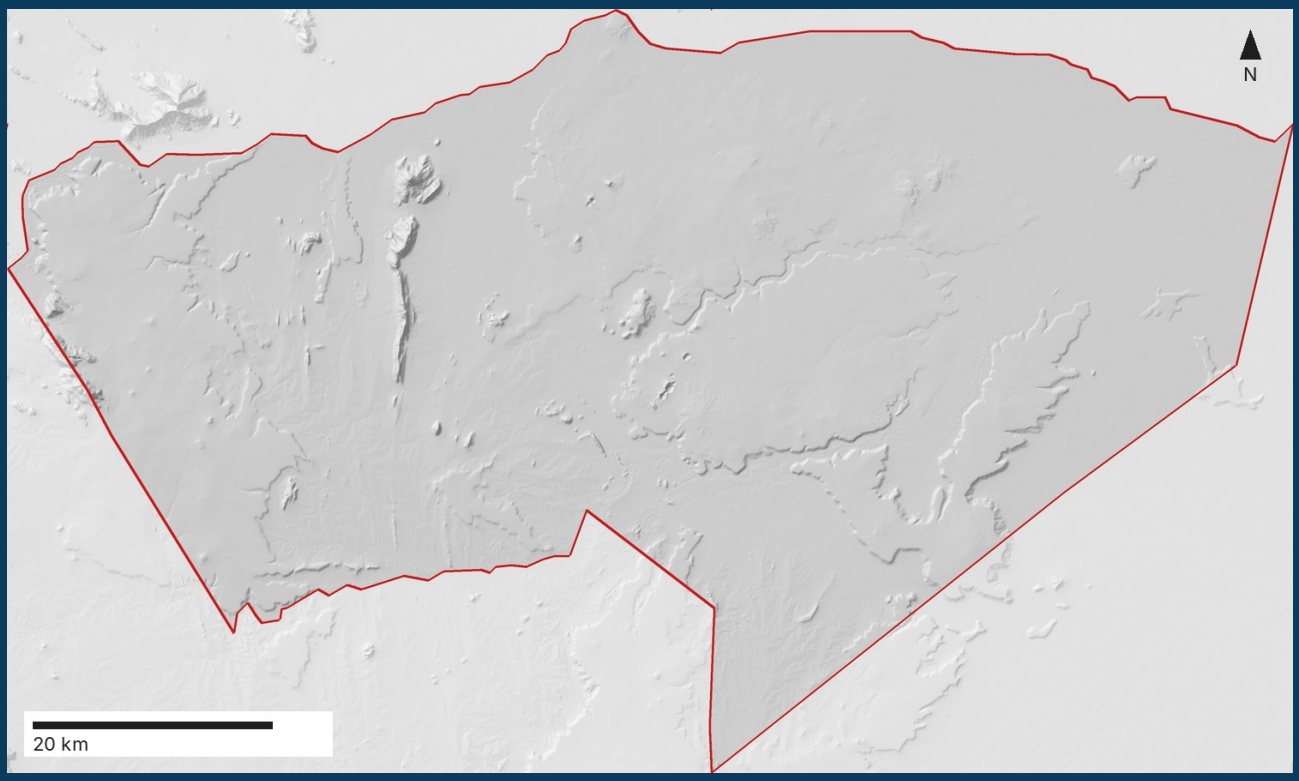
GEOVATRA BASELINE

WASH and water supply baseline: Laisamis

4,000 km² · people, water points, walking time to water, water resources and risks to water sources



Area	Laisamis, 4,000 km² (bounding box 37.41423, 1.26113, 38.37988, 1.83832, WGS84)
Date	22 November 2026
Run	fca23eba-775f-41e6-95db-4a0c969d5ca1
Workflow and engine	baseline-wash/1.1.0 · command line · code bd33677 · wash-report 1.1.0

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

Water supply baseline for Laisamis (4,000 km²): who lives here, which water points are recorded and work, how far people walk to water, what water resources there are, and which sources floods or drought threaten.

16,000-51,000
people in the area (two population models)

7
water points recorded (WPdx and OpenStreetMap)

0.06-0.19
working improved water points per 1,000 people

Not assessable
walking time to water: too few water points recorded

Main findings

- About 16,000-51,000 people live in the area; 25.5 % in urban places by GHSL's degree of urbanisation.
- 7 water points are recorded (3 working by their last report, newest 2012-07-12); 0.06-0.19 working improved points per 1,000 people.
- Walking time to water isn't assessed: below 0.5 working improved points per 1,000 people, it would show where points were recorded, not how far people walk.
- Groundwater productivity is mostly Low-moderate (0.5-1 L/s); long-term recharge averages 34 mm a year.
- 0 water points lie on flood-prone land and 7 where drought is frequent.

