

COUNTRY DOSSIER

Madagascar

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

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Avenue of the baobabs, western Madagascar, at sunset.

Foreword

This dossier describes Madagascar from the angle of irrigation water, climate, fertilisers and crops. It is written for the ministries in charge of agriculture, water and trade, the regional offices of agriculture and farmers' cooperatives. It answers three questions: Where is water used, for which crops, and in which zones? It then examines what our products can change, 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, Malagasy customs).
- **B**: Research institute, laboratory, United Nations agency or recognised climate model.
- **C**: Manufacturer statement, website, press or estimate.
- "bn" means billion; "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 Madagascar.

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Summary

The points below summarise the dossier. The figures come from public sources: The World Bank, FAO (FAOSTAT), Malagasy customs, PVGIS and ERA5. The water savings are scenarios, described in Annex B.

32.7 M
Inhabitants in 2025 (World Bank)

2.04 M ha
Of rice harvested in 2024 (FAOSTAT), the main crop

832 000 ha
Of area equipped for irrigation (FAOSTAT)

1,538 Mm³
Of water saved per year, central scenario

99 000 ha
Extra irrigable hectares with the same water

767 M$
Of agricultural exports in 2024 (FAOSTAT)

Eight key points

- **Rice dominates.** 2.04 million hectares harvested in 2024, for 4.97 million tonnes.
- **Agriculture withdraws almost all the water.** 12.9 km³ a year out of 13.5 km³ total withdrawals (96%, 2022).
- **A very contrasted climate.** From 502 mm of rain a year at Ambovombe to 2,172 mm at Toamasina.
- **The central scenario saves 1.54 billion m³ a year**, or 11.9% of agricultural withdrawals, as if about 99 000 extra hectares could be irrigated.
- **Rice accounts for 60% of this saving, on a generic assumption.** No trial is cited for rice: The central assumption is 10%.
- **The trials give the yield gains.** Central scenario: 98,311 t of extra production, for the crops where a trial is cited.
- **Vanilla and cloves make up 60% of agricultural exports**: $457 million in 2024.
- **The country imports more farm products than it exports**: $930 million of imports in 2024, including $163 million of palm oil and $128 million of milled rice.

Key figures

Key indicators for Madagascar

Indicator	Value	Year	Source (level)
Population	32.7 M	2025	World Bank (A1)
GDP per capita	599 $	2025	World Bank (A1)
Agriculture share of GDP	21.7%	2025	World Bank (A1)
Area equipped for irrigation	831,700 ha	2024	FAOSTAT (A6)
Water withdrawals, agriculture	12.9 km³	2022	World Bank (A1)
Water saved, central scenario	1,538 Mm³	—	Calculation (Annex B)
Rice harvested	2.04 M ha	2024	FAOSTAT (A2)
Agricultural exports	767 M$	2024	FAOSTAT (A4)
Agricultural imports	930 M$	2024	FAOSTAT (A4)
Mineral nitrogen, agricultural use	9,771 t	2024	FAOSTAT (A5)

Source: Table based on the sources indicated; author's calculation for the scenarios.

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.	Published certificate; potato trial combined with EVERGREEN®. Level A (certificate), C (results).
Paulownia ALTIFOLIA®	Fast-growing tree for agroforestry.	Website figures; no trial in Madagascar. 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.



Terraced paddies and well-irrigated fields on the highlands.

2. Madagascar in figures

Madagascar had 32.7 million inhabitants in 2025, 67% of them in rural areas. Agriculture accounts for 21.7% of gross domestic product and employs 69% of the labour force. The country covers 582 000 km², of which 70% is agricultural land.

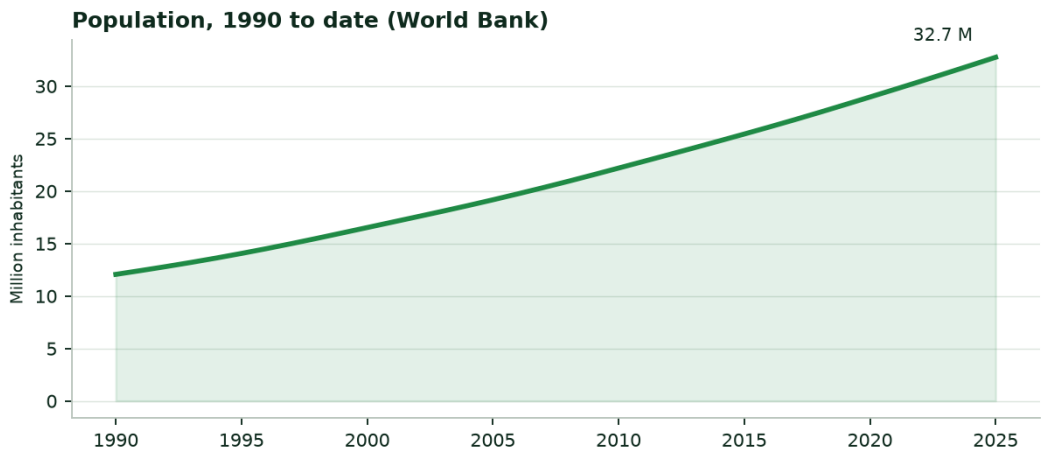


Figure 1. Population of Madagascar, 1990 to date. Source: Banque mondiale (A1)

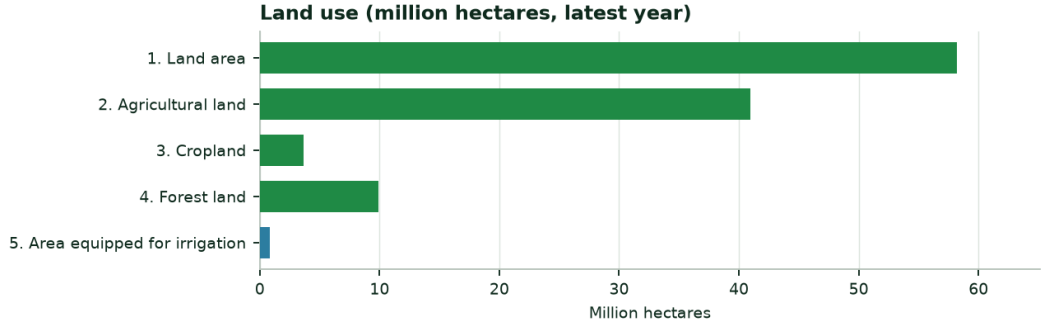


Figure 2. Land use, latest year published. Source: FAOSTAT (A6)

Agricultural and water indicators, latest year published

Indicator	Value	Year	Source
Cropland certified organic	168 000 ha	2024	FAOSTAT (A6)
Average cereal yield	2,393 kg/ha	—	World Bank (A1)
Fertiliser use	6 kg/ha	—	World Bank (A1)
Water withdrawals, agricultural share	95.9%	2022	World Bank (A1)
Internal freshwater resources	337.0 km³	—	World Bank (A1)
Internal resources per inhabitant	11,072 m³	—	World Bank (A1)



Farmland and agricultural landscapes of the highlands, in the centre of the island.

