

COUNTRY DOSSIER

Ethiopia

Irrigation water, climate, fertilisers and crops: National study and a study of each region, potential benefits of our products, external trade

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Village and teff fields in Oromia.

Foreword

This dossier describes Ethiopia from the angle of irrigation water, climate, fertilisers and crops. It is written for the ministries in charge of agriculture and water, the regional bureaus of agriculture and farmers' cooperatives. It answers three questions: Where is water used, for which crops, and in which regions? It then examines what our products can change, and what that can be worth.

Reading the sources. Every figure refers to a source, named in the text and detailed in Annex A. Each source carries a confidence level:

How to read this document

- **A**: Official statistics or international database (Ethiopian Statistics Service, FAO, World Bank).
- **B**: Research institute, United Nations agency, or recognised climate model.
- **C**: Manufacturer statement, official statement reported by the press, trade press, or estimate.
- "bn" means billion; "M" means million; "km³" means billion cubic metres; "t" means tonnes.
- The Ethiopian crop year runs from September to August. "2021/22" means the season from September 2021 to August 2022.
- A "scenario" is a calculation based on the trials cited. It is not a measurement made in Ethiopia.

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Summary

The points below summarise the dossier. The key figures come from public sources: The Ethiopian Statistics Service (ESS), FAO, the World Bank, PVGIS and ERA5. The water savings are scenarios, described in Annex B.

135.5 M
Inhabitants in 2025 (World Bank); 60% of jobs are in agriculture.

9.7 km³
Of water withdrawn each year for agriculture, 92% of all withdrawals.

858,000 ha
Equipped for irrigation (FAOSTAT, 2023), for an estimated potential of 5.3 million hectares.

1.46 km³
Of water saved per year in the central scenario, 15% of agricultural water.

129,000 ha
More could be irrigated with the water saved, for the same volume.

547,000 t
Of mineral nitrogen used in 2023 (FAOSTAT), almost all imported. Spending: At least $630 M.

Eight key points

1. **An agricultural country of 135 million people.** Agriculture provides 33% of GDP and 60% of jobs (World Bank, 2025). The population grows by 2.6% a year.

2. **Cereals grown mostly under rain.** Smallholders harvested 32.8 million tonnes of grain on 12.2 million hectares in 2021/22, excluding Tigray (ESS). Maize, teff, wheat and sorghum dominate.

3. **Very different climates.** Rainfall ranges from 149 mm a year at Semera (Afar) to 2,745 mm at Bonga (South West), 1991-2020 mean (ERA5). The eastern and south-eastern lowlands are arid.

4. **The lowlands are warming.** At Semera, the mean temperature has risen by 0.33 °C per decade since 1981 (ERA5). The 2020-2023 drought killed about 6.85 million head of livestock (OCHA, March 2023).

5. **Irrigation uses only a small part of the potential.** 858,160 ha are equipped (FAOSTAT 2023), 16% of the 5.3 million irrigable hectares estimated by IWMI. In the main season, 1.23 million smallholders irrigate 165,111 ha.

6. **Fertilisers are imported, and their cost weighs.** Nitrogen use rose from 80,503 t in 2005 to 547,262 t in 2023. At international prices, the minimum spending reached $950 M in 2022. Almost everything arrives through the port of Djibouti.

7. **The potential water saving is large.** In the central scenario, 1.46 km³ a year, 15% of agricultural water. With this water, about 129,201 more hectares could be irrigated. The range is 0.73 to 2.92 km³.

8. **Coffee carries exports.** Agricultural exports reached $2.26 bn in 2023 (FAOSTAT), including $1.22 bn of coffee. For 2024/25, the coffee authority reports a record $2.65 bn.

Key figures

Key indicators for Ethiopia

Indicator	Value	Year	Source (level)
Population	135.5 million	2025	World Bank (A1, A)
Agriculture share of GDP	32.8%	2025	(A1, A)
Water withdrawals for agriculture	9.69 km³	2022	(A1, A)
Area equipped for irrigation	858,160 ha	2023	FAOSTAT (A2, A)
Smallholder irrigated area	165,111 ha	2021/22	ESS (A4, A)
Grain harvested (smallholders)	32.8 million t	2021/22	ESS (A3, A)

Indicator	Value	Year	Source (level)
Mineral nitrogen used	547,262 t	2023	FAOSTAT (A2, A)
Solar radiation (regional capitals)	1,862 to 2,361 kWh/m²/yr	2005-2020	PVGIS (A7, A)
Potential water saving (central)	1.46 km³	Scenario	Calculation (Annex B)

Source: See the "Source" column; levels explained in the foreword.

1. Green Solutions and our products

Green Solutions develops products for water, fertilisation and crop protection. Four families concern this dossier. The performance figures cited are those published by the manufacturer or by the trials, with their confidence level.

Products covered by this dossier

Product	Claimed use	Published evidence	Level
EVERGREEN® (water retainer)	Holds rain or irrigation water as a gel, close to the roots	Trials on maize, potato, watermelon, date palm and soybean (sections 8 and 9)	B to C
ECOSORB® (water retainer based on maize starch)	Same use; effect lasts 2 to 3 years according to the website	Soybean trial (China); laboratory acrylamide analysis	B to C
ECOFERT® (fertiliser)	Fertiliser certified by SOHISCERT and EU Organic	Published certificate; potato trial combined with EVERGREEN	A (certificate), C (results)
Paulownia ALTIFOLIA®	Fast-growing tree for agroforestry	Website figures; no trial in Ethiopia	C
Water Vital®, NAPEMA®	Outside the scope of this dossier	No independent source in the documents consulted	—

Source: Green Solutions website (product sheets and published trials), Annex A, sources A20 to A25.

The indicative dose published on the website is 30 to 75 kg/ha. In Ethiopia, the products concern three situations first: Irrigated schemes (onion, potato, tomato, maize, banana), rain-fed crops exposed to late or interrupted rains, and tree planting.



Hoeing the soil on a small highland farm.

2. Ethiopia in figures

Ethiopia is Africa's second country by population: 135.5 million people in 2025 according to the World Bank. The Ethiopian Statistics Service projects 109.4 million people in July 2024, on a different basis; the two sources are quoted without being mixed. 76% of the people live in rural areas.

Agriculture provides 32.8% of GDP and 60.1% of jobs. GDP per person is 933 dollars (2025). Undernourishment still affects 19.9% of the population (2024, FAO via the World Bank).

Economic and agricultural indicators

Indicator	Value	Year
Population (World Bank)	135,472,051	2025
Population growth	2.55%	2025
GDP (current dollars)	$126.4 bn	2025
GDP per person	933 $	2025
Agriculture, share of GDP	32.8%	2025
Agricultural employment, share of jobs	60.1%	2025
Fertiliser per hectare of arable land	45.4 kg	2024
Cereal yield	2,632 kg/ha	2024
Internal renewable water resources	122 km³ (973 m³/person)	2022
Undernourishment	19.9%	2024

Source: World Bank, World Development Indicators (A1).

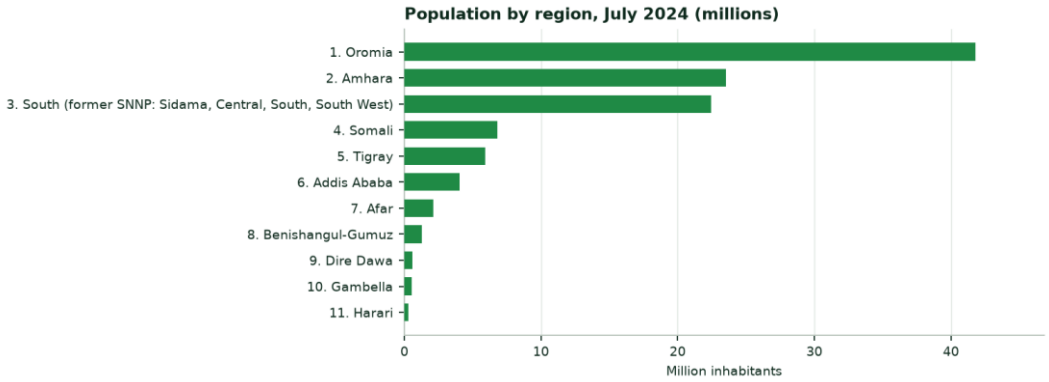


Figure 1. Population by region, July 2024 (projection). Source: ESS, population projection at 1 July 2024 (A6). The former Southern Nations, Nationalities and Peoples' Region (SNNP) now forms four regions

Population by region, July 2024 (ESS projection)

Region	Inhabitants	Share of the country
Oromia	41,790,000	38.2%
Amhara	23,549,000	21.5%
South (former SNNP: Sidama, Central, South, South West)	22,444,000	20.5%
Somali	6,808,000	6.2%
Tigray	5,936,000	5.4%
Addis Ababa	4,030,000	3.7%
Afar	2,120,000	1.9%
Benishangul-Gumuz	1,283,000	1.2%
Dire Dawa	566,000	0.5%
Gambella	540,000	0.5%

Region	Inhabitants	Share of the country
Harari	289,000	0.3%
Ethiopia	**109,355,000**	**100%**

Source: ESS, projection at 1 July 2024 (A6). Special enumeration areas are not included.

The territory covers 112.2 million hectares. Arable land occupies 16.4 million, permanent crops (coffee, khat, enset, fruit) 2.06 million and permanent meadows and pastures 20 million. Forests cover 26.8 million hectares (FAOSTAT, 2023).

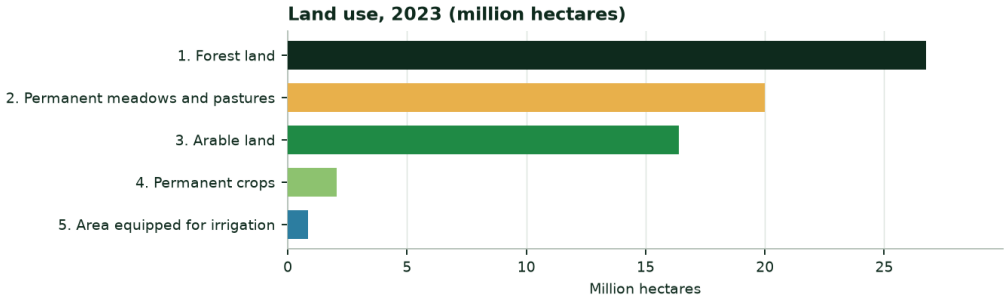


Figure 2. Land use, 2023. Source: FAOSTAT (A2)

Livestock is the second pillar of agriculture. FAOSTAT counts in 2024 71.9 million cattle, 41.1 million sheep, 54.0 million goats and 1.66 million camels. The lowlands of Afar, Somali and southern Oromia live mainly from pastoralism.



Cattle watered at the Ghibe River, south-western Ethiopia.

3. Sunshine, rainfall and climate change

3.1 Sunshine

Global solar radiation ranges from 1,862 kWh/m² a year at Bonga, in the humid and cloudy South West, to 2,361 kWh/m² at Jijiga (PVGIS, 2005-2020 mean). It is a high level everywhere, comparable to southern Spain: Light does not limit crops, water does.

