and in the south of the county. These areas have a higher proportion of fully settled or semi-nomadic inhabitants, and inhabitants are more reliant on crop production for their income. Flooding is a frequent hazard in the Turkwell Riverine Zone. As with Marsabit, the shore along Lake Turkana lies within the Lake Turkana Fishing Zone, although rainfall is lower than on the Marsabit side.[xxxviii]

Climatic trends and shocks

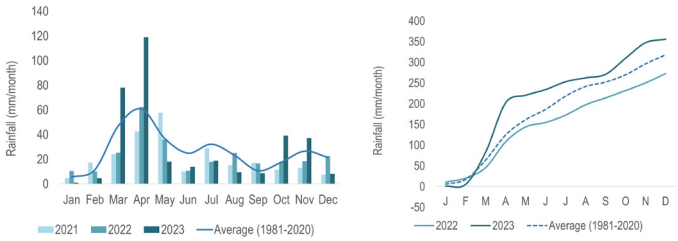
According to MSNA data collected in May 2023, the most widely reported shocks in the 3 months prior to data collection were drought (46% of assessed HHs) and lack of food (46%). Compared to the long-term average, Turkana County received marginally more rainfall in 2023, although cumulative rainfall reached only slightly above average by December 2023. March and April were the wettest months, whilst rainfall during the short rains season was only slightly above average. In 2022 meanwhile, rainfall was significantly lower than average.

Flooding was only mentioned as a shock by 1.4% of assessed HHs in May 2023 and it appears that the worst flooding occurred during the short rains. Whilst Turkana was not as badly affected by the flooding compared to other assessed counties, damage to houses, roads and bridges was reported. In October, floods were also reported at the Kakuma Refugee Camp.

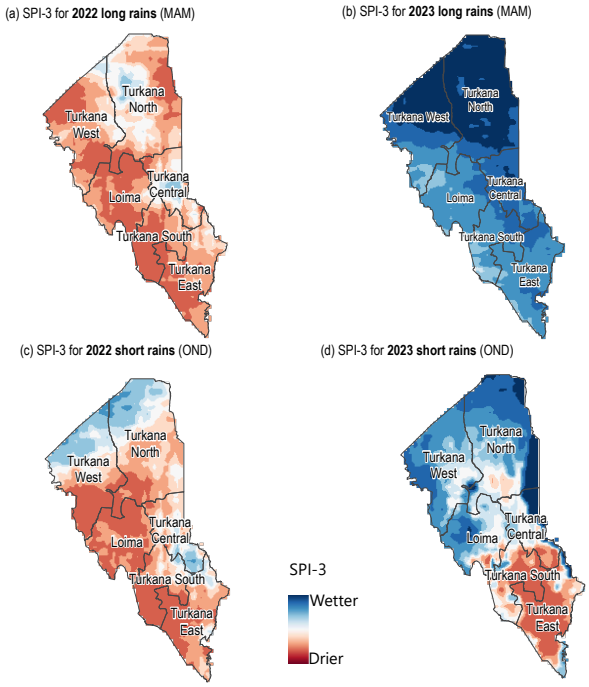
The SPI maps (Map 11) give an idea of the spatial distribution of drier and wetter conditions and highlight that the 2023 long rains season was much wetter across the whole county. However, conditions were more variable during the 2023 short rains, with dry conditions observed in the south, particularly in Turkana South and East sub-counties.

MSNA data also suggests that Turkana South and Turkana East were worst affected by drought as of May 2023, where 76% and 70% of assessed HHs respectively mentioned drought as a shock, meaning dry conditions during the short rains are likely only to have had further adverse impacts on livelihoods and water access.

Fig 12: (a) Average monthly rainfall across Turkana county (2021, 2022 and 2023 vs 2000-2020 average); and (b) cumulative monthly rainfall across county in 2022 and 2023 vs 2000-2020 average.



Map 11: (a-b) SPI-3 for March, April, May (MAM) in 2022 and 2023; and (c-d) October, November, December (OND) in the same years.