3. Sunshine, rainfall and climate change

3.1 Sunshine

Global solar radiation reaches 1,859 to 2,291 kWh/m² a year depending on the zone. It is high everywhere: Energy is not the limit, water is.

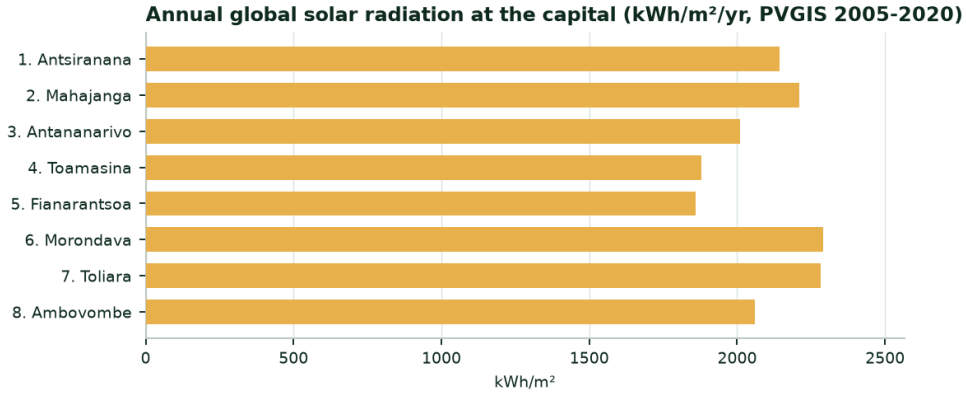


Figure 3. Annual global solar radiation at each zone capital. Source: PVGIS (A8)

3.2 Rainfall and evapotranspiration

Rainfall varies strongly from one zone to another. At Toamasina, average annual rainfall is 2,172 mm; at Ambovombe it is only 502 mm, while reference evapotranspiration there exceeds 1,700 mm a year.

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

Month	Antsiranana	Mahajanga	Antananarivo	Toamasina	Fianarantsoa	Morondava	Toliara	Ambovombe
January	237	419	301	328	290	335	199	103
February	215	316	256	322	220	254	132	93
March	142	210	141	318	150	113	60	57
April	47	45	35	166	53	28	21	37
May	13	8	13	158	25	4	7	22

Month	Antsiranana	Mahajanga	Antananarivo	Toamasina	Fianarantsoa	Morondava	Toliara	Ambovombe
June	6	1	5	140	16	2	5	18
July	7	2	5	160	17	1	4	15
August	5	1	4	114	10	1	4	15
September	4	3	6	82	11	2	6	14
October	15	20	30	90	45	11	11	22
November	29	92	84	86	98	38	32	40
December	124	225	194	209	212	130	76	67

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

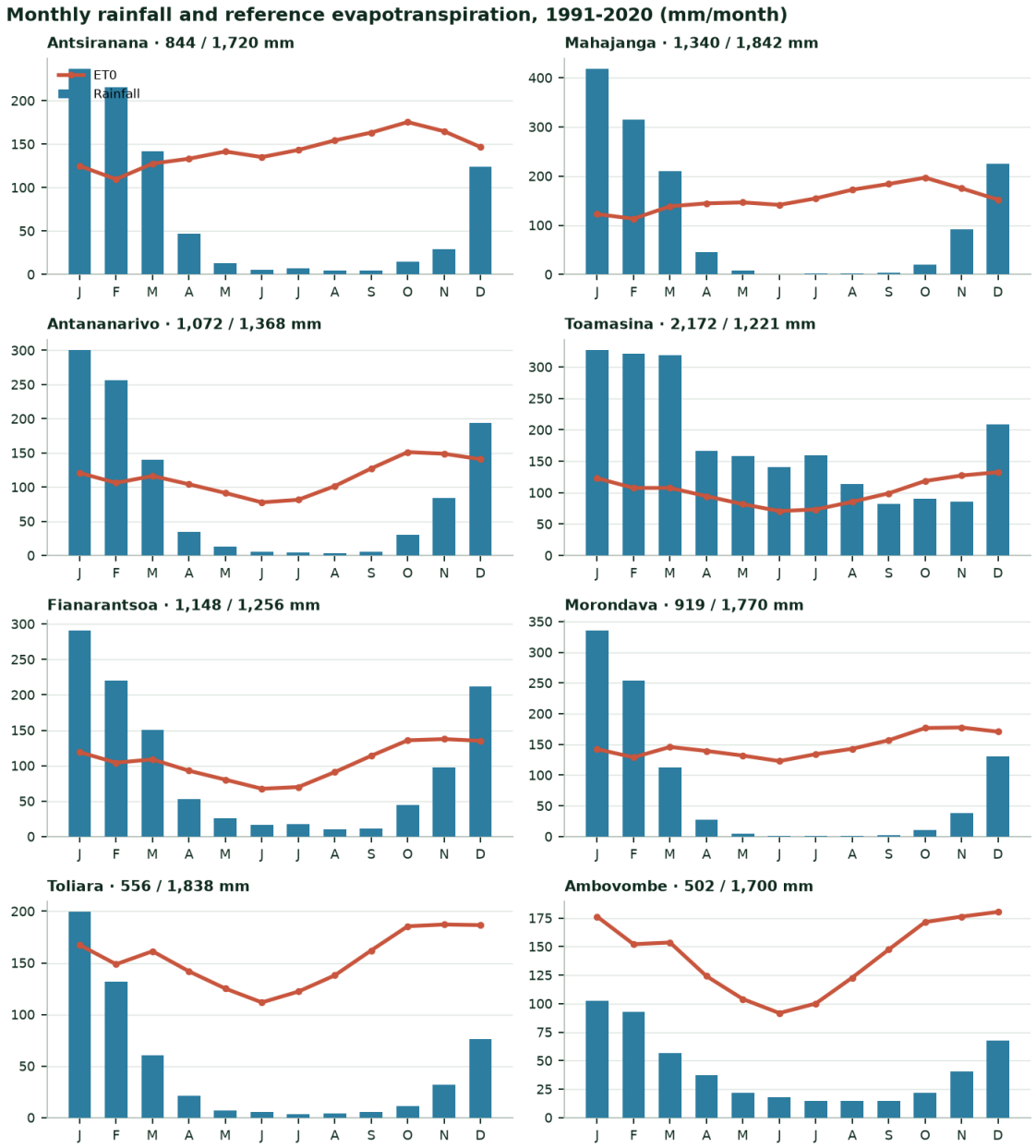


Figure 4. Monthly rainfall and reference evapotranspiration by zone, 1991-2020. Source: ERA5 via Open-Meteo (A9)