Confidence per module

Module	Confidence	Why
W1 People and settlements	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 two population models differ by a factor of 3.2. Settlements come from GHSL's 1 km degree of urbanisation: small villages and camps count as dispersed.
W2 Water points	Low	Only points recorded in WPdx or OpenStreetMap are counted; private sources mostly aren't. Half the records are over 14 years old (newest 2012-07-12). Few points are recorded: 0.06-0.19 working improved points per 1,000 people, likely far fewer than exist. The status of 57.1 % of the points is unknown.
W3 Walking time	Low	Walking speed comes from a surface with cells of about 921 m; queuing, seasons and insecurity aren't modelled. Not assessable: too few water points are recorded (0.06-0.19 working improved points per 1,000 people), so the times would show where points were recorded, not how far people walk.
W4 Water resources	Medium	BGS groundwater maps are 5 km, for Africa: they show what is likely across a region, not what a borehole will yield.
W5 Risks to water sources	Medium	A point on flood-prone land may be protected, and one in a stressed area may draw deep groundwater: these counts say where to look. Where drought is frequent comes from the Drought Baseline's stress frequency since 2001, rated medium.

Results from the area's other Baselines

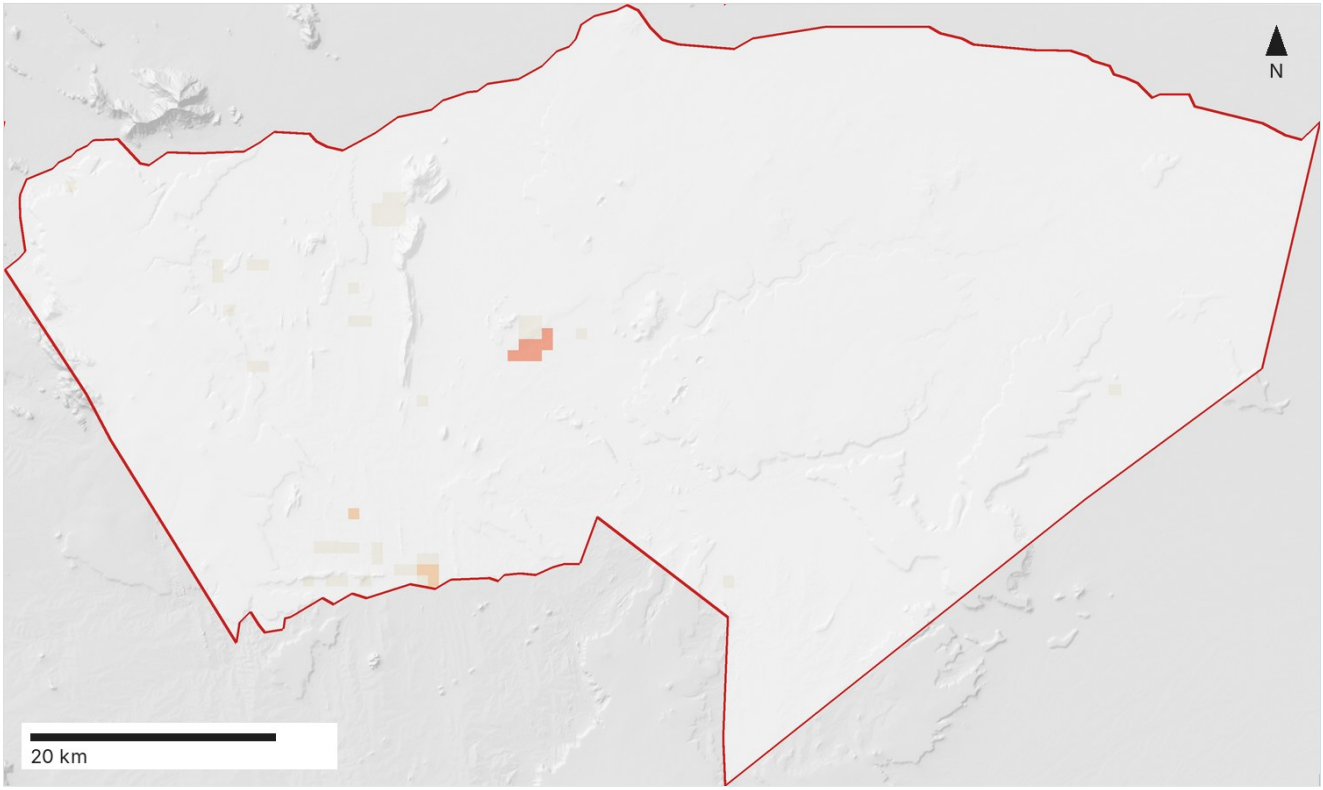
- Used: flood zones from the Flood Baseline of 22 November 2026.
- Used: drought results from the Drought Baseline of 22 November 2026.

