

Lima, Peru
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Water and Agriculture in Peru

Maps, Numbers and Stories

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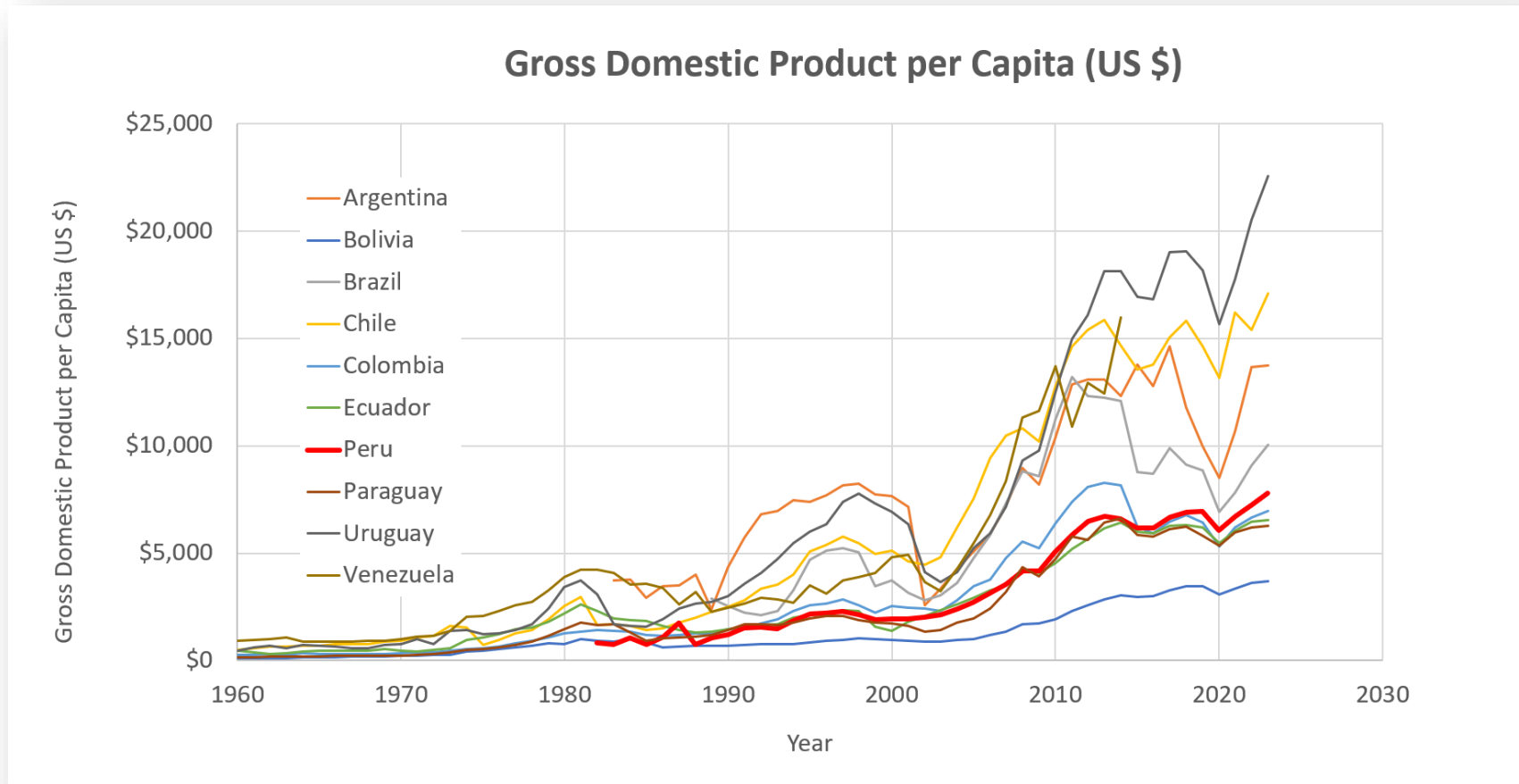
Peru – Geography

- Simplistically, Peru consists of three distinct regions:
 - **Coast:** deserts, for the most, interrupted by fertile valleys;
 - **Andes mountain range:** highlands; and
 - **Amazon jungle:** rain forest.



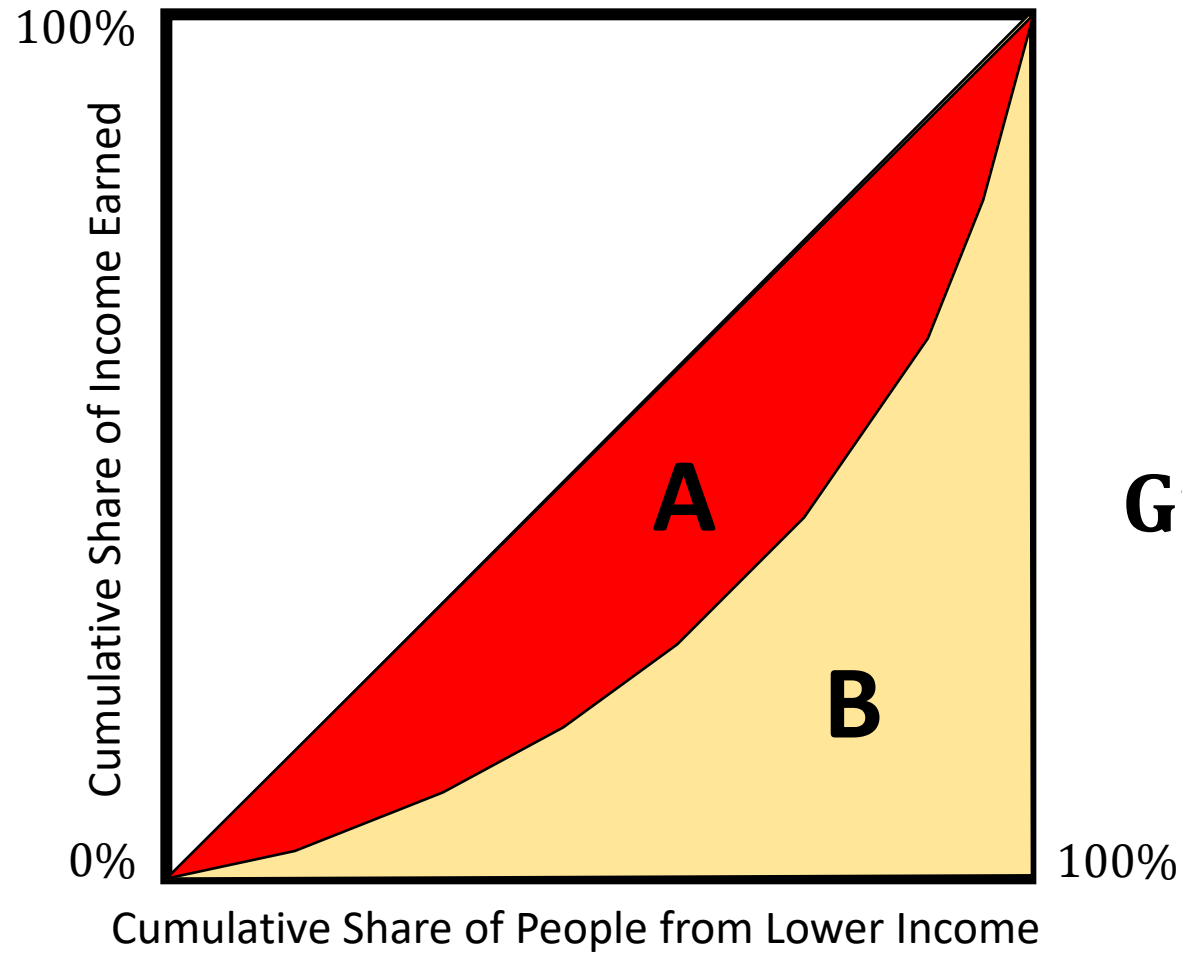
<https://perufood.blogspot.com/2006/02/geography-and-cuisine-three-regions-of.html>

