

COUNTRY DOSSIER

Argentina

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

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Vines in Tupungato (Mendoza), at the foot of the Andes.

Foreword

This dossier describes Argentina 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, Argentine public bodies (INDEC, SENASA, INTA, Secretariat of Agriculture)).

• **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 Argentina.

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Summary

The points below summarise the dossier. The figures come from public sources: The World Bank, FAO (FAOSTAT, AQUASTAT), Argentine public bodies (INDEC, SENASA, INTA, Secretariat of Agriculture), PVGIS and NASA POWER. The production gains and water savings are scenarios, described in Annex B.

45.85 M
Inhabitants in 2025 (World Bank)

16.37 M ha
Of soya beans harvested in 2024, the main crop

2.10 M ha
Equipped for irrigation (2024)

+5,627 t
Of maize per 10,000 ha treated, central scenario

3,308 Mm³
Of irrigation water saved a year, central scenario

34,614 M$
Of agricultural exports in 2024 (FAOSTAT)

Key points

• **Predominantly rainfed farming.** 2,100,000 ha equipped for irrigation in 2024, out of 48.94 million hectares of cropland: Almost every harvest depends on rain.

• **Soya beans: The main crop.** 16,371,093 ha harvested in 2024, for 48.21 million tonnes, or 2.95 t/ha.

• **Water is not scarce over the year as a whole; it is scarce between rainfall events.** National water stress is only 10.5%, but at San Juan, atmospheric water demand exceeds rainfall by 1,711 mm.

• **In rainfed farming, the gain is counted in tonnes.** In the central scenario, an additional 5,627 t of maize and 1,664 t of soybean per 10,000 ha treated.

• **In irrigated farming, the water saved could allow irrigation schemes to be expanded.** 3,308.1 Mm³ a year in the central scenario, enough to irrigate about 249,327 more ha, or 11.9% of the equipped area.

• **An organic supply chain.** 86,100 ha of certified organic cropland in 2024: ECOFERT® is EU Bio certified.

• **Fertilisers made locally.** 1,386,706 t of nitrogen used in 2024; the country produces 558,209 t and imports 828,497 t.

• **Farm trade.** $34,614 million of exports and $5,490 million of imports in 2024. Leading export: Maize (corn) ($6,551 million). Leading import: Soya beans ($3,230 million).

Key figures

Key indicators for Argentina

Indicator	Value	Year	Source (level)
Population	45.85 M	2025	World Bank (A1)
GDP per capita	14,898 $	2025	World Bank (A1)
Agriculture's share of GDP	5.5%	2025	World Bank (A1)
Agricultural employment	7.0%	2025	World Bank (A1)
Cropland	48,935,935 ha	2024	FAOSTAT (A6)
Area equipped for irrigation	2,100,000 ha	2024	FAOSTAT (A6)
Harvested area: Soya beans	16,371,093 ha	2024	FAOSTAT (A2)
Certified organic cropland	86,100 ha	2024	FAOSTAT (A6)
Agricultural exports	34,614 M$	2024	FAOSTAT (A4)
Agricultural imports	5,490 M$	2024	FAOSTAT (A4)

Indicator	Value	Year	Source (level)
Mineral nitrogen, agricultural use	1,386,706 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 Argentina. 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.



Soybean harvest in Argentina.

2. Argentina in figures

Argentina had 45.85 million inhabitants in 2025, 8% of them in rural areas. Agriculture accounts for 5.5% of gross domestic product and employs 7% of the labour force. The country covers 2,736.7 thousand km², of which 30% is agricultural land. Undernourishment affects 2.8% of the population.

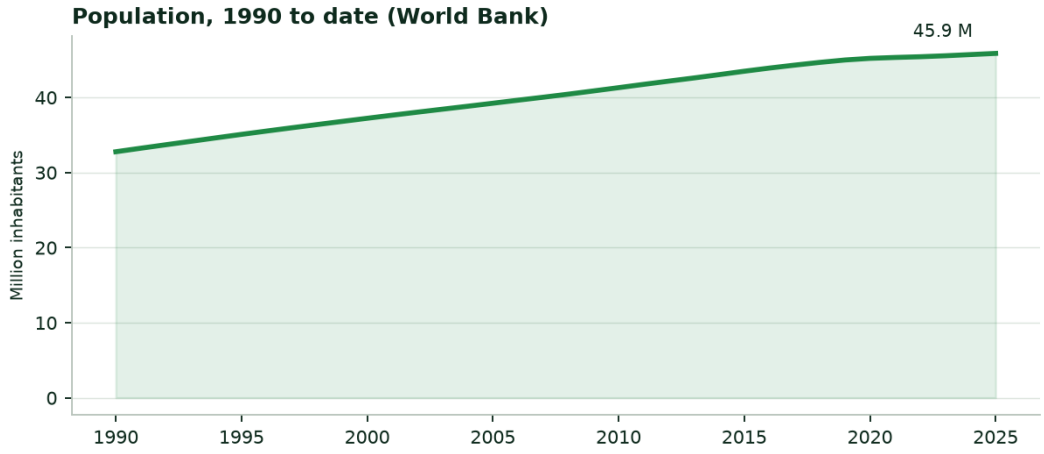


Figure 1. Population of Argentina, 1990 to date. Source: World Bank (A1)

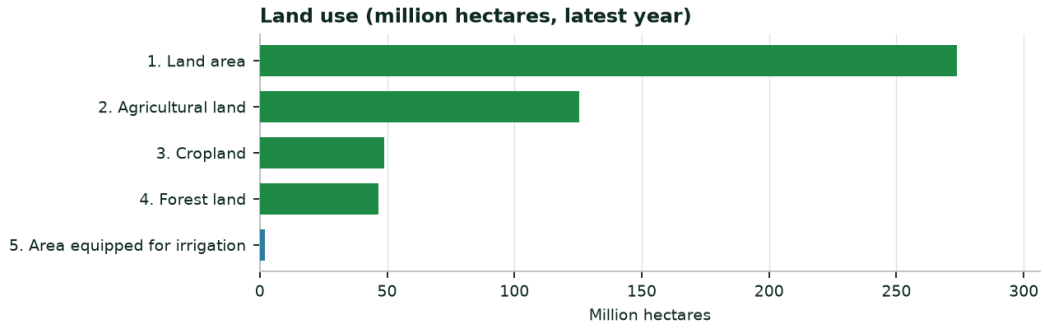


Figure 2. Land use, latest year published. Source: FAOSTAT (A6)

Agricultural and water indicators, latest year published

Indicator	Value	Year	Source
Cropland certified organic	86,100 ha	2024	FAOSTAT (A6)
Average cereal yield	4,854 kg/ha	2024	World Bank (A1)
Fertiliser use per hectare of arable land	47.0 kg/ha	2024	World Bank (A1)
Water withdrawals, agricultural share	73.9%	2022	World Bank (A1)
Internal freshwater resources	292.0 km³	2022	World Bank (A1)
Internal resources per inhabitant	6,431 m³	2022	World Bank (A1)



A soybean field in Junín (Buenos Aires province).

3. Sunshine, rainfall and climate change

3.1 Sunshine

Global solar radiation reaches 1,078 to 2,106 kWh/m² a year depending on the region. Energy is not the limiting factor: Water available at the right time determines the harvest.

