

COUNTRY DOSSIER

South Sudan

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

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Keliko women winnow sorghum after the harvest.

Foreword

This dossier describes South Sudan from the angle of water, climate, fertilisers and crops. It is written for the ministries in charge of agriculture, water and trade, the regional directorates of agriculture, cooperatives and producer organisations. It answers three questions: Where is water short, for which crops, and in which regions? It then examines what our products can change, in rainfed as well as irrigated farming, and what that can mean for the country's external trade.

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 (World Bank, FAO, South Sudanese public bodies (National Bureau of Statistics, Ministry of Agriculture and Food Security, revenue authority)).
- **B**: Research institute, laboratory, United Nations agency or recognised climate model.
- **C**: Manufacturer statement, website, press or estimate.
- "M" means million; "Mm³" means million cubic metres; "t" means tonnes; "I$" means constant 2014-2016 international dollars.
- A "scenario" is a calculation based on the trials cited. It is not a measurement made in South Sudan.

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Summary

The points below summarise the dossier. The figures come from public sources: The World Bank, FAO (FAOSTAT, AQUASTAT), South Sudanese public bodies (National Bureau of Statistics, Ministry of Agriculture and Food Security, revenue authority), PVGIS and NASA POWER. The production gains and water savings are scenarios, described in Annex B.

12.19 M
Inhabitants in 2025 (World Bank)

1.02 M ha
Of sorghum harvested in 2024, the main crop

19,000 ha
Equipped for irrigation (2024)

+825 t
Of maize per 10,000 ha treated, central scenario

54.3 Mm³
Of irrigation water saved a year, central scenario

36 M$
Of agricultural exports in 2023 (FAOSTAT)

Key points

- **A rain-fed agriculture.** 19,000 ha equipped for irrigation in 2024, for 2.48 million hectares of cropland: Almost every harvest depends on rain.
- **Sorghum: The main crop.** 1,018,687 ha harvested in 2024, for 0.96 million tonnes, or 0.94 t/ha.
- **Water is not short over the year, it is short between two rains.** National water stress is only 4.2%, but at Malakal, the air demands 1,551 mm more than it rains.
- **In rainfed farming, the gain is counted in tonnes.** In the central scenario, 825 t of maize more per 10,000 ha treated.
- **In irrigation, the water saved enlarges the schemes.** 54.3 Mm³ a year in the central scenario, enough to irrigate about 4,300 more ha, or 22.6% of the equipped area.
- **All nitrogen is imported.** 206 t of nitrogen used in 2024, 206 t imported, no national production.
- **Farm trade.** $36 million of exports and $613 million of imports in 2023. First sale: Lucerne (alfalfa) meal and pellets ($24 million). First purchase: Wheat and meslin flour ($48 million).

Key figures

Key indicators for South Sudan

Indicator	Value	Year	Source (level)
Population	12.19 M	2025	World Bank (A1)
GDP per capita	1,080 $	2015	World Bank (A1)
Agriculture share of GDP	10.4%	2015	World Bank (A1)
Agricultural employment	63.8%	2023	World Bank (A1)
Cropland	2,477,890 ha	2024	FAOSTAT (A6)
Area equipped for irrigation	19,000 ha	2024	FAOSTAT (A6)
Harvested area: Sorghum	1,018,687 ha	2024	FAOSTAT (A2)
Agricultural exports	36 M$	2023	FAOSTAT (A4)
Agricultural imports	613 M$	2023	FAOSTAT (A4)
Mineral nitrogen, agricultural use	206 t	2024	FAOSTAT (A5)

Source: Table based on the sources indicated.

1. Green Solutions and our products

Green Solutions develops products for water, fertilisation and crop protection. Four families are of interest to this dossier. The yields 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-retention polymer)	Holds rain or irrigation water as a gel, near the roots.	Trials on maize, potato, watermelon, date palm and soybean. Level B to C.
ECOSORB® (water-retention polymer based on corn starch)	Same use; action lasting 2 to 3 years according to the website.	Soybean trial (China); laboratory acrylamide analysis. Level B to C.
ECOFERT® (fertiliser)	Fertiliser certified by SOHISCERT and EU Bio, usable in organic farming.	Published certificate; potato trial combined with EVERGREEN®. Level A (certificate), C (results).
Paulownia ALTIFOLIA®	Fast-growing tree for agroforestry.	Website figures; no trial in South Sudan. Level 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.

The indicative dose published on the website is 30 to 75 kg/ha.



Sorghum in front of a house, in Bor (Jonglei).

2. South Sudan in figures

South Sudan had 12.19 million inhabitants in 2025, 78% of them in rural areas. Agriculture accounts for 10.4% of gross domestic product and employs 64% of the labour force. The country covers 631.9 thousand km², of which 45% is agricultural land. Undernourishment affects 19.1% of the population.

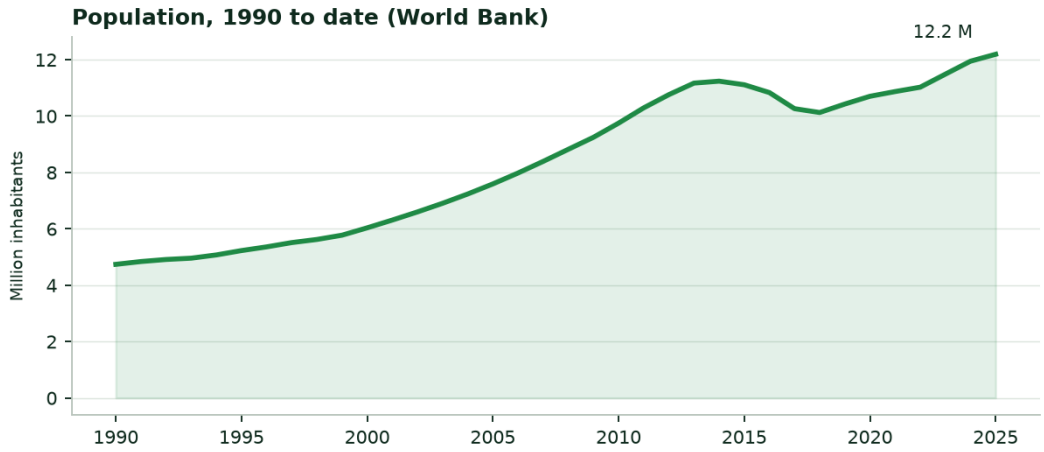


Figure 1. Population of South Sudan, 1990 to date. Source: World Bank (A1)

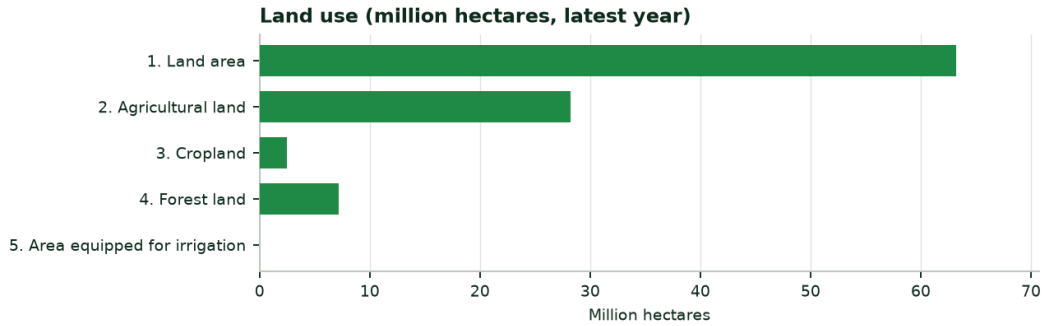


Figure 2. Land use, latest year published. Source: FAOSTAT (A6)

Agricultural and water indicators, latest year published

Indicator	Value	Year	Source
Average cereal yield	945 kg/ha	2024	World Bank (A1)
Fertiliser use per hectare of arable land	0.1 kg/ha	2024	World Bank (A1)
Water withdrawals, agricultural share	36.5%	2022	World Bank (A1)
Internal freshwater resources	26.0 km³	2022	World Bank (A1)
Internal resources per inhabitant	2,359 m³	2022	World Bank (A1)



A Dinka homestead: Maize, okra and groundnut around the huts.