South America – Gross Domestic Product



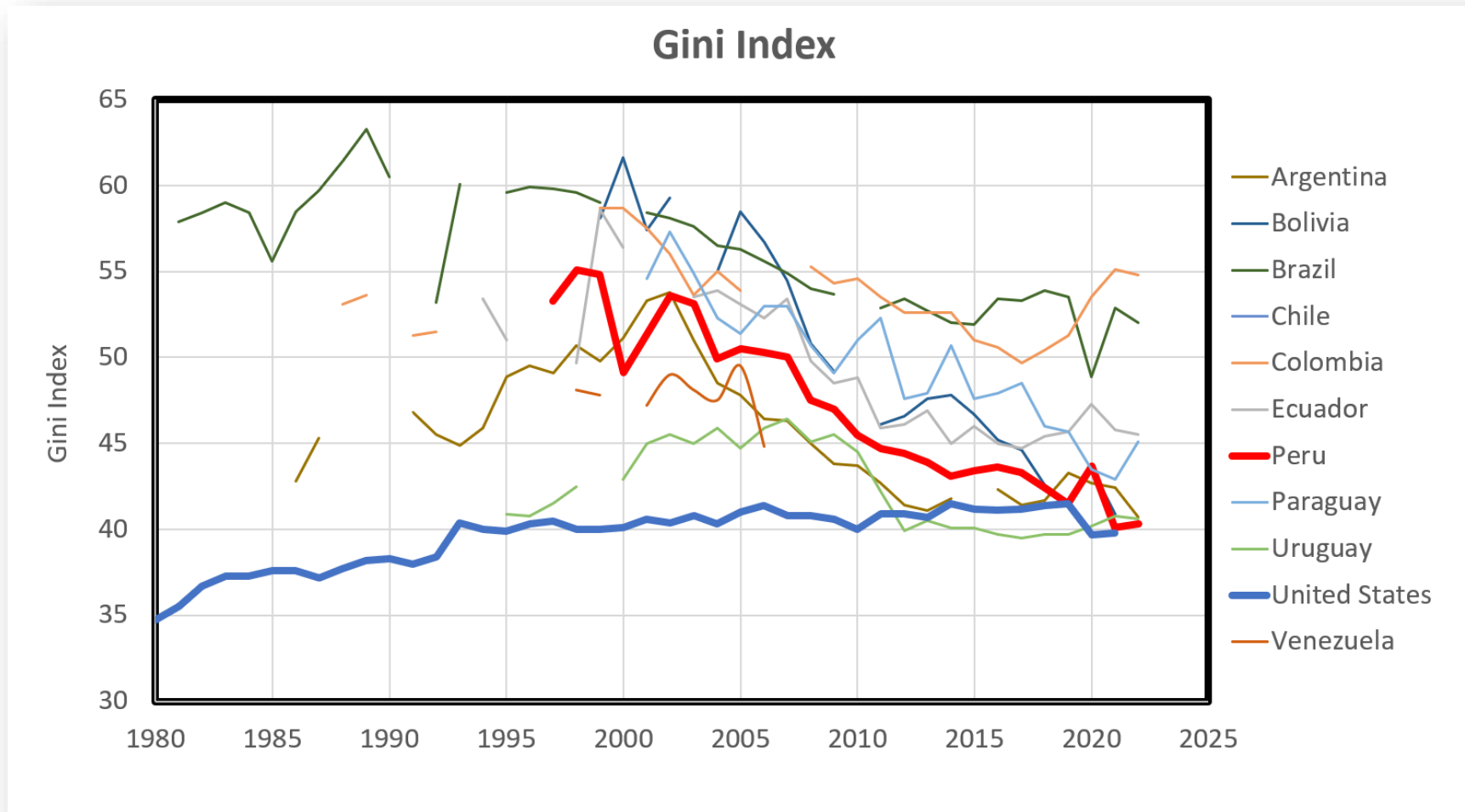
World Bank - [GDP per capita \(current US\\$\) - Latin America & Caribbean | Data \(worldbank.org\)](https://data.worldbank.org/SDY.GD.PC.CD.LA.CS)

Income Distribution



$$\text{Gini Index} = \frac{A}{A + B}$$

South America and USA – Income Distribution

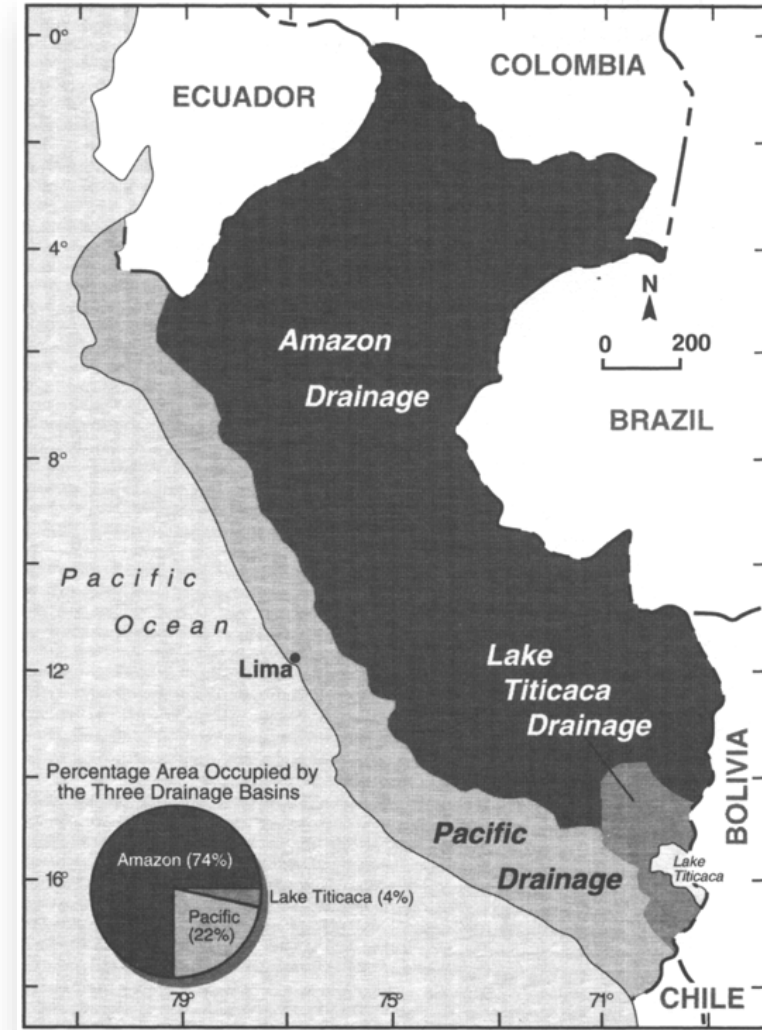


[Gini index - World | Data \(worldbank.org\)](https://data.worldbank.org/ineq)

Peru – Hydrography

- From the hydrographic point of view, Peru consists of three major basins:
 - **Pacific Ocean;**
 - **Amazon River** (Atlantic Ocean); and
 - **Titicaca Lake** (Poopo Lake).

Hydrographic Region	Area (km ²)
Pacific Ocean	279,000
Amazon River	959,000
Titicaca Lake	47,000
Total	1,285,000



Leon, B. and K. Young, "Aquatic plants of Peru: Diversity, distribution and conservation", Biodiversity and Conservation 5-10 p. 1169-1190, 1996.

