

COUNTRY DOSSIER

Senegal

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

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The Sine-Saloum delta, a UNESCO World Heritage site.

Foreword

This dossier describes Senegal 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 in short supply? For which crops? In which regions? It then examines what difference our products can make, 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, ECOWAS, WAEMU, Senegalese administration).
- **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 Senegal.

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Summary

The points below summarise the dossier. The figures come from public sources: The World Bank, FAO (FAOSTAT, AQUASTAT), ECOWAS, WAEMU, Senegalese administration, PVGIS and ERA5. The production gains and water savings are scenarios, described in Annex B.

18.93 M
Inhabitants in 2025 (World Bank)

1.27 M ha
Of groundnuts in shell harvested in 2024, the main crop

120,100 ha
Equipped for irrigation (2024)

+2,406 t
Of maize per 10,000 ha treated, central scenario

385 Mm³
Of irrigation water saved a year, central scenario

805 M$
Of agricultural exports in 2024 (FAOSTAT)

Key points

• **Predominantly rainfed farming.** 120,100 ha equipped for irrigation in 2024, out of 3.91 million hectares of cropland: Almost every harvest depends on rain.

• **Groundnuts in shell: The main crop.** 1,267,592 ha harvested in 2024, for 1.68 million tonnes, or 1.33 t/ha.

• **Water is not scarce over the year as a whole; it is scarce between rainfall events.** National water stress is only 16.3%, but at Matam, atmospheric water demand exceeds rainfall by 2,689 mm.

• **In rainfed farming, the gain is counted in tonnes.** In the central scenario, an additional 2,406 t of maize and 22,068 t of watermelon per 10,000 ha treated.

• **In irrigated farming, the water saved could allow irrigation schemes to be expanded.** 384.9 Mm³ a year in the central scenario, enough to irrigate about 16,535 more ha, or 13.8% of the equipped area.

• **An organic supply chain.** 2,780 ha of certified organic cropland in 2024: ECOFERT® is EU Bio certified.

• **Fertilisers made locally.** 54,348 t of nitrogen used in 2024; the country produces 14,039 t and imports 49,863 t.

• **Farm trade.** $805 million of exports and $2,200 million of imports in 2024. Leading export: Groundnuts, shelled ($107 million). Rice imports amount to $497 million.

Key figures

Key indicators for Senegal

Indicator	Value	Year	Source (level)
Population	18.93 M	2025	World Bank (A1)
GDP per capita	1,955 $	2025	World Bank (A1)
Agriculture's share of GDP	17.1%	2025	World Bank (A1)
Agricultural employment	29.6%	2025	World Bank (A1)
Cropland	3,912,560 ha	2024	FAOSTAT (A6)
Area equipped for irrigation	120,100 ha	2024	FAOSTAT (A6)
Harvested area: Groundnuts in shell	1,267,592 ha	2024	FAOSTAT (A2)
Certified organic cropland	2,780 ha	2024	FAOSTAT (A6)
Agricultural exports	805 M$	2024	FAOSTAT (A4)
Agricultural imports	2,200 M$	2024	FAOSTAT (A4)

Indicator	Value	Year	Source (level)
Mineral nitrogen, agricultural use	54,348 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 reported in 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 Senegal. 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.



Groundnut crop at Djissa Aliou, in the Kaolack region.

2. Senegal in figures

Senegal had 18.93 million inhabitants in 2025, 44% of them in rural areas. Agriculture accounts for 17.1% of gross domestic product and employs 30% of the labour force. The country covers 192.5 thousand km², of which 49% is agricultural land. Undernourishment affects 5.3% of the population.

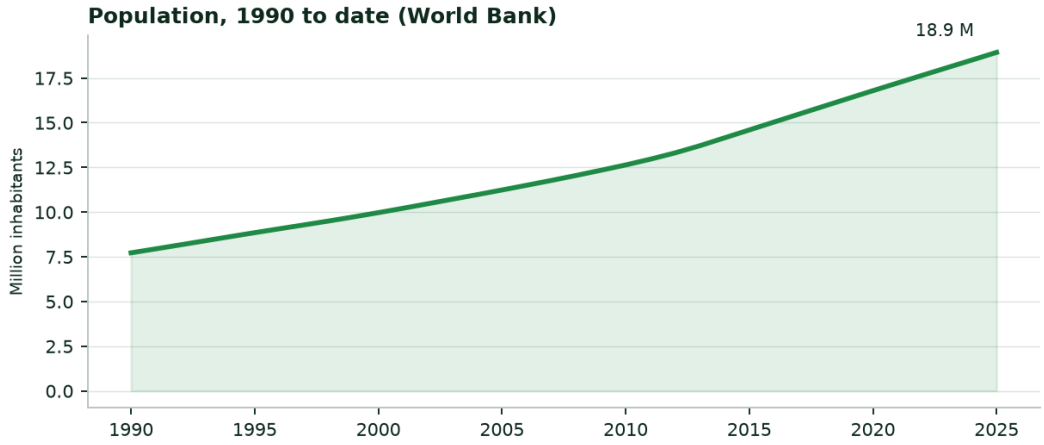


Figure 1. Population of Senegal, 1990 to date. Source: World Bank (A1)

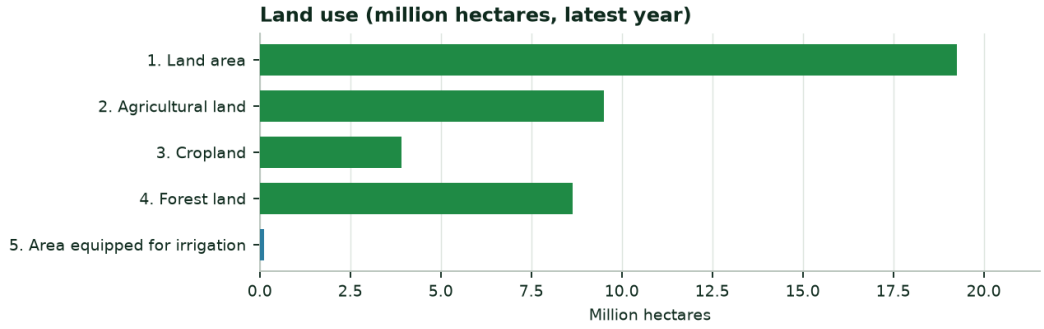


Figure 2. Land use, latest year published. Source: FAOSTAT (A6)

Agricultural and water indicators, latest year published

Indicator	Value	Year	Source
Cropland certified organic	2,780 ha	2024	FAOSTAT (A6)
Average cereal yield	2,004 kg/ha	2024	World Bank (A1)
Fertiliser use per hectare of arable land	19.3 kg/ha	2024	World Bank (A1)
Water withdrawals, agricultural share	91.3%	2022	World Bank (A1)
Internal freshwater resources	25.8 km³	2022	World Bank (A1)
Internal resources per inhabitant	1,462 m³	2022	World Bank (A1)



A Sahelian landscape in Senegal.