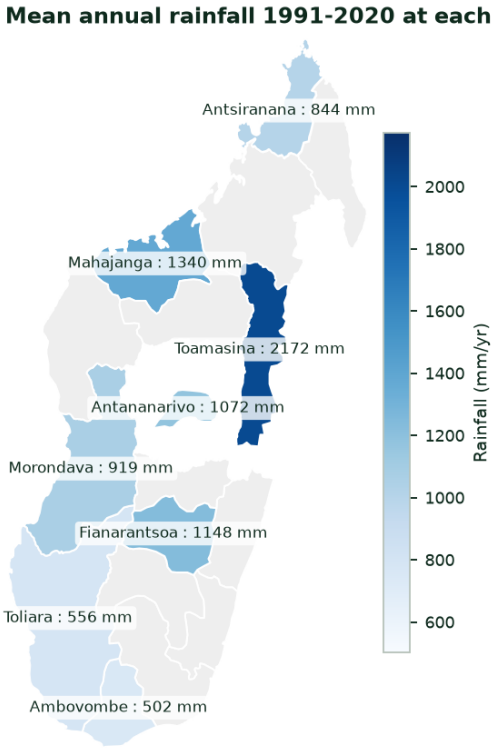


Figure 5. Mean annual rainfall 1991-2020 at each province capital. Source: ERA5 (A9) ; Natural Earth (A10)

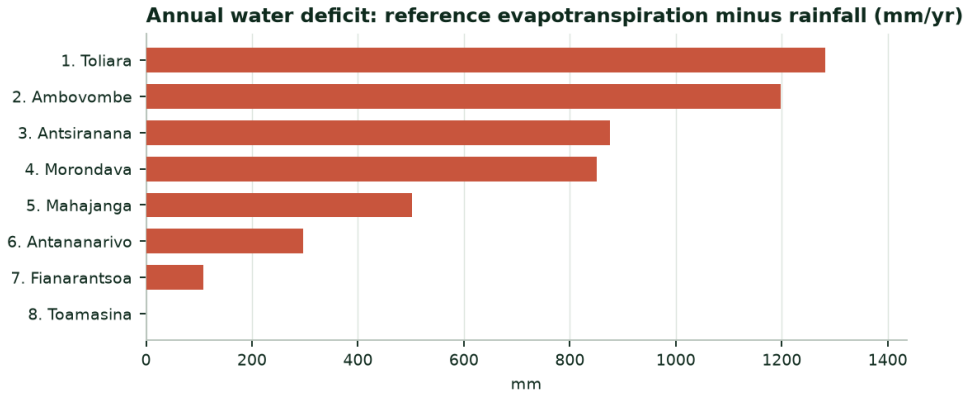


Figure 6. Annual water deficit: Reference evapotranspiration minus rainfall. Source: ERA5 (A9)

3.3 Climate change

Mean annual temperature is rising. At Antananarivo it went from 17.7 °C in 1981 to 18.9 °C in 2024, a trend of 0.23 °C per decade. At Toliara the trend is 0.22 °C per decade, from 24.2 °C to 25.9 °C.

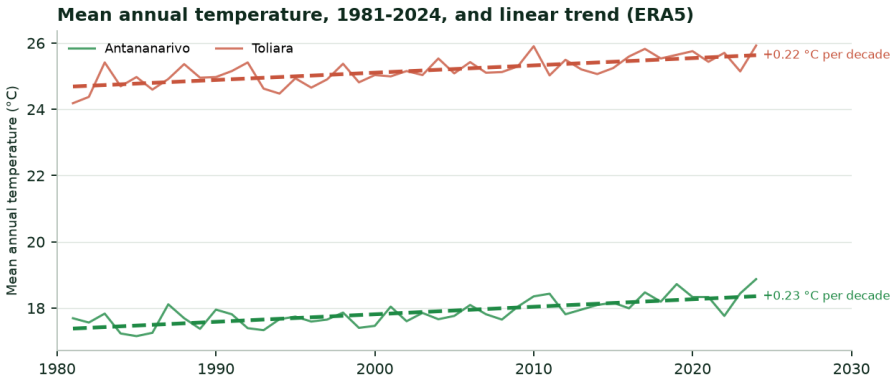


Figure 7. Mean annual temperature, 1981-2024, and linear trend. Source: ERA5 (A9)



Open western plains, where the dry season is long.

4. Irrigation water: Resources, areas, withdrawals

4.1 Resources and withdrawals

Total freshwater withdrawals reach 13.5 km³ a year (2022). Agriculture withdraws 95.9% of it, that is 12.9 km³. Internal water resources amount to 337 km³ a year, or 11,072 m³ per inhabitant.

Freshwater: Withdrawals and resources

Indicator	Value	Year	Source
Total withdrawals	13.46 km³	2022	World Bank (A1)
Agricultural share	95.9%	2022	World Bank (A1)
Agricultural withdrawals	12.90 km³	2022	Calculated from A1
Area equipped for irrigation	831,700 ha	2024	FAOSTAT (A6)
Agricultural withdrawals per equipped hectare	15,516 m³/ha	—	Calculation (Annex B)
Water stress	11.3%	—	World Bank (A1)

4.2 Irrigated areas

Equipped areas cover 831,700 hectares. Rice takes most of the cropped area: 2.04 million hectares harvested in 2024. The main irrigated crops are rice, maize, vegetables, potatoes and sweet potatoes, sugar cane and fruit.



Terraced paddies and water basins: Irrigation water is visible in the landscape.

4.3 What the water saving represents

In the central scenario, the saving is 1,538 million m³ a year, or 11.9% of agricultural withdrawals. At 15,516 m³ per equipped hectare, this water would irrigate about 99 000 more hectares.

5. Fertilisers: Quantities, purchases, spending

5.1 Quantities used

In 2024, agricultural use reaches 9,771 tonnes of nitrogen, 5,561 tonnes of phosphate (P2O5) and 4,049 tonnes of potash (K2O). Nitrogen imports were 9,681 tonnes in the same year.