Hydrography

- Rivers of the **Pacific Ocean** basin are, for the most, short and have steep slopes, which causes high velocities, turbulent waters and significant sediment transport and erosion.
- Rivers in the **Amazon River** basin are very long and have mild slopes, which causes meanders and, in general not well-defined riverbeds.



Peru – Agricultural Area

In 1961:

Arable land – 2,419,000 Ha

Permanent crops – 160,000 Ha

Permanent meadows and pastures – 15,129,000 Ha

Total: 13.8% of the national territory.

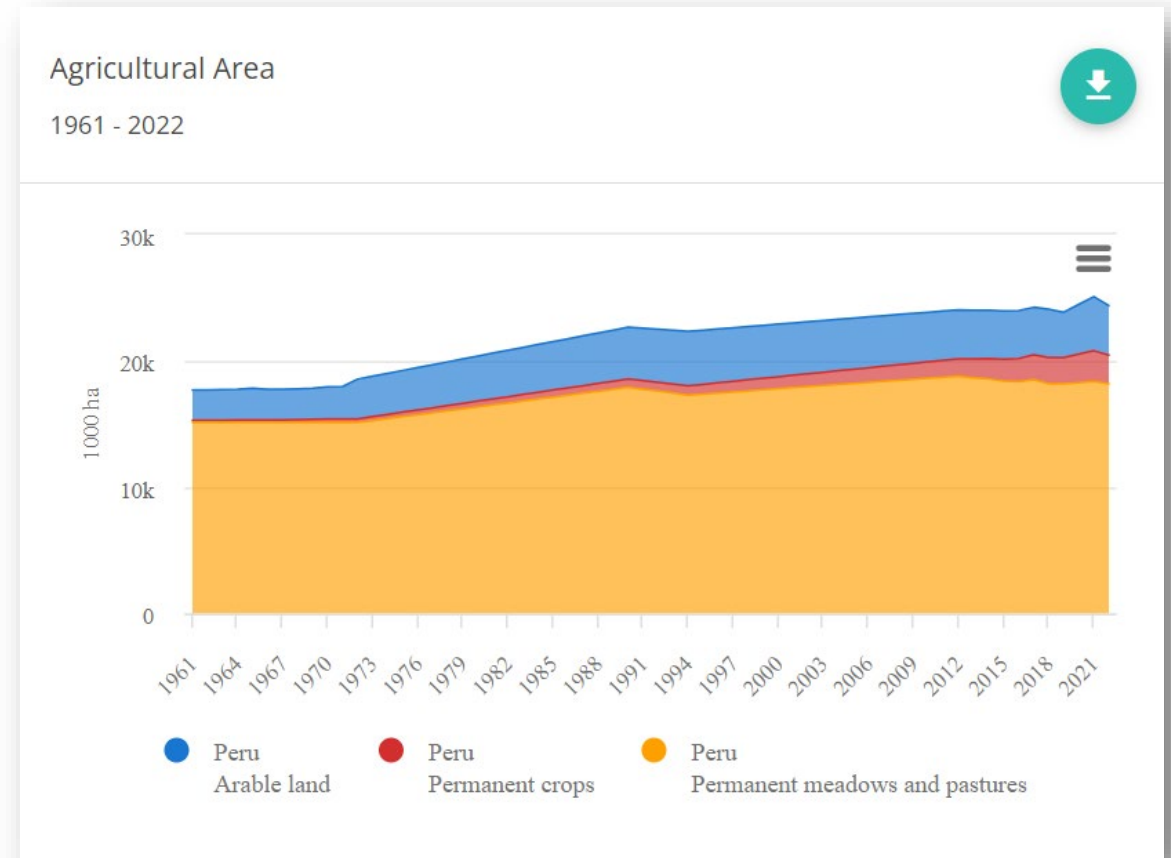
In 2022:

Arable land – 3,918,000 Ha

Permanent crops – 2,280,000 Ha

Permanent meadows and pastures – 18,187,000 Ha

Total: 19.0% of the national territory



UN FAO - [FAOSTAT](#)

Irrigation Projects

- **Majes** in Arequipa: transfers water from the Colca River (downstream called Majes) to the Sigwas River. Phase I (1971): 15,950 Ha. New phase being considered: 46,500 Ha.
- **Chavimochic** in La Libertad: involves the Chao, Viru, Moche and Chicama Rivers. Phase I and Phase II (started in 1960s): 223,000 Ha. New phase being considered.
- **Chinecas** in Ancash: Transfer water from the Santa River. Phase I (started in 1940s). New phase being considered: 83,000 Ha.
- **Andenes** (terraces) in the highlands: Recovery of 120,000 Ha being considered.

South America – Population

Country	Population 2024	Annual Change	Density (people/km ²)	Area (km ²)	Migrants (net) per 1,000 people	Urban Population %
Brazil	211,998,573	0.41%	25	8,358,140	-1.06	91%
Colombia	52,886,363	1.08%	48	1,109,500	2.68	81%
Argentina	45,696,159	0.35%	17	2,736,690	0.08	95%
Peru	34,217,848	1.10%	27	1,280,000	0.54	80%
Venezuela	28,405,543	0.37%	32	882,050	-3.71	N.A.
Chile	19,764,771	0.54%	27	743,532	2.95	85%
Ecuador	18,135,478	0.86%	73	248,360	-1.09	65%
Bolivia	12,413,315	1.38%	11	1,083,300	-0.24	70%
Paraguay	6,929,153	1.24%	17	397,300	-1.80	68%
Uruguay	3,386,588	-0.04%	19	175,020	-0.40	N.A.