3. Sunshine, rainfall and climate change

3.1 Sunshine

Global solar radiation reaches 2,183 to 2,307 kWh/m² a year depending on the region. Energy is not the limiting factor: Water available at the right time determines the harvest.

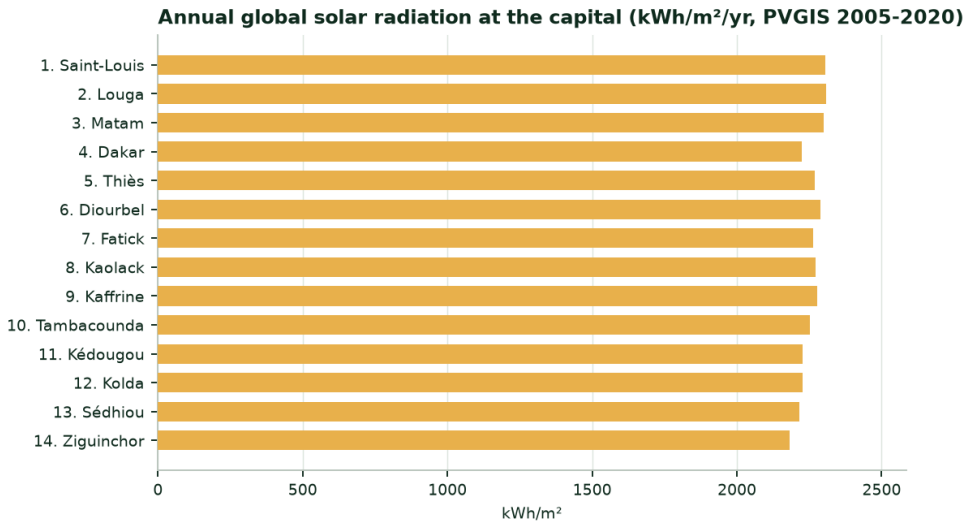


Figure 3. Annual global solar radiation at each region's capital. Source: PVGIS (A8)

3.2 Rainfall and evapotranspiration

Annual rainfall is 1,158 mm at Ziguinchor, but only 172 mm at Saint-Louis, where reference evapotranspiration reaches 2,148 mm. Rain falls in a single season, the hivernage, from June or July to October; it decreases from south to north, and the dry season lasts seven to nine months.

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

City	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

City	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Saint-Louis	3	2	0	0	0	1	16	67	62	17	1	2
Louga	3	2	0	0	0	2	31	96	87	22	1	2
Matam	1	1	0	0	0	10	42	93	62	13	0	2
Dakar	2	1	0	0	0	2	33	128	94	25	1	1
Thiès	2	1	0	0	0	3	49	146	117	34	1	1
Diourbel	3	1	0	0	0	8	65	156	123	30	1	2
Fatick	2	1	0	0	0	8	80	196	148	45	1	2
Kaolack	2	1	0	0	0	12	88	204	150	40	1	2
Kaffrine	2	1	0	0	1	18	108	214	157	41	1	2
Tambacounda	0	0	0	0	3	35	130	206	163	41	2	1
Kédougou	0	0	1	1	17	76	164	240	226	68	6	0
Kolda	0	0	0	0	3	46	203	308	214	67	5	1
Sédhiou	0	1	0	0	2	47	216	342	238	76	6	2
Ziguinchor	1	1	0	0	2	51	268	389	302	128	14	1

Source: ERA5 via Open-Meteo (A9); author's calculation.

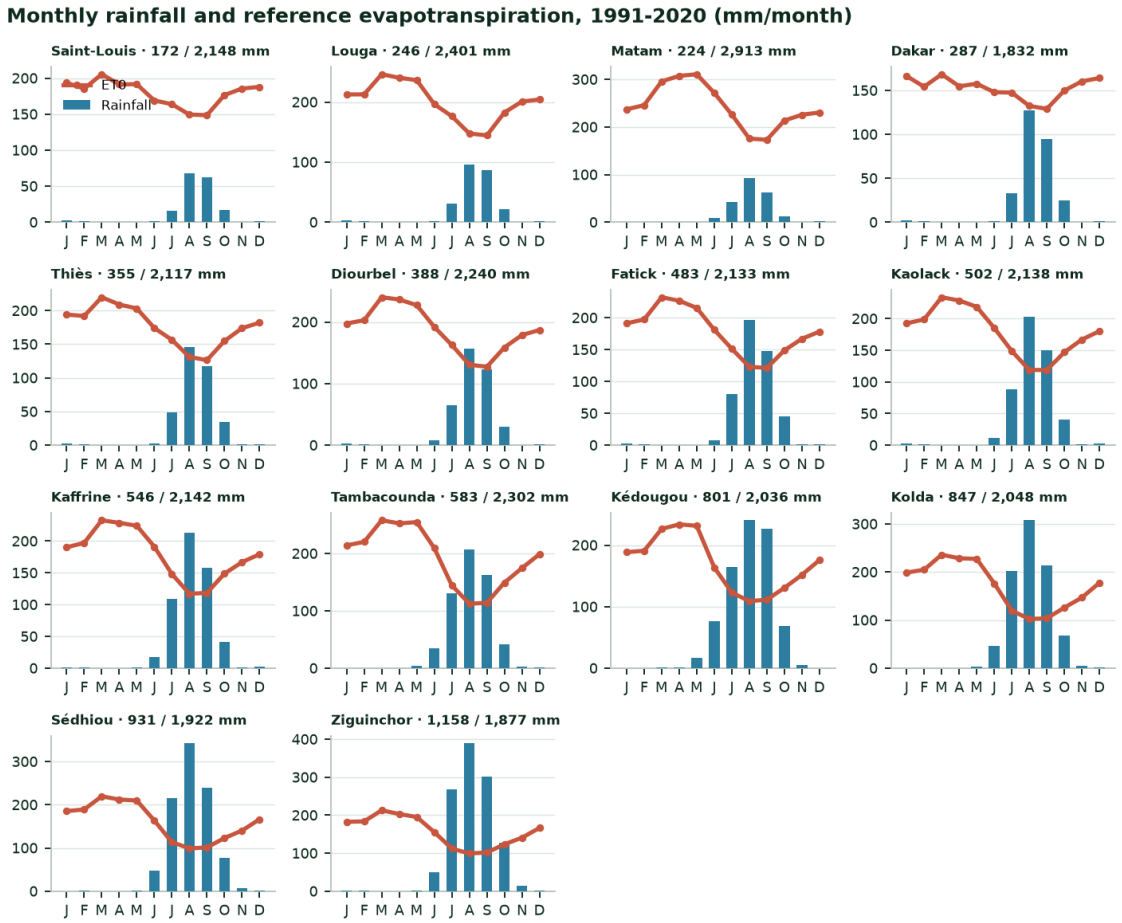


Figure 4. Monthly rainfall and reference evapotranspiration by city, 1991-2020. Source: ERA5 via Open-Meteo (A9)