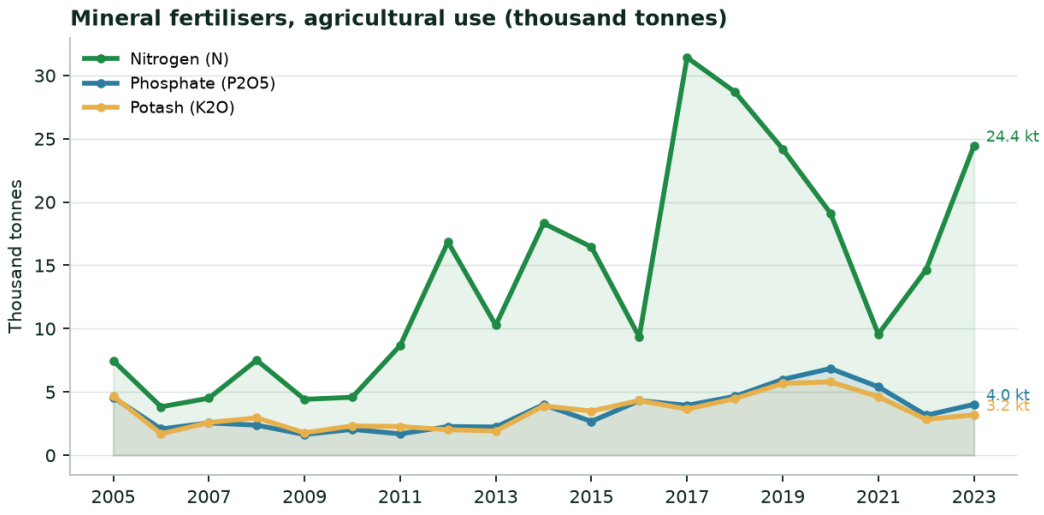


Figure 8. Mineral fertilisers, agricultural use, 2005-2023. Source: FAOSTAT (A5)

5.2 Regulatory framework

No fertiliser-specific regulatory framework was found at the date of the study. According to FAO and the Ministry of Agriculture, a technical project (August 2026 to July 2028) is to prepare one for the import, registration and control of fertilisers (A13).



Rice transplanting in the paddies: Fertilisation and water are decided in the field.

5.3 Indicative spending

In 2024, the indicative minimum spending on mineral fertilisers reaches $15 million, at international fertiliser prices (calculation in Annex B, lower bound).

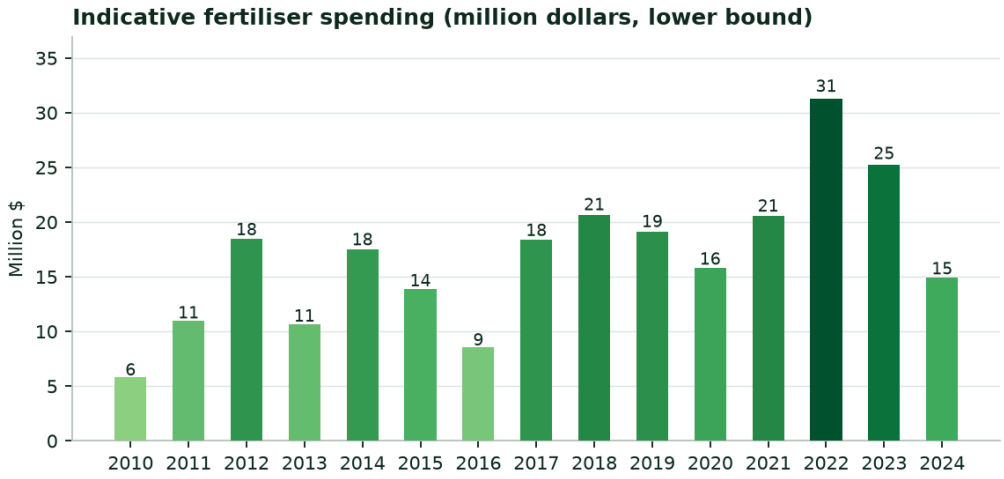


Figure 9. Indicative fertiliser spending, lower bound. Source: Author's calculation from A5 and A7

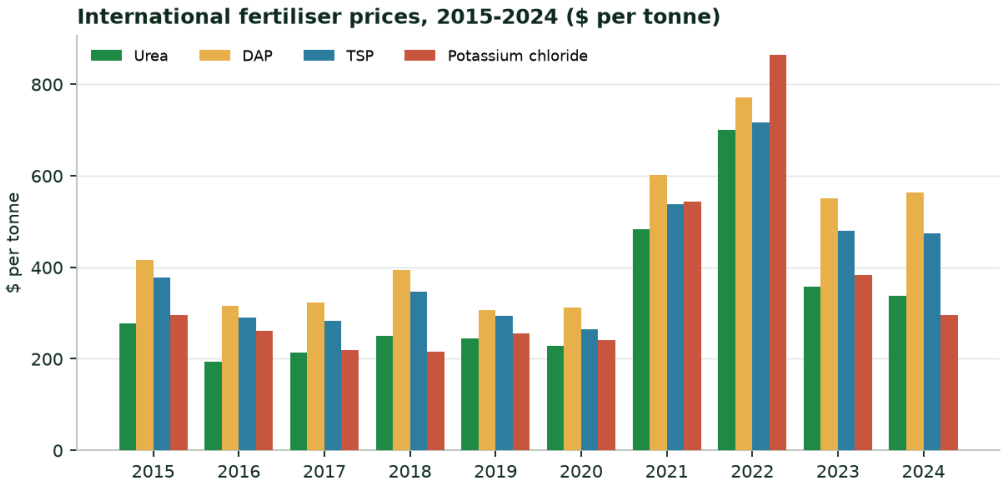


Figure 10. International prices of urea, DAP, TSP and potassium chloride. Source: Banque mondiale, Pink Sheet (A7)

6. The zones at a glance

The table compares the zones using the capital of each. Climate figures are 1991-2020 averages, except radiation (2005-2020).

Climate of the zone capitals, 1991-2020 means

Zone (capital)	Rainfall (mm/yr)	ET0 (mm/yr)	Deficit (mm/yr)	Radiation (kWh/m²/yr)	Temperature (°C)
Antsiranana	844	1,720	876	2,143	25.3
Mahajanga	1,340	1,842	502	2,209	26.9
Antananarivo	1,072	1,368	296	2,010	17.9
Toamasina	2,172	1,221	-951	1,880	23.4
Fianarantsoa	1,148	1,256	108	1,859	17.7
Morondava	919	1,770	851	2,291	25.8
Toliara	556	1,838	1,282	2,282	25.2
Ambovombe	502	1,700	1,198	2,061	23.5

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



Hills and terraces, typical of the highlands.