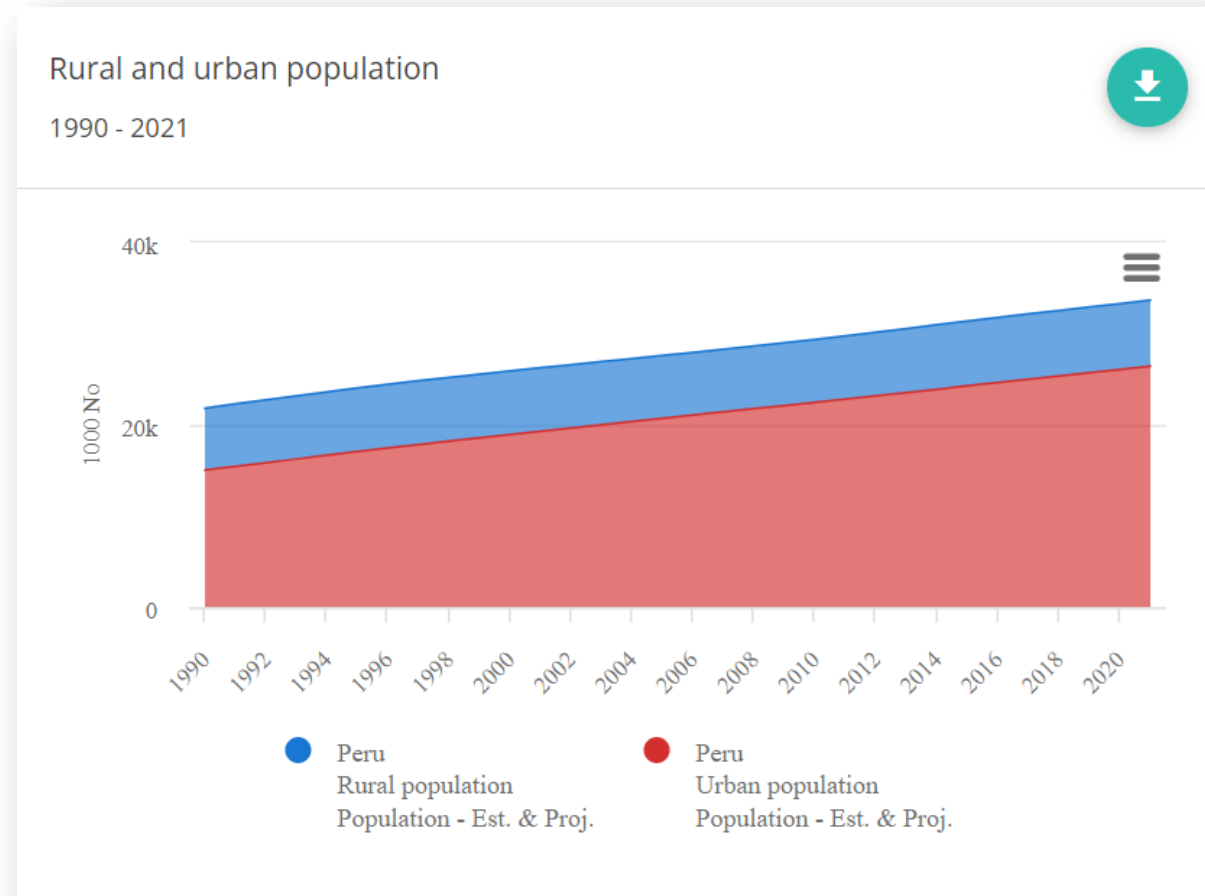


[Countries in South America by Population \(2024\) - Worldometer \(worldometers.info\)](https://worldometers.info)

Peru – Rural and Urban Population

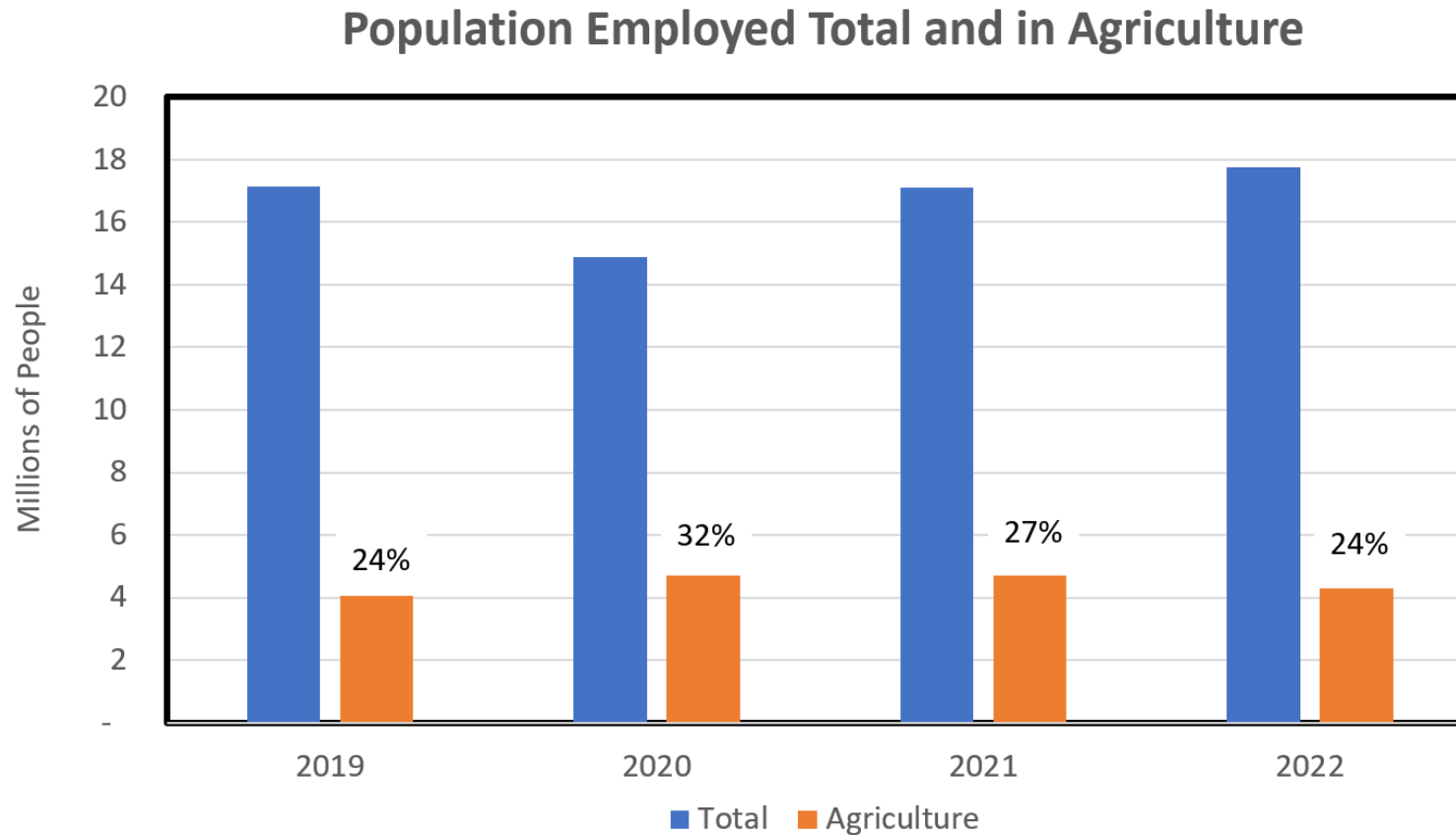
The population of Peru in 2024 is approximately 34 millions.

The rural population (blue) has remained somewhat constant, at approximately 7 millions, for the last 35 years. In 2024, it was ~21%.