3. Sunshine, rainfall and climate change

3.1 Sunshine

Global solar radiation reaches 2,042 to 2,227 kWh/m² a year depending on the region. Energy is not the limit: Water available at the right time makes the harvest.

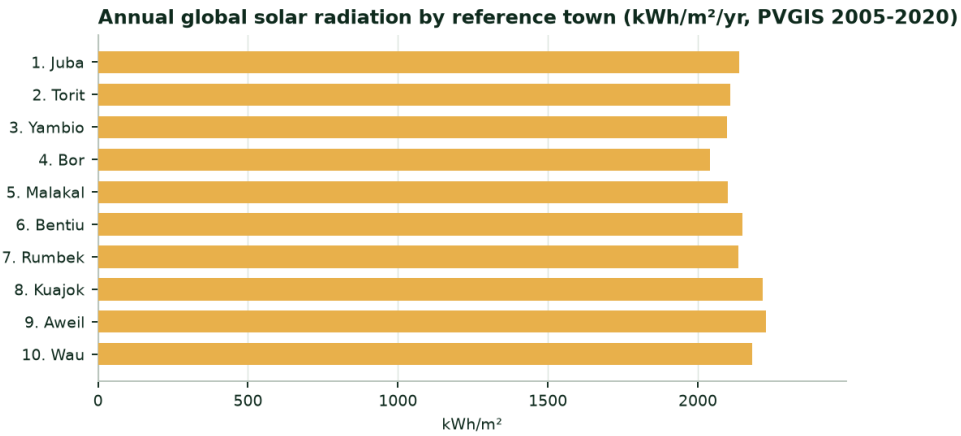


Figure 3. Annual global solar radiation in each reference town. Source: PVGIS (A8)

3.2 Rainfall and evapotranspiration

It rains 1,388 mm a year at Yambio, but only 783 mm at Malakal, where reference evapotranspiration reaches 2,334 mm. A single rainy season, from April to October, longer in the south-west (Equatoria) than in the north-east. From November to March, the dry season is hot and rainless.

Mean monthly rainfall, 1991-2020 (mm per month)

City	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Juba	6	10	25	59	136	128	143	146	118	107	45	23
Torit	13	14	41	71	114	101	126	129	103	116	53	29
Yambio	18	30	84	175	165	152	143	175	167	164	88	26
Bor	4	4	19	56	147	129	139	142	107	99	31	13
Malakal	0	0	3	25	93	108	155	164	134	95	5	1
Bentiu	0	0	4	29	113	136	164	181	148	100	5	1
Rumbek	2	3	18	80	143	149	166	186	140	122	22	7
Kuajok	0	1	8	35	118	142	170	192	145	92	5	1
Aweil	0	1	8	32	120	139	175	206	154	86	6	1
Wau	2	3	18	68	141	157	177	192	158	126	17	7

Source: NASA POWER (A9); author's calculation.

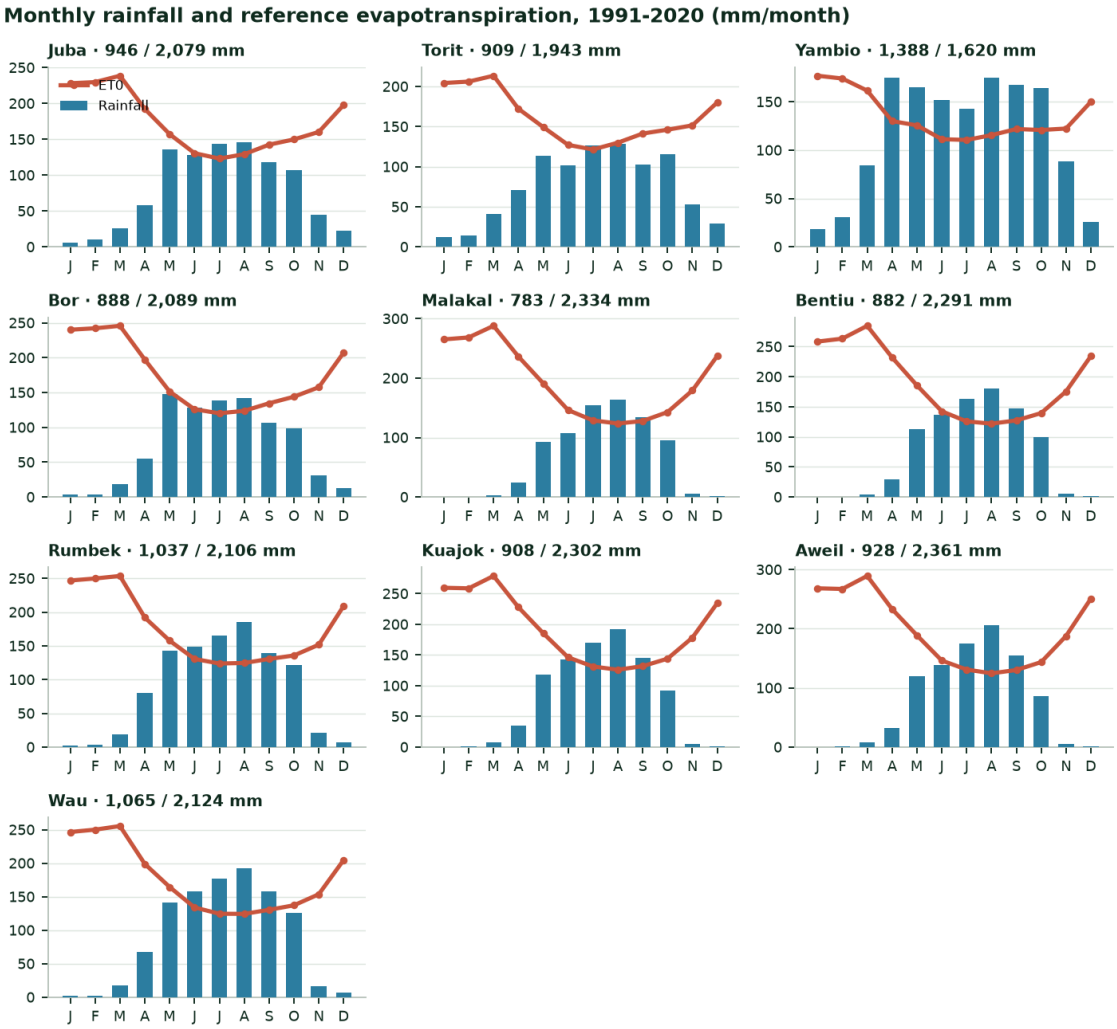


Figure 4. Monthly rainfall and reference evapotranspiration by city, 1991-2020. Source: NASA POWER (A9)