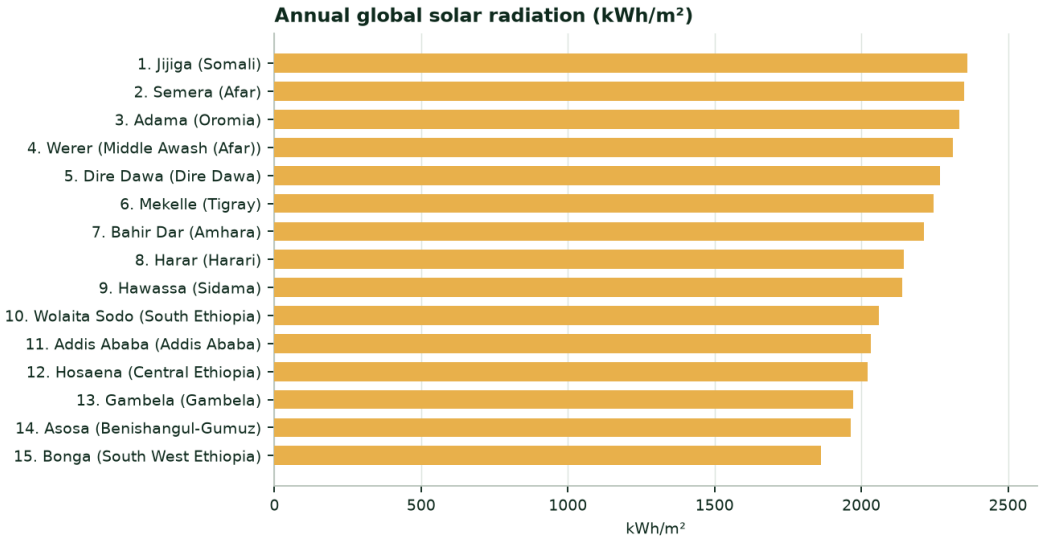


Figure 3. Annual global solar radiation at each regional capital. Source: PVGIS, JRC (A7)

3.2 Rainfall

Altitude shapes the climate. The highlands, above 1,500 m, receive most of the rain: 1,702 mm a year at Bahir Dar, 1,741 mm at Addis Ababa, 2,745 mm at Bonga. The eastern lowlands are arid: 149 mm at Semera, 473 mm at Werer in the Awash valley. These values are those of the ERA5 model for the grid cell of each capital; they can differ from station records.

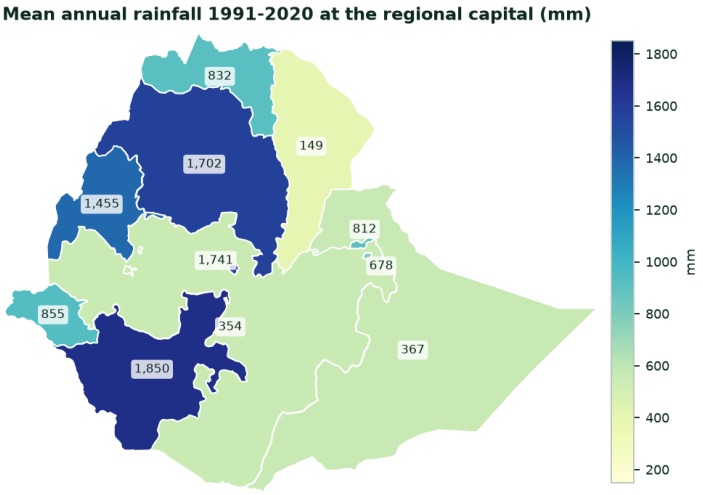


Figure 4. Mean annual rainfall 1991-2020 at each regional capital (South: Average of four capitals). Source: ERA5 via Open-Meteo (A8)

The calendar matters as much as the total. In the centre and north, the long rains (kiremt) last from June to September and carry the main harvest, called Meher. A short season (belg) falls from February to May in the east and south. In the south-east, two short seasons (gu and deyr) frame long dry periods. Figure 4 shows the gap between rainfall and reference evapotranspiration (ET0), month by month.

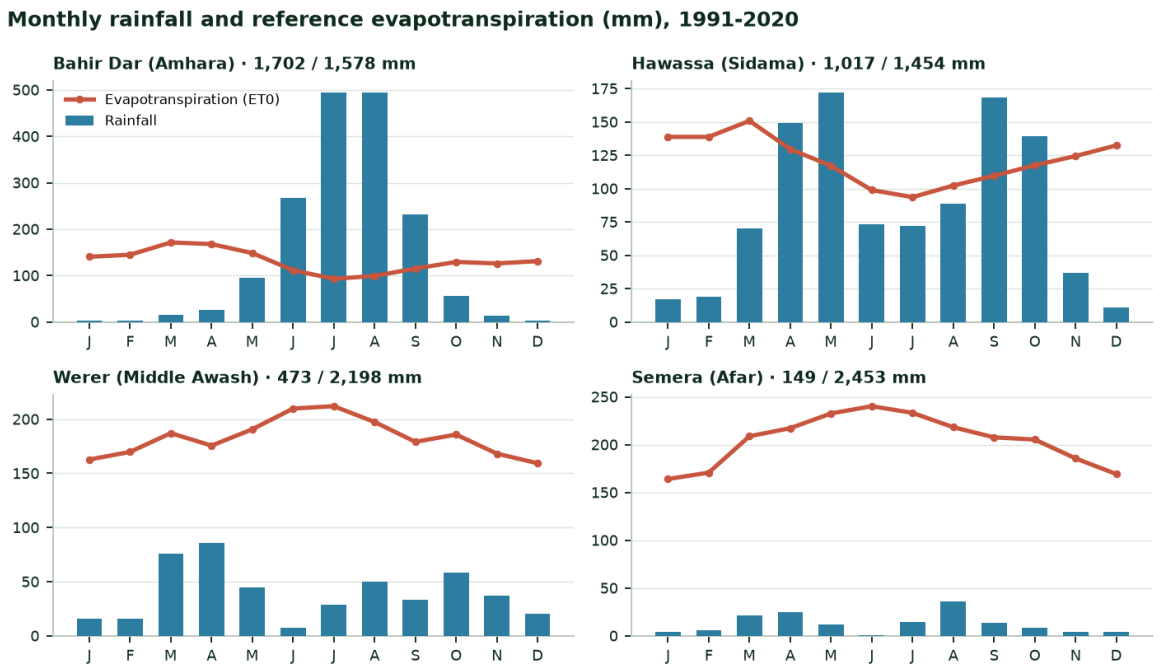


Figure 5. Monthly rainfall and reference evapotranspiration, 1991-2020, in four farming areas. Source: ERA5 via Open-Meteo (A8)

At Werer (Middle Awash), reference evapotranspiration reaches 2,198 mm a year for 473 mm of rain: No crop is possible there without irrigation. At Bahir Dar, rain exceeds needs from June to September, but the dry season lasts from November to April.

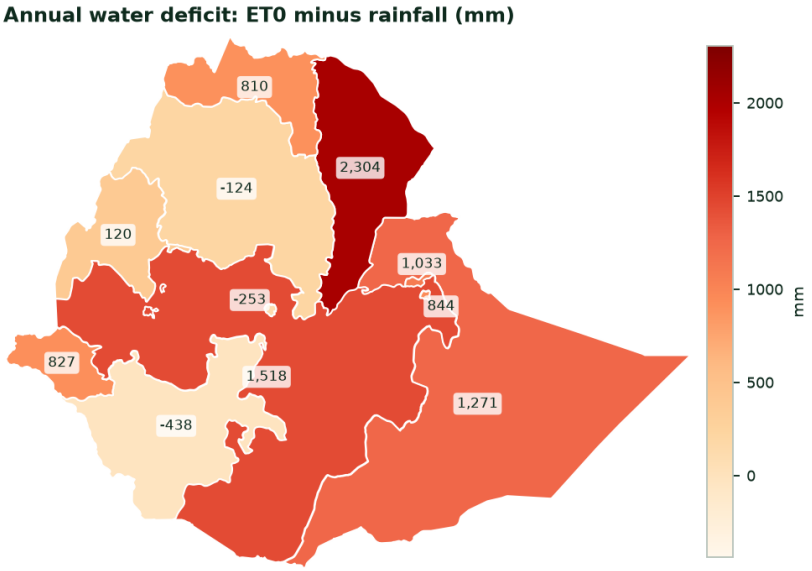


Figure 6. Annual water deficit (reference evapotranspiration minus rainfall). Source: ERA5 via Open-Meteo (A8)

Climate of the regional capitals, 1991-2020 means

Region	Station	Altitude (m)	Rain (mm)	ET0 (mm)	Deficit (mm)	Temp. (°C)	Sun (kWh/m²)
Afar	Semera	431	149	2,453	2,304	30.3	2,350
Oromia	Adama	1,619	354	1,872	1,518	20.4	2,334
Somali	Jijiga	1,648	367	1,638	1,271	19.5	2,361
Middle Awash (Afar)	Werer	734	473	2,198	1,725	28.0	2,313
Harari	Harar	1,908	678	1,522	844	18.5	2,144
Dire Dawa	Dire Dawa	1,193	812	1,845	1,033	23.6	2,269
Tigray	Mekelle	2,063	832	1,642	810	18.1	2,246

Region	Station	Altitude (m)	Rain (mm)	ET0 (mm)	Deficit (mm)	Temp. (°C)	Sun (kWh/m²)
Gambela	Gambela	435	855	1,682	827	28.1	1,972
Sidama	Hawassa	1,690	1,017	1,454	437	19.2	2,140
Benishangul-Gumuz	Asosa	1,516	1,455	1,575	120	21.5	1,965
South	Wolaita Sodo	2,032	1,580	1,478	-102	17.8	2,059
Amhara	Bahir Dar	1,795	1,702	1,578	-124	20.1	2,214
Addis Ababa	Addis Ababa	2,444	1,741	1,488	-253	15.3	2,032
Central	Hosaena	2,348	2,058	1,419	-639	15.7	2,023
South West	Bonga	1,593	2,745	1,298	-1,447	18.5	1,862

Source: ERA5 via Open-Meteo (A8); PVGIS (A7). Altitude of the model grid cell. A negative deficit means rainfall exceeds ET0 over the year.

3.3 Climate change

The ERA5 series from 1981 to 2024 shows clear warming in the lowlands: At Semera, the mean annual temperature rose from 29.7 °C (1981-1990) to 30.9 °C (2015-2024), 0.33 °C per decade. In the highlands, the rise is smaller in the same series: 0.09 °C per decade at Bahir Dar and 0.06 °C at Addis Ababa.