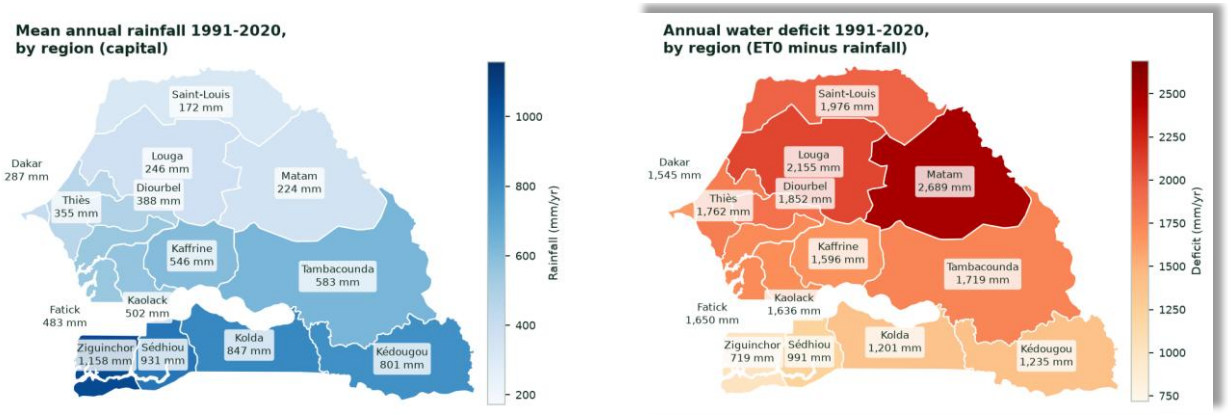


Figure 5. Mean annual rainfall 1991-2020, by region. Source: ERA5 Annual water deficit, by region. Source: ERA5 (A9), Natural Earth (A10). (A9), Natural Earth (A10).

3.3 Climate change

Mean annual temperature is rising. At Saint-Louis it went from 25.2 °C in 1981 to 26.5 °C in 2024, a trend of 0.27 °C per decade. At Ziguinchor the trend is 0.09 °C per decade, from 26.9 °C to 27.6 °C. Warmer air dries the soil faster between rainfall events.

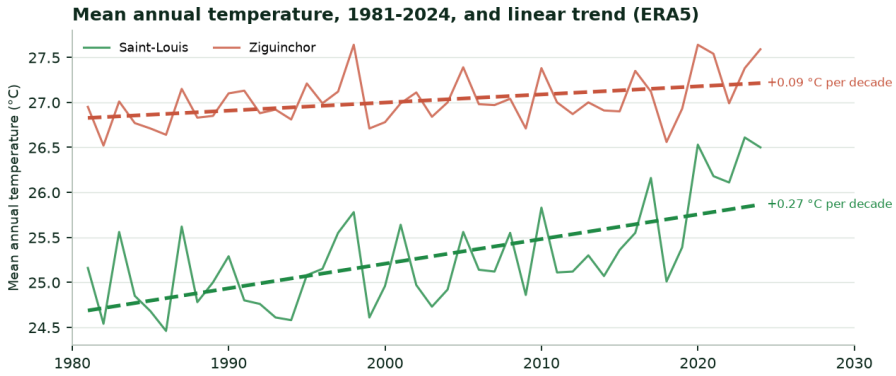


Figure 6. Mean annual temperature, 1981-2024, and linear trend. Source: ERA5 (A9)



A baobab near Darou Khoudoss, in the Thiès region.

4. Water: Resources, irrigated areas, withdrawals

4.1 Resources and withdrawals

Total freshwater withdrawals are 3,062 million m³ a year (2022). Agriculture accounts for 91.3% of these withdrawals, that is 2,796 Mm³. Internal resources are 25.8 km³ a year and water stress is 16.3%: The country has water, but little of it is mobilised for crops.

Freshwater: Withdrawals and resources

Indicator	Value	Year	Source
Total withdrawals	3,062 Mm³	2022	World Bank (A1)
Agricultural share	91.3%	2022	World Bank (A1)
Agricultural withdrawals	2,795.7 Mm³	2022	Calculated from A1
Area equipped for irrigation	120,100 ha	2024	FAOSTAT (A6)
Agricultural withdrawals per equipped hectare	23,278 m³/ha	—	Calculation (Annex B)
Water stress	16.3%	2022	World Bank (A1)

4.2 Irrigated areas

FAOSTAT counts 120,100 hectares equipped for irrigation in 2024. FAO uses an irrigation potential of 409,000 ha; depending on the study, it ranges from 160,000 to more than 640,000 ha (A11). Irrigation mostly serves rice and tomatoes in the Senegal river valley, Richard-Toll sugar cane, onions and market gardening in the Niayes.



A pumping station in the Senegal river valley.

4.3 What the water saving represents

In the central scenario, the saving is 384.9 million m³ a year, or 13.8% of agricultural withdrawals. At 23,278 m³ per equipped hectare, this water would irrigate about 16,535 more hectares, or 13.8% of today's equipped area.

5. Fertilisers: Quantities, purchases, spending

5.1 Quantities used

In 2024, agricultural use reaches 54,348 tonnes of nitrogen, 11,180 tonnes of phosphate (P2O5) and 8,346 tonnes of potash (K2O). The country produces 14,039 tonnes of nitrogen and 7,367 tonnes of phosphate (P2O5); it imported 49,863 tonnes of nitrogen in the same year. Per hectare of arable land, use is 19.3 kg per hectare.