> This report covers drinking-water supply. Sanitation, hygiene and water quality can't be mapped from open data: they are among the questions for the field. People, settlements and water points are given as totals only, never as names or locations.

1. People and settlements W1

How many people live in the area (WorldPop and GHSL population models, 2025, shown as a range), how many in urban against rural places (GHSL degree of urbanisation, 1 km), and the settlements counted by size.

> About 16,000-51,000 people live in the area (3,900-13,000 in urban places, 12,100-38,000 rural), in 3 settlements large enough for GHSL to map; 9,400-32,000 live dispersed.



Suburban or peri-urban · Rural cluster · Low density rural · Very low density rural

People in the area	16,000-51,000
In urban places	3,900-13,000
In rural places	12,100-38,000
Living dispersed (outside mapped settlements)	9,400-32,000

Settlement size	Settlements
Under 1,000 people	1
1,000-5,000	1-2
5,000-20,000	0-1
20,000-50,000	0
50,000 or more	0

Settlement type	Settlements	People
Suburban or peri-urban area	1	3,900-13,000
Village (rural cluster)	2	2,500-5,300

- People are modelled estimates, not a census; the two models are shown as a range.
- Urban and rural follow GHSL's degree of urbanisation (1 km cells, 2025): a settlement is a group of touching cells, so two villages close together count as one.

- Small villages, hamlets and pastoral camps below GHSL's rural-cluster threshold (about 300 people per km² over at least 5,000 people) count as dispersed population, not as settlements.
- The two population models differ by a factor of 3.2: a census or local count is the better figure, and it can lie between the two (in Kenya's 2019 census it did, for Marsabit County and for Laisamis ward).

2. Water points W2

Water points recorded in the Water Point Data Exchange (WPdx+) and OpenStreetMap, merged (a point within 50 m of another counts once), by type, by status at their last report and by how old that report is. Totals only.

> 7 water points are recorded: 3 working, 0 not working and 4 of unknown status by their last report. The newest report is from 2012-07-12; that gives 0.06-0.19 working improved points per 1,000 people.

Type	Points	Working	Not working	Unknown
Dug well	5	1	0	4
Tap	1	1	0	0
Spring	1	1	0	0
All	**7**	**3**	**0**	**4**

From WPdx+	3
From OpenStreetMap	4
Same point in both, counted once	0
Working improved points per 1,000 people	0.06 - 0.19

Last report	Points
Within 2 years	0
2-5 years	0
5-10 years	0
Over 10 years	3
No date (OpenStreetMap)	4

- Few known water points: 0.06-0.19 working improved points per 1,000 people (Sphere's minimum is about 2, i.e. 500 people per hand pump). Points nobody has mapped are missing, so this is a lower bound.
- The records are old: half of the water points were last reported more than 15 years ago (newest 2012-07-12). Their status may have changed.
- The status of 57.1 % of the points is unknown (OpenStreetMap has no status).

- Only water points someone has recorded in WPdx or OpenStreetMap are counted; private and household sources (own wells, rainwater tanks, vendors) mostly aren't.
- A status is as of the last report; OpenStreetMap gives no status or date.

3. Walking time to water W3

How long people walk, one way, to the nearest known working improved water point, over the Malaria Atlas Project's walking-only friction surface (Weiss et al. 2020). The UN's basic drinking-water service is an improved source within a 30-minute round trip, queuing included.