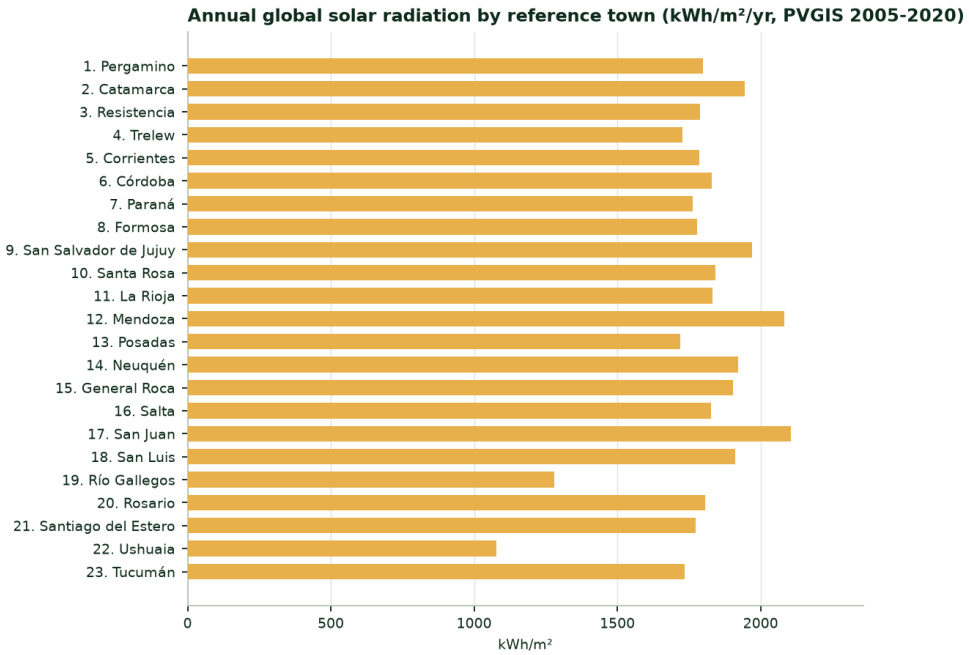


Figure 3. Annual global solar radiation in each reference town. Source: PVGIS (A8)

3.2 Rainfall and evapotranspiration

Annual rainfall is 1,820 mm at Posadas, but only 137 mm at San Juan, where reference evapotranspiration reaches 1,848 mm. In the north and the Pampas, rain falls mostly from October to March, in spring and summer. Cuyo and Patagonia are arid: Farming there depends on irrigation with Andean snowmelt.

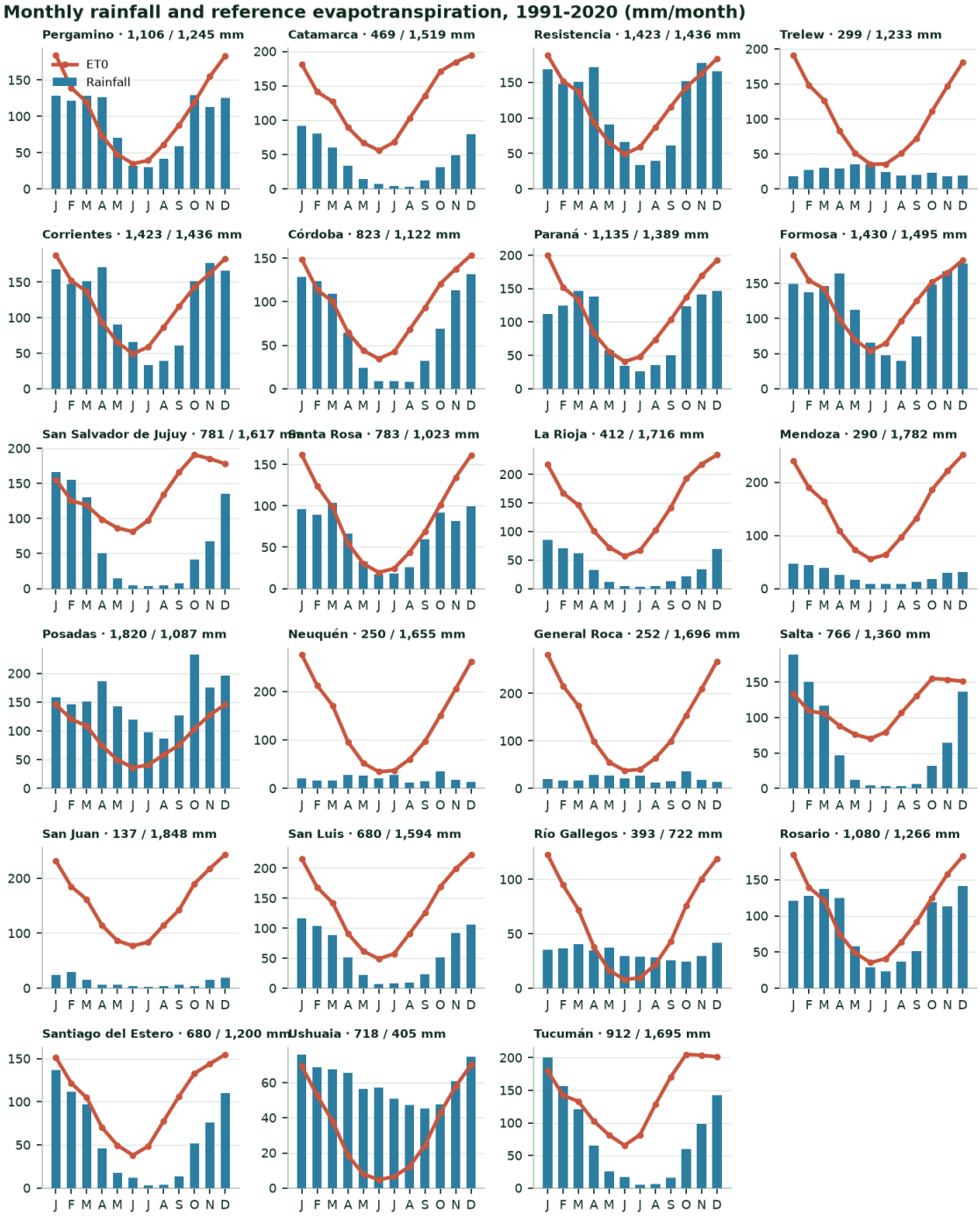


Figure 4. Monthly rainfall and reference evapotranspiration by city, 1991-2020. Source: NASA POWER (A9)

