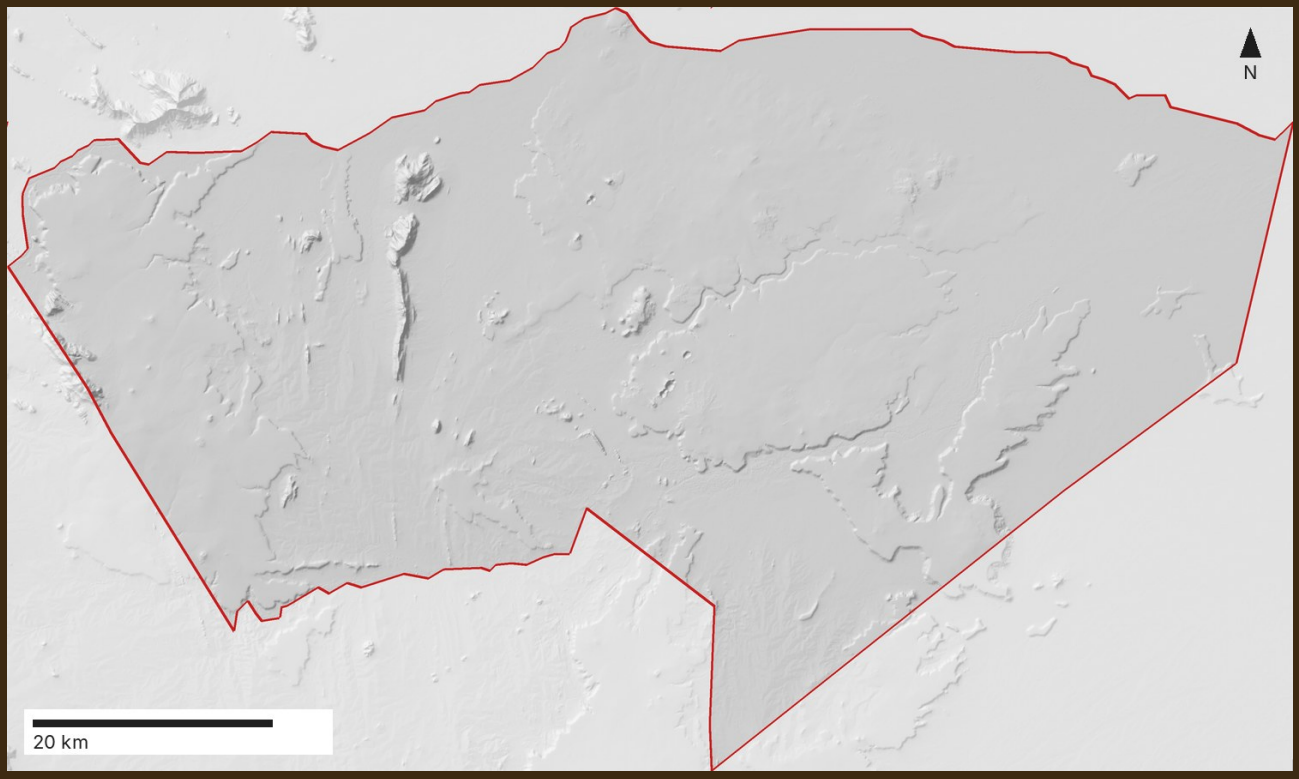
GEOVATRA BASELINE

Drought baseline: Laisamis

4,000 km² · rainfall drought, vegetation stress, water sources, exposure and data gaps



Area	Laisamis, 4,000 km² (bounding box 37.41423, 1.26113, 38.37988, 1.83832, WGS84)
Date	22 November 2026
Run	f1bf1ba3-2e05-4f84-8d14-aba18961224b
Workflow and engine	baseline-drought/1.1.0 · command line · code 9e7aac1 · drought-report 1.0.0

Produced automatically from open global data. Not checked in the field or by local experts: use it to see where to look and what to check, not to make decisions on its own.

Summary

Drought baseline for Laisamis (4,000 km²): how often rain has failed and how dry it is now, how stressed the vegetation is, which surface water lasts, and who lives where drought is frequent.

52.5
VCI3M in 2026-10: above normal vegetation greenness

-0.1
SPI-12 in 2026-10: near normal

69 / 539
months in drought (SPI-12 at -1 or less) since 1981-01

210-700
people where vegetation is in deficit now (VCI3M under 35)

Main findings

- Rain over the past year: near normal (SPI-12 -0.1 in 2026-10).
- Vegetation now: above normal vegetation greenness (VCI3M 52.5 in 2026-10).
- Rain averages 385 mm a year (1991-2020), varying by 44.8 % annually. Rainy seasons: Mar-May and Oct-Dec.
- Since 1981-01, SPI-12 was in drought in 69 of 539 months. The worst drought lasted 38 months, peaking at -2.1.
- No permanent or seasonal surface water detected. People rely on unmeasured sources like boreholes and water pans.

Confidence per module

Module	Confidence	Why
D1 rainfall drought	High	In the dry season (Aug, Sep) the 3-month SPI can't show drought. CHIRPS blends satellite estimates with rain gauges; where gauges are few (much of the drylands), it leans on the satellite estimates and can miss local storms. SPI measures rain only, not heat or evaporation.
M4 rainfall	High	Rainfall cells are about 5 km (CHIRPS) or 28 km (ERA5): detail smaller than a cell isn't resolved.
D2 vegetation stress	High	Checked against Kenya's drought early warning (NDMA's county VCI3M, Marsabit): r 0.95 over 107 months, the same side of the drought line in 91 % of them; it reads about 2 points lower. NDMA's index is made at 250 m and smoothed weekly, this one at 500 m from 16-day composites. Cloud can hide the land for weeks in the rainy season. The vegetation record comes from MODIS on NASA's Terra satellite, which is near the end of its life (it no longer holds its orbit, so its overpass time drifts): future years will need another sensor.