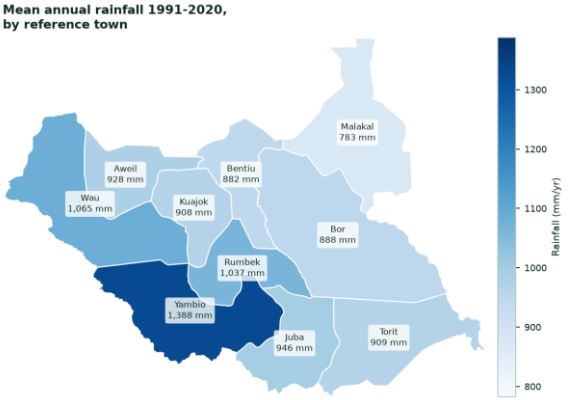
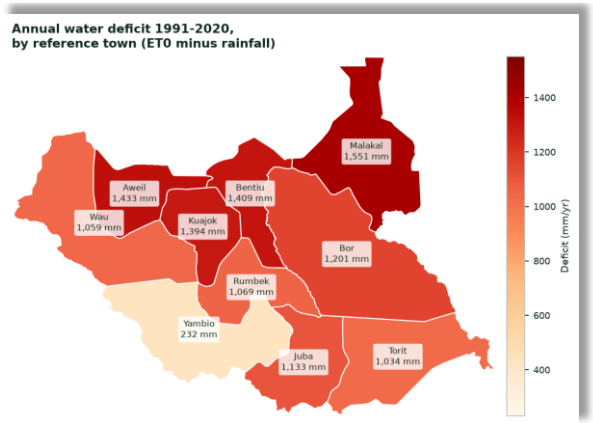


Figure 5. Mean annual rainfall 1991-2020, by region. Source: NASA POWER (A9), Natural Earth (A10).



Annual water deficit, by region. Source: NASA POWER (A9), Natural Earth (A10).

3.3 Climate change

Mean annual temperature is rising. At Juba it went from 27.1 °C in 1981 to 28.2 °C in 2024, a trend of 0.17 °C per decade. At Malakal the trend is 0.10 °C per decade, from 27.6 °C to 28.7 °C. Warmer air dries the soil faster between two rains.

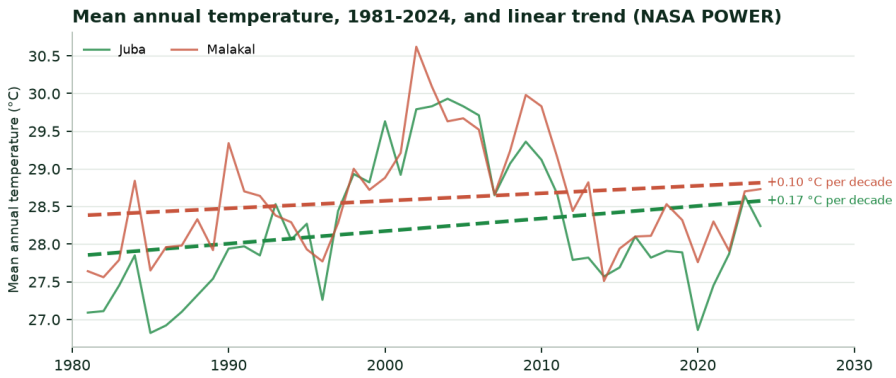


Figure 6. Mean annual temperature, 1981-2024, and linear trend. Source: NASA POWER (A9)



The White Nile at Juba.

4. Water: Resources, irrigated areas, withdrawals

4.1 Resources and withdrawals

Total freshwater withdrawals are 658 million m³ a year (2022). Agriculture withdraws 36.5% of it, that is 240 Mm³. Internal resources are 26.0 km³ a year and water stress is 4.2%: The country has water, but little of it is mobilised for crops.

Freshwater: Withdrawals and resources

Indicator	Value	Year	Source
Total withdrawals	658 Mm³	2022	World Bank (A1)
Agricultural share	36.5%	2022	World Bank (A1)
Agricultural withdrawals	240.0 Mm³	2022	Calculated from A1
Area equipped for irrigation	19,000 ha	2024	FAOSTAT (A6)
Agricultural withdrawals per equipped hectare	12,632 m³/ha	—	Calculation (Annex B)
Water stress	4.2%	2022	World Bank (A1)

4.2 Irrigated areas

FAOSTAT counts 19,000 hectares equipped for irrigation in 2024. In 2024, the area equipped for irrigation is only 19,000 ha (A6), for nearly 2.5 million hectares of cropland. The Nile and its tributaries cross the country, but almost all farming depends on rain; the development plan lists irrigation as a priority (A13).



The White Nile seen from Juba.

4.3 What the water saving represents

In the central scenario, the saving is 54.3 million m³ a year, or 22.6% of agricultural withdrawals. At 12,632 m³ per equipped hectare, this water would irrigate about 4,300 more hectares, or 22.6% of today's equipped area.

5. Fertilisers: Quantities, purchases, spending

5.1 Quantities used

In 2024, agricultural use reaches 206 tonnes of nitrogen, 9 tonnes of phosphate (P2O5) and 8 tonnes of potash (K2O). The country produces no nitrogen fertiliser: It imported 206 tonnes of nitrogen in the same year. Per hectare of arable land, use is 0.1 kg per hectare.

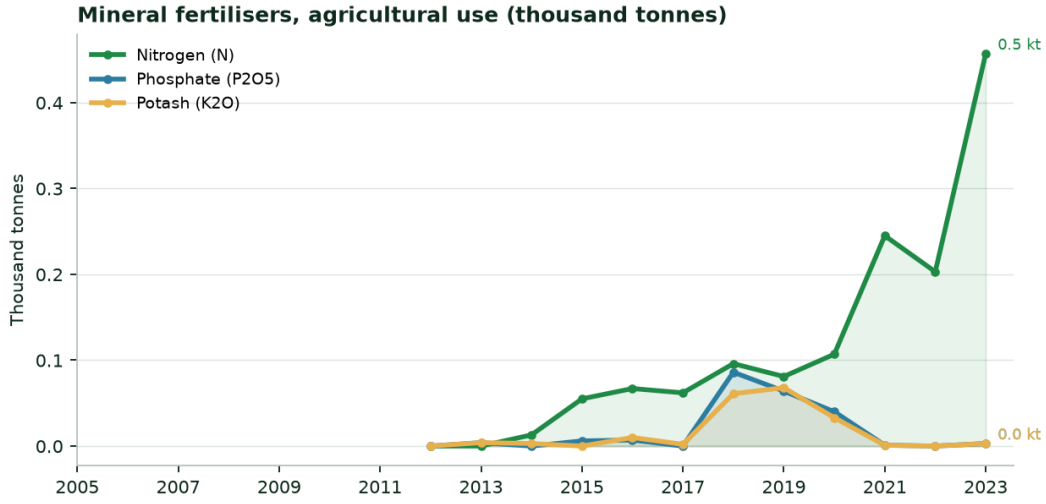


Figure 7. Mineral fertilisers, agricultural use, 2005-2023. Source: FAOSTAT (A5)

5.2 Regulatory framework

No fertiliser registration regulation was found in the FAOLEX database; the development plan makes access to seeds and fertilisers a priority (A13). The classification of a water-retaining polymer is to be confirmed with the Ministry of Agriculture.