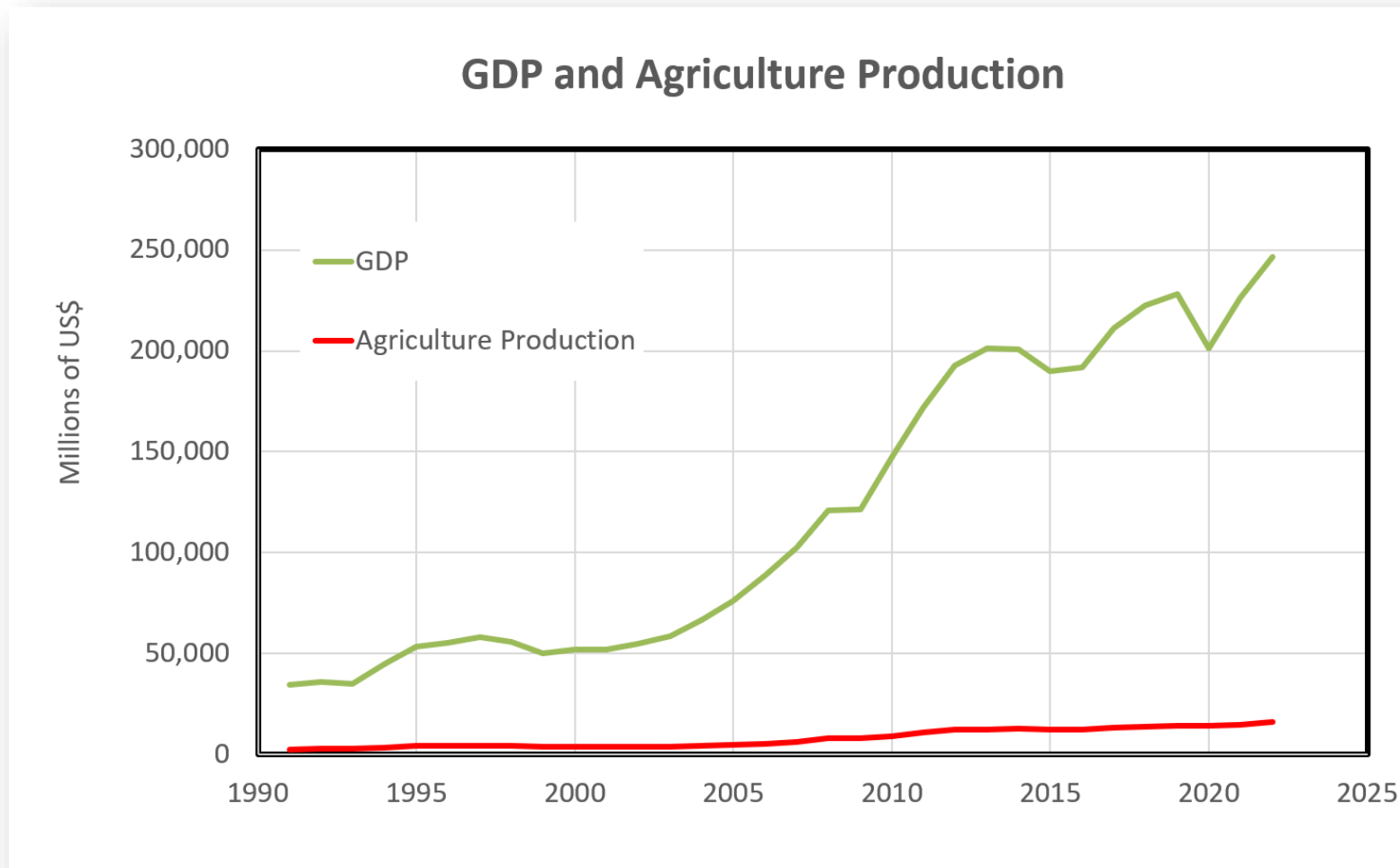
UN FAO - [FAOSTAT](#)

Peru – Population Employed in Agriculture

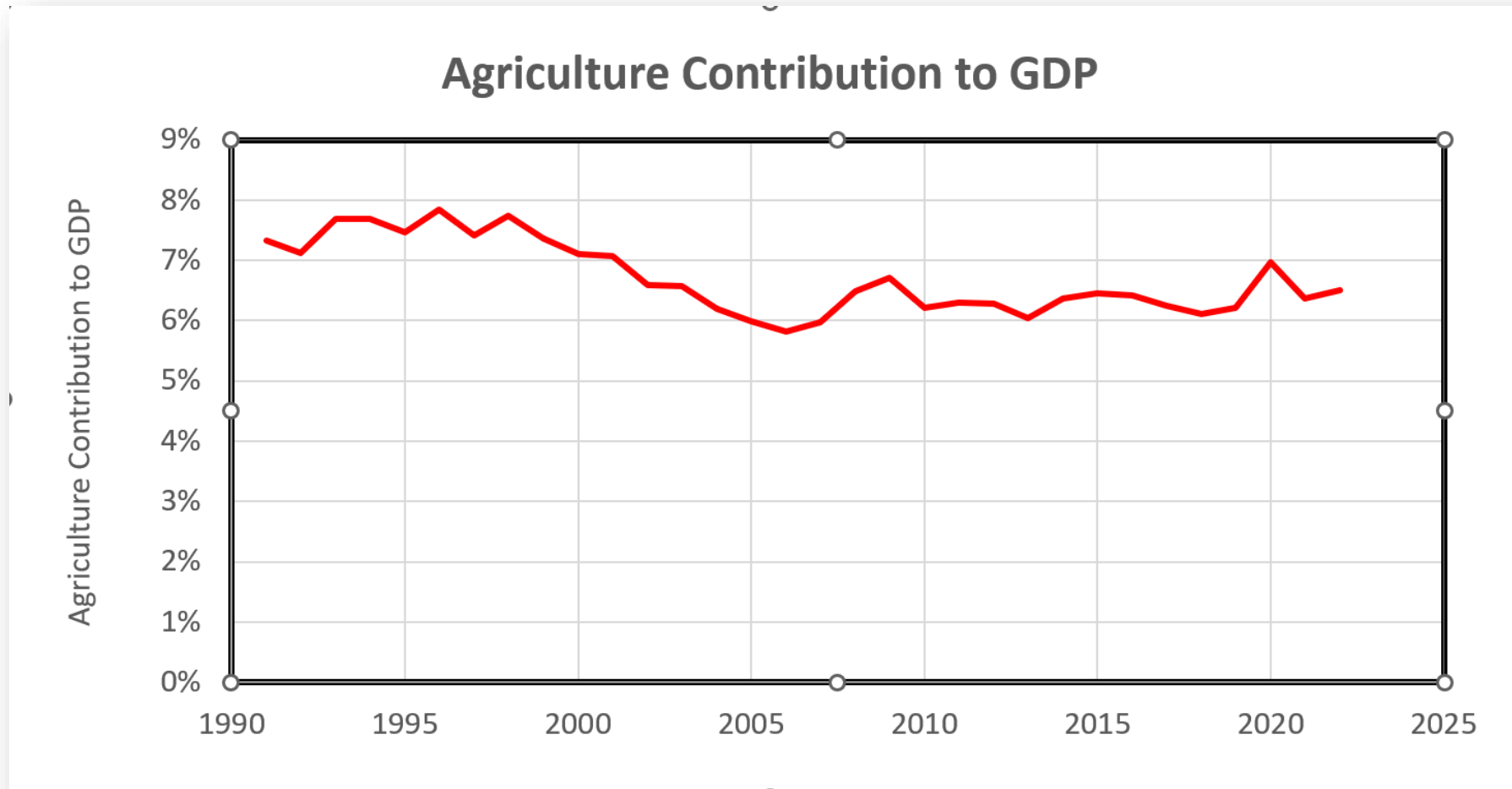


[INEI – Informe Técnico Empleo Nacional Oct-Nov-Dic 2022](#)