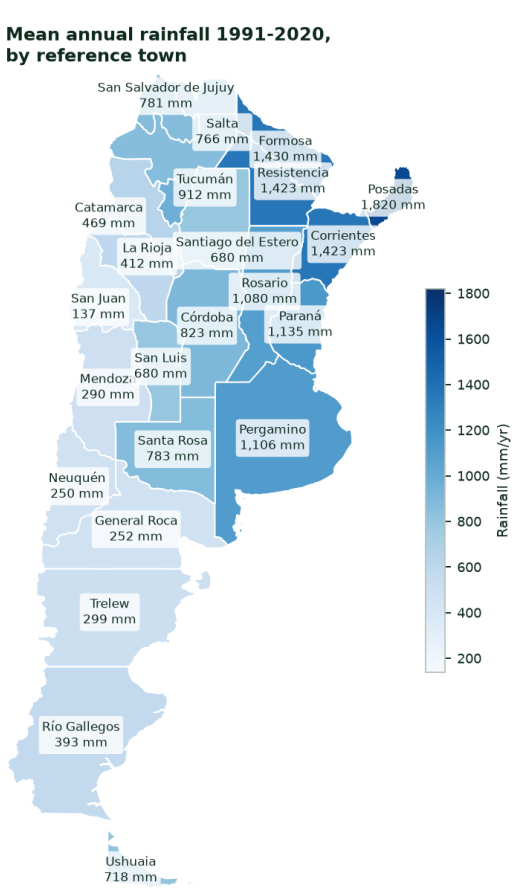
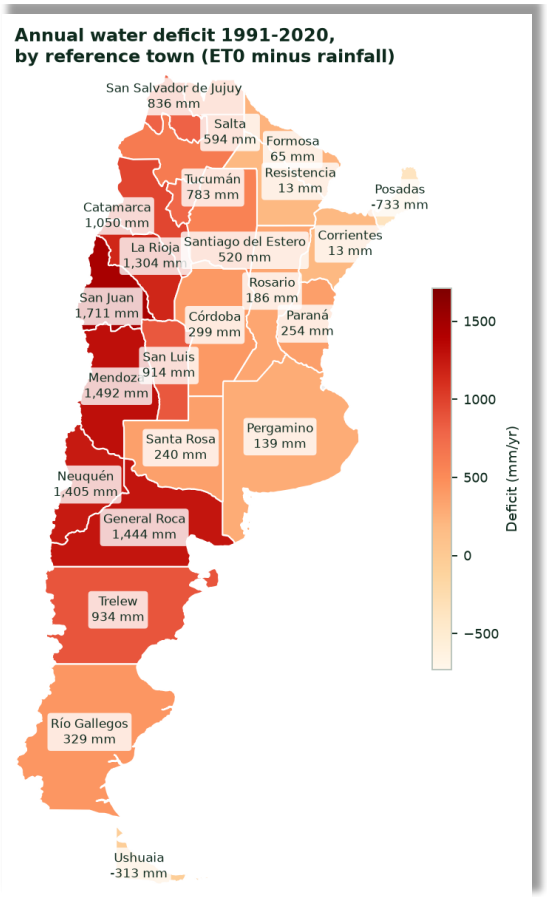


Figure 5. Mean annual rainfall 1991-2020, by region. Source: NASA POWER (A9), Natural Earth (A10).



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

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

City	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Pergamino	128	121	129	126	71	32	30	41	59	129	113	126
Catamarca	92	81	60	34	14	8	5	3	12	32	49	80
Resistencia	168	148	151	171	91	66	34	39	61	151	177	166
Trelew	18	27	30	30	35	35	24	20	20	23	18	19
Corrientes	168	148	151	171	91	66	34	39	61	151	177	166
Córdoba	129	124	110	64	24	9	9	8	32	69	113	132
Paraná	112	124	146	138	58	34	26	35	51	123	141	147
Formosa	149	138	146	164	112	66	48	39	75	148	167	178
San Salvador de Jujuy	166	155	130	51	15	5	3	4	8	41	67	135
Santa Rosa	96	89	104	67	33	18	18	26	60	92	82	99
La Rioja	86	71	62	32	11	4	4	4	13	22	34	70
Mendoza	47	44	39	26	16	9	9	9	12	17	29	31
Posadas	158	146	151	187	142	119	98	87	127	232	176	196
Neuquén	20	16	16	28	27	20	28	13	15	36	18	14
General Roca	20	17	16	28	26	21	28	13	15	35	18	14
Salta	189	151	117	46	12	4	3	3	6	32	65	137
San Juan	24	29	16	7	6	4	3	4	6	4	16	19
San Luis	116	104	89	51	22	6	9	10	24	51	92	106
Río Gallegos	36	37	40	35	37	30	29	28	26	24	30	42
Rosario	121	127	137	124	58	29	23	37	51	119	113	141

City	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Santiago del Estero	137	111	97	46	18	12	3	4	14	52	76	110
Ushuaia	76	69	68	66	57	57	51	47	45	48	61	75
Tucumán	200	156	121	66	25	17	5	6	15	59	98	143

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

3.3 Climate change

Mean annual temperature is rising. At Pergamino it went from 17.2 °C in 1981 to 17.4 °C in 2024, a trend of 0.02 °C per decade. At Mendoza the trend is 0.02 °C per decade, from 17.1 °C to 17.7 °C. Warmer air dries the soil faster between rainfall events.

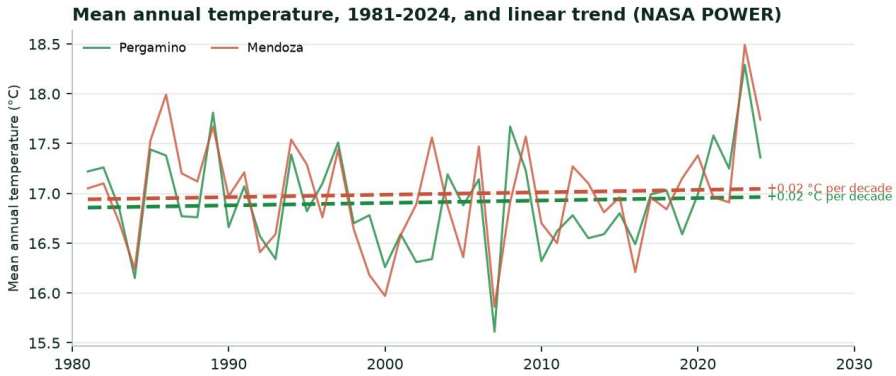


Figure 6. Mean annual temperature, 1981-2024, and linear trend. Source: NASA POWER (A9)



A wheat plot at El Recreo, near Balcarce.

4. Water: Resources, irrigated areas, withdrawals

4.1 Resources and withdrawals

Total freshwater withdrawals are 37,690 million m³ a year (2022). Agriculture accounts for 73.9% of these withdrawals, that is 27,863 Mm³. Internal resources are 292.0 km³ a year and water stress is 10.5%: The country has water, but little of it is mobilised for crops.

Freshwater: Withdrawals and resources

Indicator	Value	Year	Source
Total withdrawals	37,690 Mm³	2022	World Bank (A1)
Agricultural share	73.9%	2022	World Bank (A1)
Agricultural withdrawals	27,863.5 Mm³	2022	Calculated from A1
Area equipped for irrigation	2,100,000 ha	2024	FAOSTAT (A6)
Agricultural withdrawals per equipped hectare	13,268 m³/ha	—	Calculation (Annex B)
Water stress	10.5%	2022	World Bank (A1)

4.2 Irrigated areas

FAOSTAT gives 2,100,000 ha equipped for irrigation in 2024, 4.3% of the cropland, and 1,391,000 ha actually irrigated in 2018 (A6). Irrigation is essential in the oases of Cuyo, the Northwest and the Patagonian valleys (vines, fruit, olives, vegetables); in the Pampas it remains supplementary, by centre pivot or for rice.



Main irrigation canal of the Alto Valle of the Río Negro.

4.3 What the water saving represents

In the central scenario, the saving is 3,308.1 million m³ a year, or 11.9% of agricultural withdrawals. At 13,268 m³ per equipped hectare, this water would irrigate about 249,327 more hectares, or 11.9% of today's equipped area.

5. Fertilisers: Quantities, purchases, spending

5.1 Quantities used

In 2024, agricultural use reaches 1,386,706 tonnes of nitrogen, 746,381 tonnes of phosphate (P2O5) and 68,530 tonnes of potash (K2O). The country produces 558,209 tonnes of nitrogen and 104,013 tonnes of phosphate (P2O5); it imported 828,497 tonnes of nitrogen in the same year. Per hectare of arable land, use is 47.0 kg per hectare.