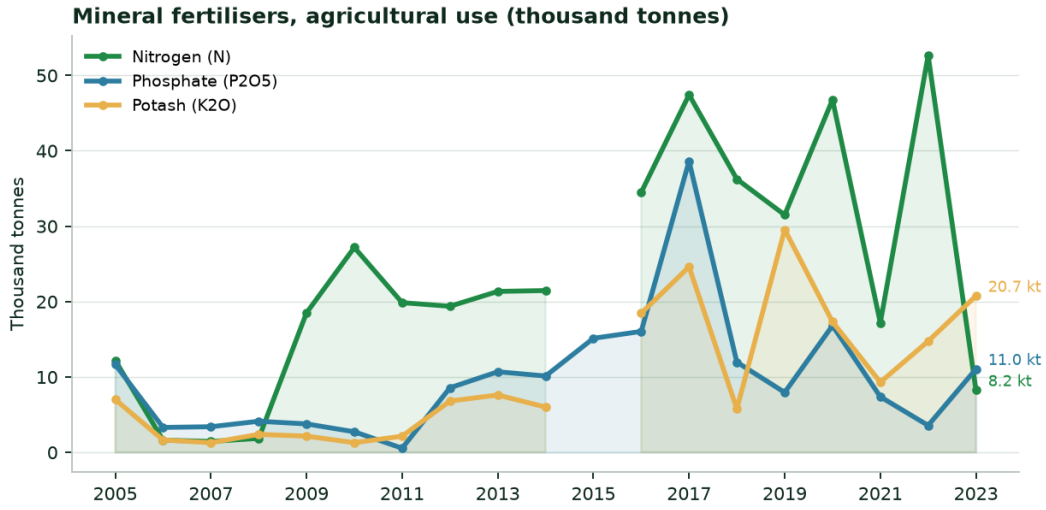


Figure 7. Mineral fertilisers, agricultural use, 2005-2023. Source: FAOSTAT (A5)

5.2 Regulatory framework

ECOWAS Regulation C/REG.13/12/12 governs fertiliser quality control in the West African area: Registration before sale, labelling, control (A13).



A woman carrying a sack of onions.

5.3 Indicative spending

In 2024, the indicative minimum spending on mineral fertilisers reaches $56 million, at international fertiliser prices (calculation in Annex B, lower bound).

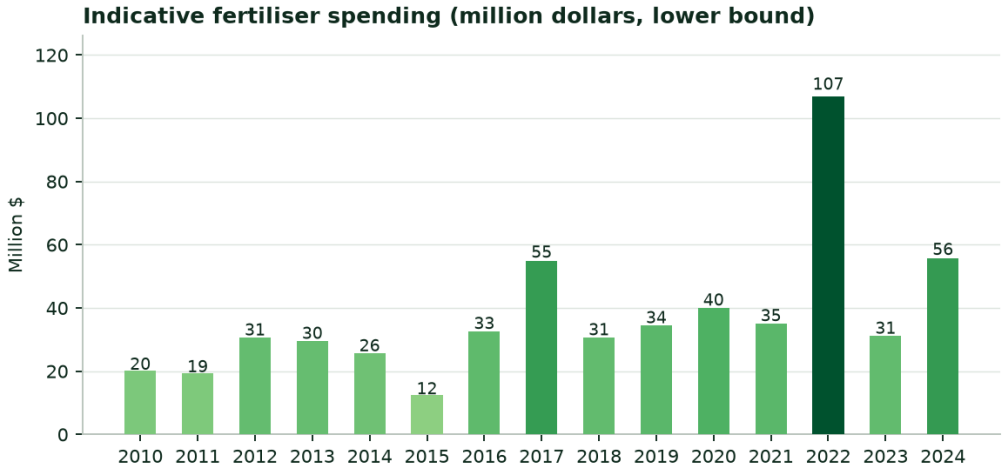


Figure 8. Indicative fertiliser spending, lower bound. Source: Author's calculation from A5 and A7

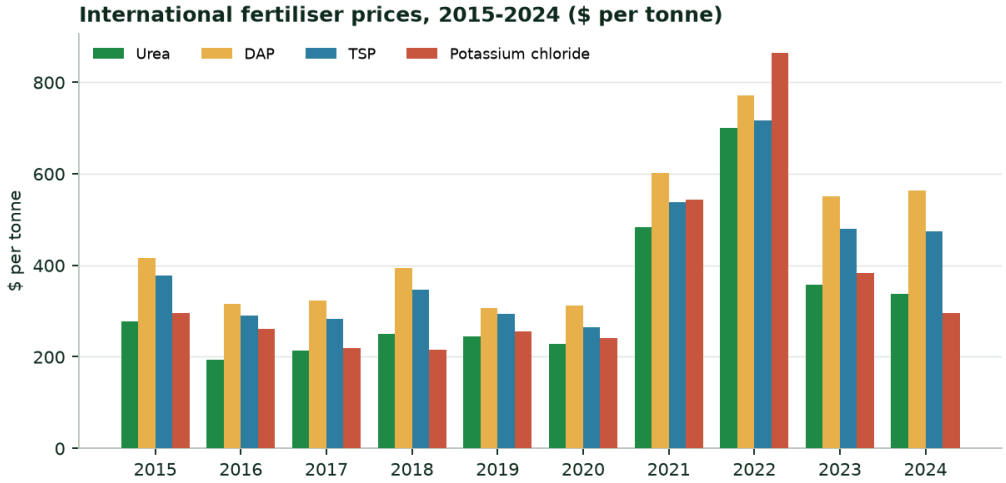


Figure 9. International prices of urea, DAP, TSP and potassium chloride. Source: World Bank, Pink Sheet (A7)

6. The regions at a glance

The table compares the country's fourteen regions using each region's 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)
Saint-Louis (Saint-Louis)	172	2,148	1,976	2,304	25.2
Louga (Louga)	246	2,401	2,155	2,307	26.7
Matam (Matam)	224	2,913	2,689	2,299	30.4
Dakar (Dakar)	287	1,832	1,545	2,224	24.6
Thiès (Thiès)	355	2,117	1,762	2,269	25.5
Diourbel (Diourbel)	388	2,240	1,852	2,289	26.9
Fatick (Fatick)	483	2,133	1,650	2,263	26.7
Kaolack (Kaolack)	502	2,138	1,636	2,272	27.1
Kaffrine (Kaffrine)	546	2,142	1,596	2,277	27.9
Tambacounda (Tambacounda)	583	2,302	1,719	2,253	29.5
Kédougou (Kédougou)	801	2,036	1,235	2,228	28.6

Region (city)	Rainfall (mm/yr)	ET0 (mm/yr)	Deficit (mm/yr)	Radiation (kWh/m²/yr)	Temperature (°C)
Kolda (Kolda)	847	2,048	1,201	2,226	28.1
Sédhiou (Sédhiou)	931	1,922	991	2,215	27.3
Ziguinchor (Ziguinchor)	1,158	1,877	719	2,183	27.0

Source: ERA5 via Open-Meteo (A9); PVGIS (A8); author's calculation.