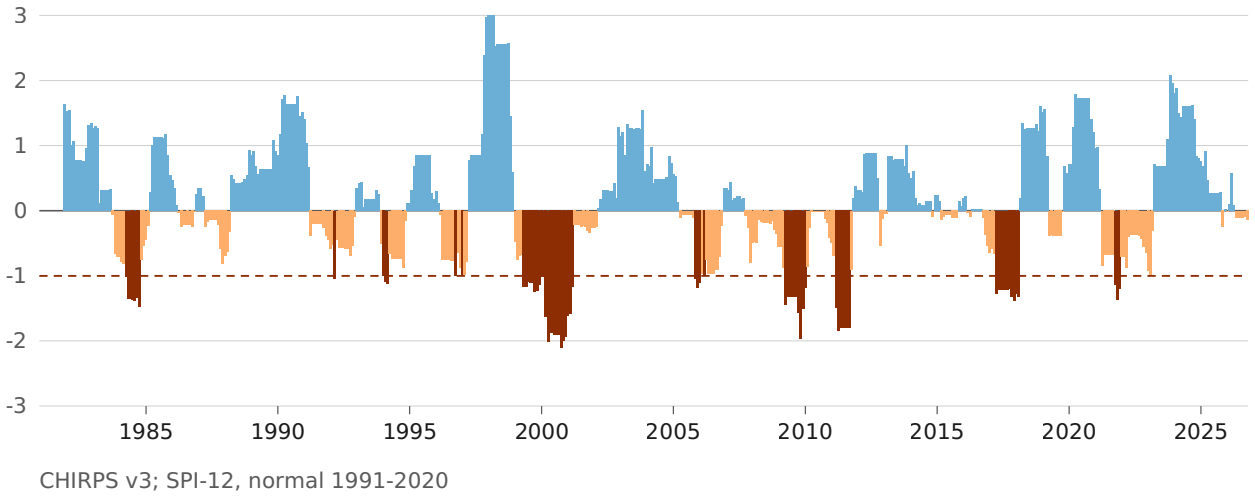
D2 stress frequency since 2001	Low	How often vegetation was stressed is checked against NDMA only from 2016 (Marsabit County: under 35 in 59 of 107 months by this index and by NDMA's); before 2016 it isn't checked. In dry places VCI3M is under 35 in most months, so this share says little about whether one place is more drought-prone than another. The area's VCI3M averaged 15 points higher in the last five years than in the first five: the land has greened, so earlier years read lower than they were. The record starts in 2001: droughts before it (e.g. the 1980s) aren't in the vegetation ranges.
D3 water sources	Low	There is no open surface water here that satellites can see: people depend on boreholes, wells, sand rivers and water pans, which this module can't measure. Surface water is from Landsat, 1984-2020: water under trees, in narrow channels or after 2020 isn't seen.
M5 land cover	High	ESA WorldCover is from 2021 (10 m).
D4 drought exposure	Medium	People are modelled estimates (not a census), shown as the range of two models; people who move with their herds are easily missed. The 'how often stressed' map rests on D2's frequency since 2001, rated medium. The two population models differ by a factor of 3.2. Water points come from WPdx+ and OpenStreetMap: only points someone has recorded, so these counts are a minimum. Rain variability comes from about 5 km rainfall cells: it shows broad patterns, not village differences.

> Drought here means rain well below normal (SPI) and vegetation less green than usual for the season (VCI). Groundwater, soil moisture, food security and markets are not assessed. People and water points are given as totals only, never as names or locations.

1. Rainfall drought D1

How unusual the rain of the last 3, 6 and 12 months was (Standardized Precipitation Index, SPI), from CHIRPS monthly rainfall since 1981-01, against the 1991-2020 normal. SPI of -1 or less is drought.

> Rain averages 385 mm a year (1991-2020), with rainy seasons in Mar-May and Oct-Dec. Current SPI-12 is -0.1 (near normal) as of 2026-10. Since 1981-01, drought occurred in 69 of 539 months. The worst drought spanned 1999-01 to 2002-02, lasting 38 months and peaking at -2.1.



CHIRPS v3; SPI-12, normal 1991-2020

SPI-12 of the area, month by month: brown at -1 or less (drought), orange below 0, blue above 0.

Now

Index	Month	SPI	Class
SPI-3	2026-10	-0.5	near normal
SPI-6	2026-10	-1.1	moderately dry
SPI-12	2026-10	-0.1	near normal

Months in drought

Index	All	Since 2011
SPI-3	64 of 456	21 of 158
SPI-6	70 of 545	23 of 190
SPI-12	69 of 539	21 of 190

Rainy seasons and the years they failed

Season	Share of the year's rain	Failed (SPI of the season at -1 or less)
Mar-May	51.3 %	1984, 2000, 2009, 2011, 2017, 2021
Oct-Dec	39.1 %	1985, 1987, 1998, 2005, 2010

The worst droughts since 1981-01 (SPI-12)

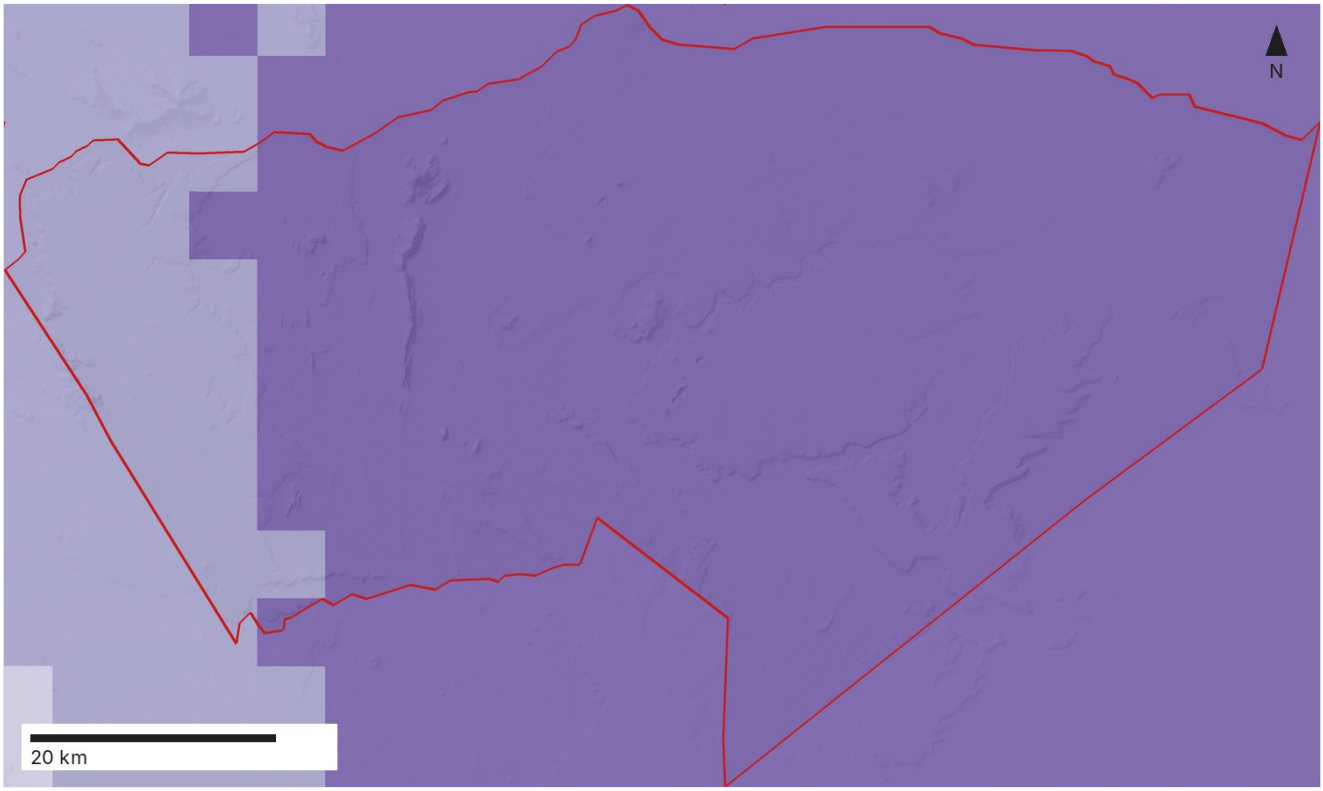
From	To	Months	Lowest SPI	Magnitude
1999-01	2002-02	38	-2.1	40.2
2007-10	2011-10	49	-2	37.1
2016-10	2018-02	17	-1.4	16.8

2021-04	2023-03	24	-1.4	16.3
1983-10	1985-02	17	-1.5	14.9

A drought starts when SPI falls below 0 in a run that reaches -1, and ends when SPI is positive again (McKee et al. 1993). Magnitude adds up how far below 0 each month was.