7. The twenty main crops: Three rankings

7.1 By harvested area

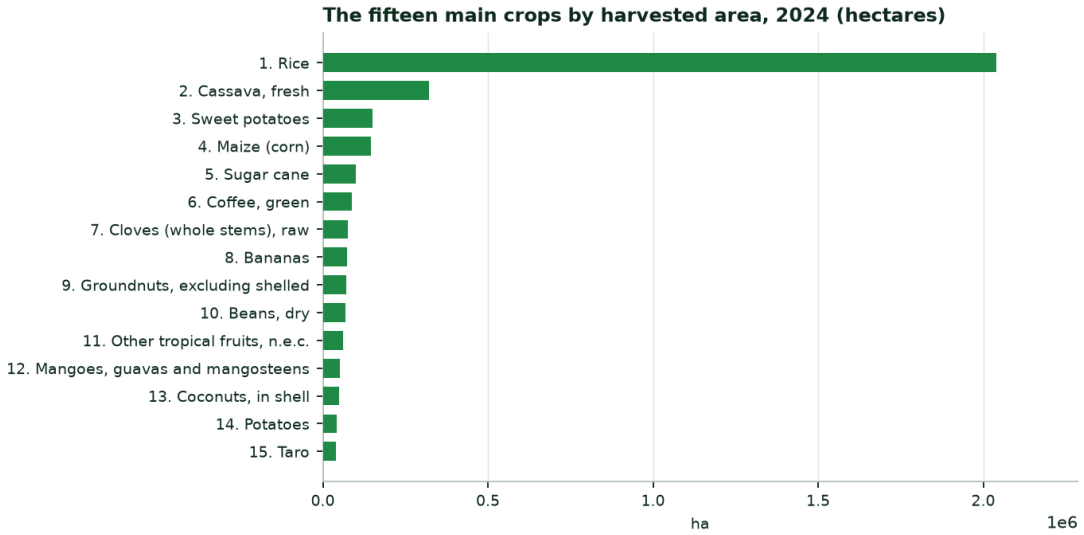


Figure 11. The fifteen main crops by harvested area, 2024 (hectares). Source: FAOSTAT (A2)

The ten main crops by area, 2024

Crop	Harvested area (ha)	Production (t)	Yield (t/ha)
Rice	2,040,884	4,970,000	2.44
Cassava, fresh	322,141	2,573,531	7.99
Sweet potatoes	150,429	1,298,147	8.63
Maize (corn)	144,592	265,000	1.83
Sugar cane	100,974	3,162,265	31.32
Coffee, green	87,583	49,561	0.57
Cloves (whole stems), raw	74,650	25,114	0.34

Crop	Harvested area (ha)	Production (t)	Yield (t/ha)
Bananas	72,365	399,940	5.53
Groundnuts, excluding shelled	70,192	58,610	0.83
Beans, dry	69,767	84,150	1.21

Source: FAOSTAT (A2). Vanilla is excluded: Its published area does not match its production.

7.2 By production

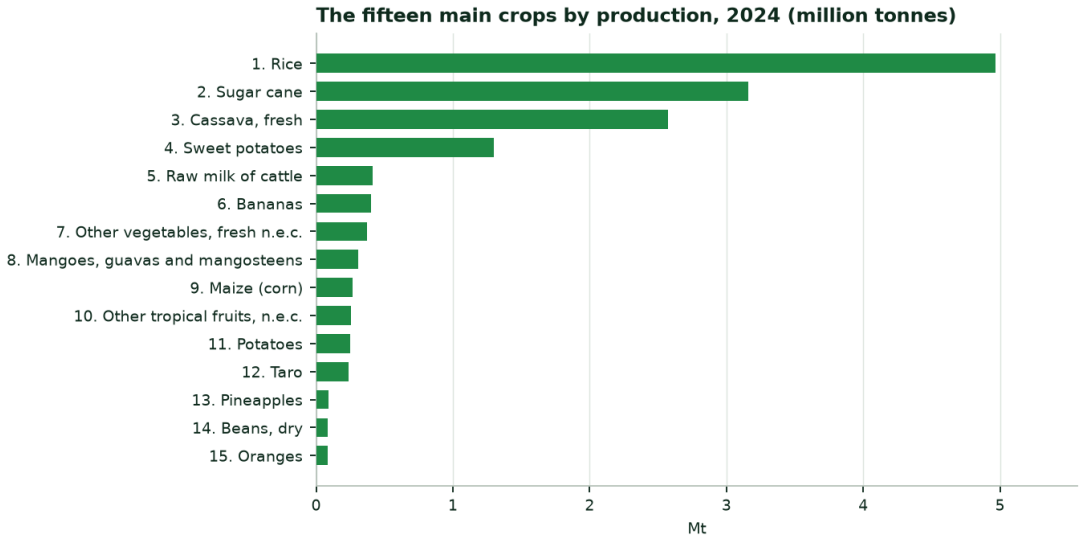


Figure 12. The fifteen main crops by production, 2024 (million tonnes). Source: FAOSTAT (A2)