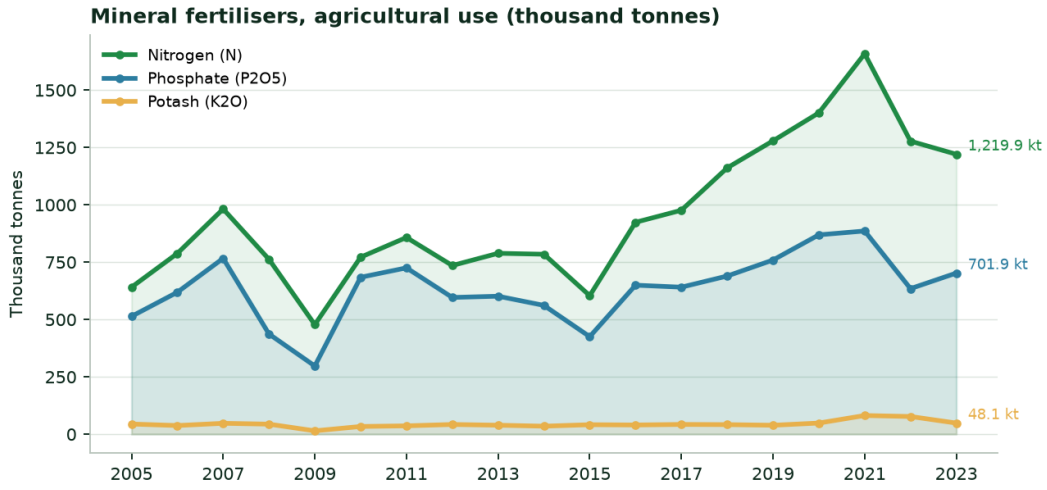


Figure 7. Mineral fertilisers, agricultural use, 2005-2023. Source: FAOSTAT (A5)

5.2 Regulatory framework

Fertilisers, amendments, substrates and soil conditioners are entered in the SENASA national register, under Resolution 264/2011 and the procedure of Resolution 431/2024; registration is the marketing permit (A13).



A maté plantation in Misiones province.

5.3 Indicative spending

In 2024, the indicative minimum spending on mineral fertilisers reaches $1,824 million, at international fertiliser prices (calculation in Annex B, lower bound).

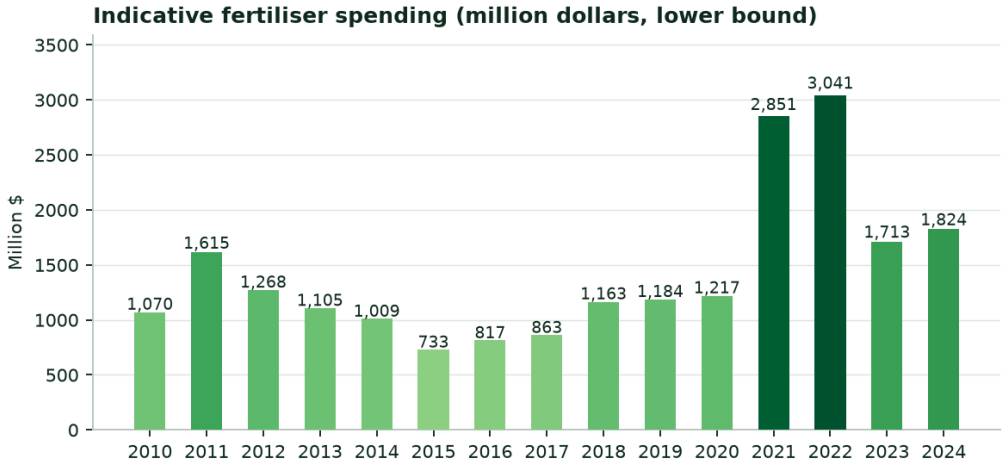


Figure 8. Indicative fertiliser spending, lower bound. Source: Author's calculation from A5 and A7

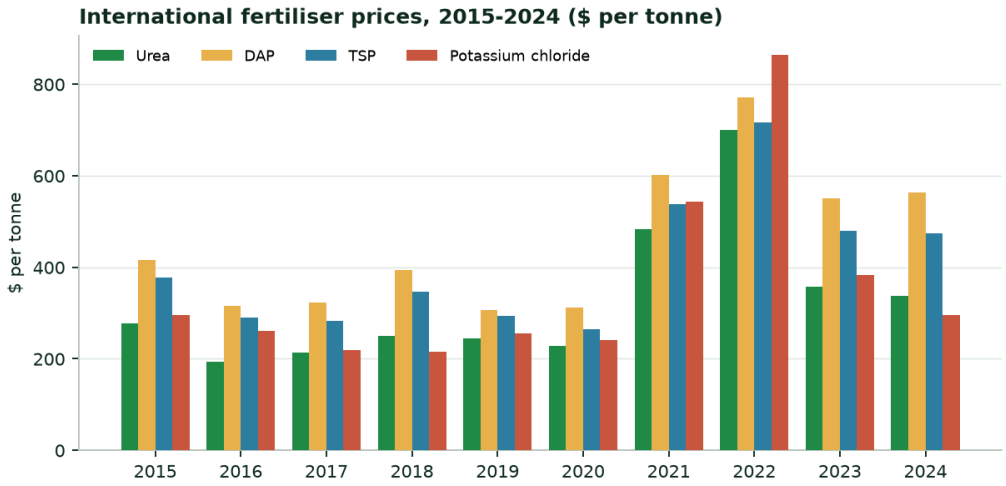


Figure 9. International prices of urea, DAP, TSP and potassium chloride. Source: World Bank, Pink Sheet (A7)

6. The regions at a glance

The table compares the twenty-three provinces, each represented by a reference town. The autonomous city of Buenos Aires is not studied. 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)
Buenos Aires (Pergamino)	1,106	1,245	139	1,798	16.8
Catamarca (Catamarca)	469	1,519	1,050	1,944	18.5
Chaco (Resistencia)	1,423	1,436	13	1,787	21.7
Chubut (Trelew)	299	1,233	934	1,726	12.9
Corrientes (Corrientes)	1,423	1,436	13	1,785	21.7
Córdoba (Córdoba)	823	1,122	299	1,831	16.7
Entre Ríos (Paraná)	1,135	1,389	254	1,763	19.3
Formosa (Formosa)	1,430	1,495	65	1,779	22.7
Jujuy (San Salvador de Jujuy)	781	1,617	836	1,971	19.8
La Pampa (Santa Rosa)	783	1,023	240	1,841	15.7
La Rioja (La Rioja)	412	1,716	1,304	1,831	19.8

Region (city)	Rainfall (mm/yr)	ET0 (mm/yr)	Deficit (mm/yr)	Radiation (kWh/m²/yr)	Temperature (°C)
Mendoza (Mendoza)	290	1,782	1,492	2,083	16.9
Misiones (Posadas)	1,820	1,087	-733	1,718	20.9
Neuquén (Neuquén)	250	1,655	1,405	1,920	14.3
Río Negro (General Roca)	252	1,696	1,444	1,903	14.8
Salta (Salta)	766	1,360	594	1,828	13.9
San Juan (San Juan)	137	1,848	1,711	2,106	16.9
San Luis (San Luis)	680	1,594	914	1,912	16.6
Santa Cruz (Río Gallegos)	393	722	329	1,280	6.8
Santa Fe (Rosario)	1,080	1,266	186	1,806	18.0
Santiago del Estero (Santiago del Estero)	680	1,200	520	1,773	21.6
Tierra del Fuego (Ushuaia)	718	405	-313	1,078	3.5
Tucumán (Tucumán)	912	1,695	783	1,736	21.8