How much annual rain varies

Year-to-year variation of annual rainfall, 1991-2020 (coefficient of variation): 44.8 % for the area. The more rain varies, the more often a year falls short.



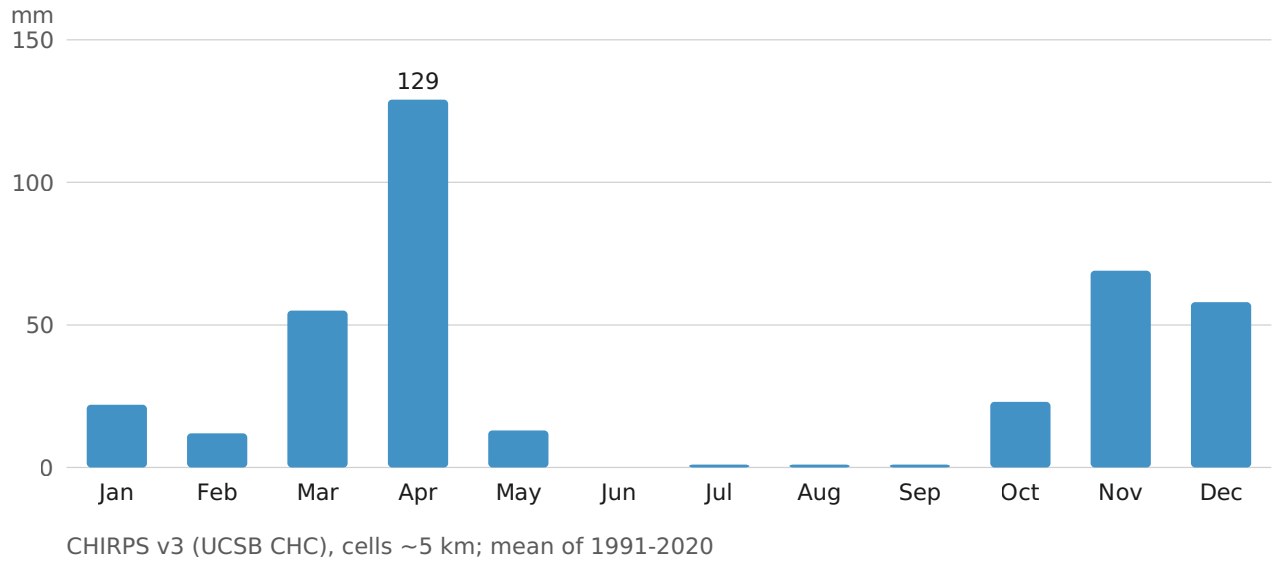
Under 20 %: reliable rain · 20-30 % · 30-40 % · Over 40 %: very variable rain

- CHIRPS cells are about 5 km; where rain gauges are few, CHIRPS leans on satellite estimates.
- SPI measures rain only; heat and evaporation (which SPEI would add) are not included.
- In the dry season (Aug, Sep) SPI-3 can't show drought: it normally rains too little then (under 10 mm in 3 months, or often none at all).

2. Rainfall and climate M4

How much rain falls and when, from CHIRPS monthly rainfall averaged over the area: the 1991-2020 normal and recent years against it.

> Annual rainfall averages 385 mm (1991-2020). The wet season is Nov-Apr, contributing 90 % of annual rain. Apr is the wettest month.



Average monthly rainfall, 1991-2020.

Normal rainfall a year	380 mm
Wet season (6 wettest months)	Nov - Apr, 90 % of the year's rain
Wettest month	Apr
Rain in 2012	90 % of normal
Rain in 2022	72 % of normal
Rain in 2024	130 % of normal
Last 12 months (2025-11 to 2026-10)	89 % of normal

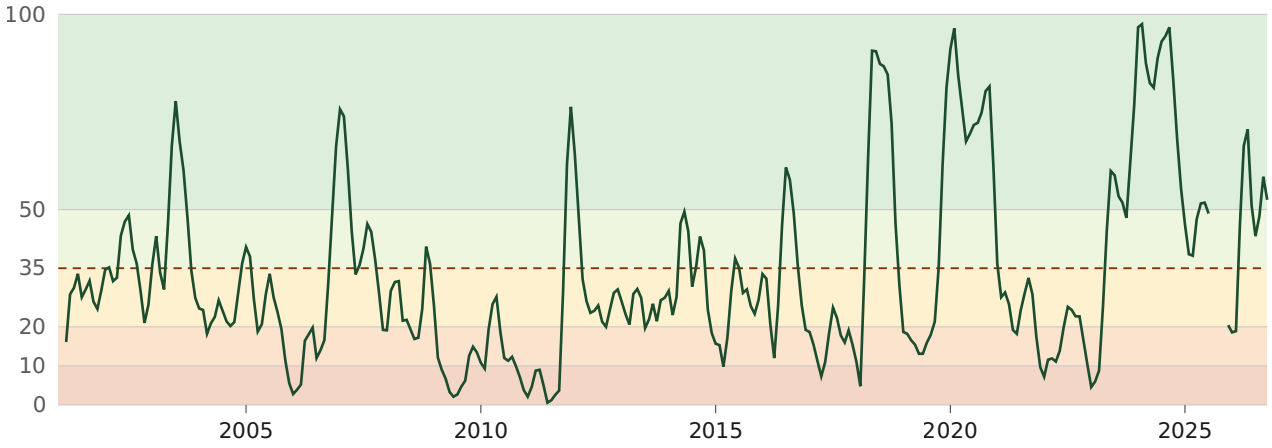
Month	Normal, mm	Month	Normal, mm
Jan	22	Feb	12
Mar	55	Apr	129
May	13	Jun	0
Jul	1	Aug	1
Sep	1	Oct	23
Nov	69	Dec	58

- Rainfall cells are about 5 km (CHIRPS) or 28 km (ERA5): detail smaller than a cell isn't resolved.

3. Vegetation stress D2

How green the land is against the same months of other years (Vegetation Condition Index, VCI: 0 the worst seen since 2001, 100 the best), from MODIS at 500 m. VCI3M is the mean of the last three months; under 35 is drought, in the classes Kenya's National Drought Management Authority (NDMA) uses.