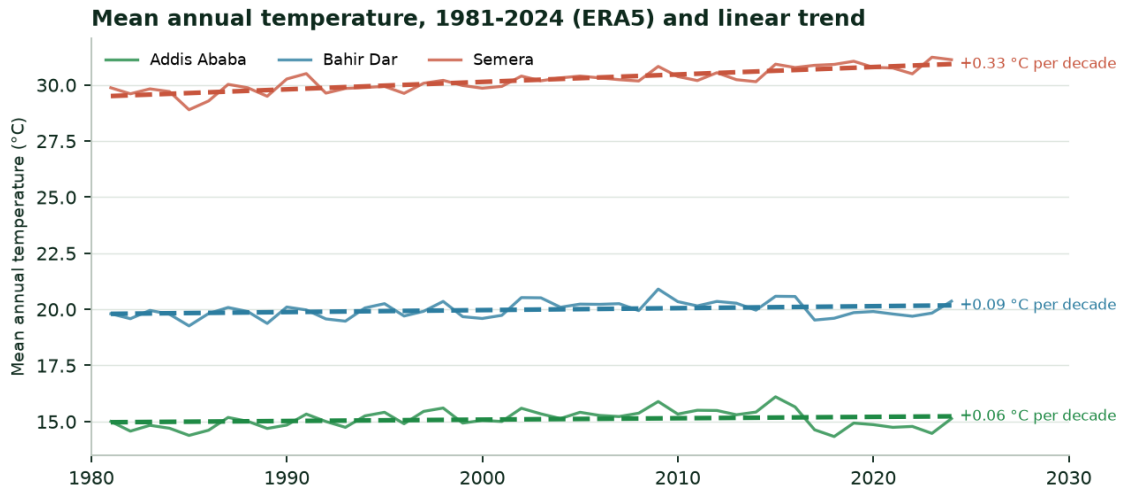


Figure 7. Mean annual temperature 1981-2024 and linear trend. Source: ERA5 via Open-Meteo (A8)

Droughts recur. From late 2020 to early 2023, five consecutive rainy seasons failed in the Horn of Africa. In Ethiopia, the UN Office for the Coordination of Humanitarian Affairs (OCHA) counted in March 2023 about 6.85 million dead livestock and about 11 million food-insecure people, mainly in Somali and southern Oromia (A10).



Herd in a dry riverbed, Afar region.

4. Irrigation water: Resources, areas, potential

4.1 Resources and withdrawals

Internal renewable water resources reach 122 km³ a year, 973 m³ per person (World Bank, 2022): Already below the threshold of 1,000 m³ per person often used to define scarcity. Withdrawals total 10.55 km³ a year, of which 91.8% for agriculture, 9.69 km³. Water stress, the ratio of withdrawals to available resources, is 32%.

The country is a regional water tower: The Blue Nile (Abbay) rises at Lake Tana, the Awash flows towards the Afar depression, the Shebelle and the Genale-Dawa run down to Somalia, the Omo to Lake Turkana. The Grand Ethiopian Renaissance Dam (GERD), on the Blue Nile, was inaugurated on 9 September 2025; it is designed for electricity (about 5,150 MW) with a reservoir of about 74 billion m³ (A11).

4.2 Irrigated areas today

FAOSTAT counts 858,160 ha equipped for irrigation in 2023. The Ethiopian Statistics Service measures, for the main season 2021/22 alone, 165,111 ha irrigated by 1,228,082 smallholders, an average of 1,344 m² per farmer (A4). This survey covers neither commercial farms, nor dry-season irrigated wheat, nor the short (belg) season.

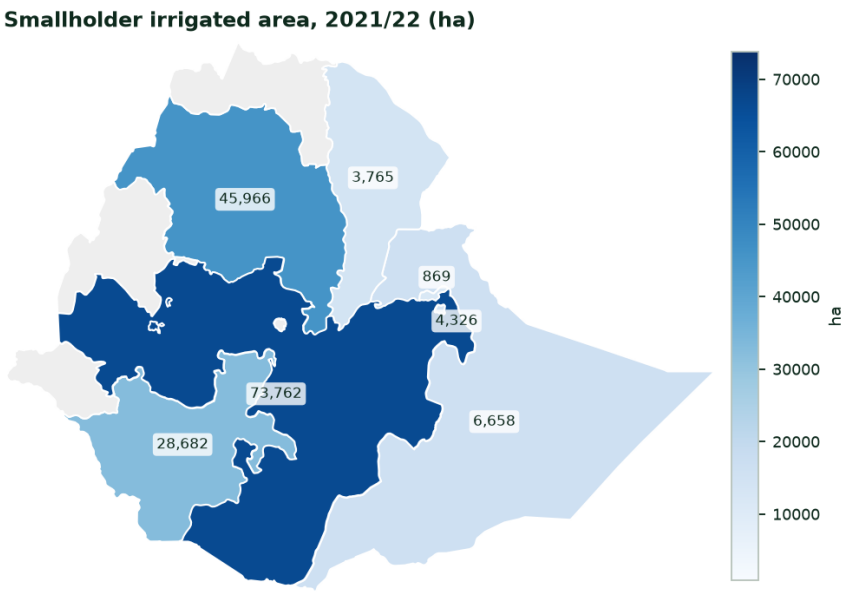


Figure 8. Smallholder irrigated area by region, main season 2021/22. Source: ESS (A4)

Smallholder irrigation by region, main season 2021/22

Region	Farmers who irrigate	Irrigated area (ha)	Share of total
Oromia	401,366	73,762	44.7%
Amhara	666,123	45,966	27.8%
South (former SNNP, with Sidama)	90,583	28,682	17.4%
Somali	15,482	6,658	4.0%
Harari	13,749	4,326	2.6%
Afar	4,860	3,765	2.3%
Dire Dawa	9,671	869	0.5%
Benishangul-Gumuz	2,619	Not published	—
Gambella	—	Not published	—
Ethiopia	**1,228,082**	**165,111**	**100%**

Source: ESS, Agricultural Sample Survey 2021/22, Farm Management Practices, table 5 (A4). "Not published": Estimate judged too imprecise by ESS. Tigray not surveyed.

Rivers supply 80% of smallholder irrigation water, wells and groundwater 12%, ponds, small dams and rainwater harvesting the rest. Irrigated crops are not those of rain-fed fields: Maize, khat, onion, banana, coffee, garlic and tomato come first.

Source of smallholder irrigation water, main season 2021/22

Source	Irrigated area (ha)	Share
River	131,379	79.6%
Well and groundwater	20,582	12.5%
Pond	4,879	3.0%
Rainwater harvesting	2,065	1.3%
Dam	1,617	1.0%
Other	4,075	2.5%
Total	**165,111**	**100%**

Source: ESS, Farm Management Practices 2021/22, table 6 (A4). Lakes (not published) are included in the total.

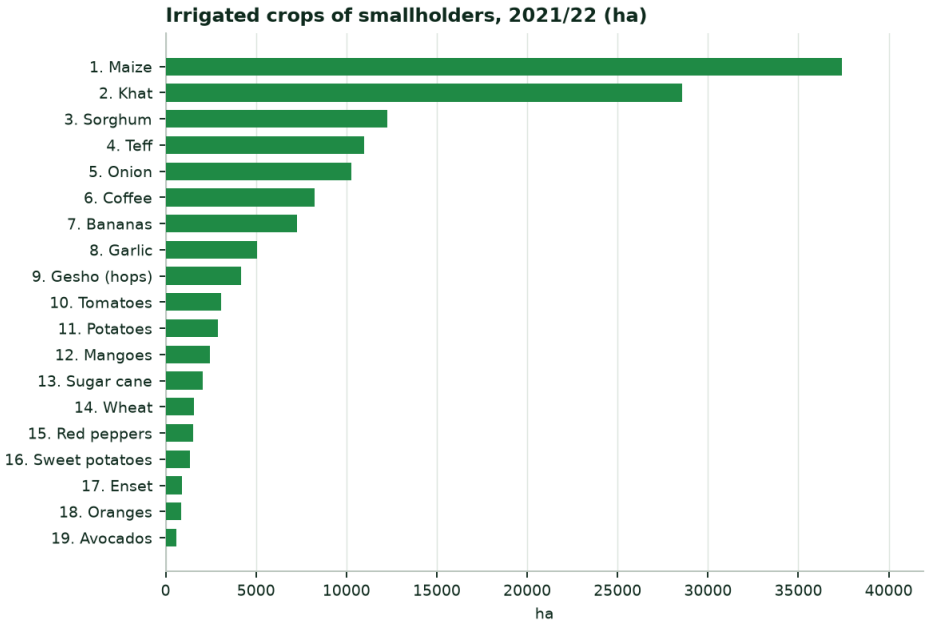


Figure 9. Irrigated crops of smallholders, main season 2021/22. Source: ESS, table 6 (A4)

The fifteen zones where smallholders irrigate most, main season 2021/22

Rank	Zone	Region	Irrigated area (ha)	Share of the country
1	East Hararghe	Oromia	25,888	15.7%
2	Gamo	South	18,566	11.2%
3	West Gojjam	Amhara	10,185	6.2%
4	West Hararghe	Oromia	9,903	6.0%
5	East Gojjam	Amhara	5,733	3.5%
6	North Wollo	Amhara	5,377	3.3%
7	Shabelle	Somali	5,345	3.2%
8	Harari	Harari	4,326	2.6%
9	Bale	Oromia	3,467	2.1%
10	Oromo special zone	Amhara	3,171	1.9%
11	Awi	Amhara	3,167	1.9%
12	North Shewa	Amhara	2,745	1.7%
13	Central Gondar	Amhara	1,995	1.2%
14	Jimma	Oromia	1,957	1.2%
15	South West Shewa	Oromia	1,709	1.0%

Source: ESS, Farm Management Practices 2021/22, table 5 (A4). Only zones with a published estimate appear here.

The two Hararghe zones, in eastern Oromia, alone irrigate more than a fifth of smallholder areas, mostly for khat and vegetables. Gamo zone, around Arba Minch, irrigates banana groves and orchards.

4.3 Potential and programmes

The International Water Management Institute (IWMI) estimates the irrigable area from rivers, groundwater and rainwater harvesting at 5.3 million hectares, of which 3.7 million from surface water (A9). The 858,160 ha equipped represent 16% of it.

Since 2019, the government has developed dry-season irrigated wheat in the lowlands (Awash, Shebelle, Omo). The Ministry of Agriculture reports a rise from 20,000 ha in 2020 to 3.5 million hectares in 2025 (A12). These areas do not yet appear in ESS surveys, and the estimates of the US agriculture department (USDA) differ (A13). The dossier quotes the official figure without using it in the calculation.

Dividing agricultural water (9.69 km³) by the equipped area gives an average of 11,288 m³ per irrigated hectare per year. It is the order of magnitude of the hot lowlands, where sugar cane, cotton and orchards need a lot of water.

5. Fertilisers: Quantities, purchases, prices, spending

5.1 Quantities used

Mineral nitrogen use rose from 80,503 t in 2005 to 547,262 t in 2023, and phosphate (P_2O_5) reaches 194,069 t. Potash remains almost absent (1,952 t of K_2O). Per hectare of arable land, the average input is 45.4 kg (World Bank, 2024), still below the 50 kg target set by the Abuja Declaration on fertilisers (2006).