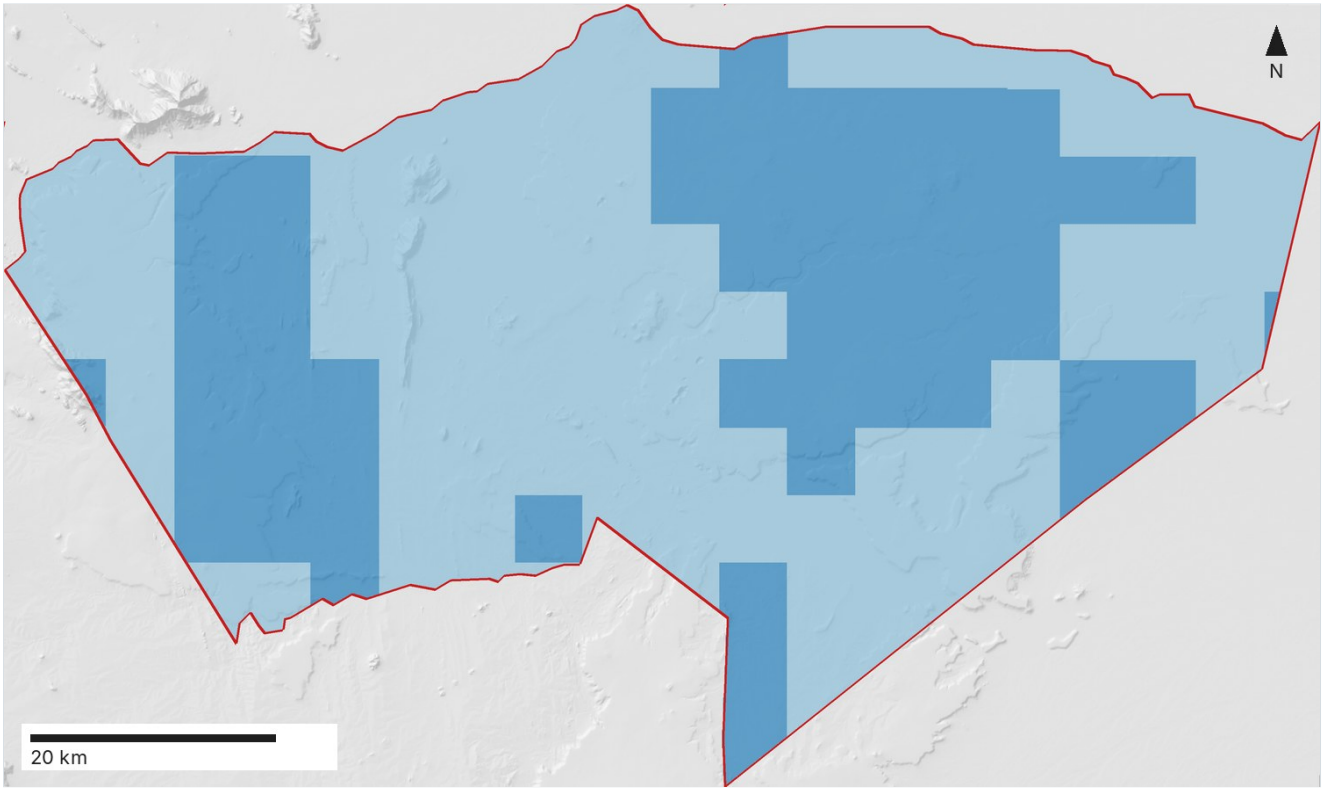
> Walking time to water isn't assessed here. Only 0.06-0.19 working improved water points per 1,000 people are recorded, below 0.5: a modelled time would show where someone recorded points, not how far people walk. The water office's inventory of water points is needed first.

- Walking time is not assessable here: too few water points are recorded (0.06-0.19 working improved points per 1,000 people; below 0.5, the time measures how many points someone recorded, not how far people walk). Ask the water office for its inventory of water points.
- Only water points someone has recorded as working and improved count; private and household sources, and points nobody has mapped, don't. Where few are recorded, walking times are too long.
- Queuing, sources that fail in the dry season, insecurity and who may use a point aren't modelled.
- The walking-speed surface has cells of about 921 m: a 15-minute walk is about one cell, so times under 15 minutes are coarse.
- Status is as of each point's last report, which may be years old (W2).

4. Water resources W4

What water there is to draw on: groundwater (British Geological Survey maps for Africa, 5 km), surface water that lasts all year, and how much rain falls and how reliably.

> Groundwater productivity is mostly Low-moderate (0.5-1 L/s) and the water table mostly Shallow-moderate (25-50 m); long-term recharge averages 34 mm a year. Rain averages 385 mm a year.



Groundwater productivity

Class	Area, km²	% of the area
Low-moderate (0.5-1 L/s)	2,385	60
Moderate (1-5 L/s)	1,588	40

Depth to groundwater

Class	Area, km²	% of the area
Very shallow (0-7 m)	172	4.3
Shallow (7-25 m)	1,346	33.9
Shallow-moderate (25-50 m)	2,455	61.8

Groundwater storage

Class	Area, km²	% of the area
Low (< 1,000 mm)	894	22.5

Low-moderate (1,000-10,000 mm)	2,027	51
Moderate (10,000-25,000 mm)	339	8.5
High (25,000-50,000 mm)	712	17.9

Long-term groundwater recharge	34 mm a year (29 - 42)
Surface water all year	0 km²
Surface water part of the year	0 km²
Normal rainfall a year	385 mm
Year-to-year variation of rainfall	44.8 %

- Groundwater maps are BGS's for Africa at 5 km (MacDonald et al. 2012, 2021): they show what is likely across a region, not what a borehole at a given place will yield.
- Water quality (fluoride, arsenic, salinity) isn't assessed.