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

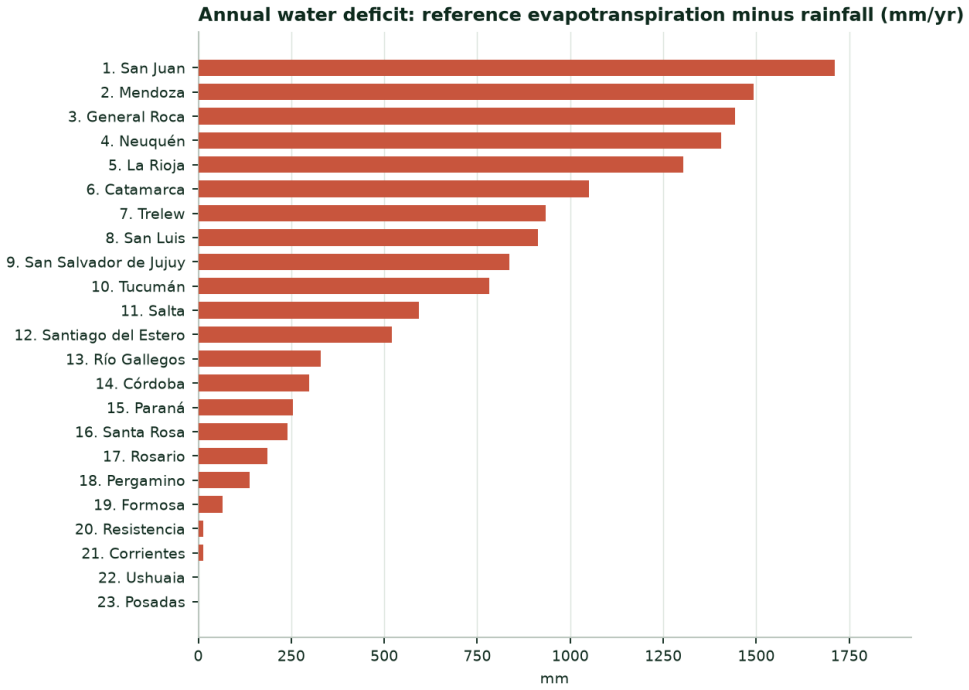


Figure 10. Annual water deficit: Reference evapotranspiration minus rainfall. Source: NASA POWER (A9)



A soybean field in February.

7. The twenty main crops: Three rankings

7.1 By harvested area

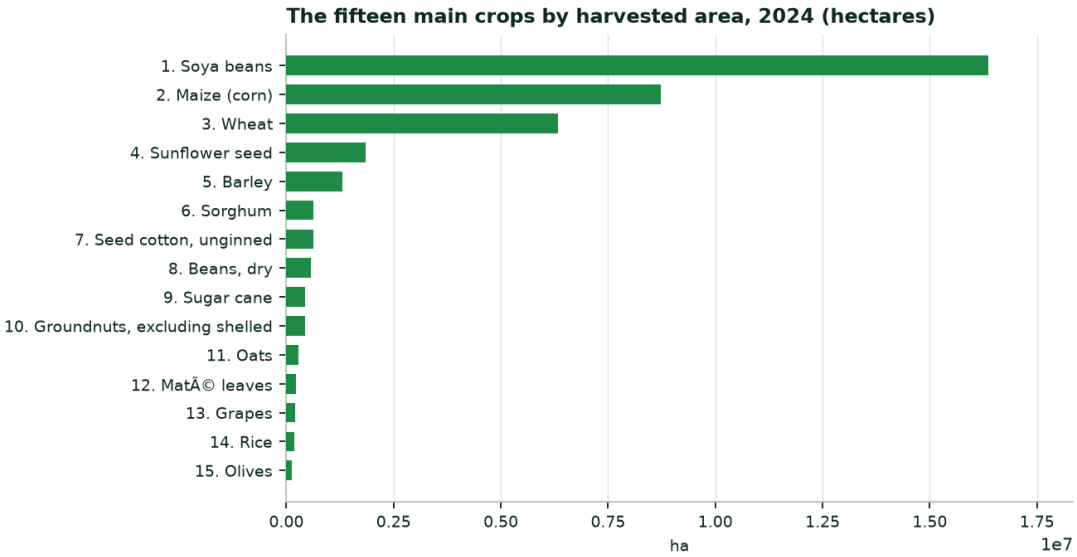


Figure 11. The fifteen main crops by harvested area, 2024 (hectares). Source: FAOSTAT (A2)

The ten main crops by area, 2024

Crop	Harvested area (ha)	Production (t)	Yield (t/ha)
Soya beans	16,371,093	48,213,207	2.95

Crop	Harvested area (ha)	Production (t)	Yield (t/ha)
Maize (corn)	8,736,712	57,494,500	6.58
Wheat	6,341,303	18,510,280	2.92
Sunflower seed	1,842,731	3,895,156	2.11
Barley	1,296,636	5,097,340	3.93
Sorghum	626,182	2,495,532	3.99
Seed cotton, unginned	622,327	1,269,399	2.04
Beans, dry	565,899	474,764	0.84
Sugar cane	432,814	12,255,902	28.32
Groundnuts in shell	431,991	1,482,827	3.43

Source: FAOSTAT (A2).

7.2 By production

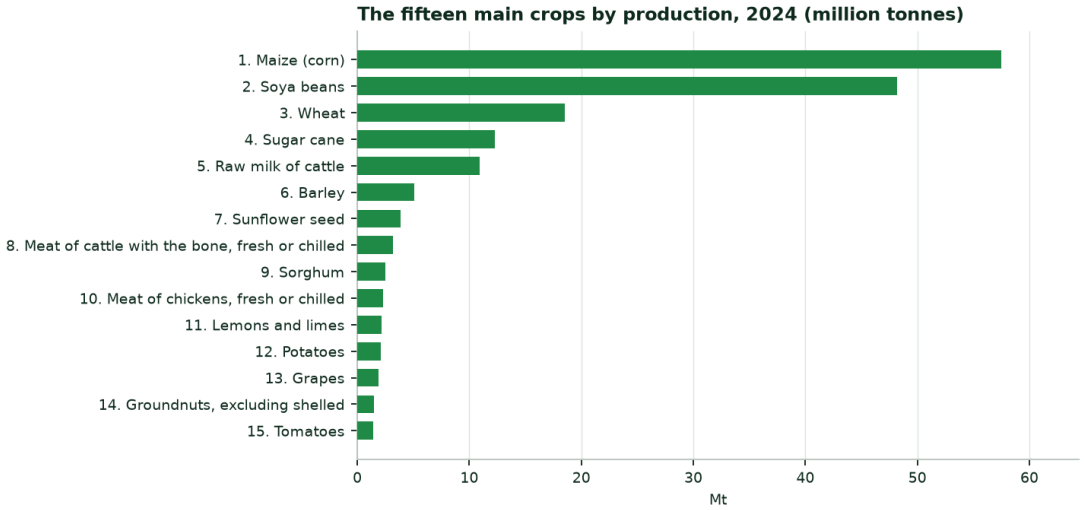


Figure 12. The fifteen main crops by production, 2024 (million tonnes). Source: FAOSTAT (A2)

7.3 By production value

By production value, the three main crops are: Soya beans, maize (corn) and wheat (FAOSTAT, 2023, constant international dollars).