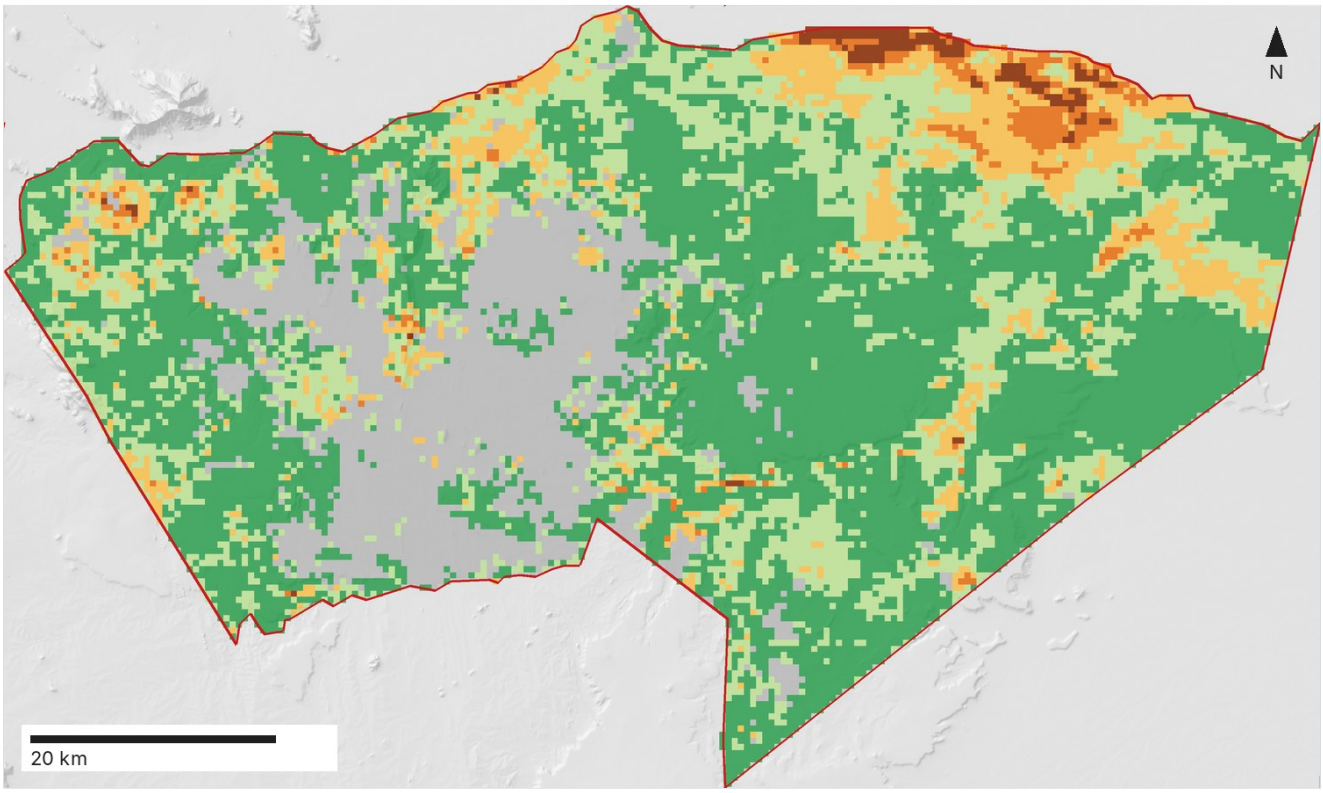
> Current VCI3M is 52.5 in 2026-10, classified as above normal vegetation greenness. Since 2001-01, vegetation stress (VCI3M under 35) occurred in 198 of 304 months. The longest stress spell lasted 34 months, from 2009-01 to 2011-10.



MODIS Terra NDVI; VCI3M of the land, record from 2001

VCI3M of the area's land, month by month, over NDMA's classes; the dashed line is 35.

Vegetation stress now (2026-10)



Extreme vegetation deficit (under 10) · Severe vegetation deficit (10-20) · Moderate vegetation deficit (20-35) · Normal vegetation greenness (35-50) · Above normal vegetation greenness (50 or more) · No data (cloud)

Now	VCI3M	Class
All land	52.5	above normal vegetation greenness
Grass and shrubland	52.4	above normal vegetation greenness

Months under 35	Months
Since 2001	198 of 304
Since 2016	62 of 126

Class now	% of the land
Extreme vegetation deficit (under 10)	1.2
Severe vegetation deficit (10-20)	2.4
Moderate vegetation deficit (20-35)	11.8
Normal vegetation greenness (35-50)	28.3
Above normal vegetation greenness (50 or more)	56.3

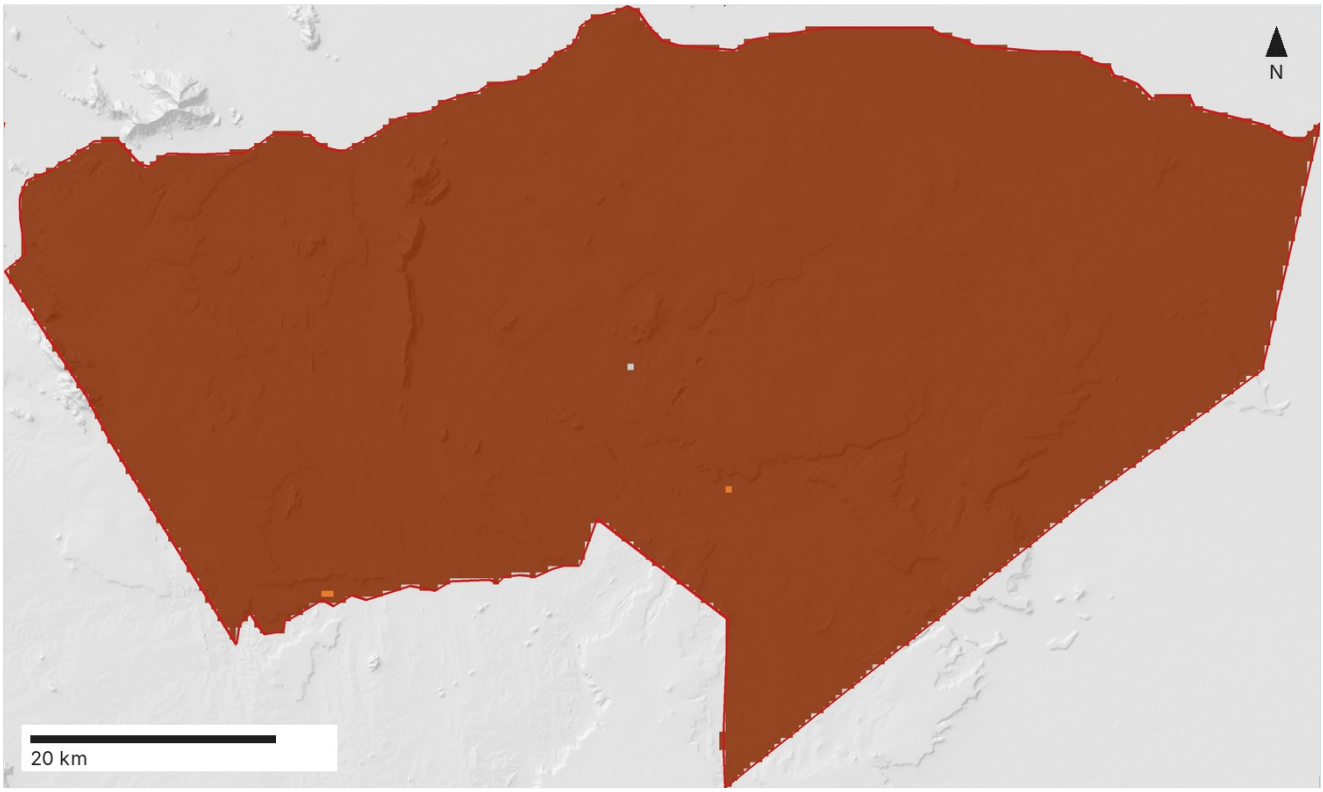
Land cover	% under 35 now
Tree cover	5.6
Grass and shrubland	15.4