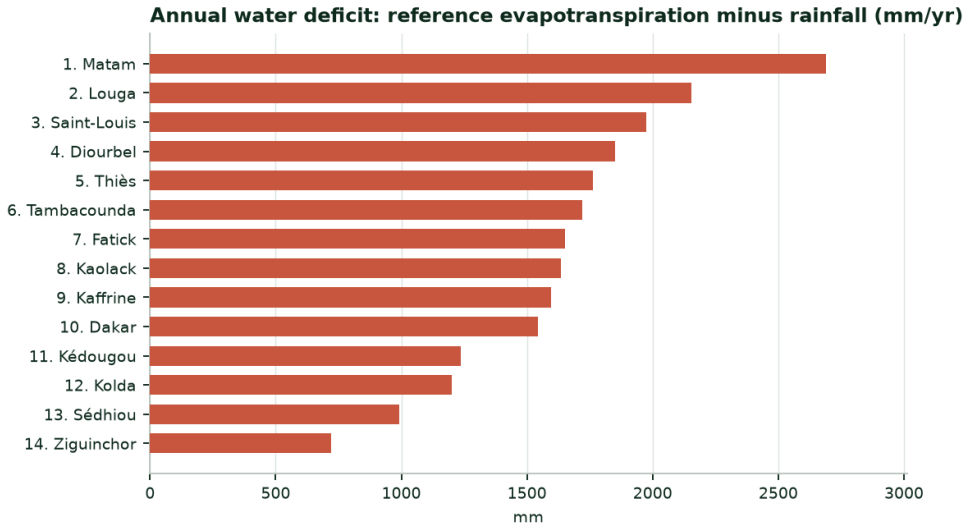


Figure 10. Annual water deficit: Reference evapotranspiration minus rainfall. Source: ERA5 (A9)



Niokolo-Koba National Park, in the east of the country.

7. The twenty main crops: Three rankings

7.1 By harvested area

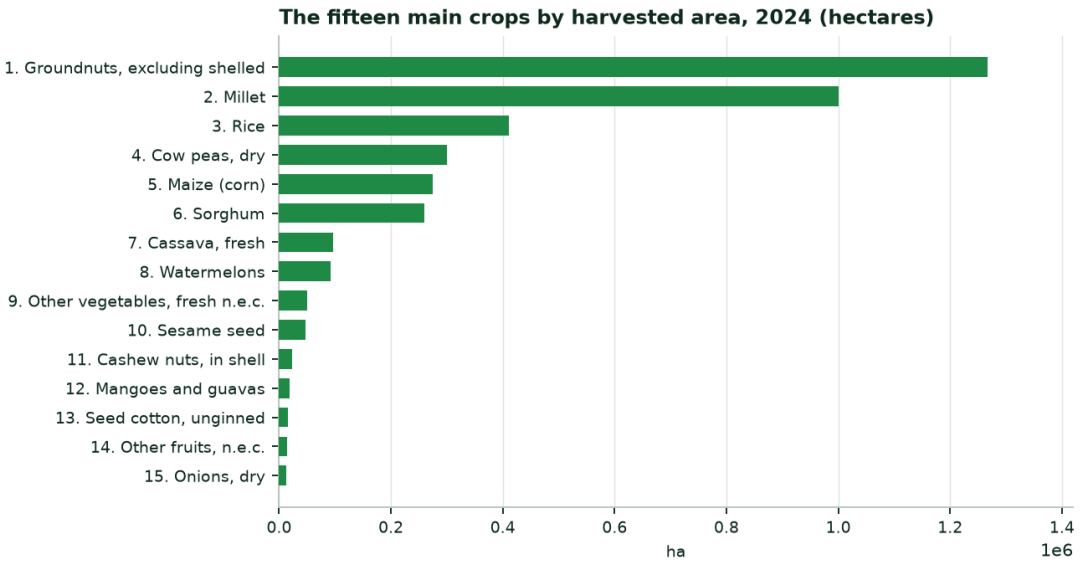


Figure 11. The fifteen main crops by harvested area, 2024 (hectares). Source: FAOSTAT (A2)

The ten main crops by area, 2024

Crop	Harvested area (ha)	Production (t)	Yield (t/ha)
Groundnuts in shell	1,267,592	1,681,953	1.33
Millet	1,000,000	1,106,000	1.11
Rice	410,271	1,580,000	3.85
Cow peas, dry	300,395	212,909	0.71
Maize (corn)	275,000	774,000	2.81
Sorghum	260,000	445,000	1.71
Cassava, fresh	96,844	1,433,575	14.80
Watermelons	92,607	1,362,440	14.71
Other vegetables, fresh n.e.c.	49,829	212,695	4.27
Sesame seed	47,000	45,000	0.96

Source: FAOSTAT (A2).

7.2 By production

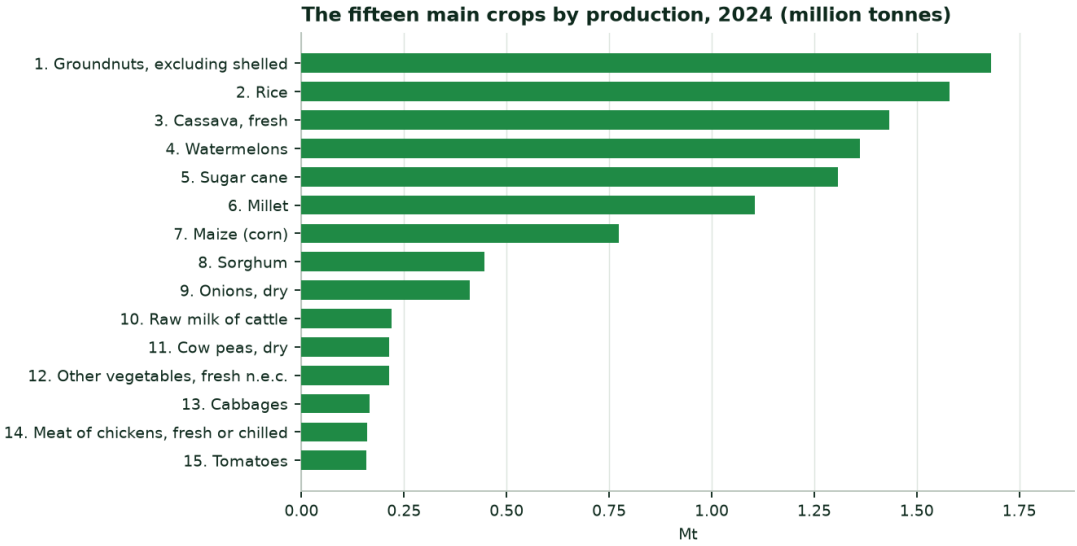


Figure 12. The fifteen main crops by production, 2024 (million tonnes). Source: FAOSTAT (A2)

7.3 By production value

By production value, the three main crops are: Groundnuts in shell, rice and millet (FAOSTAT, 2023, constant international dollars).