Adior village, in Nyang (Lakes State).

5.3 Indicative spending

In 2024, the indicative minimum spending on mineral fertilisers reaches $0 million, at international fertiliser prices (calculation in Annex B, lower bound).

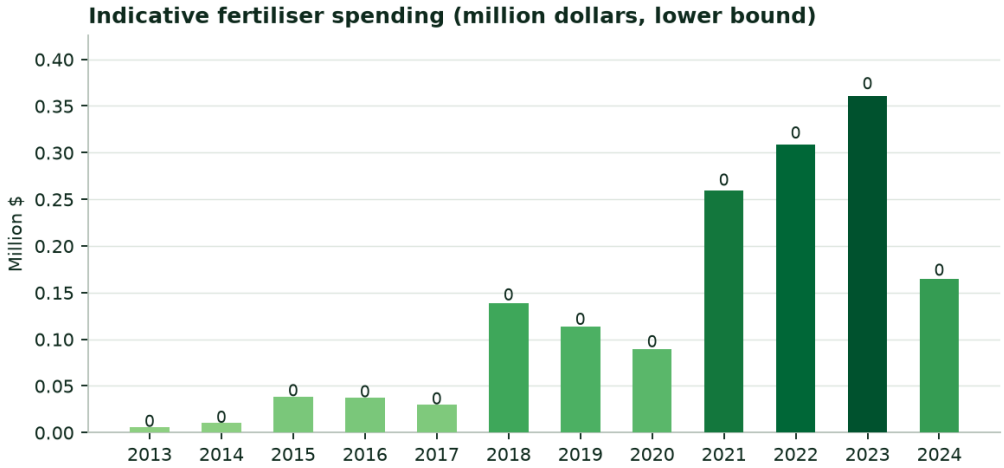


Figure 8. Indicative fertiliser spending, lower bound. Source: Author's calculation from A5 and A7

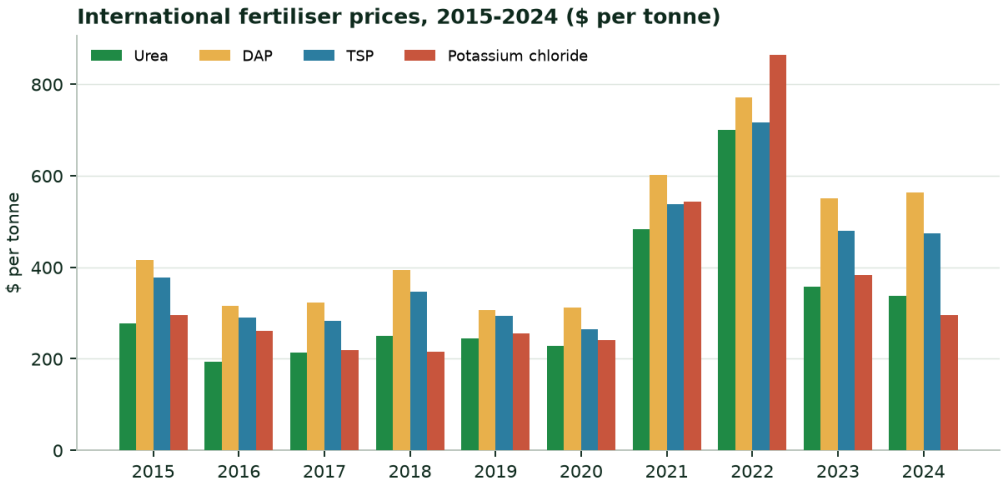


Figure 9. International prices of urea, DAP, TSP and potassium chloride. Source: World Bank, Pink Sheet (A7)

6. The regions at a glance

The table compares the ten states, each represented by its capital. Climate figures are 1991-2020 averages, except radiation (2005-2020).

Climate of the capitals, 1991-2020 means

Region (city)	Rainfall (mm/yr)	ET0 (mm/yr)	Deficit (mm/yr)	Radiation (kWh/m²/yr)	Temperature (°C)
Central Equatoria (Juba)	946	2,079	1,133	2,138	28.6
Eastern Equatoria (Torit)	909	1,943	1,034	2,109	27.5
Western Equatoria (Yambio)	1,388	1,620	232	2,096	24.9
Jonglei (Bor)	888	2,089	1,201	2,042	28.8
Upper Nile (Malakal)	783	2,334	1,551	2,101	28.8
Unity (Bentiu)	882	2,291	1,409	2,149	28.9
Lakes (Rumbek)	1,037	2,106	1,069	2,135	28.4
Warrap (Kuajok)	908	2,302	1,394	2,215	28.7
Northern Bahr el Ghazal (Aweil)	928	2,361	1,433	2,227	28.4
Western Bahr el Ghazal (Wau)	1,065	2,124	1,059	2,182	27.9

Source: NASA POWER (A9); PVGIS (A8); author's calculation.

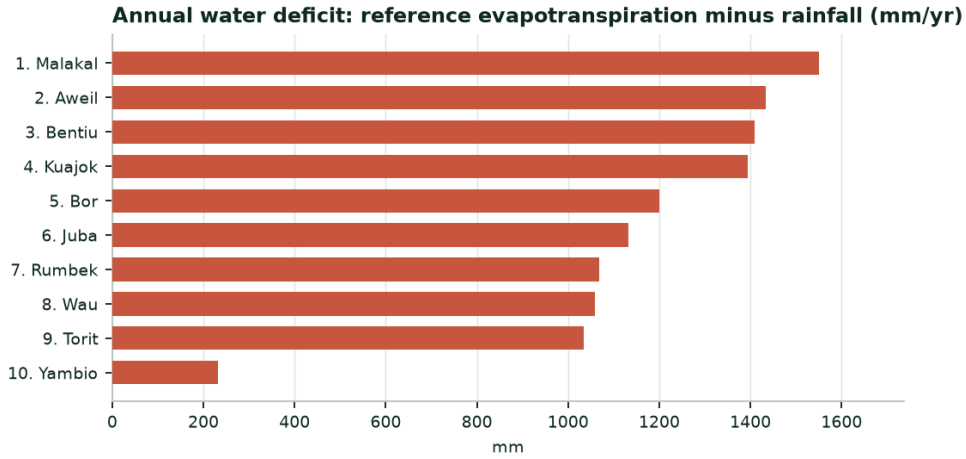


Figure 10. Annual water deficit: Reference evapotranspiration minus rainfall. Source: NASA POWER (A9)



A Mundari cattle camp in Terekeka (Central Equatoria).