The longest spells under 35

From	To	Months	Lowest VCI3M
2009-01	2011-10	34	0.6
2021-02	2023-04	27	4.6
2012-03	2014-03	25	19.7
2005-03	2006-10	20	2.8
2016-11	2018-03	17	4.8

How often vegetation was stressed in the growing seasons

Share of growing-season months with VCI3M under 35 since 2001. The growing season is taken as the rainy seasons and the month after each: Jan, Mar, Apr, May, Jun, Oct, Nov, Dec.



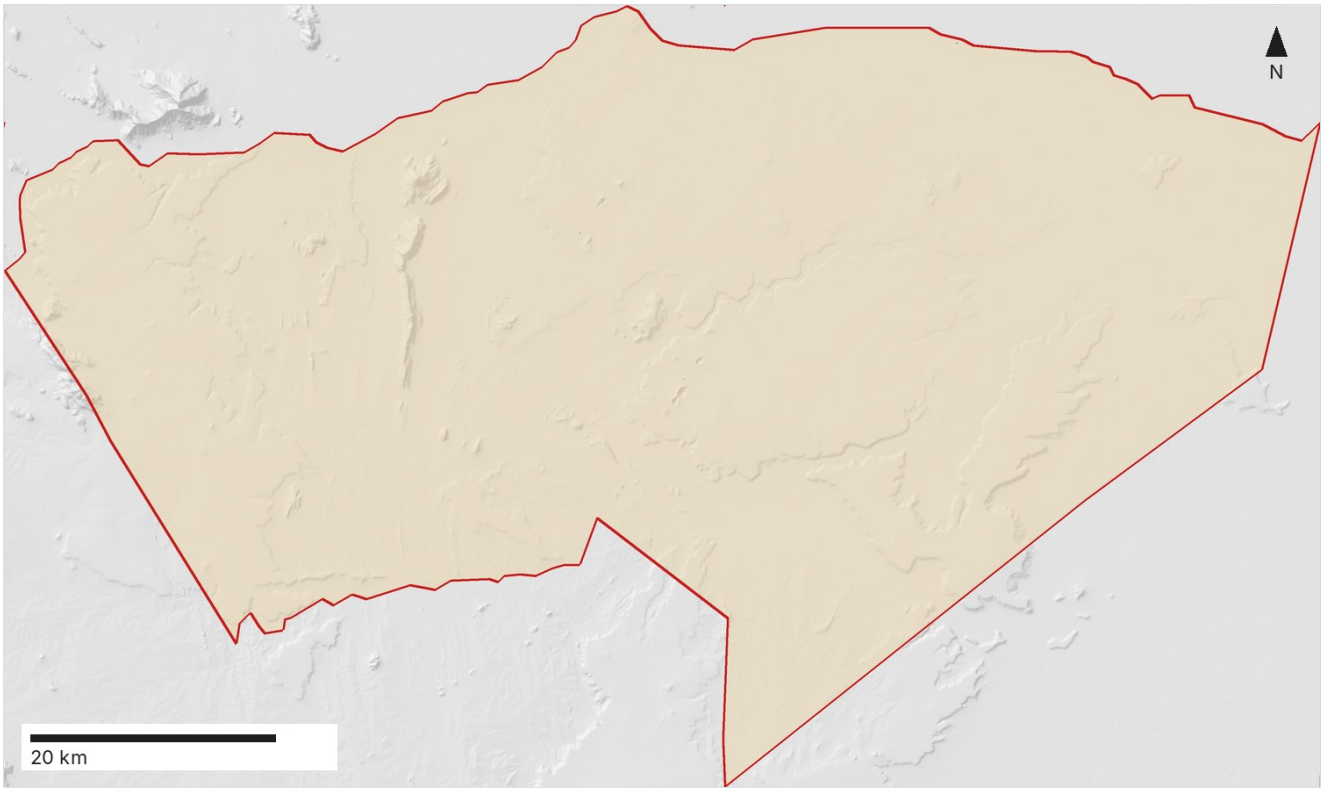
- VCI compares each place with its own record since 2001 (the 5th to 95th percentile of each calendar month): a VCI of 20 means poor for that place, not absolutely dry.
- Bare ground (mean NDVI under 0.1, or a range under 0.05) is left out: VCI means nothing there.
- NDMA's VCI uses Terra and Aqua at 250 m, smoothed weekly; this one uses Terra 16-day composites at 500 m.
- Irrigation keeps crops green in a drought, and cloud can hide the land for weeks.
- Where the land has grown greener since 2001, earlier years read lower than they were.

MODIS Terra MOD13A1 v061, 16-day NDVI, 500 m; 2001-01 to 2026-10.

4. Water sources under drought D3

Which surface water lasts all year and which dries up, how it changed from 1984 to 2020 (JRC Global Surface Water, 30 m), and how far people live from water that lasts. Water up to 10 km outside the area counts: people use the nearest source.

> No permanent or seasonal surface water detected in satellite records (1984-2020). People depend on unmeasured sources like boreholes and water pans. At least 7 water points are recorded (WPdx+ and OpenStreetMap). 16,000-51,000 people live over 5 km from any recorded surface water.



Under 2 km from permanent surface water
2-5 km from permanent surface water
5-10 km from permanent surface water
Over 10 km from permanent surface water
Permanent water (12 months)
Seasonal water (1-11 months)
Water lost since 1984

Surface water in the area	km²
Permanent (water in all 12 months)	0
Seasonal (1 to 11 months)	0
Seasonal, 1-3 months a year	0
Seasonal, 4-6 months a year	0
Seasonal, 7-11 months a year	0

Change, 1984 to 2020	km²
Water lost (permanent or seasonal, gone by 2020)	0
Water gained since 1984	0
Permanent water become seasonal	0
Seasonal water become permanent	0
Water seen only briefly (ephemeral)	1.2

> **There is no open surface water here that satellites can see: people depend on boreholes, wells, sand rivers and water pans, which this module can't measure.**