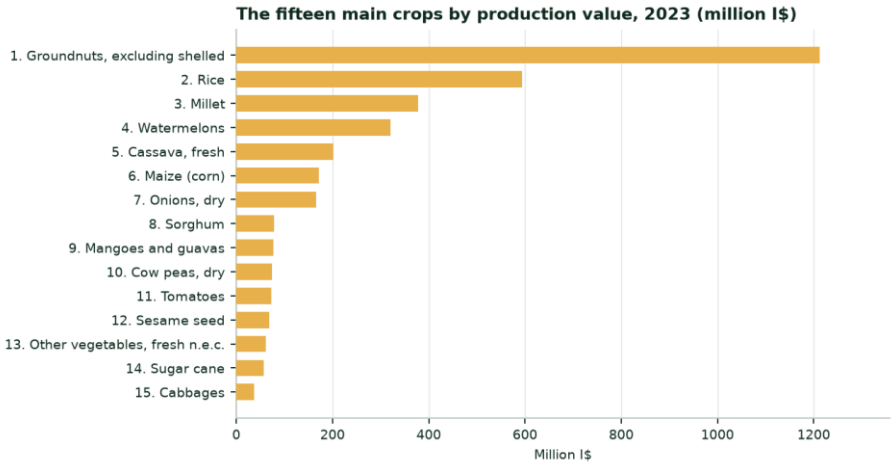


Figure 13. The fifteen main crops by production value, 2023 (million I$). Source: FAOSTAT (A3)



Tomato plants in Senegal.

8. Extrapolation by crop: Irrigation and rainfed crops

8.1 Method

Method in brief

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

• **Rainfed crops.** For crops that have a trial (maize and watermelon), 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) or the full effect (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%	Watermelon: Yield
Potato, South Africa (2025)	Potato	-52.0%	+31.4%	Potato: Water and yield
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 Senegal: The figures below apply the results of the cited trials to the country's average yields.

8.3 Rainfed crops: Maize and Watermelon

Average 2024 yields (FAOSTAT): Maize 2.81 t/ha and watermelon 14.71 t/ha. A water-retention polymer retains water from each rainfall event 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	2.81	1,203	2,406	4,813
Watermelon	14.71	11,034	22,068	44,136

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

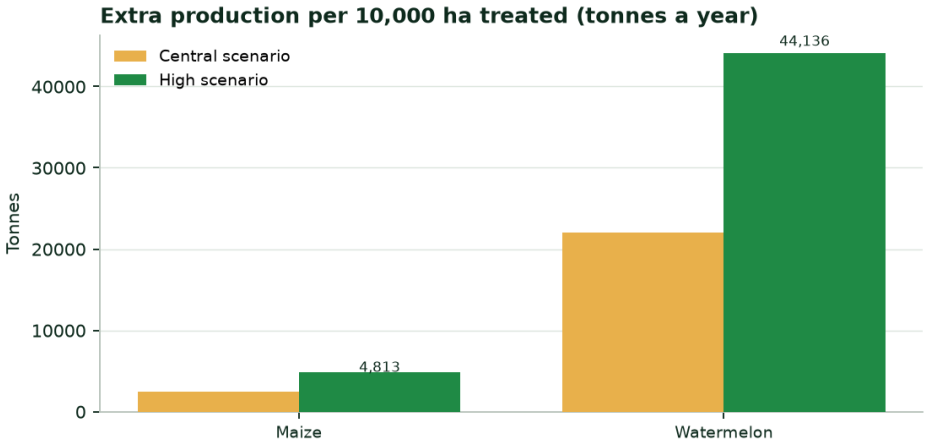


Figure 14. Extra production per 10,000 ha treated, central and high scenarios. Source: Author's calculation

8.4 Irrigation: Rice, Vegetables, Potato and Sugar cane

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

Crop group	Equipped area (ha)	Share	Trial or assumption	Water saved (Mm³/yr)
Rice (paddy)	94,810	78.9%	Generic assumption, no trial on rice	220.7
Vegetables (onion, tomato, cabbage, carrot, others)	21,234	17.7%	Watermelon, Mexico (2023)	149.5
Potato	1,406	1.2%	Potato, South Africa (2025)	8.5
Sugar cane	2,650	2.2%	Generic assumption, no trial	6.2

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	192.4	8,267	21,310
Central	384.9	16,535	42,621
High	769.8	33,069	85,241

Source: Author's calculation (Annex B).

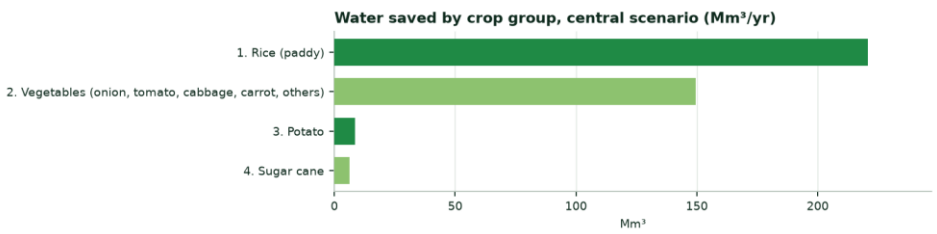


Figure 15. Water saved by crop group, central scenario. Source: Author's calculation

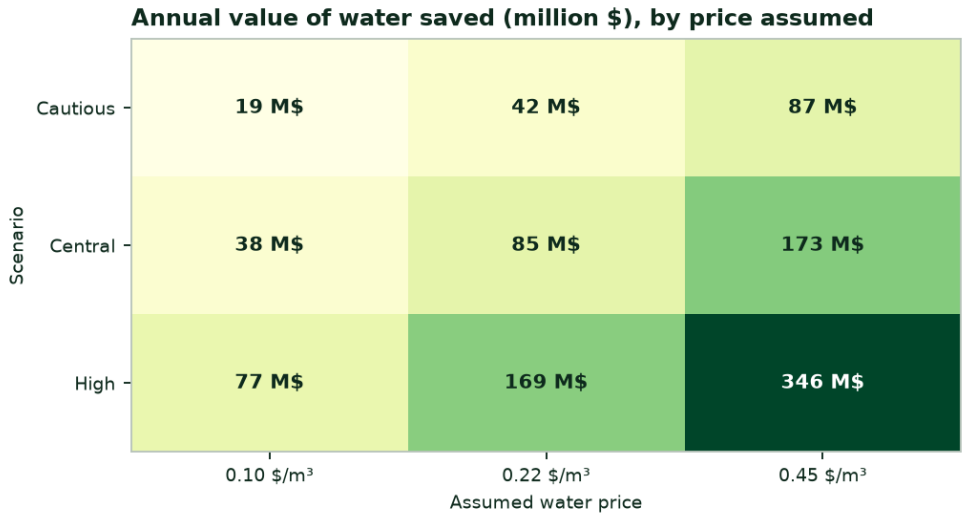


Figure 16. Annual value of the water saved, by price assumed per cubic metre. Source: Author's calculation; prices assumed, no national tariff

8.5 Reading the results

Key points

• In Senegal, the main challenge is rainfed farming: Only 120,100 ha are equipped for irrigation, out of 3,912,560 ha of cropland.