Impacts on livelihoods

Turkana County has been severely affected by the impacts of climate change in recent years, experiencing reductions in rainfall and increased dry spells, resulting in inadequate water and pasture for livestock.[xxxix] The county was one of the worst affected by the drought between 2020 and 2022, and almost half a million livestock were reported to have been killed due to drought by mid-2022.[xl]

From the start of 2021 to the end of 2023, VCI remained below 40% (Fig 14), indicative of drought conditions, except for a short peak following the 2021 long rains season. The lowest VCI was reached by early 2023, indicating the height of the prolonged drought. Following this, excessive rainfall during the 2023 long rains led to some vegetation regeneration.

Despite this, vegetation condition dropped back into drought conditions by July 2023, leading to poor conditions for crops and livestock. This is corroborated by reports which indicate low rainfall following the long rains season that resulted in large areas of rainfed crops drying up across the county. Livestock were also reportedly affected due to lack of water and poor pasture condition in July due to lower rainfall than normal.[xli]

MSNA results from May 2023 indicated a slight improvement in average FCS across Turkana County compared to November 2022.[xlii] This trend could be attributed to the improved performance of the 2023 long rains season.[xliii] However, the results found that food consumption remained poor, with nearly 33% having a poor FCS, reaching 49% in Turkana East.

In addition, MSNA results indicate that many households were still engaging in negative consumption-based coping strategies. This appears to be related to low income generation due to the ongoing impacts of the drought. This has meant that the livestock market is yet to stabilize, whilst livestock mortality has severely affected household wealth. In addition, costs of staple goods in the markets remained high due to poor harvests and high transportation costs.

Note that the MSNA data indicates that due to the difficulty of generating an income from livestock, many HHs in Turkana had adopted alternative livelihood opportunities including casual labour and sale of natural resources such as charcoal. This trend has been exacerbated by climate change, poverty and food insecurity, with climatic shocks such as the recent prolonged drought put extra pressure on these livelihoods.

MSNA results indicated that of the 56% of HHs reporting to own livestock, 45% reported a large decrease and 21% reported a minor decrease in the number of livestock in the 6 months prior to data collection. The primary reasons for this were lack of fodder (54%) and lack of water (38%), as well as disease outbreak (36%), indicating prolonged impacts from the drought.

Whilst flooding was only reported as a shock by 1.4% of assessed HHs in May 2023, secondary sources indicate localised areas were worse affected during the 2023 short rains. Whilst not as badly affected as other assessed counties, damage to bridges, roads and buildings was reported. In addition, at the Kakuma Refugee Camp in Turkana County, 43 refugee families had been affected. At least five people, including women and children, are reported to have drowned and died in various rivers in the county, according to initial reports.[xliv] Residents living near the Turkwel River, and other nearby rivers have been advised to move to higher ground for safety. Eleven houses in Loima Sub-County were reportedly flooded, and an unknown number of livestock were washed away.xliv

Fig 13: Rootzone soil moisture across Turkana County (Jan 2021 – Dec 2023)

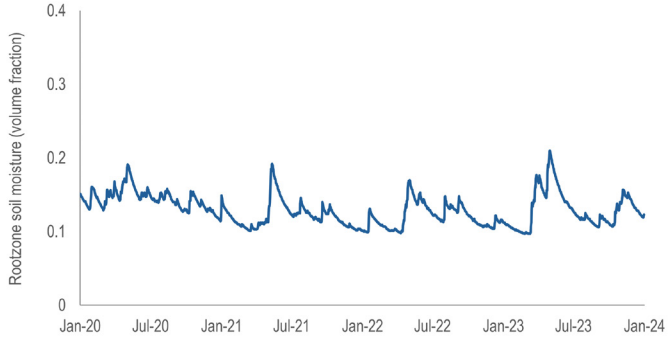
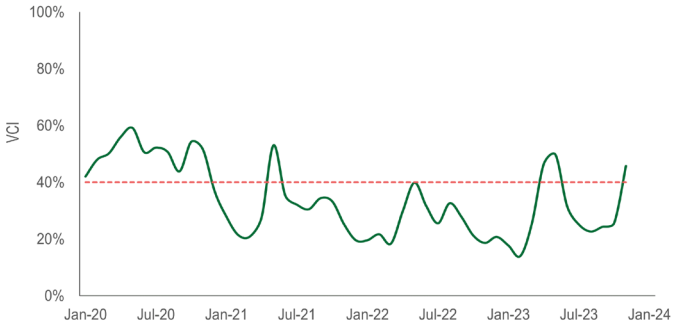
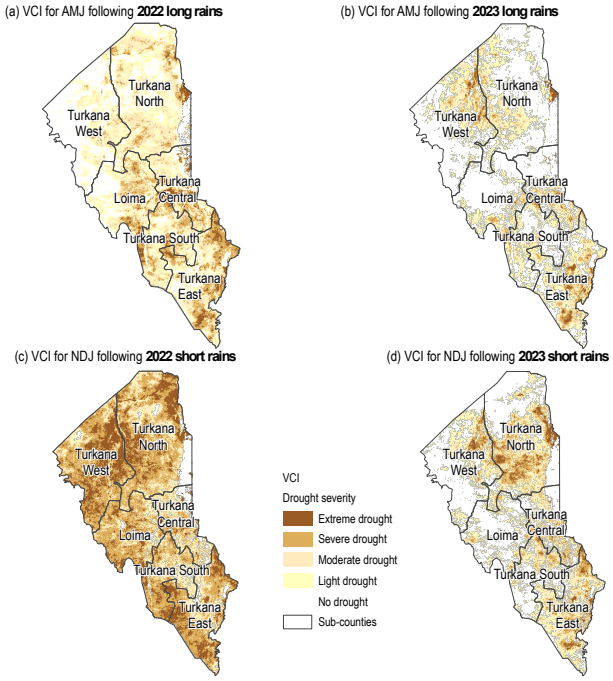