7. The twenty main crops: Three rankings

7.1 By harvested area

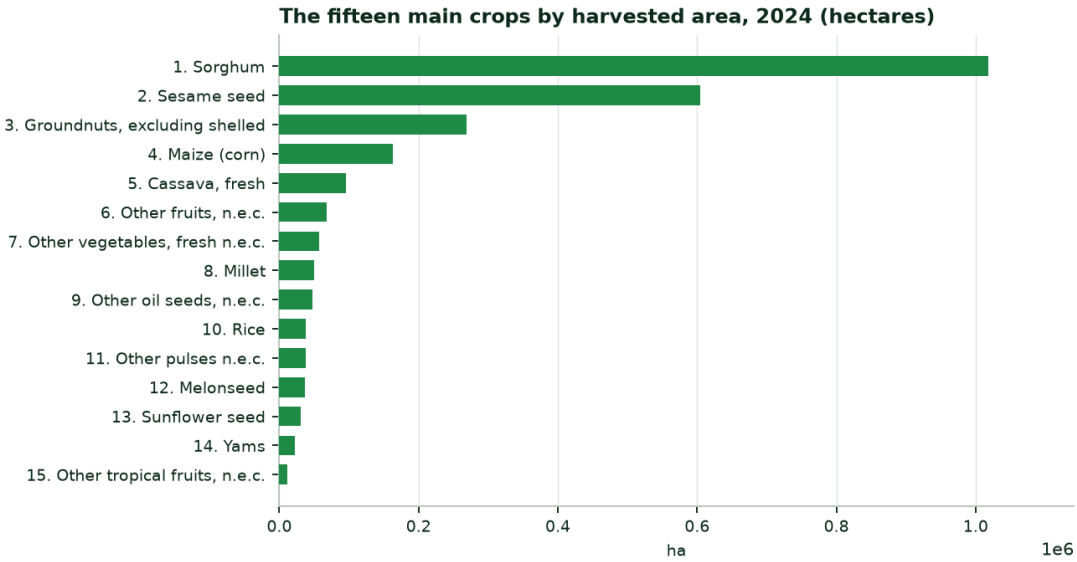


Figure 11. The fifteen main crops by harvested area, 2024 (hectares). Source: FAOSTAT (A2)

The ten main crops by area, 2024

Crop	Harvested area (ha)	Production (t)	Yield (t/ha)
Sorghum	1,018,687	960,000	0.94

Crop	Harvested area (ha)	Production (t)	Yield (t/ha)
Sesame seed	604,865	175,612	0.29
Groundnuts, excluding shelled	268,466	198,420	0.74
Maize (corn)	162,707	157,000	0.96
Cassava, fresh	95,885	1,709,494	17.83
Other fruits, n.e.c.	68,384	399,657	5.84
Other vegetables, fresh n.e.c.	56,979	435,735	7.65
Millet	50,000	45,000	0.90
Other oil seeds, n.e.c.	47,928	51,203	1.07
Rice	38,453	38,000	0.99

Source: FAOSTAT (A2).

7.2 By production

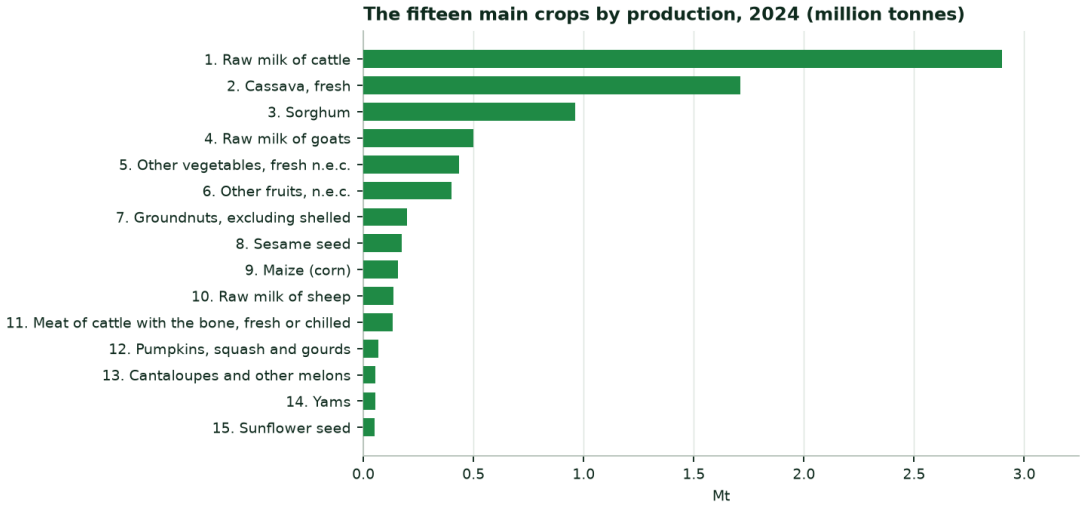


Figure 12. The fifteen main crops by production, 2024 (million tonnes). Source: FAOSTAT (A2)

7.3 By production value

By production value, the three main crops are: Cassava, fresh, sesame seed and sorghum (FAOSTAT, 2023, constant international dollars).

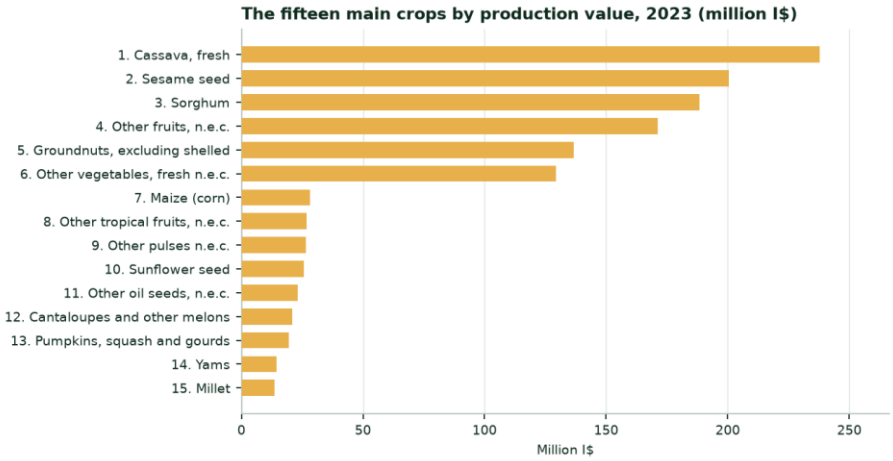


Figure 13. The fifteen main crops by production value, 2023 (million I$). Source: FAOSTAT (A3)



A farmer grinds grain on a grinding stone, in Lankien (Jonglei).

8. Extrapolation by crop: Irrigation and rainfed crops

8.1 Method

Method in brief

• **Irrigation.** National agricultural water is shared between irrigated crops (vegetables and melons and rice), in proportion to their harvested areas; the equipped area is shared the same way.

• **Rainfed crops.** For crops that have a trial (maize), the production gain is calculated per 10,000 ha treated, at the national average 2024 yield.

• Each calculation applies the effect of the trial cited: A quarter (cautious), half (central), all of it (high). Without a trial: 5, 10 and 20% of water, with no yield gain.

8.2 Trials used as analogues

Trials cited and their use in the calculation

Trial	Crop	Water	Yield	Use in the calculation
Maize, Türkiye (TIGEM, Konya, 2025)	Maize	-38.9%	+17.1%	Maize: Yield
Soybean, China	Soybean	Assumption	+11.3%	Not used; cited for reference
Watermelon, Mexico (2023)	Watermelon	-60.5%	+30.0%	Vegetables and melons: Water and yield
Potato, South Africa (2025)	Potato	-52.0%	+31.4%	Not used; cited for reference
Date palm, UAE (ICBA, 2021)	Palm	-82.0%	+20.0%	Not used; cited for reference

Source: A14 to A18 (published trials and manufacturer's website, levels B and C).