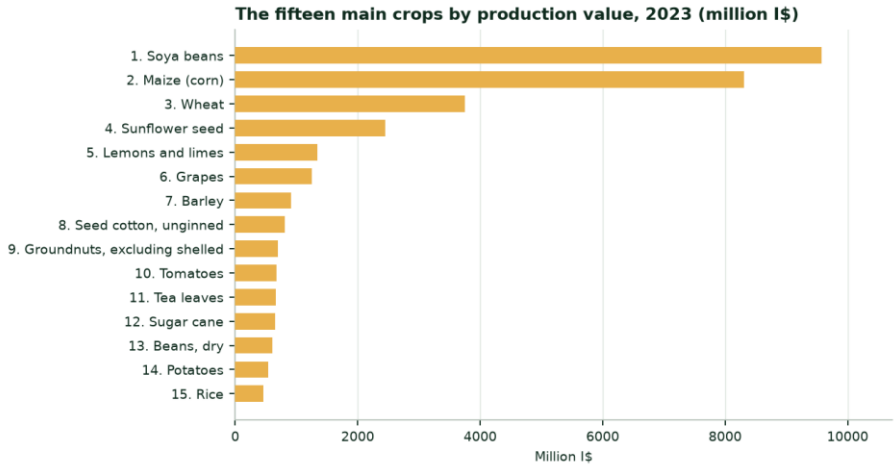


Figure 13. The fifteen main crops by production value, 2023 (million I$). Source: FAOSTAT (A3)



Vineyards near Caucete (San Juan).

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, potato, vines, fruit and olives, irrigated rice and other irrigated land), in proportion to their harvested areas; the equipped area is shared the same way.

• **Rainfed crops.** For crops that have a trial (maize and soybean), 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%	Soybean: Yield
Watermelon, Mexico (2023)	Watermelon	-60.5%	+30.0%	Vegetables and melons: Water and 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 Argentina: The figures below apply the results of the cited trials to the country's average yields.

8.3 Rainfed crops: Maize and Soybean

Average 2024 yields (FAOSTAT): Maize 6.58 t/ha and soybean 2.95 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	6.58	2,813	5,627	11,253
Soybean	2.95	832	1,664	3,328

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

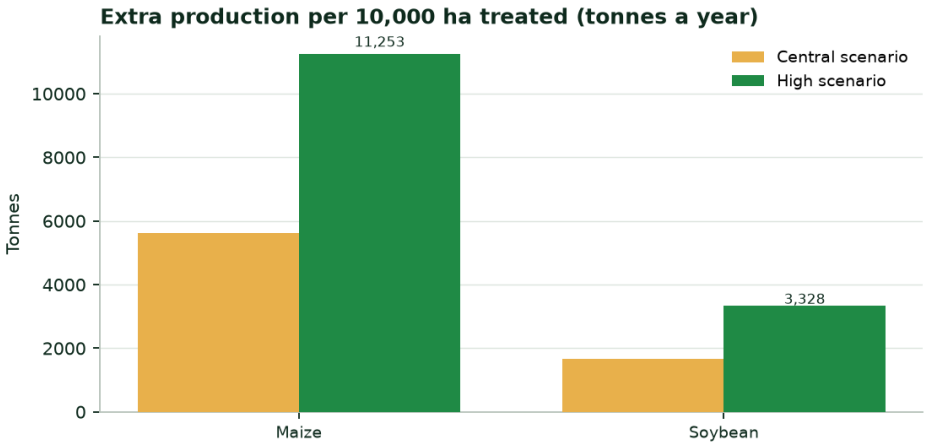


Figure 14. Extra production per 10,000 ha treated, central and high scenarios. Source: Author's calculation

8.4 Irrigation: Vegetables and melons, Potato, Vines and Fruit and olives

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 (tomato, onion, squash, others)	147,575	7.0%	Watermelon, Mexico (2023)	592.3
Potato	59,019	2.8%	Potato, South Africa (2025)	203.6
Vines (wine, table and dried grapes)	199,946	9.5%	Generic assumption, no trial	265.3
Fruit and olives (lemon, orange, pear, apple, olive, others)	373,119	17.8%	Generic assumption, no trial	495.1
Irrigated rice	190,950	9.1%	Generic assumption, no trial	253.4
Other irrigated land (maize, soybean, wheat, lucerne, fodder)	1,129,391	53.8%	Generic assumption, no trial	1,498.5

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	1,654.1	124,663	460,651
Central	3,308.1	249,327	921,302
High	6,616.3	498,654	1,842,604

Source: Author's calculation (Annex B).

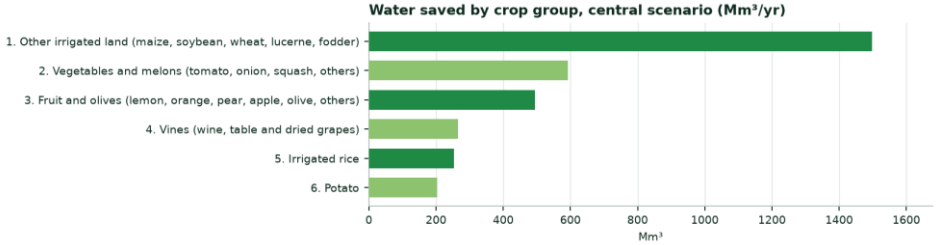


Figure 15. Water saved by crop group, central scenario. Source: Author's calculation

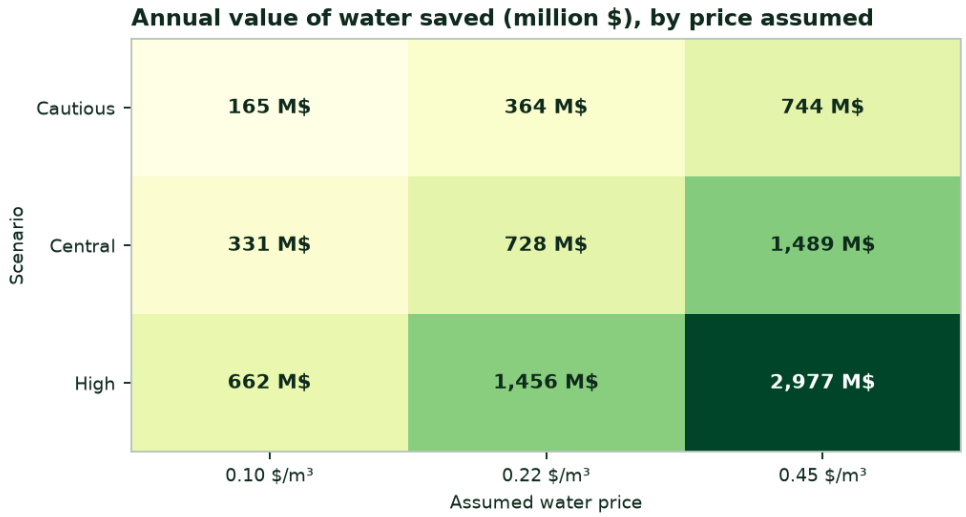


Figure 16. Annual value of the water saved, by price assumed per cubic metre. Source: Author's calculation; prices assumed, no national tariff

8.5 Reading the results

Key points

• In Argentina, the main challenge is rainfed farming: Only 2,100,000 ha are equipped for irrigation, out of 48,935,935 ha of cropland.