Fig 14: Monthly vegetation condition index (VCI) in Turkana County (Jan 2020 – Dec 2023). Values below the red line are considered drought conditions, with values lower than 20% representative of severe drought.



Map 12: Average VCI across Turkana County in April, May, June (AMJ) and November, December, January (NDJ) in 2022 and 2023. These months were selected to account for the slight lag in grassland regeneration from the start of the rainy seasons in March and October.

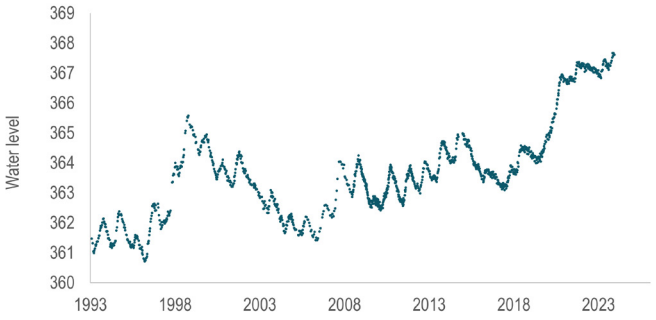


Changing water levels on Lake Turkana

As mentioned, Turkana County was one of the worst affected counties by the severe drought that struck Kenya between 2020 and 2022. Interestingly however, water levels on Lake Turkana also increased significantly during the same period.[xlv] Up to 90% of inflow to Lake Turkana comes from the Omo River in Ethiopia, and rainfall across the Omo catchment was very high during this period. This has had severe impacts on communities along the lake, as traditional fishing techniques are unable to catch fish from deeper levels in the lake.

Another driver of changing water levels on Lake Turkana is the development of the Gibe-III dam in Ethiopia, which caused water levels to drop in 2016. Whilst this was followed by an increase in water levels, local fishermen reportedly fear this is only temporary and water levels, as well as fish stocks, are at risk of falling in the long term.

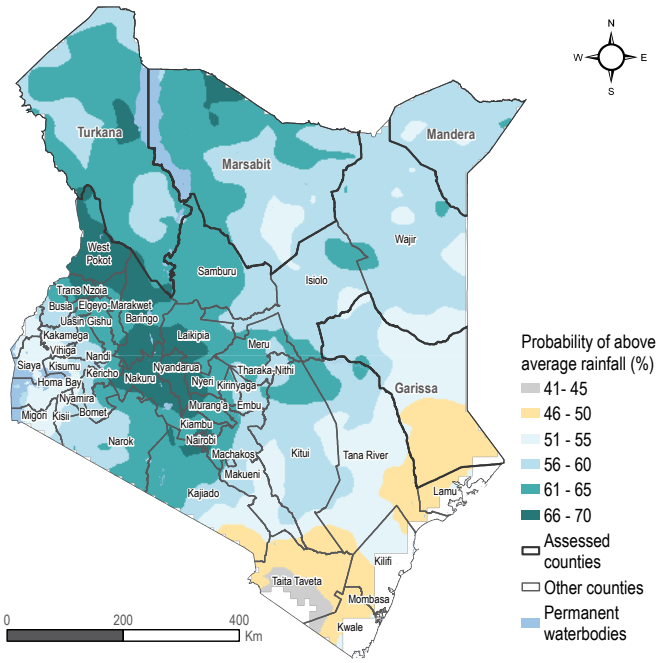
Fig 15: Changing water levels on Lake Turkana[xlvi]