No trial has yet been conducted in South Sudan: The figures below apply the trials cited to the country's average yields.

8.3 Rainfed crops: Maize

Average 2024 yields (FAOSTAT): Maize 0.96 t/ha. A water-retention polymer keeps the water of each rain near the roots and helps the crop through dry days during the season.

Extra production per 10,000 ha treated (tonnes a year)

Crop	Average yield (t/ha)	Cautious	Central	High
Maize	0.96	413	825	1,650

Source: FAOSTAT (A2); trials A14 to A18; author's calculation (Annex B).

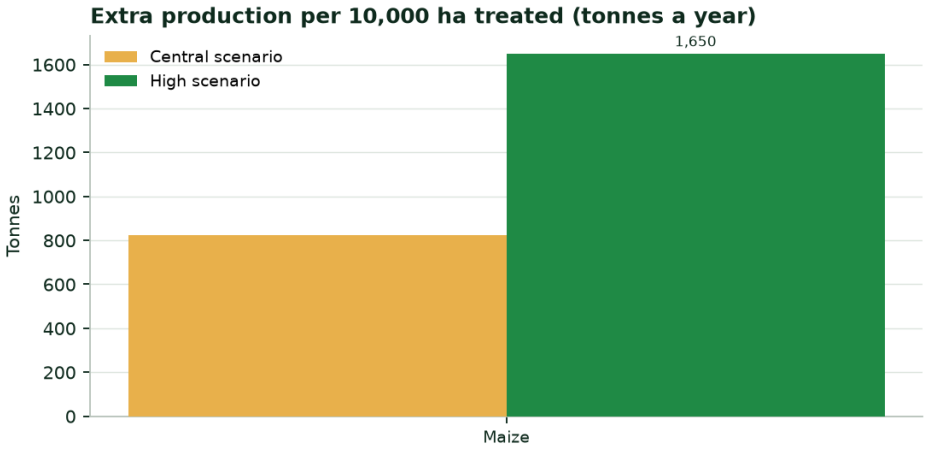


Figure 14. Extra production per 10,000 ha treated, central and high scenarios. Source: Author's calculation

8.4 Irrigation: Vegetables and melons and Rice

Equipped area assigned, trial used and water saved (central scenario)

Crop group	Equipped area (ha)	Share	Trial or assumption	Water saved (Mm³/yr)
Vegetables and melons	11,853	62.4%	Watermelon, Mexico (2023)	45.3
Rice	7,147	37.6%	Generic assumption, no trial	9.0

Source: Author's calculation (Annex B).

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

Scenario	Water (Mm³/yr)	Extra hectares	Production (t/yr)
Cautious	27.2	2,150	7,798
Central	54.3	4,300	15,595
High	108.6	8,601	31,191

Source: Author's calculation (Annex B).

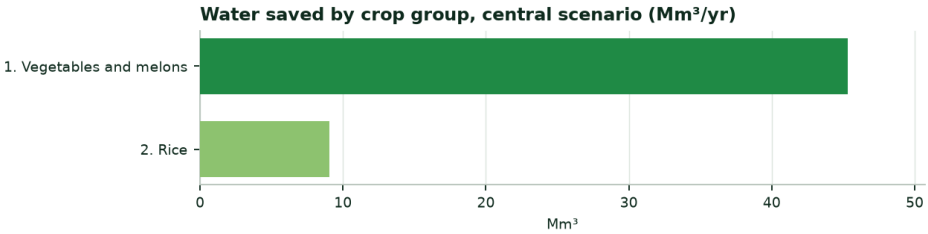


Figure 15. Water saved by crop group, central scenario. Source: Author's calculation

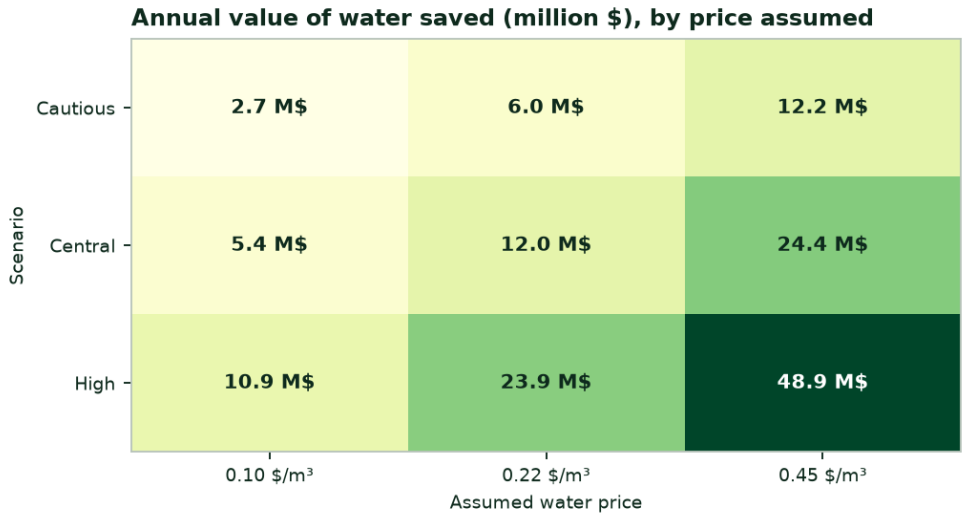


Figure 16. Annual value of the water saved, by price assumed per cubic metre. Source: Author's calculation; prices assumed, no national tariff

8.5 Reading the results

Key points

• In South Sudan, the main stake is rainfed farming: Only 19,000 ha are equipped for irrigation, for 2,477,890 ha of cropland.

• The "vegetables and melons" group gives 83% of the irrigation water saving (watermelon, Mexico (2023)).

• The gains are counted by scenario and, in rainfed farming, per 10,000 ha treated: A cooperative or a public programme can scale them to its own area.

9. Potential benefits of our products

The table lists what the products may bring according to the documents available, with their confidence level and their limit.

Potential benefits, by situation

Benefit	Published figures	Source (level)	Limit
Irrigation water saving	Date palm −82%; watermelon −60.5%; potato −52%; maize −38.9%	A14 to A18 (B, C)	One trial per crop; none in South Sudan
Yield	Maize +17.1%; potato +31.4%; watermelon +30%; date palm +20%; soybean +11.2 to +11.4%	A14 to A18 (B, C)	Trials conducted under irrigation or in other climates
Organic farming (ECOFERT®)	Certified by SOHISCERT and EU Bio	A21 (A)	Valid for the certified product
Safety: Acrylamide (ECOSORB®)	Below 3.0 µg/g	A19 (B)	One laboratory, one date
REACH compliance (EVERGREEN®)	≤ 0.1% of substances of very high concern in 233 substances tested	A20 (B)	Screening, not an approval
Agroforestry (Paulownia ALTIFOLIA®)	13 to 15 m in 6 to 8 years (website)	A22 (C)	No trial in South Sudan

Source: Annex A.



A herd at the Mundari camp of Terekeka.

10. External trade: Exports, imports, importing

10.1 Overview, 2022 and 2023

Agricultural products and total merchandise trade (million $)

Indicator	2022	2023
Agricultural exports (crops and livestock)	22	36
Agricultural imports (crops and livestock)	605	613
Exports, all merchandise	873	833
Imports, all merchandise	1,255	1,184

Source: FAOSTAT (A4).