• The "rice" group gives 57% of the irrigation water saving (generic assumption, no trial on rice).

• 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 the confidence level and limitations of each.

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 Senegal
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 Senegal

Source: Annex A.



Market gardens at Lake Mbawane, Kayar.

10. External trade: Exports, imports, importing

10.1 Overview, 2023 and 2024

Agricultural products and total merchandise trade (million $)

Indicator	2023	2024
Agricultural exports (crops and livestock)	827	805
Agricultural imports (crops and livestock)	2,224	2,200
Exports, all merchandise	5,313	6,408
Imports, all merchandise	11,064	11,807

Source: FAOSTAT (A4).

10.2 Exports

The three main farm products exported in 2024 are: Groundnuts, shelled ($107 million), cashew nuts, in shell ($86 million) and cigarettes ($56 million).

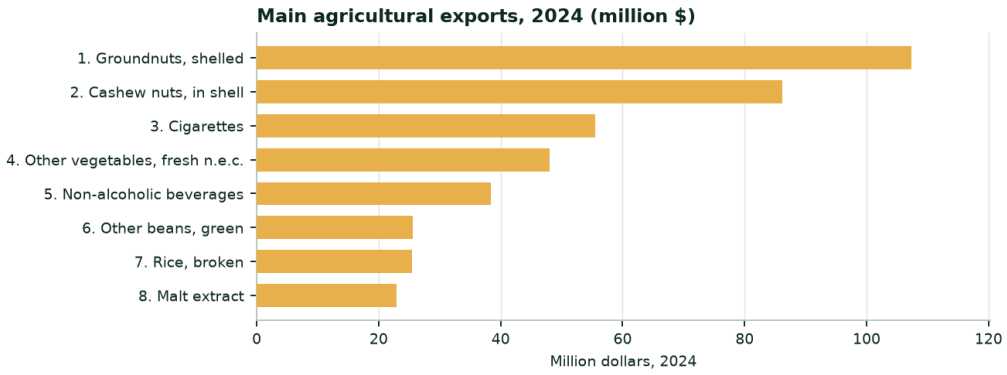


Figure 17. Main agricultural exports, 2024. Source: FAOSTAT (A4)

10.3 Imports

The main farm purchases are: Wheat ($282 million), malt extract ($216 million) and maize (corn) ($128 million). Rice imports amount to $497 million (husked, broken and milled rice): Every tonne grown locally reduces this bill.

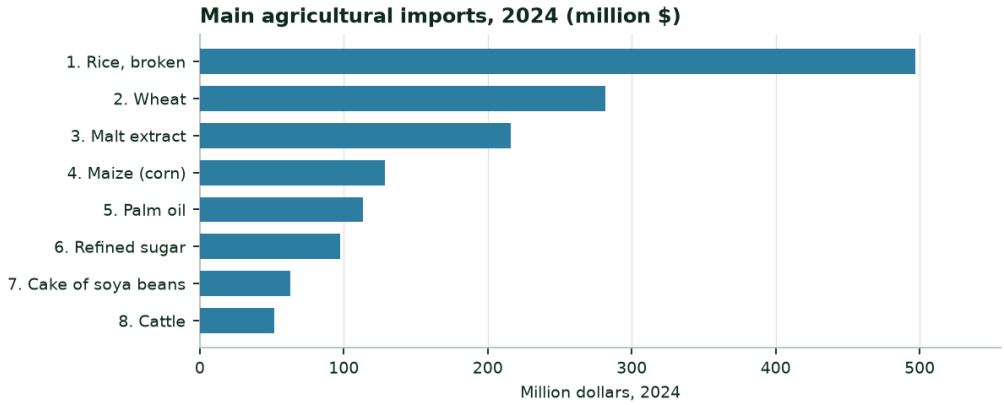


Figure 18. Main agricultural imports, 2024. Source: FAOSTAT (A4)



Figure 19. Mangoes from Senegal.



Senegalese tomatoes at the market.

10.4 Importing water-retention polymers into Senegal

What to know

• **Customs duty (code 3906.90.00.00, acrylic polymers in primary forms):** 5% under the ECOWAS common external tariff (A12).

• **Levies:** 1% statistical fee, 1% WAEMU community solidarity levy and 0.5% ECOWAS community levy (A12).

• **VAT:** 18% (A12).

• **Registration:** A fertiliser must be registered before sale, under ECOWAS Regulation C/REG.13/12/12 (A13).

• **Classification:** Code 3906.90 is an inference for our products; Senegalese customs settle 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 scarcest. The description of crops is qualitative.



Sugar cane rows at Richard-Toll.

Saint-Louis (Saint-Louis)

Senegal river valley: Irrigated rice, processing tomato, onion and Richard-Toll sugar cane.

Indicator	Value
Annual rainfall, 1991-2020	172 mm
Reference evapotranspiration	2,148 mm
Annual water deficit	1,976 mm
Months with less than 50 mm of rain	10
Global solar radiation	2,304 kWh/m²
Mean temperature	25.2 °C

Source: ERA5 via Open-Meteo (A9); PVGIS (A8); author's calculation.

Louga (Louga)

Livestock country and the northern Niayes: Groundnuts, cowpea, watermelon and market gardening.

Indicator	Value
Annual rainfall, 1991-2020	246 mm
Reference evapotranspiration	2,401 mm
Annual water deficit	2,155 mm
Months with less than 50 mm of rain	10
Global solar radiation	2,307 kWh/m²
Mean temperature	26.7 °C

Source: ERA5 via Open-Meteo (A9); PVGIS (A8); author's calculation.

Matam (Matam)

Middle river valley: Irrigated rice, flood-recession crops, millet and livestock.

Indicator	Value
Annual rainfall, 1991-2020	224 mm
Reference evapotranspiration	2,913 mm
Annual water deficit	2,689 mm
Months with less than 50 mm of rain	10
Global solar radiation	2,299 kWh/m²
Mean temperature	30.4 °C

Source: ERA5 via Open-Meteo (A9); PVGIS (A8); author's calculation.

Dakar (Dakar)

Peri-urban market gardening in the Niayes and poultry, for the country's largest market.