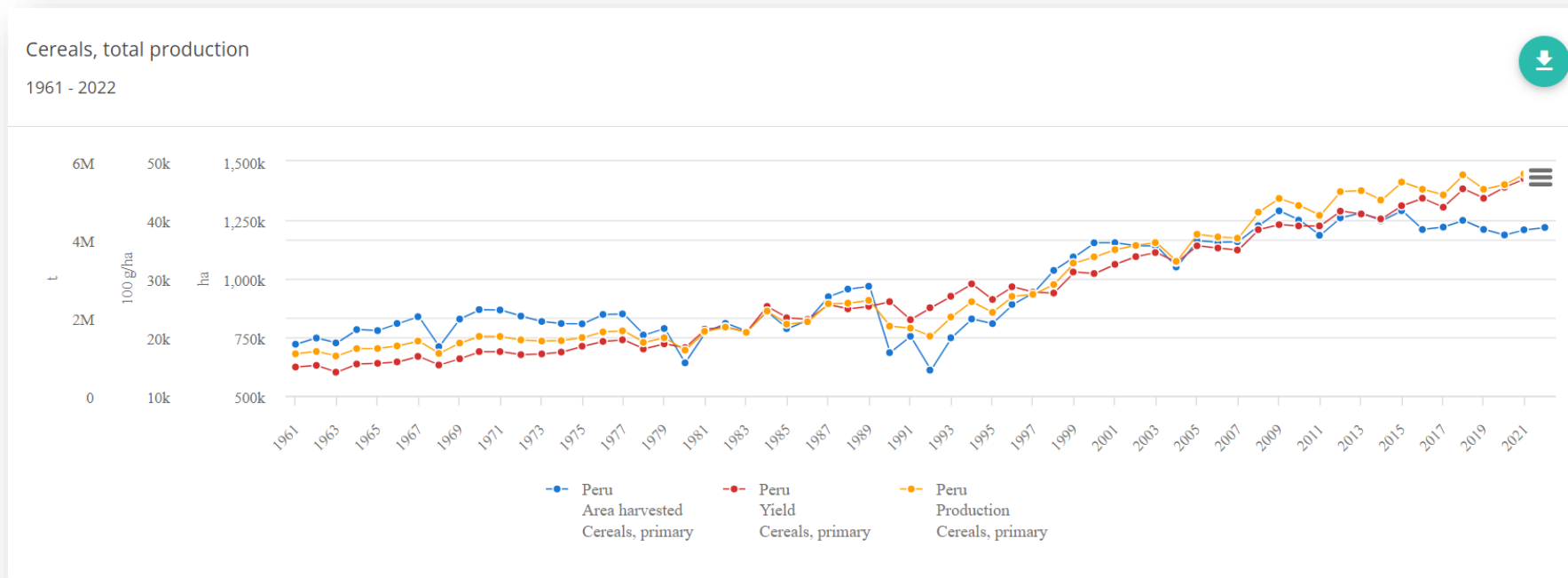
Peru – Agriculture Contribution to GDP



Peru – Agriculture Contribution to GDP



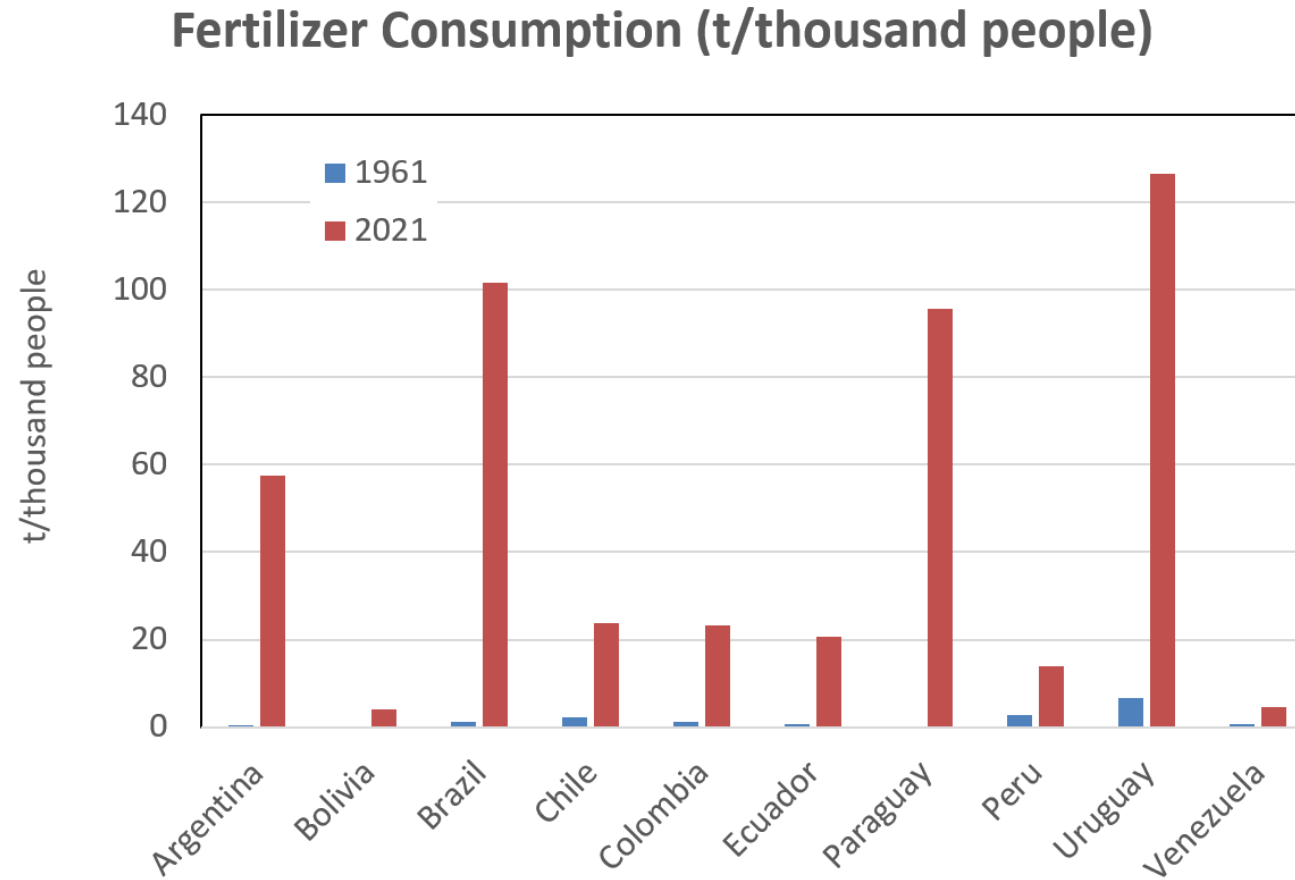
Peru - Cereal Production



In 1961:
Area harvested – 7,193 km²
Yield – 1.49 t/ha
Production – 1,070,000 t

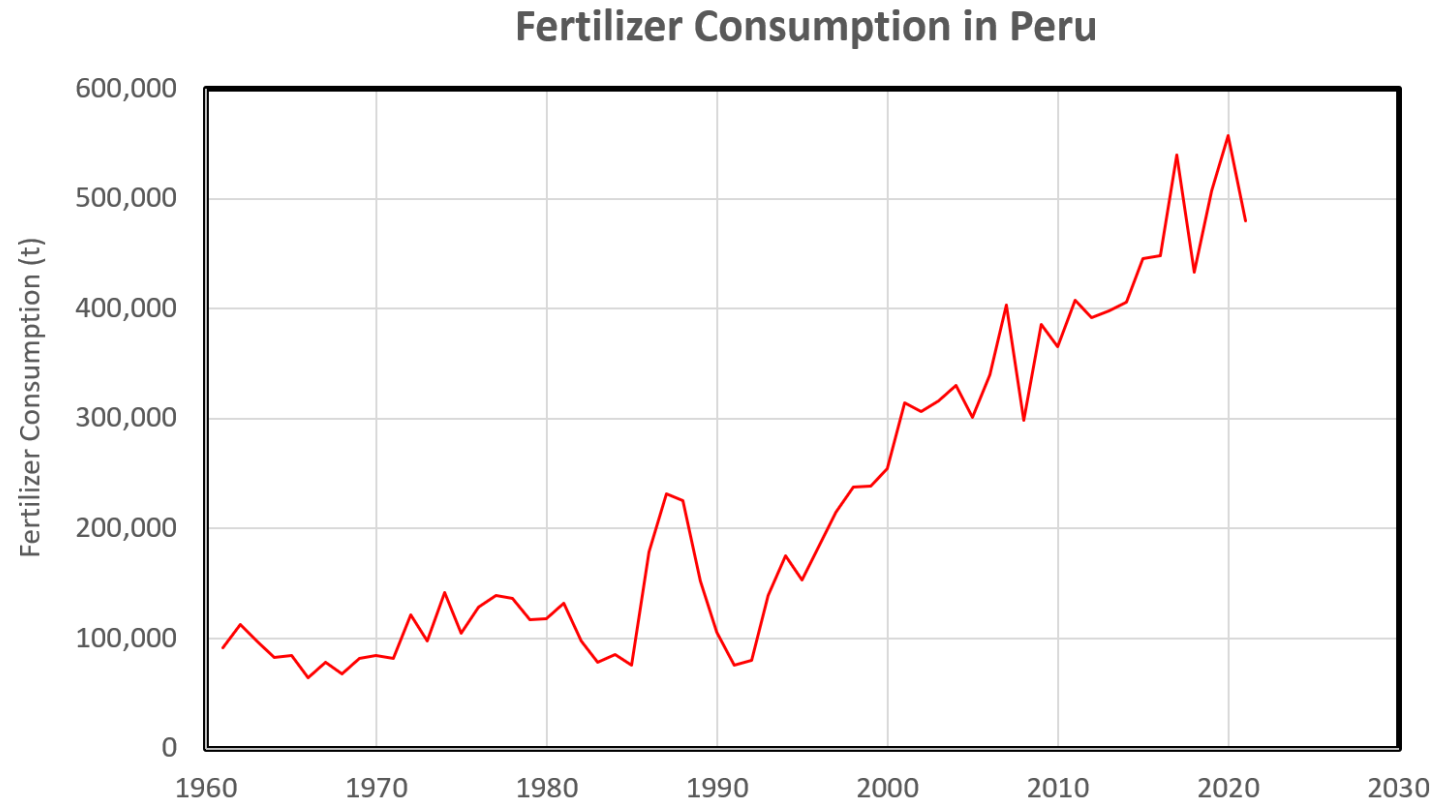
In 2022:
Area harvested – 12,177 km²
Yield – 4.63 t/ha
Production – 5,643,000 t