• The "other irrigated land" group gives 45% of the irrigation water saving (generic assumption, no trial).

• 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 Argentina
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 Argentina

Source: Annex A.



Hand-picking apples in Allen (Río Negro).

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)	32,778	34,614
Agricultural imports (crops and livestock)	7,869	5,490
Exports, all merchandise	66,787	79,721
Imports, all merchandise	73,715	60,822

Source: FAOSTAT (A4).

10.2 Exports

The three main farm products exported in 2024 are: Maize (corn) ($6,551 million), soya bean cake ($6,440 million) and soya bean oil ($5,270 million).

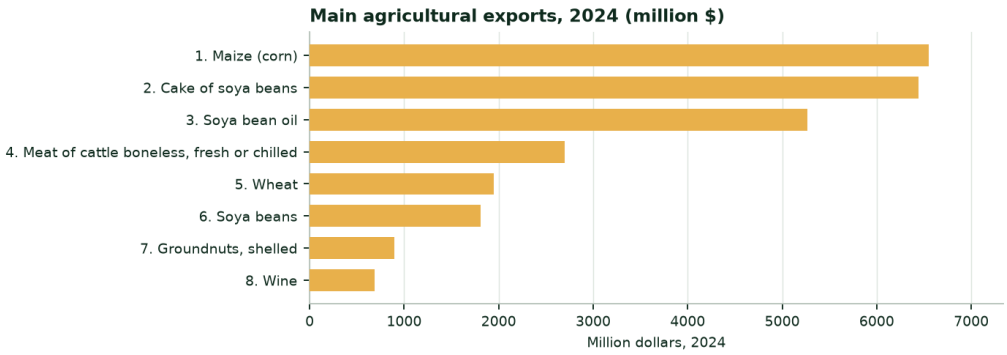


Figure 17. Main agricultural exports, 2024. Source: FAOSTAT (A4)

10.3 Imports

The main farm purchases are: Soya beans ($3,230 million), bananas ($282 million) and cocoa butter, fat and oil ($135 million).

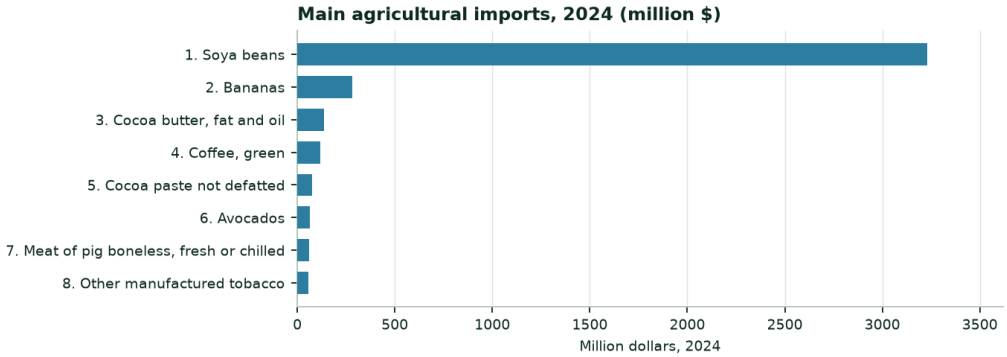


Figure 18. Main agricultural imports, 2024. Source: FAOSTAT (A4)



Figure 19. A Chaco cotton grower with an INTA-designed picker.



Mandarins harvested in Capioví (Misiones).

10.4 Importing water-retention polymers into Argentina

What to know

• **Customs duty (subheading 3906.90):** Mercosur common external tariff; the eighteen national lines range from 2 to 14%, with a simple average of 9.3% (A11). The rate depends on the exact line.

• **VAT (IVA):** General rate of 21% (A12). Other levies are added on import; they are not detailed here, for lack of an official source consulted.

• **Registration:** Fertilisers, amendments, substrates and soil conditioners must be entered in the SENASA national register; registration is the marketing permit (A13). The classification of a water-retaining agent (amendment or conditioner) is to be confirmed with SENASA.

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



Sunflowers and silos in the Pampas.

Buenos Aires (Pergamino)

Buenos Aires, heart of the humid Pampas: Soybean, maize, wheat, sunflower and cattle, almost entirely rainfed.

Indicator	Value
Annual rainfall, 1991-2020	1,106 mm
Reference evapotranspiration	1,245 mm
Annual water deficit	139 mm
Months with less than 50 mm of rain	3
Global solar radiation	1,798 kWh/m²
Mean temperature	16.8 °C

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

Catamarca (Catamarca)

Catamarca: Irrigated olives, walnuts, vines and jojoba, in very dry valleys.

Indicator	Value
Annual rainfall, 1991-2020	469 mm
Reference evapotranspiration	1,519 mm
Annual water deficit	1,050 mm
Months with less than 50 mm of rain	8
Global solar radiation	1,944 kWh/m²
Mean temperature	18.5 °C

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

Chaco (Resistencia)

Chaco: Cotton, soybean, sunflower and sorghum, on a hot plain with irregular summer rain.

Indicator	Value
Annual rainfall, 1991-2020	1,423 mm
Reference evapotranspiration	1,436 mm
Annual water deficit	13 mm

Indicator	Value
Months with less than 50 mm of rain	2
Global solar radiation	1,787 kWh/m²
Mean temperature	21.7 °C

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

Chubut (Trelew)

Chubut: The irrigated lower Chubut valley (lucerne, cherries, vegetables) amid the sheep steppe.

Indicator	Value
Annual rainfall, 1991-2020	299 mm
Reference evapotranspiration	1,233 mm
Annual water deficit	934 mm
Months with less than 50 mm of rain	12
Global solar radiation	1,726 kWh/m²
Mean temperature	12.9 °C

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

Corrientes (Corrientes)

Corrientes: Irrigated rice, citrus, tea, maté and cattle, in a humid province.

Indicator	Value
Annual rainfall, 1991-2020	1,423 mm
Reference evapotranspiration	1,436 mm
Annual water deficit	13 mm
Months with less than 50 mm of rain	2
Global solar radiation	1,785 kWh/m²
Mean temperature	21.7 °C

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

Córdoba (Córdoba)

Córdoba: Soybean, maize, groundnut and wheat; the leading province for groundnuts.

Indicator	Value
Annual rainfall, 1991-2020	823 mm
Reference evapotranspiration	1,122 mm
Annual water deficit	299 mm
Months with less than 50 mm of rain	5
Global solar radiation	1,831 kWh/m²
Mean temperature	16.7 °C

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

Entre Ríos (Paraná)

Entre Ríos: Irrigated rice, soybean, wheat, citrus along the Uruguay River and poultry.

Indicator	Value
Annual rainfall, 1991-2020	1,135 mm

Indicator	Value
Reference evapotranspiration	1,389 mm
Annual water deficit	254 mm
Months with less than 50 mm of rain	3
Global solar radiation	1,763 kWh/m²
Mean temperature	19.3 °C

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

Formosa (Formosa)

Formosa: Cattle, cotton, bananas and vegetables, on a hot and humid plain.

Indicator	Value
Annual rainfall, 1991-2020	1,430 mm
Reference evapotranspiration	1,495 mm
Annual water deficit	65 mm
Months with less than 50 mm of rain	2
Global solar radiation	1,779 kWh/m²
Mean temperature	22.7 °C

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

Jujuy (San Salvador de Jujuy)

Jujuy: Irrigated sugar cane, tobacco and valley vegetables; quinoa on the Puna.