FAOSTAT trade data for 2024 look incomplete (agricultural exports of 1 M$, against 36 M$ in 2023): This chapter therefore uses 2023.

10.2 Exports

The three main farm products exported in 2023 are: Lucerne (alfalfa) meal and pellets ($24 million), sesame seed ($2 million) and food wastes ($2 million).

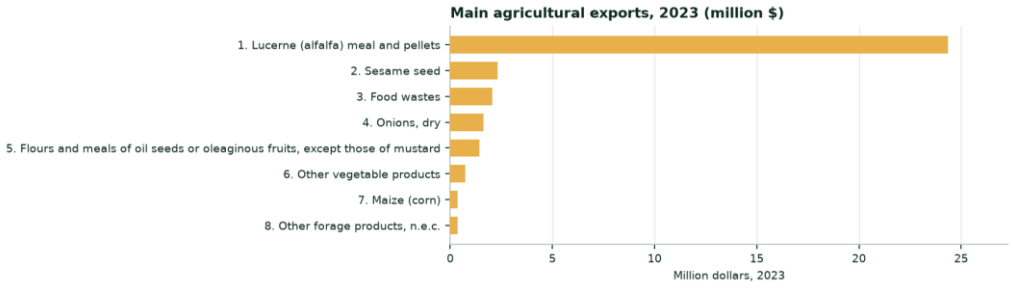


Figure 17. Main agricultural exports, 2023. Source: FAOSTAT (A4)

10.3 Imports

The main farm purchases are: Wheat and meslin flour ($48 million), sorghum ($44 million) and flour of maize ($43 million).

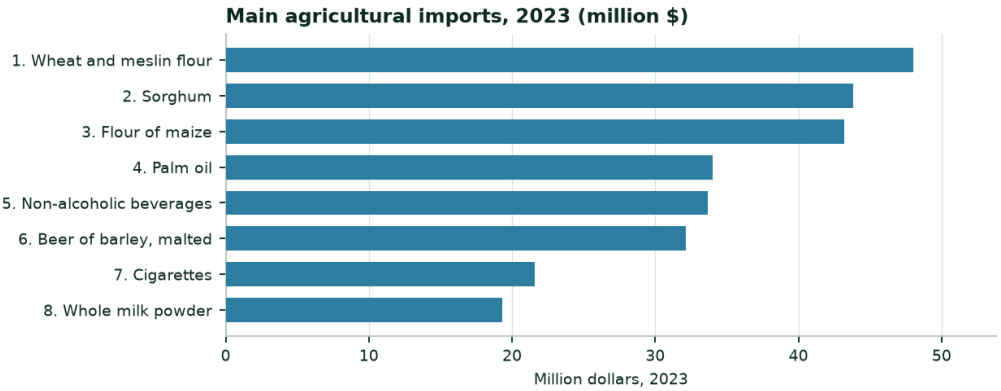


Figure 18. Main agricultural imports, 2023. Source: FAOSTAT (A4)



Figure 19. The Kapoeta market (Eastern Equatoria).



A market street in Kapoeta.

10.4 Importing water-retention polymers into South Sudan

What to know

• **Customs duty (subheading 3906.90):** The East African Community common external tariff is 10% for this subheading (A11). South Sudan has committed to apply the customs union (A12), but the WITS database does not yet hold its own tariff: The rate actually charged is to be confirmed.

• **Import tax:** No official source on the import sales tax or VAT rate was found; it is to be confirmed with a forwarding agent in Juba.

• **Registration:** No fertiliser registration regulation was found in the FAOLEX database; the development plan makes access to inputs a priority (A13). The classification of a water-retaining polymer is to be confirmed with the Ministry of Agriculture.

• **Classification:** Code 3906.90 is an inference for our products; South Sudan Customs settles it.

11. A study of each region

Each region is described through the city that represents it. The figures describe the climate; the water deficit (evapotranspiration minus rainfall) shows where water is most short. The description of crops is qualitative.



Tall grass and thatched roofs near Bor.

Central Equatoria (Juba)

Central Equatoria: Sorghum, maize, cassava, groundnut and vegetables around the capital, along the White Nile.

Indicator	Value
Annual rainfall, 1991-2020	946 mm
Reference evapotranspiration	2,079 mm
Annual water deficit	1,133 mm
Months with less than 50 mm of rain	5
Global solar radiation	2,138 kWh/m²
Mean temperature	28.6 °C

Source: NASA POWER (A9); PVGIS (A8); author's calculation.

Eastern Equatoria (Torit)

Eastern Equatoria: Sorghum and livestock on the dry plains, more varied crops on the slopes of the Imatong mountains.

Indicator	Value
Annual rainfall, 1991-2020	909 mm
Reference evapotranspiration	1,943 mm
Annual water deficit	1,034 mm
Months with less than 50 mm of rain	4
Global solar radiation	2,109 kWh/m²
Mean temperature	27.5 °C

Source: NASA POWER (A9); PVGIS (A8); author's calculation.

Western Equatoria (Yambio)

Western Equatoria, the "green belt": Maize, cassava, groundnut, fruit and teak, under the longest rainy season.

Indicator	Value
Annual rainfall, 1991-2020	1,388 mm
Reference evapotranspiration	1,620 mm

Indicator	Value
Annual water deficit	232 mm
Months with less than 50 mm of rain	3
Global solar radiation	2,096 kWh/m²
Mean temperature	24.9 °C

Source: NASA POWER (A9); PVGIS (A8); author's calculation.

Jonglei (Bor)

Jonglei: Sorghum and cattle, between Nile floods and the Sudd swamps; floods there often destroy harvests.

Indicator	Value
Annual rainfall, 1991-2020	888 mm
Reference evapotranspiration	2,089 mm
Annual water deficit	1,201 mm
Months with less than 50 mm of rain	5
Global solar radiation	2,042 kWh/m²
Mean temperature	28.8 °C

Source: NASA POWER (A9); PVGIS (A8); author's calculation.

Upper Nile (Malakal)

Upper Nile: Sorghum and former irrigation schemes on the Nile, livestock and fishing.

Indicator	Value
Annual rainfall, 1991-2020	783 mm
Reference evapotranspiration	2,334 mm
Annual water deficit	1,551 mm
Months with less than 50 mm of rain	6
Global solar radiation	2,101 kWh/m²
Mean temperature	28.8 °C

Source: NASA POWER (A9); PVGIS (A8); author's calculation.

Unity (Bentiu)

Unity: Sorghum, livestock and fishing on a floodplain, hit by floods in recent years.

Indicator	Value
Annual rainfall, 1991-2020	882 mm
Reference evapotranspiration	2,291 mm
Annual water deficit	1,409 mm
Months with less than 50 mm of rain	6
Global solar radiation	2,149 kWh/m²
Mean temperature	28.9 °C

Source: NASA POWER (A9); PVGIS (A8); author's calculation.

Lakes (Rumbek)

Lakes: Sorghum, groundnut, sesame and large cattle herds.

Indicator	Value

Indicator	Value
Annual rainfall, 1991-2020	1,037 mm
Reference evapotranspiration	2,106 mm
Annual water deficit	1,069 mm
Months with less than 50 mm of rain	5
Global solar radiation	2,135 kWh/m²
Mean temperature	28.4 °C

Source: NASA POWER (A9); PVGIS (A8); author's calculation.