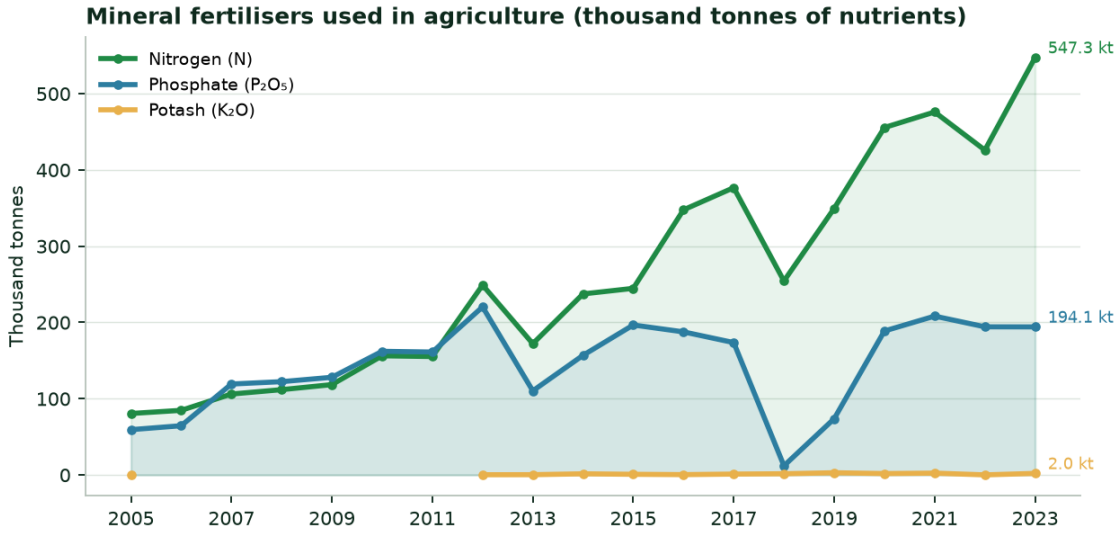


Figure 10. Mineral fertilisers used in agriculture, 2005-2023. Source: FAOSTAT (A2)

Mineral fertilisers: Agricultural use and imports (tonnes of nutrients)

Year	Nitrogen used	Phosphate used	Potash used	Nitrogen imported	Phosphate imported	Minimum spending ($M)
2015	244,613	196,584	759	138,650	33,137	310
2016	347,560	187,525	323	154,834	62,971	265
2017	376,625	173,486	1,057	127,491	23,849	282
2018	254,253	11,937	1,469	254,253	11,937	147
2019	349,522	73,692	2,806	349,522	73,692	235
2020	455,512	188,702	1,728	455,512	188,702	336
2021	475,877	208,199	2,296	475,877	208,199	746
2022	425,893	194,170	0	425,905	194,185	950
2023	547,262	194,069	1,952	547,262	194,069	630

Source: FAOSTAT (A2); World Bank prices (A16); calculation (Annex B).

The ESS survey details use by smallholders in the 2021/22 main season: 2.06 million tonnes of chemical fertiliser on 9.6 million hectares. The NPS and urea combination dominates (785,206 t), ahead of blended fertilisers used with urea (887,965 t). Teff, maize and wheat receive most of it (A4).

5.2 Purchasing and supply

The State buys fertilisers by tender, through the Ethiopian Agricultural Businesses Corporation (EABC), then distributes them through unions and cooperatives. For the 2025/26 season, the announced target was about 24 million quintals, 2.4 million tonnes; by March 2025, 797,463 t had already been unloaded from 15 ships at the port of Djibouti (A14). Almost all the volume goes through this port, then by road and by the Djibouti-Addis Ababa railway.

In August 2025, Ethiopian Investment Holdings and the Dangote group signed an agreement for a urea plant at Gode (Somali region), with an announced capacity of 3 million tonnes a year, supplied with gas from the Calub and Hilala fields; the investment is estimated at 2.5 billion dollars (A15).

5.3 Prices and spending

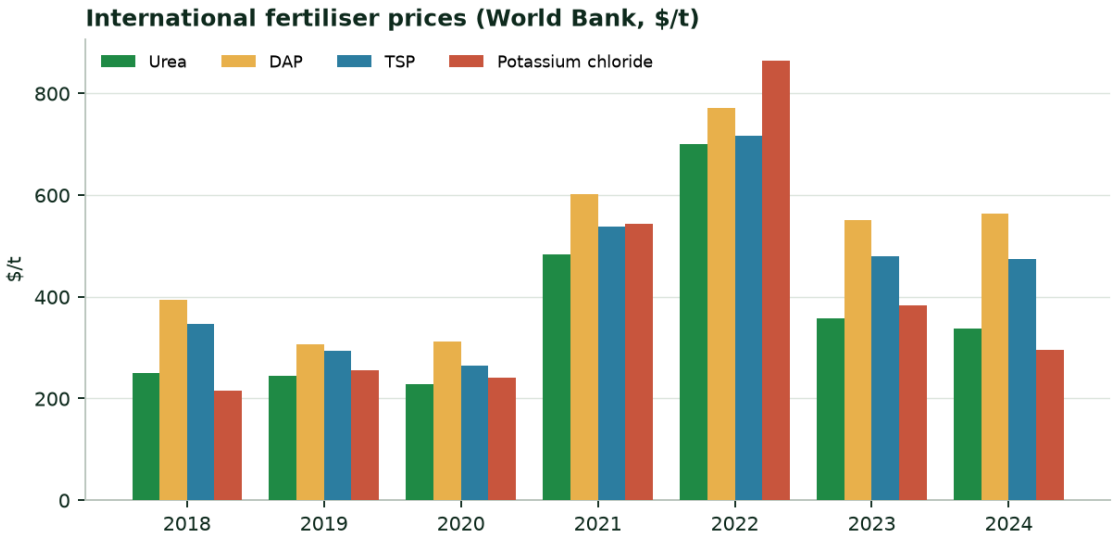


Figure 11. International fertiliser prices, 2018-2024. Source: World Bank, commodity price data (A16)

International prices doubled in 2021-2022 before falling back: Urea cost 700 $ a tonne in 2022 and 338 $ in 2024. Converting nutrients into urea, TSP and potassium chloride at international prices, the country's minimum spending reached $950 M in 2022 and $630 M in 2023. Prices paid delivered to Ethiopia are higher.

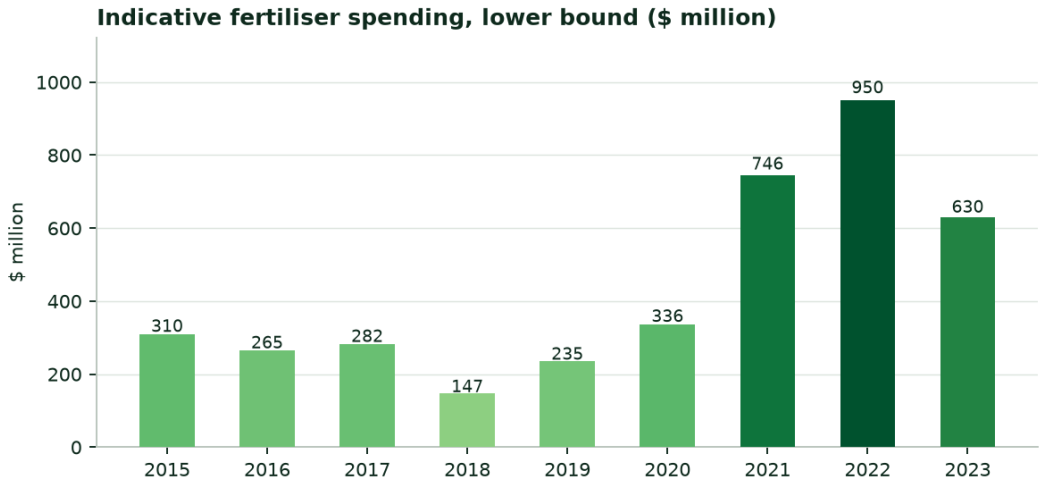


Figure 12. Indicative fertiliser spending, lower bound. Source: FAOSTAT (A2), World Bank (A16), calculation

6. The regions at a glance

The table brings together, for each region, the population, the rainfall and evapotranspiration at the capital, grain production and the smallholder irrigated area. Regions follow the breakdown of ESS publications; the four regions formed from the former SNNP are grouped.

The regions in figures

Region	Population 2024 (M)	Rain / ET0 (mm)	Grain 2021/22 (thousand t)	Irrigated 2021/22 (ha)
Oromia	41.79	354 / 1,872	17,554	73,762
Amhara	23.55	1,702 / 1,578	11,253	45,966
South (former SNNP)	22.44	1,017 / 1,454	3,182	28,682
Somali	6.81	367 / 1,638	25	6,658
Tigray	5.94	832 / 1,642	—	—
Afar	2.12	149 / 2,453	5	3,765
Benishangul-Gumuz	1.28	1,455 / 1,575	710	—
Gambella	0.54	855 / 1,682	29	—
Harari	0.29	678 / 1,522	22	4,326
Dire Dawa	0.57	812 / 1,845	11	869
Addis Ababa	4.03	1,741 / 1,488	—	—

Source: ESS (A3, A4, A6); ERA5 (A8). South: Rainfall and ET0 of Hawassa. "—": Not surveyed or not published.

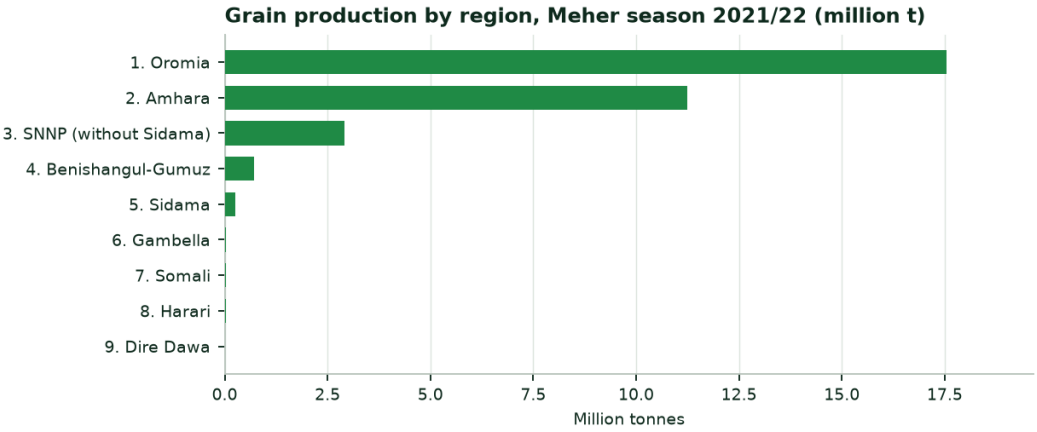


Figure 13. Grain production by region, Meher season 2021/22. Source: ESS, Agricultural Sample Survey 2021/22, volume I (A3). Tigray not surveyed

Production of the five main cereals by region, Meher 2021/22 (thousand tonnes)

Region	Teff	Maize	Wheat	Sorghum	Barley
Oromia	2,997	6,191	3,467	1,665	1,240
Amhara	2,254	2,642	1,922	1,529	646
SNNP (without Sidama)	329	1,389	409	198	166
Benishangul-Gumuz	33	309	—	—	—
Sidama	—	176	—	—	17
Somali	—	10	—	—	—
Gambella	—	23	—	6	—
Harari	—	6	0	15	0
Dire Dawa	—	1	—	9	—
Afar	—	4	—	1	—

Source: ESS, Agricultural Sample Survey 2021/22, volume I (A3). A dash means not grown, not published or inconsistent row.

Oromia and Amhara together produce 88% of the country's grain. The pastoral regions (Afar, Somali) produce very little, but they concentrate livestock and a large share of the irrigable land of the lower valleys.

7. The twenty main crops: Three rankings

FAOSTAT records 17.9 million hectares harvested in 2024, all crops together. The three rankings below show the crops that occupy the most land, those that produce the most tonnes, and those that create the most value.