5. Risks to water sources W5

Water points that floods or drought threaten: on flood-prone land, where vegetation is stressed now or often, and on seasonal surface water. From the area's Flood and Drought Baselines when they have been run. Totals only.

> 0 water points lie on flood-prone land (zones A and B) and 7 where vegetation was stressed in 20 % or more of growing-season months. These are totals only.

Flood zones (the area's Flood Baseline)

Class	Water points	Working
Zone A (strong evidence)	0	0
Zone B (moderate evidence)	0	0
Zone C (weak evidence)	2	1
Permanent water	0	0
Not flood-prone	5	2

From flood zones from the Flood Baseline of 22 November 2026.

Vegetation stress now (the area's Drought Baseline)

Class	Water points	Working
Extreme vegetation deficit	0	0
Severe vegetation deficit	0	0
Moderate vegetation deficit	1	0
Normal vegetation greenness	0	0
Above normal vegetation greenness	3	2
No data	3	1

From drought results from the Drought Baseline of 22 November 2026.

How often vegetation was stressed (the area's Drought Baseline)

Class	Water points	Working
Under 10 % of growing-season months	0	0
10-20 %	0	0
20-30 %	0	0
30 % or more	7	3

From drought results from the Drought Baseline of 22 November 2026.

Surface water (JRC, 2020)

Class	Water points	Working
Permanent water (all 12 months)	0	0

Seasonal water (1-11 months)	0	0
No surface water	7	3

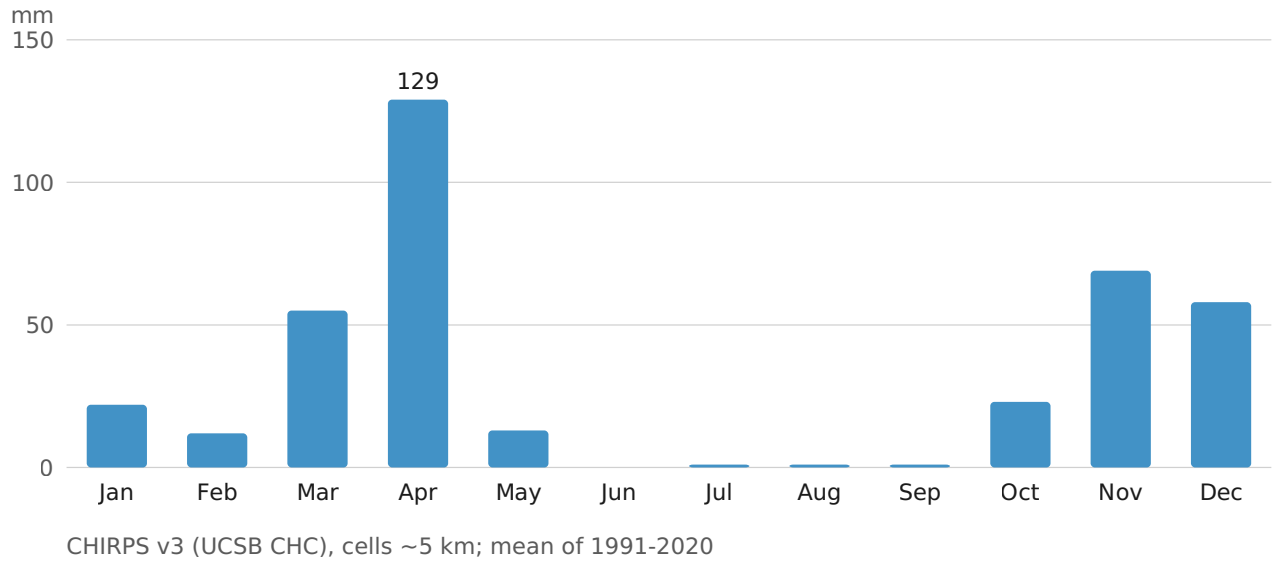
Not assessed: arsenic, fluoride and salinity maps for groundwater have no terms of use that allow this use (catalog: eawag-gap-hazard).

- A water point on flood-prone land may be raised or protected; one in a stressed area may draw on deep groundwater. These counts say where to look, not which points fail.

6. 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.