7.3 By production value

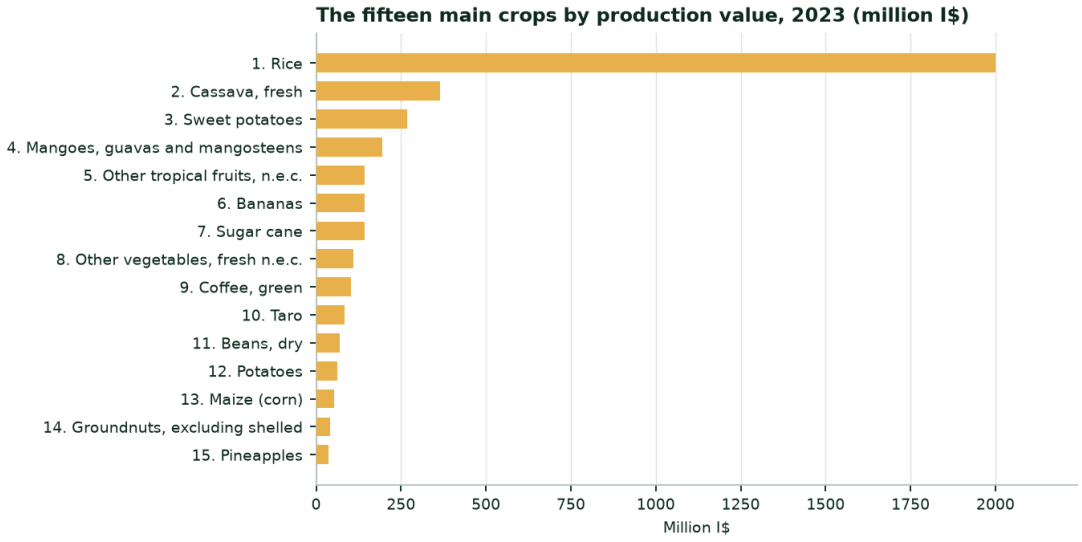
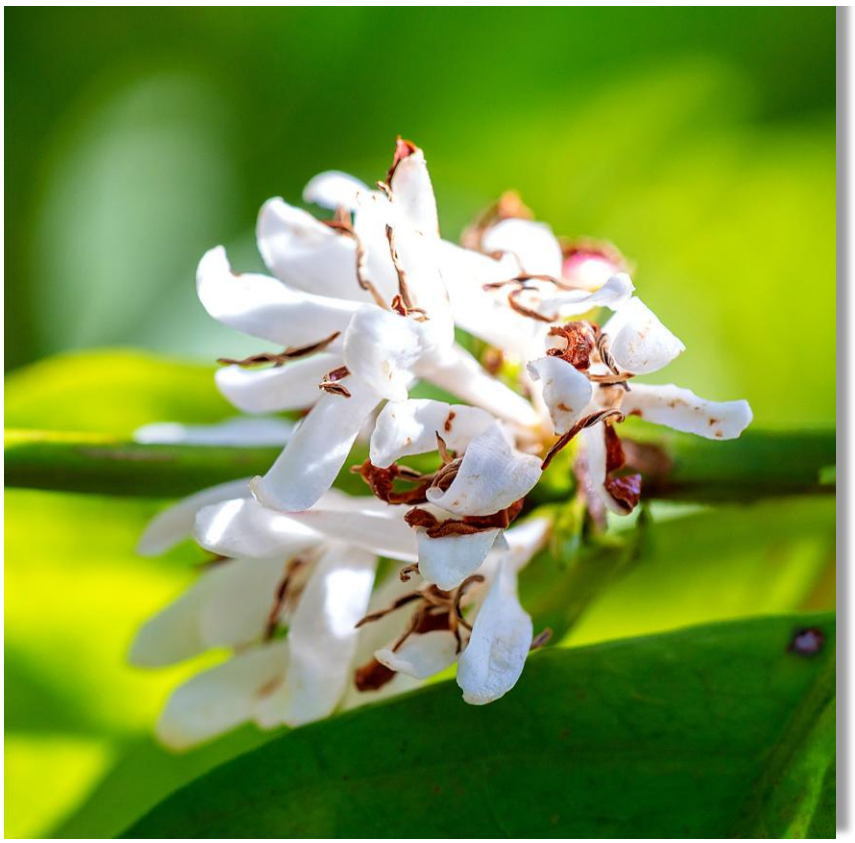


Figure 13. The fifteen main crops by production value, 2023 (million I$). Source: FAOSTAT (A3)



Coffee flowers: Coffee is one of the country's perennial crops.

8. Extrapolation by crop and water savings

8.1 Method

Method in brief

- National agricultural water is shared among irrigable crops in proportion to their harvested areas (assumption: No irrigation statistics by crop).
- Each group receives the effect of the trial cited for its crop: A quarter (cautious), half (central), all of it (high).
- Without a trial, the generic assumption is 5, 10 and 20% of water saved, 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
Date palm, UAE (ICBA, 2021)	Palm	−82 %	+20 %	Not used (no date palm crop); cited for reference
Watermelon, Mexico (2023)	Watermelon	−60,5 %	+30 %	Vegetables and melons
Potato, South Africa (2025)	Potato	−52 %	+31,4 %	Potato, sweet potato, onion, garlic
Maize, Türkiye (TIGEM, Konya, 2025)	Maize	−38,9 %	+17,1 %	Maize
Soybean, China	Soybean	Assumption	+11,3 %	Rainfed pulses: No irrigation water in the calculation

Source: A15 to A18 (published trials and manufacturer's website, levels B and C).

8.3 Parameters by crop group

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)	598,341	71.9%	Generic assumption, no trial on rice	928.4
Maize	42,391	5.1%	Maize, Türkiye (TIGEM, 2025)	128.3
Potato, sweet potato, onion, garlic	56,850	6.8%	Potato, South Africa (2025)	229.3
Vegetables and melons	13,939	1.7%	Watermelon, Mexico (2023)	65.4
Sugar cane	29,603	3.6%	Generic assumption, no trial	45.9
Fruit (banana, mango, citrus, avocado, pineapple)	90,576	10.9%	Generic assumption, no trial	140.5

Source: Author's calculation (Annex B).

8.4 National results

1,538 Mm³
Of water saved per year (central, 11.9% of agricultural withdrawals)

99 000 ha
Extra irrigable hectares with this water

98 000 t
Of extra production, for the crops with a trial

23 M I$
Of extra production value (2014-2016)

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

Scenario	Water (Mm³/yr)	Extra hectares	Production (t/yr)	Value (M I$/yr)
Cautious	769	49,558	49,156	11.6
Central	1,538	99,116	98,311	23.1
High	3,076	198,231	196,622	46.2

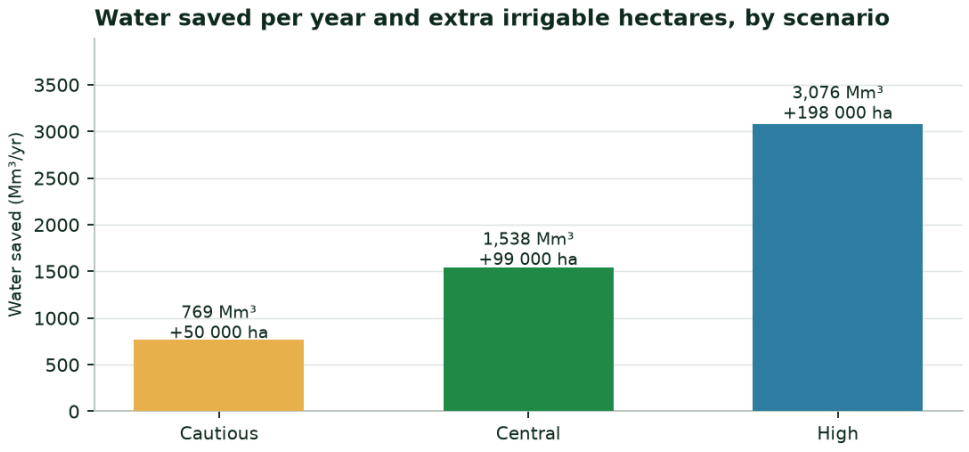


Figure 14. Water saved per year and extra irrigable hectares, by scenario. Source: Author's calculation