7.1 By harvested area

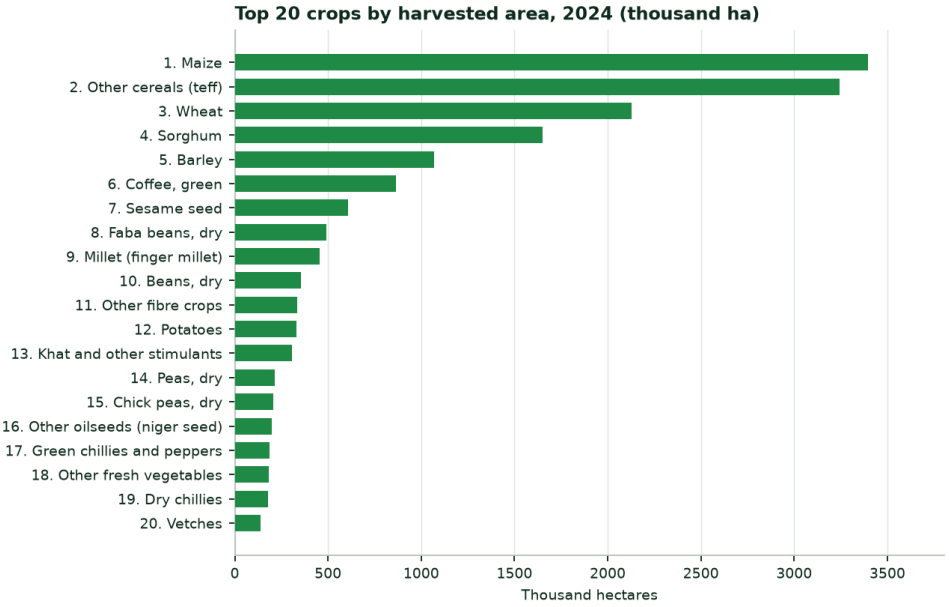


Figure 14. The twenty main crops by harvested area, 2024. Source: FAOSTAT (A2)

The twenty main crops by area: Area, production and yield, 2024

Rank	Crop	Area (ha)	Production (t)	Yield (t/ha)
1	Maize	3,397,928	11,701,131	3.44
2	Other cereals (teff)	3,245,192	5,798,195	1.79
3	Wheat	2,129,952	6,185,341	2.90
4	Sorghum	1,650,000	4,100,000	2.48
5	Barley	1,069,033	2,517,344	2.35
6	Coffee, green	862,943	575,696	0.67
7	Sesame seed	608,111	435,456	0.72
8	Faba beans, dry	491,913	1,156,009	2.35
9	Millet (finger millet)	455,000	1,125,000	2.47
10	Beans, dry	354,072	604,791	1.71
11	Other fibre crops	334,356	21,980	0.07
12	Potatoes	332,146	4,089,166	12.31
13	Khat and other stimulants	306,400	283,916	0.93
14	Peas, dry	215,377	399,813	1.86
15	Chick peas, dry	207,378	443,954	2.14

Rank	Crop	Area (ha)	Production (t)	Yield (t/ha)
16	Other oilseeds (niger seed)	196,687	270,050	1.37
17	Green chillies and peppers	187,924	397,890	2.12
18	Other fresh vegetables	180,918	499,656	2.76
19	Dry chillies	177,971	298,080	1.67
20	Vetches	139,813	320,718	2.29

Source: FAOSTAT (A2)

7.2 By production

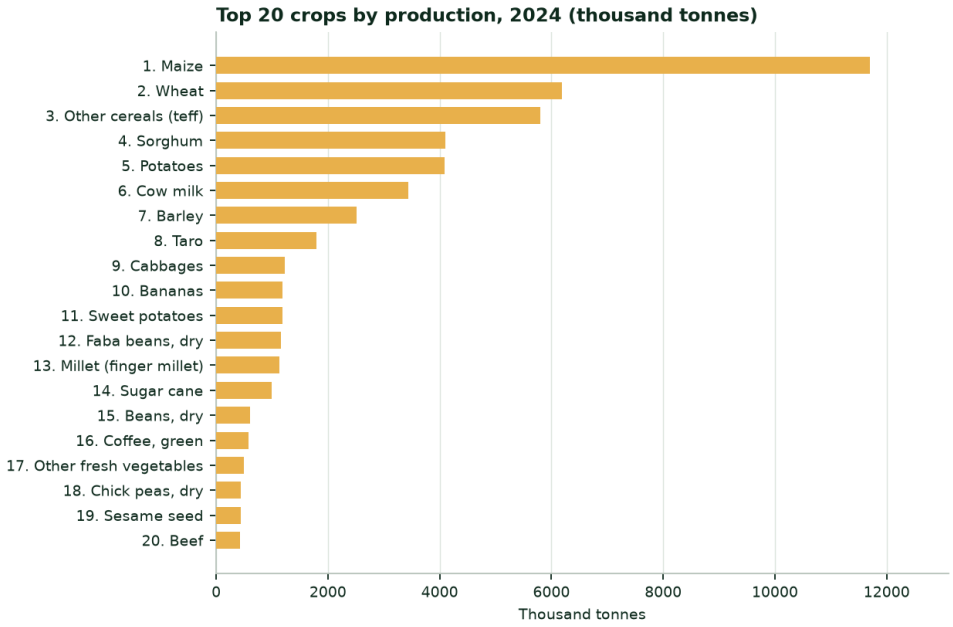


Figure 15. The twenty main crops by production, 2024. Source: FAOSTAT (A2)

7.3 By value of production

Value is expressed in constant 2014-2016 international dollars, to avoid exchange-rate effects. Crops represent $16.1 bn out of a total agricultural production of $21.7 bn in 2023; livestock provides the rest.

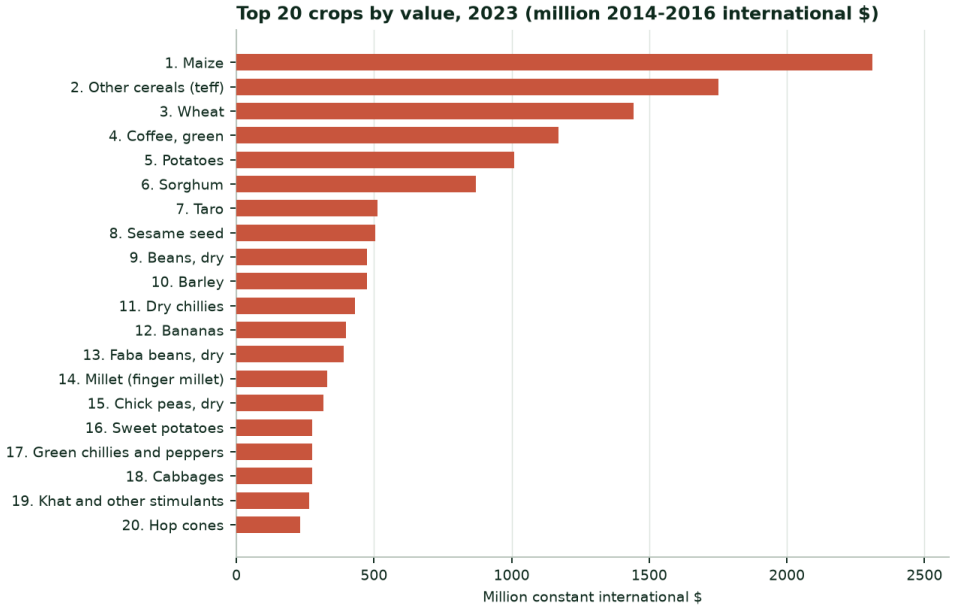


Figure 16. The twenty main crops by value of production, 2023. Source: FAOSTAT (A2)

8. Extrapolation by crop and water savings

8.1 Method

Method in brief

• **Agricultural water**: 9.69 km³ a year (World Bank, 2022), shared between crop groups according to their share of the irrigated area.

• **Irrigated area**: 858,160 ha equipped (FAOSTAT 2023). Estate sugar cane (23,419 ha harvested) is counted separately; the rest follows the mix of smallholder irrigated crops (ESS 2021/22).

• **Water saving**: For each group, a quarter (cautious), half (central) or all (strong) of the saving measured in the closest trial. Without a trial, 5, 10 or 20%.

• **Yield gain**: Same rule, applied to FAOSTAT 2024 average yields and valued at constant 2014-2016 prices.

• **What the calculation does not contain**: No product price, no application cost.

8.2 Trials used as analogues

Trials cited and their use in the calculation

Trial	Published water saving	Published yield gain	Use in this dossier	Level
Maize, Türkiye (TIGEM, 2025)	−39%	+17.1%	Irrigated maize	C
Potato, South Africa (2025-2026)	−52%	+31.4%	Onion, garlic, potato	C
Watermelon, Mexico (2023)	−60.5%	+30%	Vegetables	C
Soybean, China (Shandong)	Not measured	+11.2 to 11.4%	Yield of other cereals and pulses	B
Date palm, UAE (ICBA, 2020-2021)	−82%	+20%	Not used (no irrigated palm groves recorded)	B

Source: Trials published on the Green Solutions website (A20 to A24).

The trial closest to Ethiopian conditions is maize in Türkiye: 39% less irrigation water and 17.1% more yield, on one plot per treatment. Maize is both the country's first cereal and the first irrigated crop of smallholders.

8.3 Parameters by crop group

Areas and parameters used, by scenario (cautious / central / strong)

Group	Area (ha)	Analogue	Water	Yield
Maize	189,237	Maize, Türkiye (TIGEM, 2025)	9.8% / 19.5% / 39.0%	4.3% / 8.6% / 17.1%
Other cereals (sorghum, teff, wheat)	162,483	Water: Generic assumption; yield: Soybean, China	5% / 10% / 20%	2.8% / 5.7% / 11.3%
Pulses	20,339	Water: Generic assumption; yield: Soybean, China	5% / 10% / 20%	2.8% / 5.7% / 11.3%
Vegetables (tomato, pepper, cabbage)	42,528	Watermelon, Mexico (2023)	15.1% / 30.2% / 60.5%	7.5% / 15.0% / 30.0%
Onion, garlic, potato	104,970	Potato, South Africa (2025-2026)	13.0% / 26.0% / 52.0%	7.8% / 15.7% / 31.4%
Fruit (banana, mango, citrus, avocado)	65,400	Generic assumption, no trial	5% / 10% / 20%	—
Khat, coffee, gesho	207,160	Generic assumption, no trial	5% / 10% / 20%	—
Sugar cane	33,874	Generic assumption, no trial	5% / 10% / 20%	—
Other (enset, oilseeds, misc.)	32,169	Generic assumption, no trial	5% / 10% / 20%	—

Source: ESS (A4), FAOSTAT (A2), author's calculation (Annex B).

8.4 National results

1.46 km³
Of water saved per year in the central scenario (15% of agricultural water).

129,000 ha
More irrigable with the same water, at today's average use.

335,000 t
Of additional production in the central scenario (onion, garlic, potato, maize, vegetables).

Water saved, extra irrigable hectares and production gain, by scenario

Scenario	Water (million m³/yr)	Share of agricultural water	Extra irrigable hectares	Extra production (t)	Value ($M 2014-2016)
Cautious	729	7.5%	64,600	167,387	41.6
Central	1,458	15.1%	129,201	334,774	83.3
Strong	2,917	30.1%	258,401	669,548	166.6

Source: Author's calculation (Annex B).