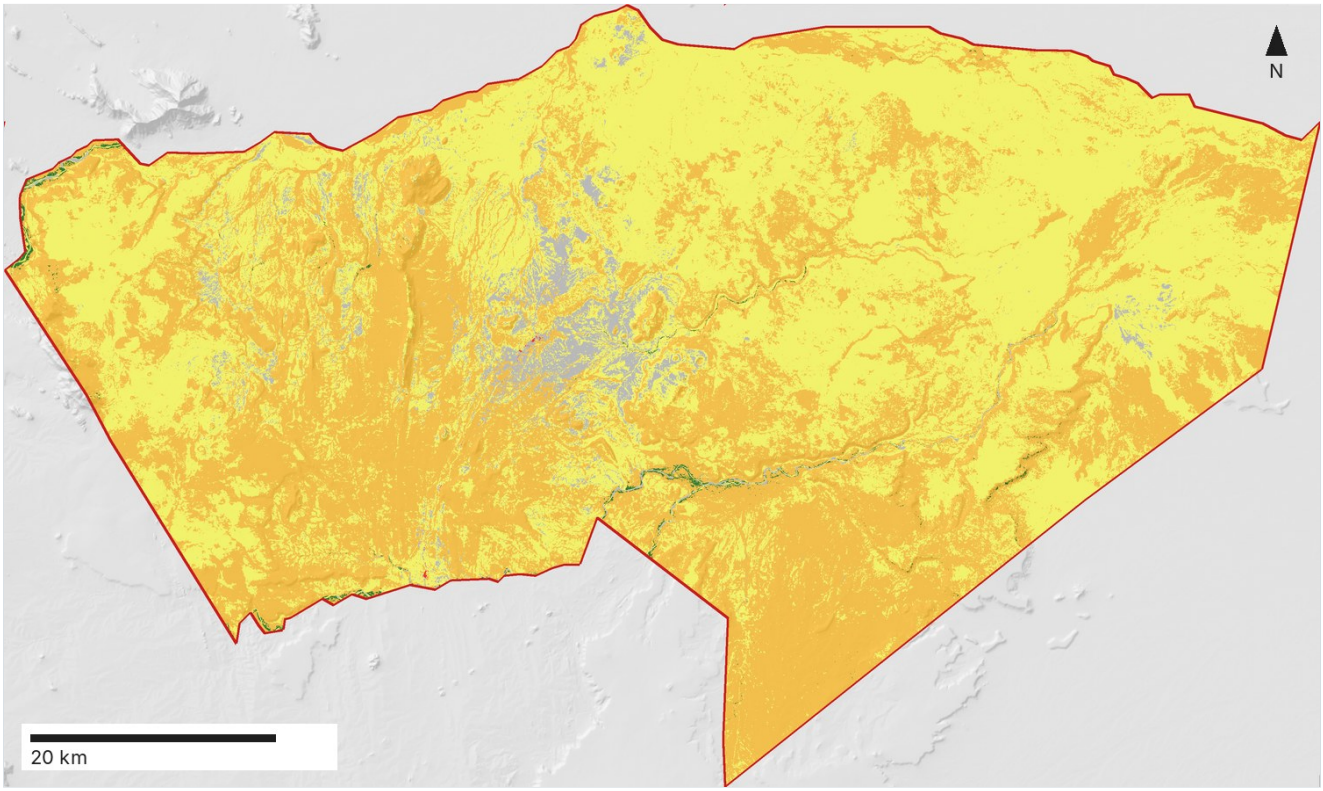
7 water points are on record in the area (WPdx+ and OpenStreetMap): 1.4-4.4 per 10,000 people.

- No permanent surface water within 10 km of the area: people depend on seasonal water and groundwater.
- Surface water from Landsat, 1984-2020: water under trees, in narrow channels or after 2020 isn't seen.
- Groundwater, soil moisture and recent reservoir levels are not assessed.
- Water points from WPdx+ and OpenStreetMap: only points someone has recorded, so a minimum.

5. Land cover M5

What the land is used for (ESA WorldCover 2021, 10 m, most common class per 30 m cell).

Grassland covers 52.8 % of the area, the dominant land cover.



Tree cover · Shrubland · Grassland · Cropland · Built-up · Bare/sparse vegetation

Class	Area, km²	% of the area
Grassland	2,100	52.8
Shrubland	1,700	43.7
Bare/sparse vegetation	130	3.2
Tree cover	12	0.3
Built-up	0.4	0
Cropland	0	0

6. Drought exposure D4

Who and what lies where vegetation is most often stressed, where it is stressed now, and where rain is least reliable. Totals only: no names or locations of people, places or water points.

> About 16,000-51,000 people live in the area, with 20 % in zones where vegetation stress occurred in over a fifth of growing-season months since 2001. 210-700 people live where vegetation is currently under 35. Totals only, no locations.

How often vegetation was stressed in the growing seasons since 2001, relative to this place's own record (VCI3M under 35; medium confidence)

	People (range of two models)	Cropland, km²	Grass and shrubland, km²	Built-up land, km²	Water points
Under 10 % of growing-season months	0	0	0	0	0
10-20 %	0	0	0	0	0
20-30 %	0	0	0.7	0	0
30 % or more	16,000-51,000	0	3,800	0.4	7
Not assessed	90-94	0	17	0	0
Stressed in 20 % or more of growing-season months	**16,000-51,000**	**0**	**3,800**	**0.4**	**7**
Whole area	**16,000-51,000**	**0**	**3,800**	**0.4**	**7**

Vegetation stress now (VCI3M, NDMA's classes) (2026-10)

	People (range of two models)	Cropland, km²	Grass and shrubland, km²	Built-up land, km²	Water points
Extreme vegetation deficit (under 10)	3-17	0	39	0	0
Severe vegetation deficit (10-20)	4-28	0	77	0	0
Moderate vegetation deficit (20-35)	200-660	0	380	0	1
Normal vegetation greenness (35-50)	660-2,100	0	910	0	0
Above normal vegetation greenness (50 or more)	4,500-14,000	0	1,800	0.1	3

Not assessed	10,000-34,000	0	630	0.4	3
Vegetation deficit now (VCI3M under 35)	**210-700**	**0**	**490**	**0**	**1**
Whole area	**16,000-51,000**	**0**	**3,800**	**0.4**	**7**

How much annual rain varies from year to year (1991-2020)

	People (range of two models)	Cropland, km²	Grass and shrubland, km²	Built-up land, km²	Water points
Under 20 %: reliable rain	0	0	0	0	0
20-30 %	0	0	0	0	0
30-40 %	1,800-3,200	0	510	0	1
Over 40 %: very variable rain	14,000-47,000	0	3,300	0.4	6
Not assessed	0	0	0	0	0
Annual rain varies by 30 % or more	**16,000-51,000**	**0**	**3,800**	**0.4**	**7**
Whole area	**16,000-51,000**	**0**	**3,800**	**0.4**	**7**

People: WorldPop and GHSL population models (estimates, not a census), shown as a range. Land: ESA WorldCover. Water points: WPdx+ and OpenStreetMap.

- Water points come from WPdx+ and OpenStreetMap: only points someone has recorded, so these counts are a minimum.
- People are modelled estimates (not a census); the two models are shown as a range.
- Rain variability comes from about 5 km rainfall cells: it shows broad patterns, not village differences.

7. Data gaps and confidence M7

What isn't known, and how far each result can be trusted. Levels come from fixed rules on the results and the data.