Warrap (Kuajok)

Warrap: Sorghum, groundnut and livestock, on clay soils that waterlog in the rainy season.

Indicator	Value
Annual rainfall, 1991-2020	908 mm
Reference evapotranspiration	2,302 mm
Annual water deficit	1,394 mm
Months with less than 50 mm of rain	6
Global solar radiation	2,215 kWh/m²
Mean temperature	28.7 °C

Source: NASA POWER (A9); PVGIS (A8); author's calculation.

Northern Bahr el Ghazal (Aweil)

Northern Bahr el Ghazal: Sorghum, groundnut and lowland rice, with the former Aweil rice scheme.

Indicator	Value
Annual rainfall, 1991-2020	928 mm
Reference evapotranspiration	2,361 mm
Annual water deficit	1,433 mm
Months with less than 50 mm of rain	6
Global solar radiation	2,227 kWh/m²
Mean temperature	28.4 °C

Source: NASA POWER (A9); PVGIS (A8); author's calculation.

Western Bahr el Ghazal (Wau)

Western Bahr el Ghazal: Sorghum, cassava, groundnut and sesame, between wooded savannah and plains.

Indicator	Value
Annual rainfall, 1991-2020	1,065 mm
Reference evapotranspiration	2,124 mm
Annual water deficit	1,059 mm
Months with less than 50 mm of rain	5
Global solar radiation	2,182 kWh/m²
Mean temperature	27.9 °C

Source: NASA POWER (A9); PVGIS (A8); author's calculation.

Annex A. Sources and confidence levels

Ref.	Source	Level
A1	World Bank, World Development Indicators (WDI), South Sudan	A
A2	FAOSTAT, crops and livestock (QCL), areas, production, 2014-2024	A
A3	FAOSTAT, value of production (QV), constant 2014-2016 I$, 2019-2024	A
A4	FAOSTAT, trade in crops and livestock products, 2018-2023	A
A5	FAOSTAT, mineral fertilisers, agricultural use, production and imports, 2005-2023	A
A6	FAOSTAT, land use, areas equipped for irrigation, organic farming	A
A7	World Bank, Pink Sheet (world prices of urea, DAP, TSP and potassium chloride)	A
A8	PVGIS (European Commission Joint Research Centre), radiation, 2005-2020	B
A9	NASA POWER (NASA Langley Research Center), daily data: Rainfall, temperature, humidity, wind and radiation, 1981-2024; reference evapotranspiration calculated by the author with FAO-56 (Penman-Monteith)	B
A10	Natural Earth, first-level administrative boundaries and country outline	B
A11	World Bank, WITS (UNCTAD TRAINS database), East African Community common external tariff, subheading 3906.90, 2023 (Kenya, Uganda, Rwanda; no line for South Sudan)	A
A12	National Policy and Strategy on EAC Implementation (South Sudan), as held in FAO's FAOLEX database: Commitment to implement the customs union	B
A13	South Sudan Development Plan, as held in FAO's FAOLEX database: Access to inputs (seeds, fertilisers) and irrigation development	B
A14	Soybean trial, China (yield), manufacturer's website	C
A15	Date palm trial, UAE (ICBA, 2021), manufacturer's website	B
A16	Watermelon trial, Mexico (2023), manufacturer's website	C
A17	Potato trial, South Africa (2025), manufacturer's website	C
A18	Maize trial, Türkiye (TIGEM, Konya, 2025), manufacturer's website	B
A19	ECOSORB® acrylamide analysis (Polymex laboratory, 2024)	B
A20	EVERGREEN® REACH / SVHC screening (SGS, 2023)	B
A21	ECOFERT® certificate (SOHISCERT, EU Bio)	A
A22	Paulownia ALTIFOLIA® sheet figures (website)	C

Annex B. Calculation method

1. Agricultural water. Total withdrawals (658 Mm³, 2022) × agricultural share (36.47%) = 240.0 Mm³.

2. Irrigation. The equipped area (19,000 ha) and agricultural water are shared between irrigated groups (vegetables and melons and rice) in proportion to their harvested areas (102,230 ha), without exceeding each group's harvested area. Our sources have no irrigation statistic by crop. Other crops are treated as rainfed and receive no irrigation water in the calculation. The equipped area is much smaller than the harvested area of irrigable crops (vegetables, rice): It is shared among them pro rata, and the rest of their area is rainfed. Maize is treated as rainfed: Its yield gain is given for 10,000 ha treated. Sorghum, the first crop, has no trial: No yield gain is attributed to it.

3. Scenarios. Water saved = group water × trial effect: A quarter (cautious), half (central), all of it (high). Without a trial: 5, 10 and 20%.

4. Extra hectares. Water saved ÷ water per equipped hectare (12,632 m³/ha).

5. Rainfed crops. Gain per 10,000 ha = 10,000 × average 2024 yield (production ÷ harvested area, FAOSTAT) × trial effect on yield (maize 17.1%), with the same quarter, half and whole.

6. Value of water. Three assumed prices (0.10; 0.22 and 0.45 $/m³); no national tariff was adopted.

7. Fertilisers. Minimum spending = nitrogen ÷ 0.46 × urea price + phosphate ÷ 0.46 × TSP price + potash ÷ 0.60 × potassium chloride price (A7).

8. Climate. Rainfall, reference evapotranspiration (FAO-56) and temperature: 1991-2020 means of the NASA POWER grid cell containing each city; radiation: PVGIS, 2005-2020. Temperature trends are linear regressions over 1981-2024. NASA POWER combines reanalyses and satellite data on a grid of about 50 km: Two nearby cities can share the same cell, and its rainfall can differ from local station records. On the maps, each state is coloured according to the value of its capital. The Abyei, Pibor and Ruweng administrative areas are not distinguished in the Natural Earth boundaries.

9. Trade. Totals are those of the FAOSTAT crops and livestock line; products are listed one by one, without aggregates. Rice amounts add husked rice, broken rice and milled rice.

Annex C. Photo credits

File (Wikimedia Commons)	Author	Licence
Keliko Women at work.jpg	Eawisdom	CC0
Traditional dinka homestead.jpg	Jayyeass	CC BY-SA 4.0
House with sorghum in the foreground.jpg	Mr leroy playpus	CC BY 4.0
MAJESTIC VIEW OF WHITE NILE , JUBA, SOUTH SUDAN.jpg	Umar sheriff habibullah	CC BY-SA 4.0
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Campamento de ganado de la tribu Mundari, Terekeka, Sudán del Sur, 202	Diego Delso	CC BY-SA 4.0
Nyamor Nwat, Lankien, South Sudan (16715638768).jpg	Oxfam East Africa	CC BY 2.0
Campamento de ganado de la tribu Mundari, Terekeka, Sudán del Sur, 202	Diego Delso	CC BY-SA 4.0
Kapoeta, Sudán del Sur, 2024-01-25, DD 53.jpg	Diego Delso	CC BY-SA 4.0
Kapoeta, Sudán del Sur, 2024-01-25, DD 46.jpg	Diego Delso	CC BY-SA 4.0
Landscape with thatch roofs and tall grass.jpg	Mr leroy playpus	CC BY 4.0
A fishing community relaxing in their hut in South Sudan.jpg	Lomoraronald	CC BY-SA 4.0

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A fishing community in its hut.

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