> Rain averages 385 mm a year (1991-2020). The wet season is Nov-Apr, with 90 % of the year's 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

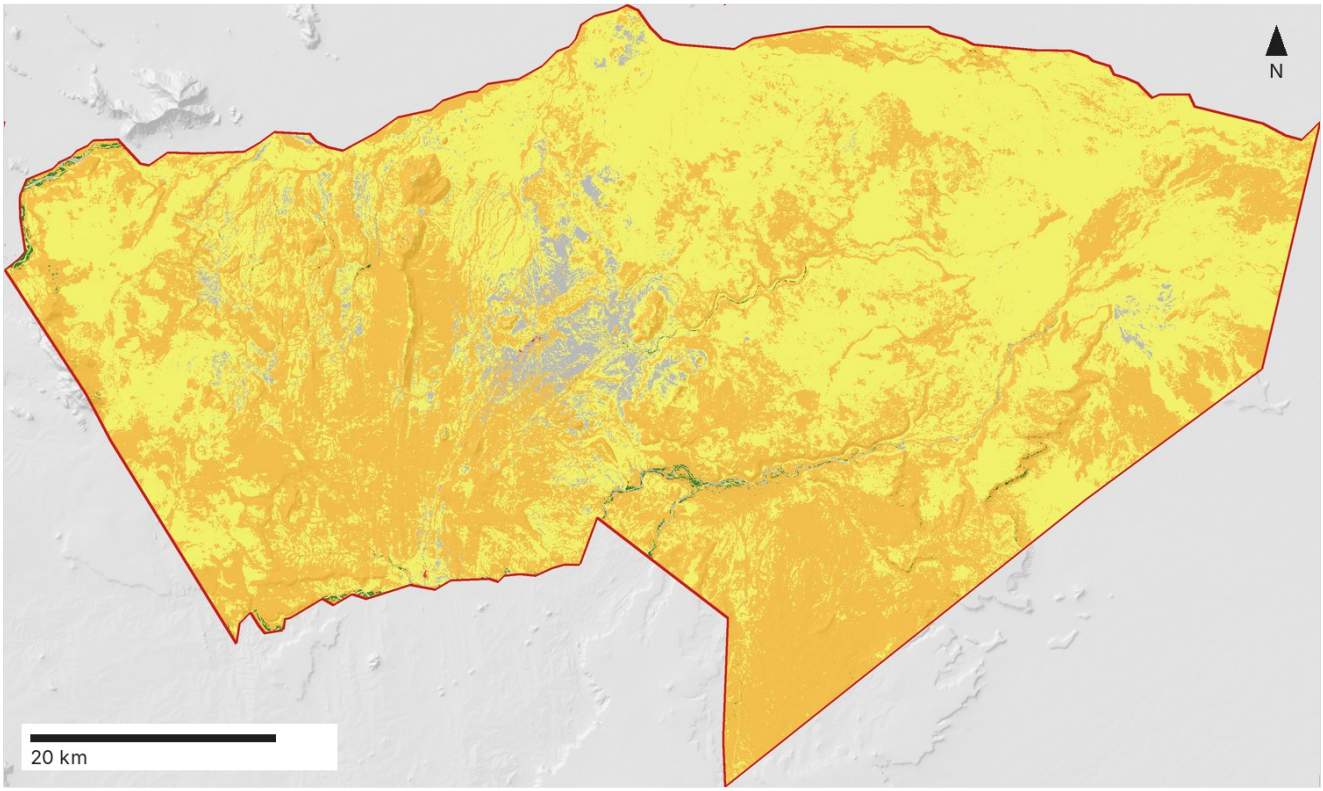
Month	Normal, mm	Month	Normal, mm
Jan	22	Feb	12
Mar	55	Apr	129
May	13	Jun	0
Jul	1	Aug	1
Sep	1	Oct	23
Nov	69	Dec	58

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

7. Land cover M5

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

Grassland is the most common land cover, 52.8 % of the area.



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

8. 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
W1 People and settlements	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 two population models differ by a factor of 3.2. • Settlements come from GHSL's 1 km degree of urbanisation: small villages and camps count as dispersed.
W2 Water points	Low	• Only points recorded in WPdx or OpenStreetMap are counted; private sources mostly aren't. • Half the records are over 14 years old (newest 2012-07-12). • Few points are recorded: 0.06-0.19 working improved points per 1,000 people, likely far fewer than exist. • The status of 57.1 % of the points is unknown.
W3 Walking time	Low	• Walking speed comes from a surface with cells of about 921 m; queuing, seasons and insecurity aren't modelled. • Not assessable: too few water points are recorded (0.06-0.19 working improved points per 1,000 people), so the times would show where points were recorded, not how far people walk.
W4 Water resources	Medium	• BGS groundwater maps are 5 km, for Africa: they show what is likely across a region, not what a borehole will yield.
W5 Risks to water sources	Medium	• A point on flood-prone land may be protected, and one in a stressed area may draw deep groundwater: these counts say where to look. • Where drought is frequent comes from the Drought Baseline's stress frequency since 2001, rated medium.