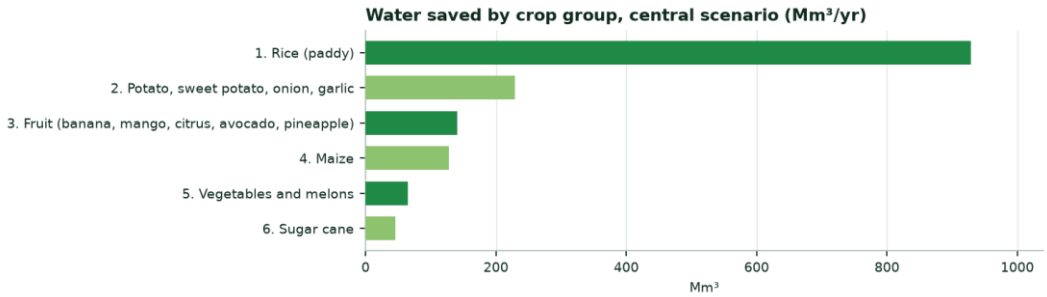


Figure 15. Water saved by crop group, central scenario. Source: Author's calculation

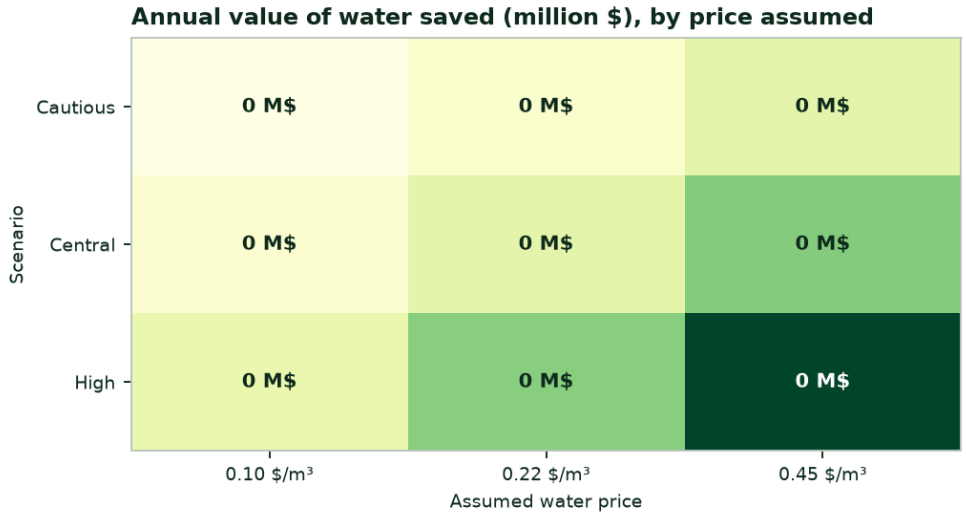


Figure 16. Annual value of the water saved, by price assumed per cubic metre. Source: Author's calculation; prices assumed, no national tariff

8.5 Reading the results

Key points

- Rice gives 60% of the central saving, on a generic assumption (10%): No trial is cited for rice.
- Maize, roots and vegetables give 28% of the central saving, based on published trials.
- The production gain, 98,311 t in the central scenario, concerns only crops where a trial is cited.

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%	A15 to A18 (B, C)	One trial per crop; conditions not comparable with Madagascar
Yield	Maize +17.1%; potato +31.4%; watermelon +30%; date palm +20%; soybean +11.2 to +11.4%	A15 to A18 (B, C)	One or two trials per crop; controls sometimes different
Safety: Acrylamide (ECOSORB®)	Below 3.0 µg/g	A19 (B)	One laboratory, one date

Benefit	Published figures	Source (level)	Limit
REACH compliance (EVERGREEN®)	≤ 0.1% of substances of very high concern in 233 substances tested	A20 (B)	Screening, not an approval
Certification (ECOFERT®)	Certified by SOHISCERT and EU Bio	A21 (A)	Valid for the certified product
Agroforestry (Paulownia ALTIFOLIA®)	13 to 15 m in 6 to 8 years (website)	A22 (C)	No trial in Madagascar

Source: Annex A.



Sunset over the baobabs: Water and light make the landscape.

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)	766	767
Agricultural imports (crops and livestock)	855	930
Exports, all merchandise	3,213	2,582
Imports, all merchandise	4,750	4,833

Source: FAOSTAT (A4).

10.2 Exports

Vanilla is the first farm product exported ($265 million in 2024), followed by cloves ($192 million). Together they make up 60% of agricultural exports.

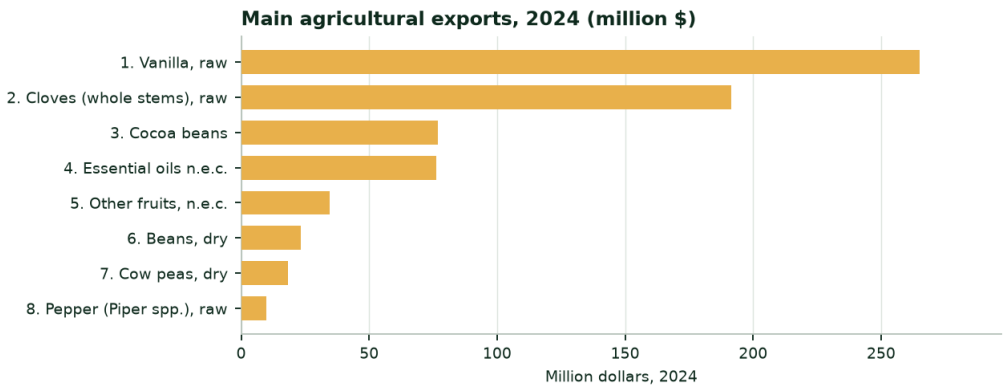


Figure 17. Main agricultural exports, 2024. Source: FAOSTAT (A4)

10.3 Imports

The country imports more farm products than it exports. Palm oil ($163 million), milled rice ($128 million), sugar and wheat flour are among the main imports.