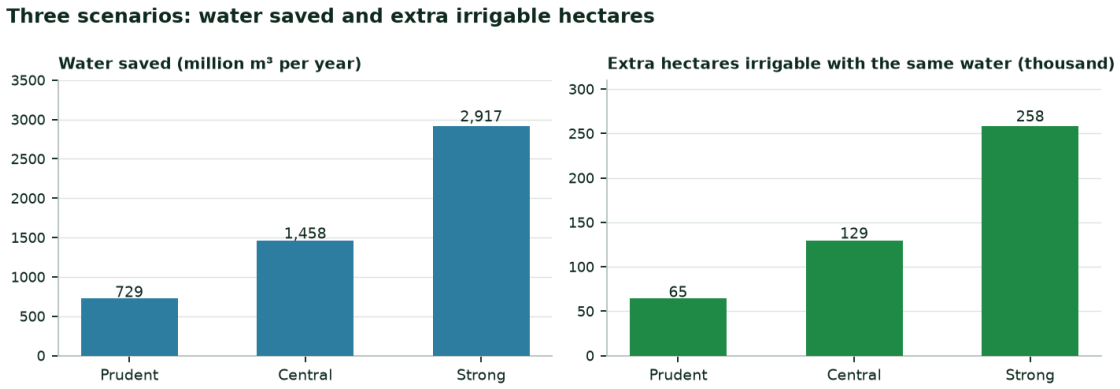


Figure 17. Water saved and extra irrigable hectares, by scenario. Source: Author's calculation

Irrigation water has no single price in Ethiopia: It is often free for smallholders and paid as pumping energy elsewhere. The matrix below gives the annual value of the water saved for three values per cubic metre, as a benchmark.

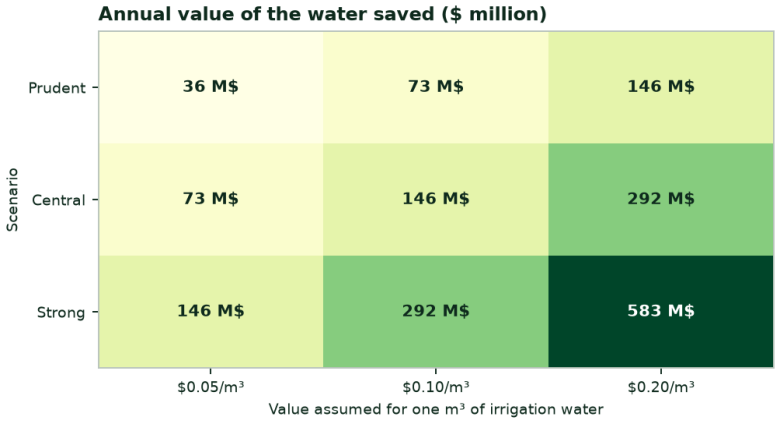


Figure 18. Annual value of the water saved, by scenario and value per cubic metre. Source: Author's calculation

8.5 Water saved by crop group (central scenario)

Water saved by crop group (central scenario)

Group	Share of irrigated area	Water used (Mm³/yr)	Water saved (Mm³/yr)	Extra production (t)

Group	Share of irrigated area	Water used (Mm³/yr)	Water saved (Mm³/yr)	Extra production (t)
Maize	22.1%	2,136	416.5	55,717
Onion, garlic, potato	12.2%	1,185	308.1	224,671
Khat, coffee, gesho	24.1%	2,338	233.8	—
Other cereals (sorghum, teff, wheat)	18.9%	1,834	183.4	24,166
Vegetables (tomato, pepper, cabbage)	5.0%	480	145.2	27,906
Fruit (banana, mango, citrus, avocado)	7.6%	738	73.8	—
Sugar cane	3.9%	382	38.2	—
Other (enset, oilseeds, misc.)	3.7%	363	36.3	—
Pulses	2.4%	230	23.0	2,314

Source: Author's calculation (Annex B).

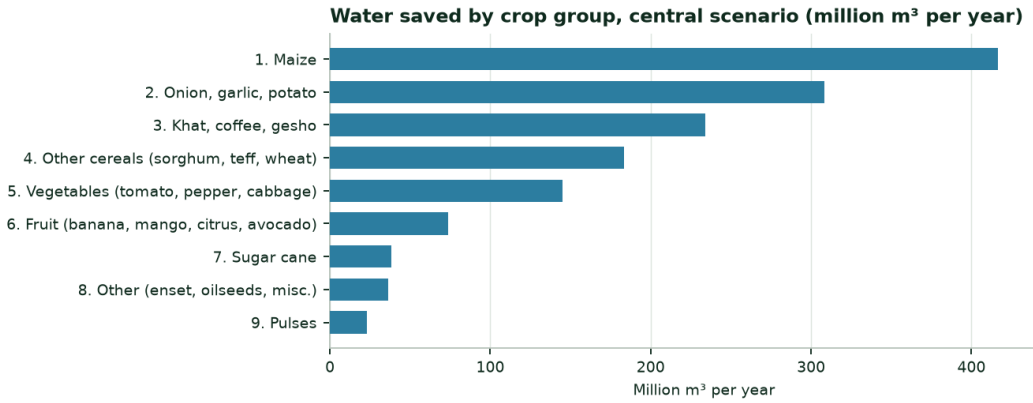


Figure 19. Water saved by crop group, central scenario. Source: Author's calculation

Regional split of the central saving, according to smallholder irrigation

Region	Irrigated area 2021/22 (ha)	Water saved (Mm³/yr)	Extra irrigable hectares
Oromia	73,762	651.5	57,719
Amhara	45,966	406.0	35,969
South (former SNNP, with Sidama)	28,682	253.3	22,444
Somali	6,658	58.8	5,210
Harari	4,326	38.2	3,385
Afar	3,765	33.3	2,946
Dire Dawa	869	7.7	680

Source: ESS (A4); author's calculation (Annex B).

8.6 Reading the results

Key points

• Maize (417 Mm³) and the onion, garlic and potato group (308 Mm³) give half of the saving, because published trials exist for these crops.

• Khat and coffee occupy a large share of irrigated areas but rely on a generic assumption: A trial in Ethiopia on these crops would change the result strongly.

• Shared according to smallholder irrigation, the central result gives about 652 Mm³ for Oromia, 406 Mm³ for Amhara and 253 Mm³ for the southern regions.

• Dry-season irrigated wheat is not counted. If it occupies the announced areas, the water at stake is much larger.

9. Potential benefits of our products

The benefits below follow from the figures in the previous sections. They are grouped by type of situation.

Potential benefits, by situation

Situation	Figure at stake	Product	Expected benefit
Irrigated schemes (Awash, Rift, Gamo, Shebelle)	858,160 ha equipped; 11,288 m³/ha/yr	EVERGREEN®, ECOSORB®	1.46 km³ saved per year (central)
Irrigated onion, garlic, potato	104,970 ha estimated	EVERGREEN®, ECOFERT®	224,671 t of extra production (central)
Rain-fed cereals exposed to dry spells	12.2 Mha of grain	ECOSORB®	Water reserve near the roots during dry spells (to be measured by trial)
Imported fertilisers	At least $630 M in 2023	ECOFERT®	Certified organic fertilisation, alongside mineral fertilisers
Reforestation and agroforestry	26.8 Mha of forest; degraded highland land	Paulownia ALTIFOLIA®, EVERGREEN®	Better seedling survival in the dry season (to be measured by trial)

Source: Sections 2 to 8 of this dossier.

The southern regions and Amhara count hundreds of thousands of small irrigators, with plots of a few hundred square metres. For them, the benefit is measured mainly in irrigation days saved and in a secured harvest during the dry season.

10. External trade: Exports and imports

10.1 Overview, 2023

In 2023, Ethiopia exported $2.26 bn of agricultural products and imported $2.09 bn (FAOSTAT). Agricultural products make up most of merchandise exports ($3.62 bn in total), while the country imports $17.9 bn of goods. FAOSTAT 2024 data are still incomplete for Ethiopia; 2023 is used as the reference.

10.2 Exports

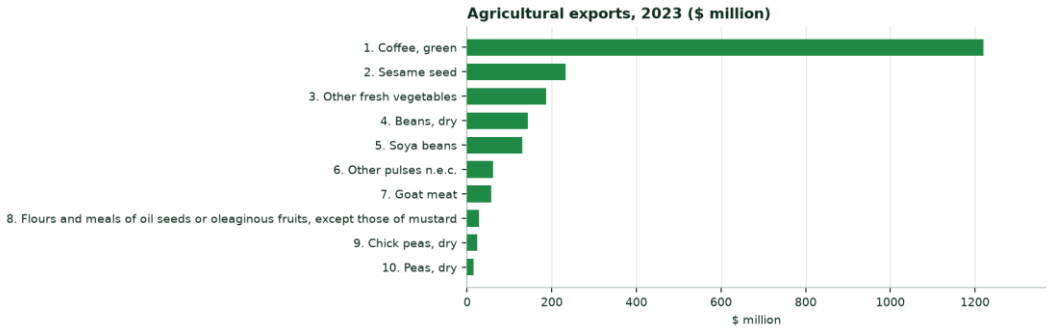


Figure 20. The ten main agricultural exports, 2023. Source: FAOSTAT (A2)

Main agricultural exports and imports, 2022 and 2023 ($ million)

Export	2022	2023	Import	2022	2023
Coffee, green	1,509	1,221	Palm oil	894	492
Sesame seed	183	233	Wheat	866	338
Other fresh vegetables	233	187	Raw sugar	506	238
Beans, dry	108	143	Rice, milled	371	190
Soya beans	45	130	Sunflower-seed oil, crude	438	155

Export	2022	2023	Import	2022	2023
Other pulses n.e.c.	44	62	Wheat and meslin flour	32	130
Goat meat	82	56	Peas, dry	115	99
Flours and meals of oil seeds or oleaginous fruits, except those of mustard	24	27	Lentils, dry	78	56
Chick peas, dry	—	23	Flour-based food preparations	36	49
Peas, dry	—	16	Refined sugar	71	40

Source: FAOSTAT (A2). A dash means outside the top twelve products in 2022.

Coffee dominates. For the 2024/25 fiscal year, the Ethiopian Coffee and Tea Authority reports a record 2.65 billion dollars for 468,967 t exported (A17). Horticulture (cut flowers, fruit and vegetables) earned 565 million dollars over the same year (A18).

10.3 Imports

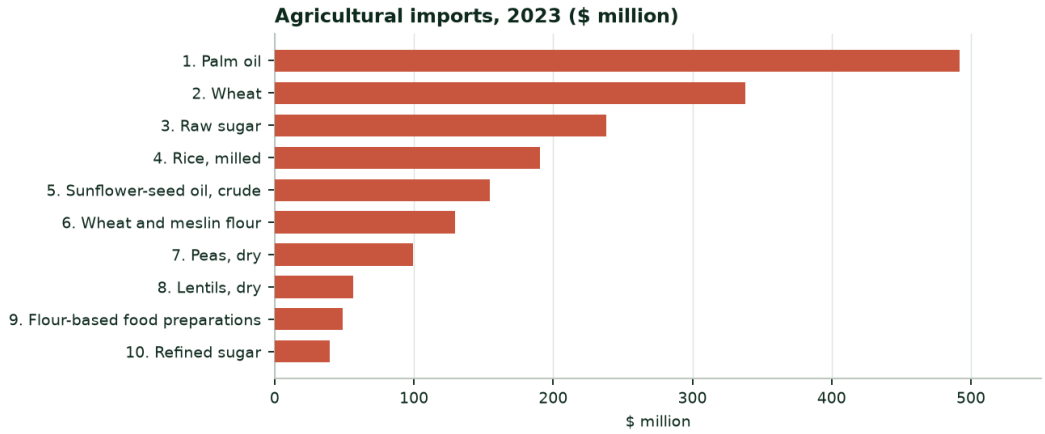


Figure 21. The ten main agricultural imports, 2023. Source: FAOSTAT (A2)

The country mainly imports oils (palm oil, sunflower), wheat (567 thousand tonnes in 2023), raw sugar (547 thousand tonnes) and rice. Every extra tonne of wheat or sugar produced thanks to irrigation reduces these foreign-currency purchases.