Not assessed

- Sanitation and hygiene aren't mapped from open data: they are for the field questions.
- Water quality (fluoride, arsenic, salinity, bacteria) isn't assessed: no usable open maps.
- How much water each point gives, whether it lasts through the dry season, and queues aren't known.
- Who may use a point, what it costs and who maintains it aren't known.
- Livestock water use, which drives demand in pastoral areas, isn't assessed.
- Private and household sources (own wells, rainwater tanks, vendors, water trucking) are mostly missing.

What would improve it

- The water office's own water-point inventory, with status and yields, to replace old or missing records.
- Borehole records (depths, yields, failures), for the groundwater maps' 5 km view.
- Water quality tests (fluoride, salinity, bacteria) at the main sources.
- A household survey of water sources and collection times, to check the walking-time model.

9. 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
☐	**Check on site** Of the 7 recorded water points, which work all year, and which dry up or slow down in the dry season? A point that fails in the dry season doesn't serve people when they need it most.	W2 water points: 7 points
☐	**Check on site** Most water-point records are old (the newest is from 2012-07-12). Check which points still work and add any new ones. Status changes fast: a record years old says little about today.	W2 water points: median report 14.5 years old
☐	**Ask locally** Only 0.06-0.19 working improved water points per 1,000 people are recorded. Ask the water office for its inventory of water points, and ask people where they really fetch water and how long it takes, queue included. With so few points recorded, a modelled walking time shows where someone recorded points, not how far people walk.	W3 walking time: not assessable (0.06-0.19 per 1,000 people recorded)
☐	**Check on site** At the busiest points, how long is the queue, at what times, and how much water does each give in a day? Queuing counts in the 30-minute round trip, and yield limits how many people a point serves.	M7 data gaps: queues and yields aren't known
☐	**Ask locally** Do people complain about the taste, salt or colour of any point, or about illness after drinking? Has any point been tested (fluoride, salinity, bacteria)? Fluoride and salinity are common in groundwater in dry regions; no open map can be used here.	M7 data gaps: water quality isn't assessed
☐	**Ask locally** Who looks after each point (a committee, the county, a private operator), and who pays for repairs? Do users pay per container? Points without a paid maintainer break down and stay broken.	M7 data gaps: management and payment aren't known
☐	**Ask locally** What sanitation do households use (own or shared latrines, open defecation), and how far are latrines from wells? Latrines near shallow wells contaminate them; open data can't show sanitation.	M7 data gaps: sanitation isn't mapped
☐	**Collect data** Groundwater productivity is low to low-moderate over 60 % of the area. Ask the water office for borehole records: depths, yields and failed boreholes. Where productivity is low, many boreholes fail or give little; local records show where.	W4 water resources: low productivity over 60 % of the area
☐	**Ask locally** 7 water points are where drought is frequent. Ask which dry up or get crowded in a drought, and where people go then. In a drought, people and herds crowd the points that last.	W5 risks: 7 points where drought is frequent
☐	**Ask locally** Do livestock drink at the same points as people? In the dry season, how many animals come, and from how far? In pastoral areas animals can need more water than people and wear points out.	M7 data gaps: livestock water use isn't assessed

Appendix A. Methods log

Every step of run fca23eba-775f-41e6-95db-4a0c969d5ca1 (baseline-wash/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 bd33677. Working grid: EPSG:32637, 30 m (maps and land cover), 100 m (people), about 930 m (walking speed), 5 km (groundwater); water points and walking within a 20 km margin. Compute time 61.4 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. m4 template, m5 template, w1 template, w2 template, w3 template, w4 template, w5 template, summary template.

#	Operation	Settings and data	Time, s
1	**flood_link** data.link_flood_baseline 1.0.0	Geovatra Flood Baseline (run 4595f813) baseline/1.3.0, accessed 2026-11-22	1.2
2	**drought_link** data.link_drought_baseline 1.0.0	Geovatra Drought Baseline (run f1bf1ba3) baseline-drought/1.1.0, accessed 2026-11-22	1.6

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`
			2

4	**urbanisation** data.fetch_urbanisation 1.0.0	GHSL GHS-SMOD degree of urbanisation (R2023A) GHS-SMOD R2023A, epoch 2025, 30 arc-seconds (V2-0), accessed 2026-11-22	0.7
5	**friction** data.fetch_walking_friction 1.0.0	`buffer_m = 20000` Global walking-only friction surface 2019 (Malaria Atlas Project) Global walking-only friction surface, nominal year 2019 (MAP, released 2020), accessed 2026-11-22	2
6	**wpdx** data.fetch_wpdx 1.0.0	`buffer_m = 20000` Water Point Data Exchange (WPdx+) WPdx+ (latest record per water point), accessed 2026-11-22	1.1