South America – Fertilizer Consumption



[CEPALSTAT DataBank](#)

Peru - Fertilizer Consumption



[CEPALSTAT DataBank](#)

Peru – Fertilizer Consumption in Nutrients

In 1961:

Nitrogen N (total) – 54,300 t

Phosphate P₂O₅ (total) – 30,300 t

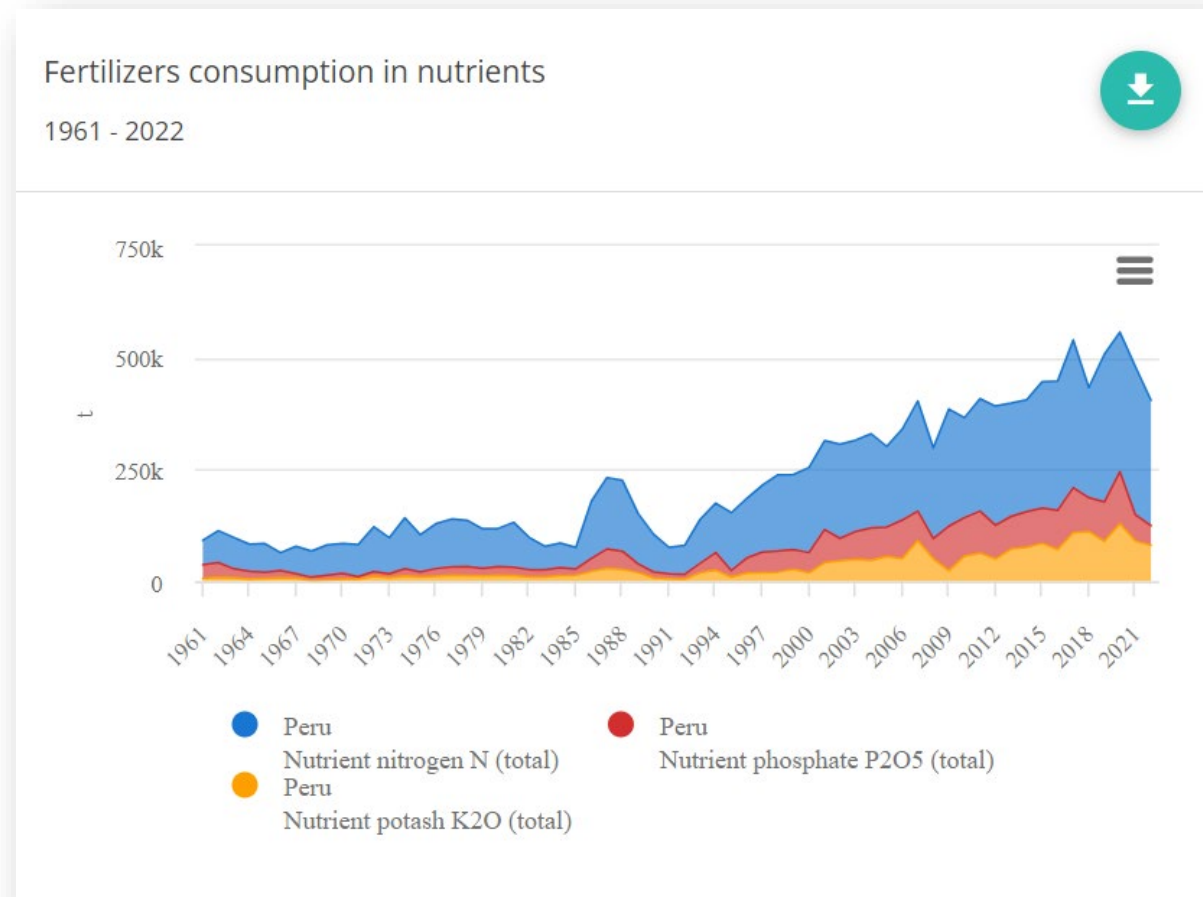
Potash K₂O – 6,800 t

In 2022:

Nitrogen N (total) – 280,000 t

Phosphate P₂O₅ (total) – 43,700 t

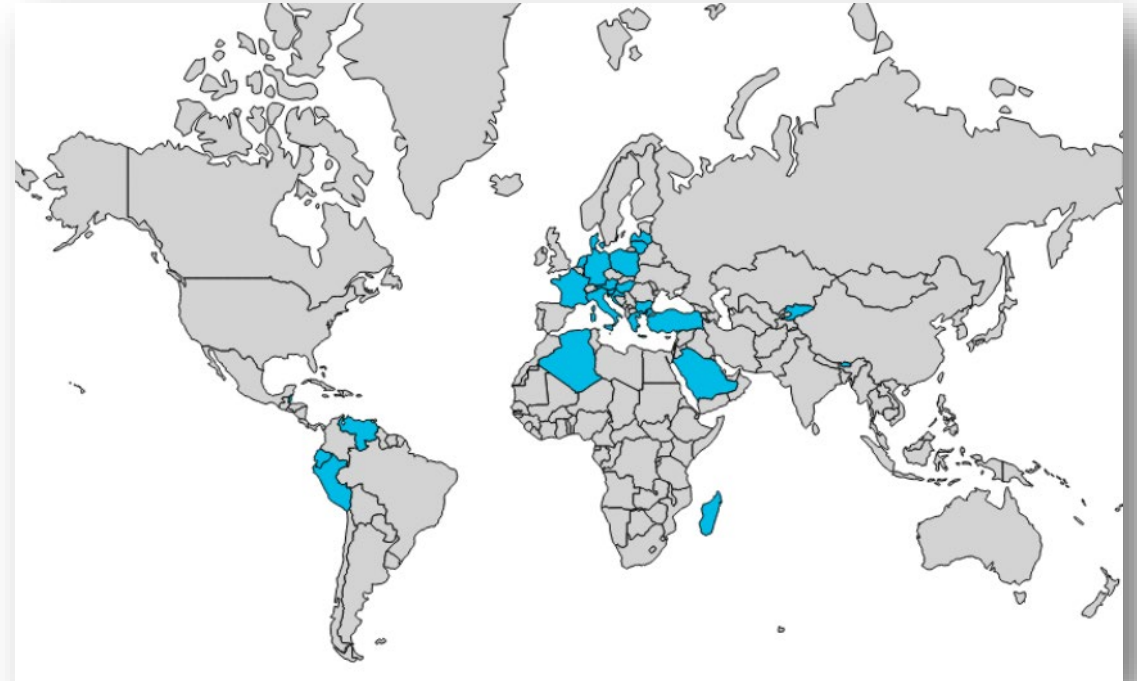
Potash K₂O – 80,900 t



UN FAO - [FAOSTAT](#)