Indicator	Value
Annual rainfall, 1991-2020	287 mm
Reference evapotranspiration	1,832 mm
Annual water deficit	1,545 mm
Months with less than 50 mm of rain	10
Global solar radiation	2,224 kWh/m²
Mean temperature	24.6 °C

Source: ERA5 via Open-Meteo (A9); PVGIS (A8); author's calculation.

Thiès (Thiès)

Niayes and the western groundnut basin: Market gardening, mango, groundnuts, millet and cowpea.

Indicator	Value
Annual rainfall, 1991-2020	355 mm
Reference evapotranspiration	2,117 mm
Annual water deficit	1,762 mm
Months with less than 50 mm of rain	10
Global solar radiation	2,269 kWh/m²
Mean temperature	25.5 °C

Source: ERA5 via Open-Meteo (A9); PVGIS (A8); author's calculation.

Diourbel (Diourbel)

The heart of the groundnut basin: Groundnuts, millet and cowpea on sandy soils.

Indicator	Value
Annual rainfall, 1991-2020	388 mm
Reference evapotranspiration	2,240 mm
Annual water deficit	1,852 mm
Months with less than 50 mm of rain	9
Global solar radiation	2,289 kWh/m²
Mean temperature	26.9 °C

Source: ERA5 via Open-Meteo (A9); PVGIS (A8); author's calculation.

Fatick (Fatick)

Sine and Saloum: Groundnuts and millet, on land partly affected by salt.

Indicator	Value
Annual rainfall, 1991-2020	483 mm
Reference evapotranspiration	2,133 mm
Annual water deficit	1,650 mm
Months with less than 50 mm of rain	9
Global solar radiation	2,263 kWh/m²
Mean temperature	26.7 °C

Source: ERA5 via Open-Meteo (A9); PVGIS (A8); author's calculation.

Kaolack (Kaolack)

Groundnut basin: Groundnuts, millet and maize; a major farm market.

Indicator	Value
Annual rainfall, 1991-2020	502 mm
Reference evapotranspiration	2,138 mm
Annual water deficit	1,636 mm
Months with less than 50 mm of rain	9
Global solar radiation	2,272 kWh/m²
Mean temperature	27.1 °C

Source: ERA5 via Open-Meteo (A9); PVGIS (A8); author's calculation.

Kaffrine (Kaffrine)

The eastern groundnut basin: Groundnuts, millet, maize and sorghum.

Indicator	Value
Annual rainfall, 1991-2020	546 mm
Reference evapotranspiration	2,142 mm
Annual water deficit	1,596 mm
Months with less than 50 mm of rain	9
Global solar radiation	2,277 kWh/m²
Mean temperature	27.9 °C

Source: ERA5 via Open-Meteo (A9); PVGIS (A8); author's calculation.

Tambacounda (Tambacounda)

The east of the country: Cotton, millet, maize, groundnuts, and bananas along the Gambia river.

Indicator	Value
Annual rainfall, 1991-2020	583 mm
Reference evapotranspiration	2,302 mm
Annual water deficit	1,719 mm
Months with less than 50 mm of rain	9
Global solar radiation	2,253 kWh/m²
Mean temperature	29.5 °C

Source: ERA5 via Open-Meteo (A9); PVGIS (A8); author's calculation.

Kédougou (Kédougou)

South-eastern uplands: Maize, fonio, sorghum and cotton.

Indicator	Value
Annual rainfall, 1991-2020	801 mm
Reference evapotranspiration	2,036 mm
Annual water deficit	1,235 mm
Months with less than 50 mm of rain	7
Global solar radiation	2,228 kWh/m²
Mean temperature	28.6 °C

Source: ERA5 via Open-Meteo (A9); PVGIS (A8); author's calculation.

Kolda (Kolda)

Upper Casamance: Cotton, maize, rice, groundnuts and cashew.

Indicator	Value
Annual rainfall, 1991-2020	847 mm
Reference evapotranspiration	2,048 mm
Annual water deficit	1,201 mm
Months with less than 50 mm of rain	8
Global solar radiation	2,226 kWh/m²
Mean temperature	28.1 °C

Source: ERA5 via Open-Meteo (A9); PVGIS (A8); author's calculation.

Sédhiou (Sédhiou)

Middle Casamance: Rice, cashew, groundnuts, maize and mango.

Indicator	Value
Annual rainfall, 1991-2020	931 mm
Reference evapotranspiration	1,922 mm
Annual water deficit	991 mm
Months with less than 50 mm of rain	8
Global solar radiation	2,215 kWh/m²
Mean temperature	27.3 °C

Source: ERA5 via Open-Meteo (A9); PVGIS (A8); author's calculation.

Ziguinchor (Ziguinchor)

Lower Casamance: Lowland and mangrove rice, cashew, mango and citrus.

Indicator	Value
Annual rainfall, 1991-2020	1,158 mm
Reference evapotranspiration	1,877 mm
Annual water deficit	719 mm
Months with less than 50 mm of rain	7
Global solar radiation	2,183 kWh/m²
Mean temperature	27.0 °C

Source: ERA5 via Open-Meteo (A9); PVGIS (A8); author's calculation.

Annex A. Sources and confidence levels

Ref.	Source	Level
A1	World Bank, World Development Indicators (WDI), Senegal	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, 2018-2024	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	ERA5 (Copernicus), via Open-Meteo: Rainfall, reference evapotranspiration, temperature, 1981-2024	B
A10	Natural Earth, first-level administrative boundaries and country outline	B
A11	FAO, AQUASTAT, Senegal country profile (2005 version): Irrigation potential and range of estimates	A
A12	ECOWAS common external tariff (heading 3906.90.00.00: Customs duty, statistical fee, levies); Senegal general tax code (VAT)	A
A13	ECOWAS Regulation C/REG.13/12/12 on fertiliser quality control	A
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 (3,062 Mm³, 2022) × agricultural share (91.31%) = 2,795.7 Mm³.

2. Irrigation. The equipped area (120,100 ha) and agricultural water are shared between irrigated groups (rice, vegetables, potato and sugar cane) in proportion to their harvested areas (519,707 ha), without exceeding each group's harvested area. Our sources provide no irrigation statistics by crop. Other crops are treated as rainfed and receive no irrigation water in the calculation. Groundnuts, millet, sorghum, cowpea and mango are treated as rainfed.

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

4. Extra hectares. Water saved ÷ water per equipped hectare (23,278 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% and watermelon 30.0%), using the same quarter, half and full trial effect.

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 ERA5 grid cell containing each city; radiation: PVGIS, 2005-2020. Temperature trends are linear regressions over 1981-2024. ERA5 is a reanalysis: Its rainfall can differ from local station records. On the maps, each region takes the value of its capital.

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.

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The Sine-Saloum delta.

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