7	**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)`
			3.7

8	**gw_productivity** data.fetch_groundwater 1.0.0	`layer = productivity` Quantitative maps of groundwater resources in Africa (BGS) GWPROD v1 (2012), accessed 2026-11-22	0.9
9	**gw_depth** data.fetch_groundwater 1.0.0	`layer = depth` Quantitative maps of groundwater resources in Africa (BGS) DTW v2 (2012), accessed 2026-11-22	1.3
10	**gw_storage** data.fetch_groundwater 1.0.0	`layer = storage` Quantitative maps of groundwater resources in Africa (BGS) GWSTOR v1 (2012), accessed 2026-11-22	1.1
11	**gw_recharge** data.fetch_groundwater 1.0.0	`layer = recharge` Groundwater recharge in Africa from ground based measurements (BGS) Long-term average recharge 1970-2020 (2021), accessed 2026-11-22	0.7

12	**seasonality**
	data.fetch_water_layer 1.0.0
		`layer = seasonality, buffer_m = 0, 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 2026-11-22
		`30E_10Nv1_3_2020`
			1.5

13	**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`
			1.1

14	**rainfall**
	data.fetch_rainfall 1.0.0
		`start_year = 1991`
		CHIRPS v3.0 rainfall v3.0 monthly, accessed 2026-11-22
		`1991.01 to 2026.10`
			51.5

15	**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`
			0.8

16	**m4** module.m4_rainfall 1.0.0	`compare_years = 2012,2022,2024`	0
17	**m5** module.m5_land_cover 1.1.0	`buffer_m = 0`	2.5
18	**w1** module.w1_people_settlements 1.0.1		0.3
19	**w2** module.w2_water_points 1.0.0		0
20	**w3** module.w3_walking_time 1.1.0		0.4
21	**w4** module.w4_water_resources 1.1.0		0.8
22	**w5** module.w5_water_source_risks 1.0.0		0.1
23	**m7** module.wash_data_gaps 1.1.0		0
24	**m8** module.wash_field_questions 1.1.0		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/
GHSL GHS-SMOD degree of urbanisation (R2023A) European Commission JRC	CC BY 4.0 (European Commission reuse policy) checked 2026-11-22	European Commission, Joint Research Centre (JRC) Schiavina, M., Melchiorri, M., Pesaresi, M. (2023). GHS-SMOD R2023A - GHS settlement layers, application of the Degree of Urbanisation methodology (stage I) to GHS-POP R2023A and GHS-BUILT-S R2023A, multitemporal (1975-2030). European Commission, JRC. doi:10.2905/A0DF7A6F-49DE-46EA-9BDE-563437A6E2BA https://human-settlement.emergency.copernicus.eu/ghs_smod2023.php

Global walking-only friction surface 2019 (Malaria Atlas Project) Malaria Atlas Project	CC BY 3.0 (MAP open access policy for its maps) checked 2026-11-22	Malaria Atlas Project, CC BY 3.0 Weiss, D.J. et al. (2020). Global maps of travel time to healthcare facilities. Nature Medicine 26, 1835-1838. doi:10.1038/s41591-020-1059-1 https://data.malariaatlas.org/
Groundwater recharge in Africa from ground based measurements (BGS) British Geological Survey (UKRI)	Open Government Licence checked 2026-11-22	Contains data supplied by UKRI MacDonald, A.M. et al. (2021). Mapping groundwater recharge in Africa from ground observations and implications for water security. Environ. Res. Lett. 16, 034012. doi:10.1088/1748-9326/abd661. Dataset: BGS NGDC doi:10.5285/45d2b71c-d413-44d4-8b4b-6190527912ff https://doi.org/10.5285/45d2b71c-d413-44d4-8b4b-6190527912ff
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Quantitative maps of groundwater resources in Africa (BGS) British Geological Survey (UKRI)	Open Government Licence checked 2026-11-22	Contains data supplied by UKRI MacDonald, A.M., Bonsor, H.C., Ó Dochartaigh, B.É., Taylor, R.G. (2012). Quantitative maps of groundwater resources in Africa. Environ. Res. Lett. 7, 024009. doi:10.1088/1748-9326/7/2/024009. Dataset: BGS NGDC doi:10.5285/e37d09e7-6388-494b-99c8-10958d6d78c4 https://doi.org/10.5285/e37d09e7-6388-494b-99c8-10958d6d78c4
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 wash-report 1.1.0. Numbers are rounded: 1 decimal under 10, whole numbers under 100, otherwise 2 significant figures; people to 2 significant figures.