Module	Confidence	Reasons
D1 rainfall drought	High	• In the dry season (Aug, Sep) the 3-month SPI can't show drought. • CHIRPS blends satellite estimates with rain gauges; where gauges are few (much of the drylands), it leans on the satellite estimates and can miss local storms. • SPI measures rain only, not heat or evaporation.
M4 rainfall	High	• Rainfall cells are about 5 km (CHIRPS) or 28 km (ERA5): detail smaller than a cell isn't resolved.
D2 vegetation stress	High	• Checked against Kenya's drought early warning (NDMA's county VCI3M, Marsabit): r 0.95 over 107 months, the same side of the drought line in 91 % of them; it reads about 2 points lower. NDMA's index is made at 250 m and smoothed weekly, this one at 500 m from 16-day composites. • Cloud can hide the land for weeks in the rainy season. • The vegetation record comes from MODIS on NASA's Terra satellite, which is near the end of its life (it no longer holds its orbit, so its overpass time drifts): future years will need another sensor.
D2 stress frequency since 2001	Low	• How often vegetation was stressed is checked against NDMA only from 2016 (Marsabit County: under 35 in 59 of 107 months by this index and by NDMA's); before 2016 it isn't checked. In dry places VCI3M is under 35 in most months, so this share says little about whether one place is more drought-prone than another. • The area's VCI3M averaged 15 points higher in the last five years than in the first five: the land has greened, so earlier years read lower than they were. • The record starts in 2001: droughts before it (e.g. the 1980s) aren't in the vegetation ranges.
D3 water sources	Low	• There is no open surface water here that satellites can see: people depend on boreholes, wells, sand rivers and water pans, which this module can't measure. • Surface water is from Landsat, 1984-2020: water under trees, in narrow channels or after 2020 isn't seen.
M5 land cover	High	• ESA WorldCover is from 2021 (10 m).

D4 drought exposure	Medium	• People are modelled estimates (not a census), shown as the range of two models; people who move with their herds are easily missed. • The 'how often stressed' map rests on D2's frequency since 2001, rated medium. • The two population models differ by a factor of 3.2. • Water points come from WPdx+ and OpenStreetMap: only points someone has recorded, so these counts are a minimum. • Rain variability comes from about 5 km rainfall cells: it shows broad patterns, not village differences.

Not assessed

- Soil moisture and groundwater are not assessed: a drought below ground (falling water tables, failing boreholes) can last after the rain and the vegetation recover.
- Heat and evaporation are not assessed (SPI measures rain only).
- Food security, crop yields, livestock condition and market prices are not assessed: they are for the field questions and for national early warning bulletins.
- There is no drought forecast: the Baseline describes the past and the present.

What would improve it

- Rain gauge records from the meteorological service, to check the satellite rainfall.
- Borehole and well records (yields, water levels, failures), for the groundwater this report can't see.
- The national drought early warning bulletins for the area, to compare with the vegetation index.
- Local knowledge of past droughts: failed harvests, livestock losses, water trucking.

8. Questions for the field M8

What to check on site, ask locally, or collect on arrival. Each question comes from a fixed rule on the results above and says which result or gap raised it.

	Question	Points to
☐	**Ask locally** Rain failed in the seasons since 2011 for these periods: Mar-May: 2011, 2017, 2021. Ask how the harvests and pasture were in each season, and which one people remember as the worst. Rainfall data show that a season failed, not what it did to people's food and herds.	D1 rainfall drought: failed seasons since 2011 (Mar-May: 2011, 2017, 2021)
☐	**Ask locally** Vegetation stayed stressed from 2021-02 to 2023-04, lasting 27 months. Ask if livestock died or were sold during this time, and where the herds moved. Livestock losses and migration are the drought's impact in pastoral areas; satellites don't see them.	D2 vegetation stress: VCI3M under 35 from 2021-02 to 2023-04
☐	**Ask locally** There is no permanent surface water within 10 km of zone A. Ask where people and herds get water in the dry season and during a drought, and whether water was trucked in during the last drought, for how long, and at what cost. Water trucking and its cost show where water runs out first.	D3 water sources: no permanent surface water within 10 km
☐	**Collect data** Collect the borehole records from the water office: note the yields, depths, which ones failed or dried up in the last drought, and how long the queues are in the dry months. In drylands most water comes from boreholes and wells, which the Baseline can't see.	M7 data gaps: groundwater not assessed
☐	**Collect data** The area is currently in a drought, described as moderately dry, 6-month SPI. Ask for the market prices of staple food, livestock, and water over the past year, and how they compare to a normal year. Prices show how a drought reaches households; the Baseline doesn't assess them.	D1 rainfall drought: SPI-6 -1.1 in 2026-10
☐	**Ask locally** 16,000-51,000 people live in areas where vegetation was stressed in 20% or more of growing-season months. Ask which settlements suffer first in a drought and why. The map shows where the land suffers; local people know which communities do.	D4 drought exposure: 16,000-51,000 people where stress is most frequent
☐	**Collect data** Population estimates for the area vary widely, ranging from 16,000-51,000. Ask for the latest census or local counts, including people who move with their herds. A local count turns the range into one number; mobile people are often missed.	D4 drought exposure: 16,000-51,000 people
☐	**Collect data** Check if the area is covered by a national drought early warning bulletin, such as those issued in Kenya or West Africa. Obtain the bulletins for the past year to compare with these findings. An agency's own monitoring is the closest check on the Baseline's drought signal.	M7 data gaps: D2 checked against an agency's index in Kenya only
☐	**Collect data** Are there rain gauges in or near the area? Request monthly records from the meteorological service to verify the satellite rainfall data. Satellite rainfall is weakest where gauges are few.	M7 data gaps: CHIRPS where rain gauges are few

Appendix A. Methods log

Every step of run f1bf1ba3-2e05-4f84-8d14-aba18961224b (baseline-drought/1.1.0), in order, with the operation version, settings and data read. The full machine-readable log is the run's run.json.

Software: gdal 3.10.3, django 5.2.5, engine python, python 3.11.18. Engine command line, code 9e7aac1. Working grid: EPSG:32637, 30 m (maps and land cover), 500 m (MODIS), about 5 km (CHIRPS); surface water with a 10 km buffer. Compute time 108 s.

Report text (baseline-narrative 1.0.0): drafted by AI with placeholders for every figure; the figures are filled in by code from the results and checked, and any section that failed the check twice uses the plain template text. d1 ai, d2 ai, d3 ai, d4 ai, m4 ai, m5 ai, summary ai.