10.4 The Djibouti corridor

Ethiopia has no access to the sea. According to the figures published for 2025/26, the ports of Djibouti handled 96.7% of Ethiopia's external freight (A19). The Addis Ababa-Djibouti electric railway (753 km, 2018) and the main road carry imported fertilisers, cereals and oils. A separate dossier covers Djibouti.

11. A study of each region

Each study gives the population, the climate of the capital (rainfall, reference evapotranspiration, temperature, sunshine), the main smallholder crops in 2021/22 and irrigation. Crop figures come from ESS; only consistent rows (area, production and yield matching) are kept.

11.1 Oromia

Indicator	Value
Population (July 2024)	41.79 million
Climate of the capital (Adama)	Rain 354 mm; ET0 1,872 mm; 20.4 °C; 2,334 kWh/m²

Indicator	Value
Grain 2021/22 (smallholders)	17,554,271 t on 6,100,988 ha (53.5% of the country)
Irrigation (main season 2021/22)	73,762 ha; 401,366 farmers
Water saved, central scenario	About 651.5 million m³ per year

Source: ESS (A3, A4, A6); ERA5 (A8); PVGIS (A7); calculation (Annex B).

Oromia is the largest and most populous region (41.8 million people). It surrounds Addis Ababa and stretches from the Rift Valley lakes to the wheat and barley plateaus of Arsi and Bale, the coffee forests of Jimma and Ilu Ababor in the west, and the pastoral lowlands of Borena and Guji in the south.

It is the country's first granary: 54% of smallholder grain. It is also the first irrigated region (73,762 ha), along the upper Awash (Wonji and Metehara sugar estates), around the Rift lakes and in eastern Hararghe. Adama, the capital used for the climate, receives 354 mm a year for 1,872 mm of evapotranspiration in the ERA5 grid cell.

Main smallholder crops, 2021/22

Crop	Area (ha)	Production (t)
Teff	1,519,815	2,996,759
Maize	1,464,048	6,190,777
Wheat	1,030,582	3,467,385
Sorghum	612,807	1,664,915
Coffee	583,298	385,069
Barley	434,183	1,239,939
Faba beans	253,158	577,712

Source: ESS (A3)

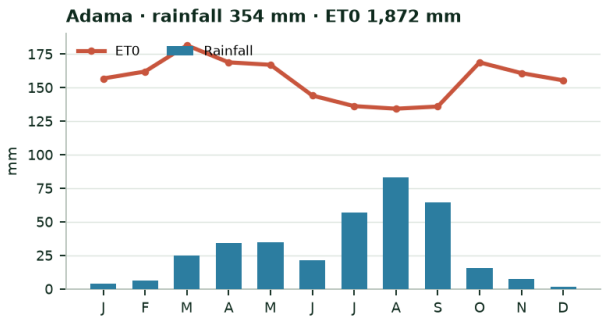
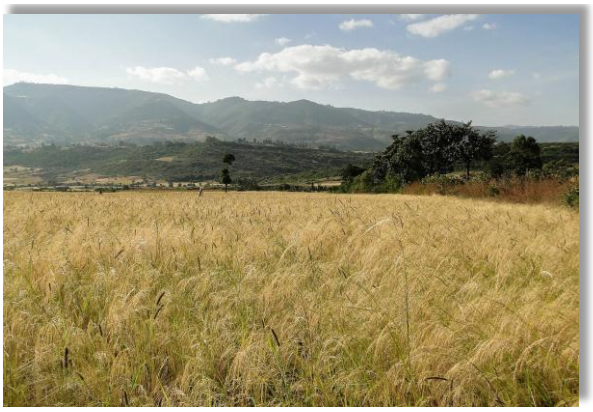


Figure 22. Monthly rainfall and reference evapotranspiration at Adama, 1991-2020. Source: ERA5 (A8)



Teff field, the cereal of injera.

11.2 Amhara

Indicator	Value
Population (July 2024)	23.55 million
Climate of the capital (Bahir Dar)	Rain 1,702 mm; ET0 1,578 mm; 20.1 °C; 2,214 kWh/m²
Grain 2021/22 (smallholders)	11,252,869 t on 4,586,326 ha (34.3% of the country)
Irrigation (main season 2021/22)	45,966 ha; 666,123 farmers
Water saved, central scenario	About 406.0 million m³ per year

Source: ESS (A3, A4, A6); ERA5 (A8); PVGIS (A7); calculation (Annex B).

Amhara (23.5 million people) covers the north-western highlands: Gojjam, Gondar, Wollo and northern Shewa. Lake Tana, where the Blue Nile begins, lies at its centre. Teff covers more than one million hectares there.

Amhara counts the largest number of irrigators (666,123), on very small plots: 690 m² on average. Public schemes exist around Lake Tana. During the 2021/22 survey, several zones (North and South Wollo, Waghemra, the Oromo zone) could not be visited for security reasons; ESS estimated their figures.

Main smallholder crops, 2021/22

Crop	Area (ha)	Production (t)
Teff	1,177,078	2,254,030
Wheat	689,614	1,922,029
Maize	616,502	2,642,189
Sorghum	576,148	1,529,198
Barley	286,865	646,476
Finger millet	243,448	632,893
Faba beans	186,562	352,205

Source: ESS (A3)

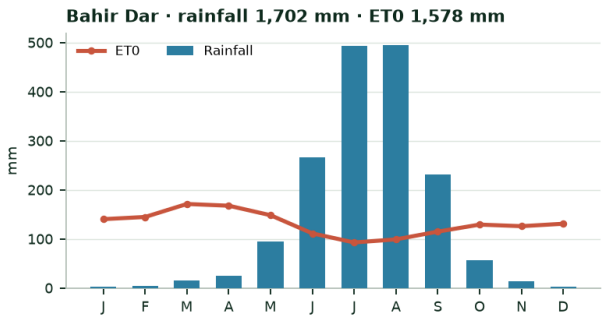


Figure 23. Monthly rainfall and reference evapotranspiration at Bahir Dar, 1991-2020. Source: ERA5 (A8)



Harvest in Lebe village, Amhara region.

11.3 The South: Sidama, Central, South and South West

Indicator	Value
Population (July 2024)	22.44 million
Climate of the capital (Hawassa)	Rain 1,017 mm; ET0 1,454 mm; 19.2 °C; 2,140 kWh/m²
Grain 2021/22 (smallholders)	3,181,526 t on 1,182,441 ha (9.7% of the country)
Irrigation (main season 2021/22)	28,682 ha; 90,583 farmers
Water saved, central scenario	About 253.3 million m³ per year

Source: ESS (A3, A4, A6); ERA5 (A8); PVGIS (A7); calculation (Annex B).

The former Southern Nations, Nationalities and Peoples' Region (SNNP) now forms four regions: Sidama (2020), South West (2021), Central and South (2023). It is the land of enset, coffee (Sidama, Gedeo, Kaffa), fruit and tubers. The four capitals receive from 1,017 mm (Hawassa) to 2,745 mm (Bonga) a year.

Smallholder irrigation covers 28,682 ha there, of which 18,566 ha in Gamo zone, around Arba Minch (bananas, mangoes). In the lower Omo valley, a large public sugar project irrigates lowland areas.

Main smallholder crops, 2021/22

Crop	Area (ha)	Production (t)
Maize	388,091	1,565,320
Teff	211,639	328,840
Coffee	181,572	153,179
Wheat	142,739	409,266
Red Haricot beans	120,209	190,692
Faba beans	80,078	160,343
Sorghum	79,130	197,617

Source: ESS (A3)

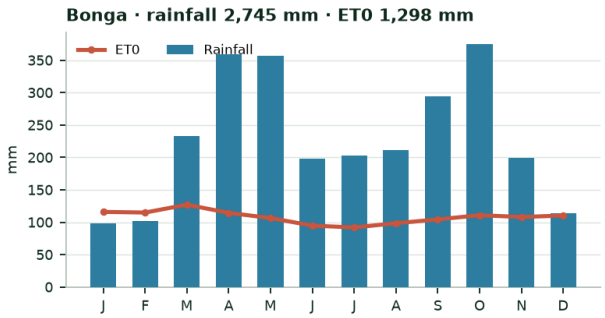


Figure 24. Monthly rainfall and reference evapotranspiration at Hawassa, 1991-2020. Source: ERA5 (A8)



Ploughing with oxen in south-western Ethiopia.

11.4 Somali

Indicator	Value
Population (July 2024)	6.81 million
Climate of the capital (Jijiga)	Rain 367 mm; ET0 1,638 mm; 19.5 °C; 2,361 kWh/m²
Grain 2021/22 (smallholders)	24,649 t on 30,956 ha (0.1% of the country)
Irrigation (main season 2021/22)	6,658 ha; 15,482 farmers
Water saved, central scenario	About 58.8 million m³ per year

Source: ESS (A3, A4, A6); ERA5 (A8); PVGIS (A7); calculation (Annex B).

The Somali region (6.8 million people) is the largest pastoral region. Crops concentrate along the Shebelle and the Genale-Dawa, and around Jijiga. The ESS survey covers only settled farming there: 30,956 ha of grain in 2021/22.

Irrigation covers 6,658 ha, of which 5,345 ha in Shebelle zone. The region was the hardest hit by the 2020-2023 drought. It will host at Gode the urea plant announced in 2025 (section 5.2).

Main smallholder crops, 2021/22

Crop	Area (ha)	Production (t)
Maize	10,419	10,251
Khat	192	101

Source: ESS (A3)

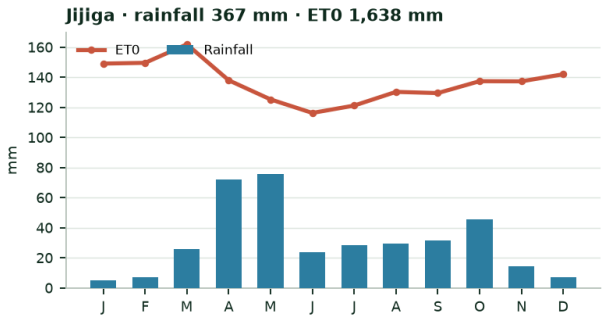


Figure 25. Monthly rainfall and reference evapotranspiration at Jijiga, 1991-2020. Source: ERA5 (A8)



Irrigated schemes along the Shebelle, seen from the International Space Station.

11.5 Afar

Indicator	Value
Population (July 2024)	2.12 million
Climate of the capital (Semera)	Rain 149 mm; ET0 2,453 mm; 30.3 °C; 2,350 kWh/m²
Grain 2021/22 (smallholders)	4,933 t on 9,943 ha (0.0% of the country)
Irrigation (main season 2021/22)	3,765 ha; 4,860 farmers
Water saved, central scenario	About 33.3 million m³ per year

Source: ESS (A3, A4, A6); ERA5 (A8); PVGIS (A7); calculation (Annex B).

Afar (2.12 million people) is a hot, arid depression: 149 mm of rain at Semera for 2,453 mm of reference evapotranspiration, the highest in the country. The middle and lower Awash carry irrigated estates (sugar cane, cotton) and the Werer agricultural research centre.

Smallholders irrigate 3,765 ha, mostly maize. The road and the railway to Djibouti cross the region; livestock exported through Djibouti leave from the Mille quarantine centre.