Peru – GMOs

- On 3 November 2011, Congress approved the moratorium (with no votes against and only two abstentions) and then, on 9 December 2011, President Humala promulgated the law, banning the entry and production of GMOs for **ten years**. ([Latin America Bureau – LAB](#)).
- On January 6, 2021, the Peruvian Congress enacted a moratorium law prohibiting the entry and production of genetically modified organisms (GMOs) within its borders for the next **fifteen years**. ([International Federation of Organic Agriculture Movements – IFOAM](#)).
- No GMOs from 2011 until, at least, 2036.



[The Maca Team - Peru Bans GMOs Until 2035](#)
[Where Are GMOs Banned?](#)

El Niño and Climate Change

- Near the end of the year, unusual heavy rains have been observed along the coasts of northern Peru and Ecuador. Locals referred to this annual meteorological phenomenon as “El Niño,” meaning “The Baby Christ”, due to its appearance around the Christmas season.
- El Niño – Southern Oscillation (ENSO) causes ocean surface temperatures to increase in northern Peru and Ecuador, which, in turn, cause heavy rains and floods in northern Peru (e.g., Piura), and dry conditions and droughts in southern Peru (e.g., Puno).



<https://perufood.blogspot.com/2006/02/geography-and-cuisine-three-regions-of.html>

El Niño and Climate Change

- In the Apata district, and much of the central Junín region, the mountain is **drying** out. The parched margins of Lake Pomacocha, at 4,479 meters, are also a concern for alpaca herders, as **drought** conditions take hold, exacerbated by **climate change**, and particularly by the **El Niño** weather phenomenon. [The New Humanitarian | On El Niño's front line, drought drives Peruvian farmers off the land | Dec. 11, 2023.](#)
- Since 1st of December of 2023, the impact of heavy rains has caused **flooding**, landslides, and hailstorms throughout the country, particularly in the south, the Amazon rainforest, and the Northern coast. [UNICEF RELiefWeb | Peru Flash Update No. 1 \(Flooding and Dengue Outbreak\) - 01 Dec 2023 - 01 March 2024 - Peru | March 8, 2024.](#)
- The adverse impacts of the **climate** phenomenon affected Peru's economic growth in 2023 and brought damage to the **agricultural** sector, which according to experts had the worst decline since 1992. [AmericaEconomia | Coastal El Niño threat remains in effect in Peru, but would dissipate in April | March 18,2024.](#)

Deforestation

“Peru is among the world’s most biodiverse countries, although this status is threatened by **deforestation** and soil degradation.”

Deforestation is occurring at an annual rate of 0.2%. Drivers of deforestation include: (1) infrastructure development; (2) expansion of the agricultural frontier; (3) new settlements; (4) mining and hydrocarbon exploitation; (5) illegal mining; (6) logging; and (7) coca leaf cultivation.

Highway construction is the main driver of **deforestation** (Piu & Menton, 2014), not only for the construction itself but the development that occurs because of the presence of the road. 75% of deforestation in the Amazon region occurs within 20 km of a road (Oliviera et al 2007).

USAID, “Peru”, available at <https://www.land-links.org/country-profile/peru/>, accessed on 2 August 2024.

Moray (Valle Sagrado)



Laboratory for testing the adaptability of crops to different microclimates. The arrangement of the *andenes* (terraces) produces around 20 microclimates with higher temperatures in the bottom and lower temperatures as one moves up.

Tipon (Valle Sur)



Irrigation system consisting of *andenes* (terraces) and water distribution channels. Given that there are a number of micro-climates in the complex, it is believed that it was used as a laboratory.

Amaru Inca Yupanqui

History books are not rich in details, but it is said that ...

- **Amaru Inca Yupanqui**, Pachacutec's son and heir of the throne of the Inca Empire, was smart, charismatic and loved by the people, though he was not a warrior.
- Apparently, **Amaru Inca Yupanqui** was "*too good-of-a-person to be a ruler*" and, after less than ten years co-ruling with Pachacutec, his father decided to select Tupac Yupanqui, other of his sons, to be the next Inca.
- The problem with **Amaru Inca Yupanqui** is that he was more interested in developing the agriculture and managing the water resources of the empire than on conquering more land. He spent too much time building channels and dams, and managing the land ... and not enough fighting.



Thank you ...

- Moray was a laboratory for testing the adaptability of crops. The arrangement of the andenes (terraces) produces a gradient of microclimates with higher temperatures in the bottom and lower temperatures as one moves up. This way, up to 20 different microclimates could be represented.
- *Moray* era posiblemente un centro de investigación agrícola [incaico](#) donde se llevaron a cabo experimentos de cultivos a diferentes alturas, la disposición de sus [andenes](#) produce un gradiente de microclimas teniendo el centro de los andenes circulares concéntricos una temperatura más alta y reduciéndose gradualmente hacia el exterior a temperaturas más bajas, pudiendo de esta forma simular hasta 20 diferentes tipos de microclimas.²³ Se cree que Moray pudo haber servido como modelo para el cálculo de la producción agrícola no solo del [Valle del Urubamba](#) sino también de diferentes partes del [Tahuantinsuyo](#).

Kk Urban Water Supply

- Quality
- Losses

Hydro Power in Peru

Water and Government

Flooding

Droughts

Kk Urban Stormwater Drainage

- No slopes
- It does not rain in Lima

Agriculture

- In 2014, 22% of the population was rural, most of which work-in/depend-on **agriculture**.
- In 2013, 19% of the land was used for **agriculture**; and 58% were **forests**.
- In 2014, 7% of the annual Gross Domestic Product (GDP) was attributed to **agriculture**; 55%, to services; and 38%, to industry (including mining).

USAID, “Peru”, available at <https://www.land-links.org/country-profile/peru/>, accessed on 2 August 2024.

- Agricultural history of Peru - https://en.wikipedia.org/wiki/Agricultural_history_of_Peru

History

- Pre-Inca irrigation systems
- Nazca Puquios - <https://en.wikipedia.org/wiki/Puquios>
- Chavin agriculture - https://en.wikipedia.org/wiki/Chav%C3%ADn_culture
- Paracas culture - https://en.wikipedia.org/wiki/Paracas_culture#:~:text=The%20valley%20has%20extensive%20irrigation,the%20Paracas%20sphere%20of%20influence.
- Inca irrigation systems - https://en.wikipedia.org/wiki/Inca_aqueducts
- Colonial times

Horticulture in Pre-Inca Times

- The Guitarrero (Ancash) bean is the oldest bean of the American continent. There is evidence that local people domesticated it more than 8,000 years ago and, until now, it is part of their diet.
- There is evidence of horticulture in the:
 - Coast: Peanuts (1,800 BC), yuca (2,000 BC), sweet potato (2,000 BC), and achira (canna lily) (2,300 BC).
 - Andean mountain range: Potato (3,000 BC), quinoa (4,500 BC), beans (6,500 BC)

Agriculture in Pre-Inca Times

Macera, P., Historia del Peru Vol. 1, Editorial Bruño, 1990