#	Operation	Settings and data	Time, s

1	**rainfall**
	data.fetch_rainfall_grid 1.0.0
		`start_year = 1981, margin_cells = 1`
		CHIRPS v3.0 rainfall v3.0 monthly, accessed 2026-11-22
		`1981.01 to 2026.10`
			28

2	**land_cover**
	data.fetch_land_cover 1.2.0
		`year = 2021, buffer_m = 0, output_crs = EPSG:4326, resolution_deg = 0.0001`
		ESA WorldCover 10 m (2020 v100, 2021 v200) 2021 v200, data 2021-01-01 to 2021-12-31, accessed 2026-11-17
		`ESA_WorldCover_10m_2021_v200_N00E036`
			0.6

3	**population**
	data.fetch_population 1.1.0
		GHSL GHS-POP population GHS-POP R2023A, epoch 2025, 3 arc-seconds (V1-0), accessed 2026-11-17
		`R9_C22`
		WorldPop population (constrained, 100 m) 2025, constrained, 100 m (R2025A v1), accessed 2026-11-17
		`KEN/ken_pop_2025_CN_100m_R2025A_v1.tif`
			1.5

4	**water_points**
	data.fetch_osm 2.0.0
		`kind = water_points, max_features = 20000`
		OpenStreetMap Geofabrik extracts of 2026-11-16, accessed 2026-11-22
		`kenya (2026-11-16)`
			3.4

5	**wpdx** data.fetch_wpdx 1.0.0	`buffer_m = 0` Water Point Data Exchange (WPdx+) WPdx+ (latest record per water point), accessed 2026-11-22	0.9
6	**points** data.merge_water_points 1.0.0		0

7	**seasonality**
	data.fetch_water_layer 1.0.0
		`layer = seasonality, buffer_m = 10000, output_crs = EPSG:4326, resolution_deg = 0.0003`
		JRC Global Surface Water v1.3 (1984-2020) v1.3 (1984-2020), data 1984-03-01 to 2020-12-31, accessed 2026-11-17
		`30E_10Nv1_3_2020`
			1.3

8	**transitions**
	data.fetch_water_layer 1.0.0
		`layer = transitions, buffer_m = 10000, output_crs = EPSG:4326, resolution_deg = 0.0003`
		JRC Global Surface Water v1.3 (1984-2020) v1.3 (1984-2020), data 1984-03-01 to 2020-12-31, accessed 2026-11-17
		`30E_10Nv1_3_2020`
			0.9

9	**dem**
	data.fetch_dem 1.2.0
		`buffer_m = 0, output_crs = EPSG:4326, resolution_deg = 0.0008333333333`
		Copernicus DEM GLO-30, accessed 2026-11-17
		`Copernicus_DSM_COG_10_N01_00_E037_00_DEM, Copernicus_DSM_COG_10_N01_00_E038_00_DEM`
			0.5

10	**d1** module.d1_rainfall_drought 1.2.0		1.1
11	**m4** module.m4_rainfall 1.0.0	`compare_years = 2012,2022,2024`	0
12	**m5** module.m5_land_cover 1.0.0	`buffer_m = 0`	2.1

13	**d2**
	module.d2_vegetation_stress 1.1.0
		`first_year = 2001`
		MODIS Terra Vegetation Indices 16-day 500 m (MOD13A1 v061) MOD13A1 v061; record 2001-01 to 2026-10, accessed 2026-11-22
		`MOD13A1.A2001001.h21v08.061.2020061200314, MOD13A1.A2001017.h21v08.061.2020061220229, MOD13A1.A2001033.h21v08.061.2020064144850, MOD13A1.A2001049.h21v08.061.2020062011354, MOD13A1.A2001065.h21v08.061.2020062024809, MOD13A1.A2001081.h21v08.061.2020062051720 and 582 more`
			76.4

14	**d3** module.d3_water_sources 1.1.0		2.1
15	**d4** module.d4_drought_exposure 1.1.0		1.7
16	**m7** module.drought_data_gaps 1.3.0		0
17	**m8** module.drought_field_questions 1.3.0		0

Appendix B. Licences and attribution

Every dataset this report uses, with its licence and how it must be credited, from Geovatra's dataset catalog.

Dataset	Licence	Attribution and citation
CHIRPS v3.0 rainfall UCSB Climate Hazards Center	CC BY 4.0 checked 2026-11-05	Climate Hazards Center, UC Santa Barbara Funk, C. et al. (2015). The climate hazards infrared precipitation with stations. Scientific Data 2, 150066 https://www.chc.ucsb.edu/data/chirps3
Copernicus DEM GLO-30 ESA / Copernicus (via Microsoft Planetary Computer)	Copernicus DEM licence (GLO-30): free use with attribution	© DLR e.V. 2010-2014 and © Airbus Defence and Space GmbH 2014-2018 provided under COPERNICUS by the European Union and ESA; all rights reserved European Space Agency, Sinergise (2021). Copernicus Global Digital Elevation Model. Distributed by OpenTopography. https://doi.org/10.5069/G9028PQB https://planetarycomputer.microsoft.com/dataset/cop-dem-glo-30
ESA WorldCover 10 m (2020 v100, 2021 v200) ESA (via Microsoft Planetary Computer)	CC BY 4.0 checked 2026-11-12	© ESA WorldCover project / Contains modified Copernicus Sentinel data processed by ESA WorldCover consortium Zanaga, D. et al. (2022). ESA WorldCover 10 m 2021 v200. https://doi.org/10.5281/zenodo.7254221 https://esa-worldcover.org/
GHSL GHS-POP population European Commission JRC	CC BY 4.0 (European Commission reuse policy) checked 2026-11-22	Schiavina, M. et al. (2023). GHS-POP R2023A - GHS population grid multitemporal (1975-2030). European Commission, JRC https://human-settlement.emergency.copernicus.eu/
JRC Global Surface Water v1.3 (1984-2020) European Commission JRC / Google (via Planetary Computer)	Free use with attribution	Source: EC JRC/Google Pekel, J.-F., Cottam, A., Gorelick, N., Belward, A. S. (2016). High-resolution mapping of global surface water and its long-term changes. Nature 540, 418-422 https://global-surface-water.appspot.com/

MODIS Terra Vegetation Indices 16-day 500 m (MOD13A1 v061) NASA LP DAAC	Openly shared without restriction on use, sale or redistribution (NASA EOSDIS data use guidance); cite the dataset checked 2026-11-14	NASA LP DAAC (MODIS MOD13A1 v061) Didan, K. (2021). MODIS/Terra Vegetation Indices 16-Day L3 Global 500m SIN Grid V061. NASA EOSDIS Land Processes DAAC. doi:10.5067/MODIS/MOD13A1.061 https://doi.org/10.5067/MODIS/MOD13A1.061
OpenStreetMap OpenStreetMap contributors (via Geofabrik extracts)	ODbL 1.0 checked 2026-11-05	© OpenStreetMap contributors © OpenStreetMap contributors, https://www.openstreetmap.org/copyright https://www.openstreetmap.org/copyright
Water Point Data Exchange (WPdx+) Water Point Data Exchange (data.waterpointdata.org; also on HDX)	CC BY-SA (Creative Commons Attribution Share-Alike), as WPdx publishes its country datasets on HDX checked 2026-11-22	Water Point Data Exchange (WPdx), www.waterpointdata.org Water Point Data Exchange (WPdx+), data.waterpointdata.org, dataset eqje-vguj, accessed on the date in the methods log https://www.waterpointdata.org/
WorldPop population (constrained, 100 m) WorldPop, University of Southampton	CC BY 4.0 checked 2026-11-05	WorldPop (www.worldpop.org) https://www.worldpop.org/

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Report drought-report 1.0.0. Numbers are rounded: 1 decimal under 10, whole numbers under 100, otherwise 2 significant figures; people to 2 significant figures.