Main smallholder crops, 2021/22

Crop	Area (ha)	Production (t)
Maize	4,651	3,604
Sorghum	2,501	1,200
Mung bean	729	122
Sesame	77	8

Source: ESS (A3)

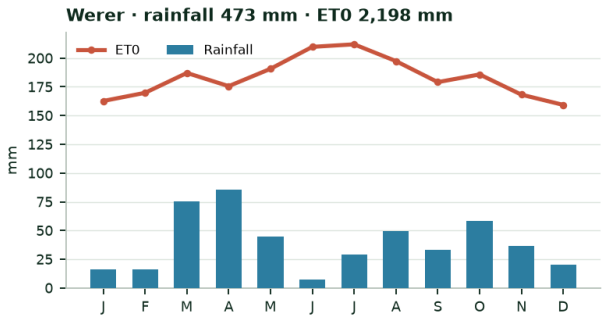


Figure 26. Monthly rainfall and reference evapotranspiration at Semera, 1991-2020. Source: ERA5 (A8)



Irrigated maize in the Subuli savanna, Afar region.

11.6 Tigray

Indicator	Value
Population (July 2024)	5.94 million
Climate of the capital (Mekelle)	Rain 832 mm; ET0 1,642 mm; 18.1 °C; 2,246 kWh/m²

Source: ESS (A3, A4, A6); ERA5 (A8); PVGIS (A7); calculation (Annex B).

Tigray (5.94 million people) was not covered by the 2021/22 agricultural surveys, after the 2020-2022 conflict. Its highlands receive 832 mm at Mekele in the ERA5 grid cell, in a single rainy season, from June to September.

The region is known for its terraces, small dams and soil conservation works. Recent production data remain to be obtained from the regional bureau of agriculture.

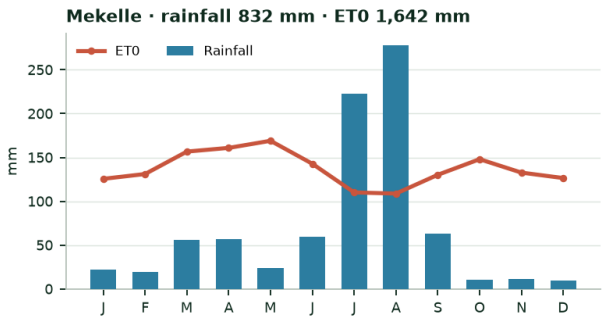


Figure 27. Monthly rainfall and reference evapotranspiration at Mekelle, 1991-2020. Source: ERA5 (A8)



Threshing wheat near Mekele.

11.7 Benishangul-Gumuz and Gambella

Indicator	Value
Population (July 2024)	1.28 + 0.54 million
Climate of the capital (Asosa)	Rain 1,455 mm; ET0 1,575 mm; 21.5 °C; 1,965 kWh/m²
Grain 2021/22 (smallholders)	738,999 t on 265,583 ha (2.3% of the country)

Source: ESS (A3, A4, A6); ERA5 (A8); PVGIS (A7); calculation (Annex B).

The two western regions (1.28 million and 0.54 million people) are humid lowlands. Asosa receives 1,455 mm a year, Gambella 855 mm. The GERD lies in Benishangul-Gumuz, near the Sudanese border.

Maize, groundnut, soybean and finger millet dominate in Benishangul-Gumuz. In Gambella, commercial farms occupy the Baro plains. Smallholder irrigation data are not published there.

Main smallholder crops, 2021/22

Crop	Area (ha)	Production (t)
Maize	76,961	332,264
Groundnuts	28,899	55,405
Soya beans	26,305	63,026
Finger millet	23,554	52,538
Teff	22,021	33,445
Niger seed (nug)	9,326	8,977

Crop	Area (ha)	Production (t)
Sesame	7,246	4,893

Source: ESS (A3)

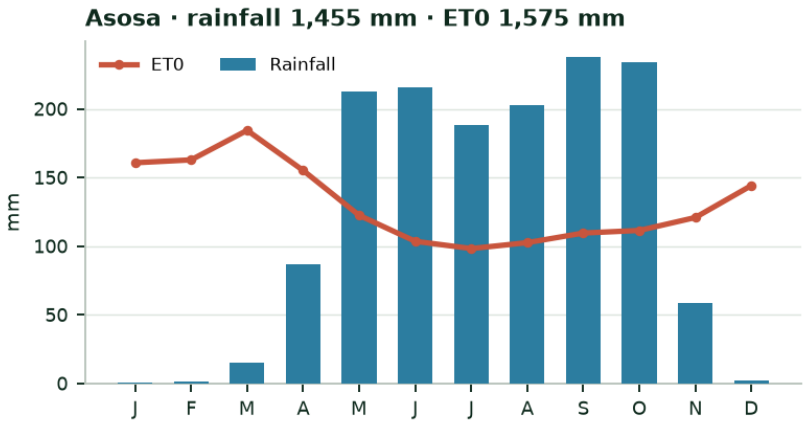


Figure 28. Monthly rainfall and reference evapotranspiration at Asosa, 1991-2020. Source: ERA5 (A8)

11.8 Harari, Dire Dawa and Addis Ababa

Indicator	Value
Population (July 2024)	Harari 289,000; Dire Dawa 566,000; Addis Ababa 4.03 million
Climate of the capital (Harar)	Rain 678 mm; ET0 1,522 mm; 18.5 °C; 2,144 kWh/m²
Grain 2021/22 (smallholders)	33,105 t on 20,311 ha (0.1% of the country)
Irrigation (main season 2021/22)	4,326 ha; 13,749 farmers
Water saved, central scenario	About 38.2 million m³ per year

Source: ESS (A3, A4, A6); ERA5 (A8); PVGIS (A7); calculation (Annex B).

Harari (289,000 people) and Dire Dawa (566,000) are small eastern regions. Khat and sorghum dominate. Harari irrigates 4,326 ha, mostly from wells and sources other than rivers; Dire Dawa 869 ha. Dire Dawa is a stop on the railway to Djibouti.

Addis Ababa (4.03 million people) is first of all a market: Peri-urban vegetables, dairies, and the seat of public fertiliser purchasing.

Main smallholder crops, 2021/22

Crop	Area (ha)	Production (t)
Sorghum	15,945	24,458
Khat	8,973	6,621
Maize	2,527	6,964
Groundnuts	1,185	1,005
Mangoes	553	4,203
Wheat	246	377
Coffee	177	47

Source: ESS (A3)

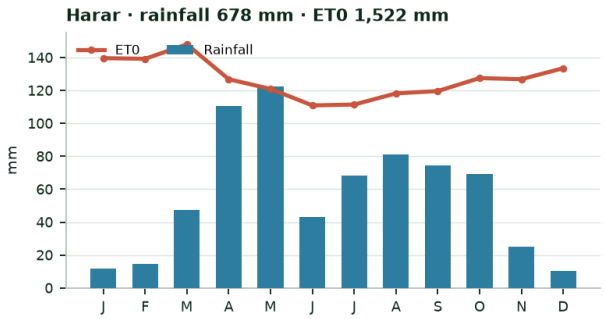


Figure 29. Monthly rainfall and reference evapotranspiration at Harar, 1991-2020. Source: ERA5 (A8)



Farmland on the road to Harar.

Annex A. Sources and confidence levels

Ref.	Source	Level
A1	World Bank, World Development Indicators (API, accessed 2026)	A
A2	FAO, FAOSTAT: Crops and livestock, value of production, trade, fertilisers, land use (bulk files, 2026)	A
A3	Ethiopian Statistics Service (ESS), Agricultural Sample Survey 2021/22, Volume I, Report on Area and Production of Major Crops, Meher Season	A
A4	ESS, Agricultural Sample Survey 2021/22, Report on Farm Management Practices, Main Season	A
A5	ESS, Large and Medium Scale Commercial Farms Sample Survey 2021/22	A
A6	ESS, Population Size by Sex, Area and Density by Region, Zone and Wereda, July 2024	A
A7	European Commission, JRC, PVGIS (solar radiation)	A
A8	Copernicus ERA5, via Open-Meteo: Rainfall, reference evapotranspiration and temperature, 1981-2024	B
A9	Awulachew et al., IWMI, Ethiopia's irrigation potential (5.3 million hectares)	B
A10	OCHA, Ethiopia Drought Situation Update No. 1, 10 March 2023	B
A11	GERD inauguration, 9 September 2025 (press: AFP, ENR, Water Power Magazine)	C
A12	Ethiopian Ministry of Agriculture, irrigated wheat initiative (ministry website, ENA)	C
A13	USDA Foreign Agricultural Service, Ethiopia Grain and Feed Annual	B
A14	Ethiopian Business Review, Addis Fortune, Argus Media: Fertiliser purchases 2025/26	C
A15	Dangote Group and Ethiopian Investment Holdings, Gode urea plant agreement, August 2025	C
A16	World Bank, Commodity Price Data (annual fertiliser prices)	A
A17	Ethiopian Coffee and Tea Authority, coffee exports 2024/25 (press)	C
A18	Ethiopian Horticulture Producer Exporters Association (EHPEA), exports 2024/25	C
A19	Djibouti's share of Ethiopia's external freight, 2025/26 (regional business press)	C
A20	Green Solutions, maize trial, Türkiye (TIGEM, 2025)	C
A21	Green Solutions, potato trial, South Africa (2025-2026)	C
A22	Green Solutions, watermelon trial, Mexico (2023)	C
A23	Green Solutions, soybean trial, China (Shandong)	B
A24	Green Solutions, date palm trial, United Arab Emirates (ICBA, 2020-2021)	B
A25	Green Solutions, product sheets (green-solutions-group.com)	C

Annex B. Calculation method

1. Agricultural water. Water withdrawals for agriculture amount to 9.69 km³ a year: 10.55 km³ of total withdrawals × 91.84% for agriculture (World Bank, 2022).

2. Areas by group. The equipped area (858,160 ha, FAOSTAT 2023) is split in two: Sugar cane harvested by the estates (23,419 ha, FAOSTAT 2024), then the rest according to the mix of smallholder irrigated crops (ESS 2021/22, table 6). This split is an assumption: Commercial farms grow more cane, cotton, fruit and flowers.

3. Water by group. Agricultural water is shared in proportion to areas. The thirstiest crops (cane, bananas) are therefore underestimated, cereals overestimated.

4. Water saving. For each group, the saving measured in the analogous trial is applied at a quarter, half or in full (cautious, central, strong scenarios). Without a trial, 5, 10 or 20%.

5. Yield. The trial's yield gain, applied the same way, multiplies the group's FAOSTAT 2024 average yield and its irrigated area. It is valued at the implicit price at constant 2014-2016 value (FAOSTAT 2023 production value ÷ 2023 production).

6. Extra irrigable hectares. The water saved is divided by today's average use (11,288 m³ per hectare per year).

7. Regions. The national result is shared according to the smallholder irrigated area in 2021/22 (ESS, table 5).

8. Fertilisers. Minimum spending = nitrogen ÷ 0.46 × urea price + phosphate ÷ 0.46 × TSP price + potash ÷ 0.60 × potassium chloride price (World Bank prices).

9. Climate. Rainfall, reference evapotranspiration (FAO-56) and temperature: 1991-2020 means of the ERA5 grid cell containing each capital; radiation: PVGIS, 2005-2020. Temperature trends are linear regressions over 1981-2024.

Annex C. Photo credits

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