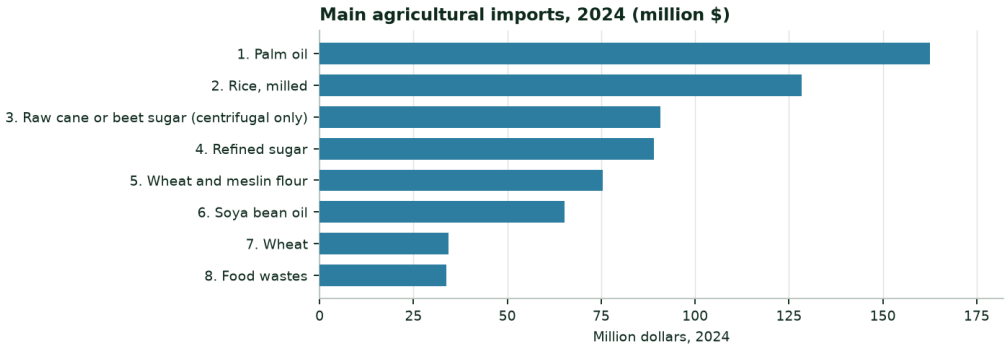


Figure 18. Main agricultural imports, 2024. Source: FAOSTAT (A4)



Vanilla beans: The first farm product exported.

10.4 Importing water-retention polymers into Madagascar

What to know

• **Customs duty (code 3906.90, acrylic polymers in primary forms):** 5% under the general tariff; 0% under COMESA, COI and APEI; 10% under SADC (A11).

• **VAT:** 20%, calculated on the CIF value plus duties (A11).
• **Mandatory document:** The cargo tracking note (BSC), filled in online (A12).
• **Specific regulation:** No rule specific to water-retention polymers was found at the date of the study (A13).
• **Classification:** Code 3906.90 is an inference for our products; the customs advance-ruling service settles it (A11).

11. A study of each zone

Each zone is described through the capital that represents it. The figures describe the climate; the water deficit (evapotranspiration minus rainfall) shows where water is most short.



Village and paddies on the highland hills.

Antsiranana

Indicator	Value
Annual rainfall, 1991-2020	844 mm
Reference evapotranspiration	1,720 mm
Annual water deficit	876 mm
Global solar radiation	2,143 kWh/m²
Mean temperature	25.3 °C

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

Mahajanga

Indicator	Value
Annual rainfall, 1991-2020	1,340 mm
Reference evapotranspiration	1,842 mm
Annual water deficit	502 mm

Indicator	Value
Global solar radiation	2,209 kWh/m²
Mean temperature	26.9 °C

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

Antananarivo

Indicator	Value
Annual rainfall, 1991-2020	1,072 mm
Reference evapotranspiration	1,368 mm
Annual water deficit	296 mm
Global solar radiation	2,010 kWh/m²
Mean temperature	17.9 °C

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

Toamasina

Indicator	Value
Annual rainfall, 1991-2020	2,172 mm
Reference evapotranspiration	1,221 mm
Annual water deficit	-951 mm
Global solar radiation	1,880 kWh/m²
Mean temperature	23.4 °C

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

Fianarantsoa

Indicator	Value
Annual rainfall, 1991-2020	1,148 mm
Reference evapotranspiration	1,256 mm
Annual water deficit	108 mm
Global solar radiation	1,859 kWh/m²
Mean temperature	17.7 °C

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

Morondava

Indicator	Value
Annual rainfall, 1991-2020	919 mm
Reference evapotranspiration	1,770 mm
Annual water deficit	851 mm
Global solar radiation	2,291 kWh/m²
Mean temperature	25.8 °C

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

Toliara

Indicator	Value
Annual rainfall, 1991-2020	556 mm
Reference evapotranspiration	1,838 mm

Indicator	Value
Annual water deficit	1,282 mm
Global solar radiation	2,282 kWh/m²
Mean temperature	25.2 °C

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

Ambovombe

Indicator	Value
Annual rainfall, 1991-2020	502 mm
Reference evapotranspiration	1,700 mm
Annual water deficit	1,198 mm
Global solar radiation	2,061 kWh/m²
Mean temperature	23.5 °C

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

Annex A. Sources and confidence levels

Ref.	Source	Level
A1	Banque mondiale, indicateurs du développement dans le monde (WDI), Madagascar	A
A2	FAOSTAT, cultures et élevage (QCL), surfaces, productions, 2014-2024	A
A3	FAOSTAT, valeur de la production (QV), I$ constants 2014-2016, 2019-2024	A
A4	FAOSTAT, commerce des cultures et élevage, 2018-2024	A
A5	FAOSTAT, engrais minéraux, usage agricole et importations, 2005-2023	A
A6	FAOSTAT, usage des terres et surfaces équipées pour l'irrigation, 2000-2024	A
A7	Banque mondiale, Pink Sheet (prix mondiaux de l'urée, du TSP et du chlorure de potassium)	A
A8	PVGIS (Centre commun de recherche de la Commission européenne), rayonnement, 2005-2020	B
A9	ERA5 (Copernicus), via Open-Meteo : Pluie, évapotranspiration de référence, température, 1981-2024	B
A10	Natural Earth, limites administratives de niveau 1 (carte) ; découpage de 2009	B
A11	Douanes de Madagascar, tarif douanier 2026 (code 3906.90) ; SADC, COMESA, COI, APEI	A
A12	Bordereau de suivi des cargaisons (BSC), exigence documentaire, 2026	A
A13	FAO et ministère de l'agriculture, actualités d'août 2026 sur le cadre des engrais	B
A14	Essai soja, Chine (rendement), site du fabricant	C
A15	Essai palmier dattier, Émirats (ICBA, 2021), site du fabricant	B
A16	Essai pastèque, Mexique (2023), site du fabricant	C
A17	Essai pomme de terre, Afrique du Sud (2025), site du fabricant	C
A18	Essai maïs, Turquie (TIGEM, Konya, 2025), site du fabricant	B
A19	Analyse d'acrylamide ECOSORB® (laboratoire Polymex, 2024)	B
A20	Cribage REACH / SVHC EVERGREEN® (SGS, 2023)	B
A21	Certificat ECOFERT® (SOHISCERT, EU Bio)	A
A22	Chiffres de la fiche Paulownia ALTIFOLIA® (site web)	C

Annex B. Calculation method

1. Agricultural water. Total withdrawals (13.46 km³, 2022) × agricultural share (95.89%) = 12.90 km³.

2. Allocation. The equipped area (831,700 ha) is shared among irrigable groups in proportion to their harvested areas (2,836,849 ha). Vanilla is excluded (published area inconsistent with production); rainfed crops receive no irrigation water in this calculation.

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 (15,516 m³/ha).

5. Production and value. Production gain = group area × average yield × trial effect; value at the implicit 2023 average price (production value ÷ production).

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 capital; radiation: PVGIS, 2005-2020. Temperature trends are linear regressions over 1981-2024.

9. Trade. Totals are those of the FAOSTAT crops and livestock line; products are listed one by one, without aggregates.

Annex C. Photo credits

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