Indicator	Value
Annual rainfall, 1991-2020	781 mm
Reference evapotranspiration	1,617 mm
Annual water deficit	836 mm
Months with less than 50 mm of rain	6
Global solar radiation	1,971 kWh/m²
Mean temperature	19.8 °C

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

La Pampa (Santa Rosa)

La Pampa: Wheat, sunflower, maize and cattle, on the dry edge of the Pampas.

Indicator	Value
Annual rainfall, 1991-2020	783 mm
Reference evapotranspiration	1,023 mm
Annual water deficit	240 mm
Months with less than 50 mm of rain	4
Global solar radiation	1,841 kWh/m²
Mean temperature	15.7 °C

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

La Rioja (La Rioja)

La Rioja: Olives, vines (torrontés) and walnuts, irrigated from wells.

Indicator	Value
Annual rainfall, 1991-2020	412 mm
Reference evapotranspiration	1,716 mm
Annual water deficit	1,304 mm
Months with less than 50 mm of rain	8
Global solar radiation	1,831 kWh/m²
Mean temperature	19.8 °C

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

Mendoza (Mendoza)

Mendoza: The country's leading wine region, with fruit and vegetables irrigated by Andean snowmelt.

Indicator	Value
Annual rainfall, 1991-2020	290 mm
Reference evapotranspiration	1,782 mm
Annual water deficit	1,492 mm
Months with less than 50 mm of rain	12
Global solar radiation	2,083 kWh/m²
Mean temperature	16.9 °C

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

Misiones (Posadas)

Misiones: Maté, tea, tobacco and planted forest, under the country's heaviest rainfall.

Indicator	Value
Annual rainfall, 1991-2020	1,820 mm
Reference evapotranspiration	1,087 mm
Annual water deficit	-733 mm
Months with less than 50 mm of rain	0
Global solar radiation	1,718 kWh/m²
Mean temperature	20.9 °C

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

Neuquén (Neuquén)

Neuquén: Pears and apples of the Alto Valle and vines, irrigated by Andean rivers.

Indicator	Value
Annual rainfall, 1991-2020	250 mm
Reference evapotranspiration	1,655 mm
Annual water deficit	1,405 mm
Months with less than 50 mm of rain	12
Global solar radiation	1,920 kWh/m²
Mean temperature	14.3 °C

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

Río Negro (General Roca)

Río Negro: The Alto Valle, the leading pear and apple basin; the surrounding steppe gets little rain.

Indicator	Value
Annual rainfall, 1991-2020	252 mm
Reference evapotranspiration	1,696 mm
Annual water deficit	1,444 mm
Months with less than 50 mm of rain	12
Global solar radiation	1,903 kWh/m²
Mean temperature	14.8 °C

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

Salta (Salta)

Salta: Tobacco, sugar cane, dry beans, high-altitude vines of Cafayate and soybean in the east.

Indicator	Value
Annual rainfall, 1991-2020	766 mm
Reference evapotranspiration	1,360 mm
Annual water deficit	594 mm
Months with less than 50 mm of rain	7
Global solar radiation	1,828 kWh/m²
Mean temperature	13.9 °C

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

San Juan (San Juan)

San Juan: Vines, raisins, olives and vegetables, all irrigated, under the driest climate.

Indicator	Value
Annual rainfall, 1991-2020	137 mm
Reference evapotranspiration	1,848 mm
Annual water deficit	1,711 mm
Months with less than 50 mm of rain	12
Global solar radiation	2,106 kWh/m²
Mean temperature	16.9 °C

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

San Luis (San Luis)

San Luis: Maize, soybean and cattle, with spreading centre-pivot irrigation.

Indicator	Value
Annual rainfall, 1991-2020	680 mm
Reference evapotranspiration	1,594 mm
Annual water deficit	914 mm
Months with less than 50 mm of rain	5
Global solar radiation	1,912 kWh/m²
Mean temperature	16.6 °C

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

Santa Cruz (Río Gallegos)

Santa Cruz: Extensive sheep farming on the cold steppe; a few irrigated valleys.

Indicator	Value
Annual rainfall, 1991-2020	393 mm
Reference evapotranspiration	722 mm
Annual water deficit	329 mm
Months with less than 50 mm of rain	12
Global solar radiation	1,280 kWh/m²
Mean temperature	6.8 °C

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

Santa Fe (Rosario)

Santa Fe: Soybean, maize and wheat, and the great crushing and export hub of the Paraná.

Indicator	Value
Annual rainfall, 1991-2020	1,080 mm
Reference evapotranspiration	1,266 mm
Annual water deficit	186 mm
Months with less than 50 mm of rain	3
Global solar radiation	1,806 kWh/m²
Mean temperature	18.0 °C

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

Santiago del Estero (Santiago del Estero)

Santiago del Estero: Cotton, soybean, maize and lucerne, partly irrigated by the Dulce River.

Indicator	Value
Annual rainfall, 1991-2020	680 mm
Reference evapotranspiration	1,200 mm
Annual water deficit	520 mm
Months with less than 50 mm of rain	6
Global solar radiation	1,773 kWh/m²
Mean temperature	21.6 °C

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

Tierra del Fuego (Ushuaia)

Tierra del Fuego: Sheep farming; little cropping in a cold climate.

Indicator	Value
Annual rainfall, 1991-2020	718 mm
Reference evapotranspiration	405 mm
Annual water deficit	-313 mm
Months with less than 50 mm of rain	3
Global solar radiation	1,078 kWh/m²
Mean temperature	3.5 °C

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

Tucumán (Tucumán)

Tucumán: Lemons (the world's leading exporter), sugar cane, blueberries and strawberries.

Indicator	Value
Annual rainfall, 1991-2020	912 mm
Reference evapotranspiration	1,695 mm
Annual water deficit	783 mm
Months with less than 50 mm of rain	5
Global solar radiation	1,736 kWh/m²
Mean temperature	21.8 °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), Argentina	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	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), Argentina, applied MFN duties, subheading 3906.90 (eighteen national lines), 2023	A
A12	PwC, Worldwide Tax Summaries, Argentina, other taxes: Value-added tax (IVA)	C
A13	SENASA, Resolution 264/2011 (regulation of the national register of fertilisers, amendments, substrates, conditioners, protectants and raw materials) and Resolution 431/2024 (registration procedure)	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 (37,690 Mm³, 2022) × agricultural share (73.93%) = 27,863.5 Mm³.

2. Irrigation. The equipped area (2,100,000 ha) and agricultural water are shared between irrigated groups (vegetables and melons, potato, vines, fruit and olives, irrigated rice and other irrigated land) in proportion to their harvested areas (2,100,000 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. The equipped area exceeds the harvested area of the selected irrigable crops: The difference forms an "other irrigated land" group (maize, soybean and wheat under pivots,

lucerne, fodder), with the generic assumption. Soybean, maize and wheat are otherwise treated as rainfed for the rest of their area, most of it being unirrigated. Olives are counted with irrigated fruit, as in the Northwest oases.

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 (13,268 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 soybean 11.3%), 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 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 province is coloured according to the value of its reference town.

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
Viñas en Tupungato Mendoza.jpg	Daniel Velasquez	CC BY-SA 4.0
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A tea plantation near Guaraní (Misiones).

Green Solutions

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