Forecast

Map 13: March-May 2024 rain forecast

The rainfall forecast for the 2024 March-May season (long rains) indicates that there is a high probability of higher-than-average rainfall across the country. This may mean there is an increased risk of further flooding.



Conclusion

Due to recent shifts in climate patterns and the influence of climate change, much of Kenya and the wider Horn of Africa has experienced extreme climate variability in the last few years. Following five failed rainy seasons between late 2020 and late 2022, 2023 was significantly wetter, resulting in extensive flooding, especially in the northeast of the country. The susceptibility to flooding was increased further due to the dry conditions left by the multi-year drought, reducing the ability of the soil to absorb water. This assessment triangulated remote sensing data with REACH's Multi-Sectoral Needs Assessment (MSNA) conducted in May 2023, which showed that long-term impacts of the prolonged drought were still being felt at that time, despite the higher rainfall experienced during the 2023 long rains. By the end of 2023, substantial improvements to vegetation condition were observed. Whilst this would have led to some improvements in food security, livelihoods and water access, flooding caused further devastation to communities whose resilience had already been dented by the drought. In addition, rainfall in some areas, such as Turkana South and East, was again lower than average during the 2023 short rains and the data suggests that food security was among the poorest of all assessed areas as of May 2023. This suggests that many areas, including parts of Turkana in particular, remain highly vulnerable to further climatic shocks. Finally, it is worth noting that the upcoming 2024 long rains are forecast to be much wetter than normal, which could lead to further flooding in some areas.

Methodology

Precipitation trends (monthly total and cumulative)
Precipitation trends were calculated in Google Earth Engine using the Climate Hazards Group InfraRed Precipitation with Station (CHIRPS) rainfall data for each of the focus counties. The long-term average was acquired by calculating the monthly average between 2000 and 2020 for comparison with monthly totals in 2021, 2022 and 2023.

Standard Precipitation Index (SPI)
The SPI calculates the rainfall anomaly for a specified period (usually a period of 1, 2, 3, 6, 12 or 24 months) from a long-term average baseline for the same period. The index can be a useful indicator of potential drought conditions or excess rainfall. In this case, the SPI-3 was used as it effectively identifies seasonal variations in rainfall, especially considering that the two rainy seasons in Kenya last approximately 3 months. When calculating SPI, the full period of CHIRPS rainfall data availability, from 1981 to present, was used as a baseline.

Vegetation Condition Index (VCI)
The VCI highlights impacts of meteorological drought on vegetation condition through comparing vegetation greenness (from NDVI/EVI) in a specified time period (e.g. a month/season) with the average long-term value for that time period in 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. Note that here "drought" may refer to ecological or agricultural drought as the focus is on the impact of low rainfall on vegetation.

April-June was selected to analyse vegetation condition following the March-May rainy season to account for the lag in vegetation response following the start of the rainy season. To understand crop condition in agropastoral areas, VCI was analysed in July, prior to the harvests.

VCI was calculated in GEE using Moderate Resolution Imaging Spectroradiometer (MODIS) Enhanced Vegetation Index (EVI) data sources were accessed through Google Earth Engine (GEE), with further analysis using methodology adapted from UNSPIDER undertaken to obtain the VCI.

Soil moisture

Soil moisture indicates the amount of water content within soils, and can be measured at different depths. Rootzone soil moisture (RZSM) was selected for this analysis as it provides insights into the availability of water for plants and crops, and can support early warning of potential drought conditions, or in the case of over-saturation, potential waterlogging or flooding. RZSM was extracted from Soil Moisture Active / Passive (SMAP) data using GEE.

Food Consumption Score

The Food Consumption Score (FCS) is an indicator used to measure dietary diversity, food frequency, and the relative nutritional importance of food groups based on seven day recall period of food consumed at HH level. This indicator was collected in the MSNA data collection in the focus counties between May 22 and June 2, 2023.

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