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FAOSTAT ANALYTICAL BRIEF 68

# Inorganic fertilizers

2000–2021

## HIGHLIGHTS

- In 2021 world agriculture used 109 million tonnes of nitrogen, 46 million tonnes of phosphorus and 40 million tonnes of potassium fertilizers, down 1 percent since the previous year due to high fertilizers prices and disruptions to global supply chains that followed the COVID-19 pandemic.
- In the two most recent decades, the mean annual growth rate was 2.5 million tonnes per year, compared to 3.7 million tonnes per year in 1961–1990.
- Global use of inorganic fertilizers per area of cropland rose from 82 to 112 kilograms per hectare of cropland from 2000 to 2021. At the same time, use per value of production decreased from 51 to 47 kilograms per thousand dollars, while fertilizer use per person remained roughly constant, at around 25 kilograms per capita.
- Inorganic fertilizers agricultural use almost doubled in Africa between 2000 and 2021, to 7.6 million tonnes. Agricultural use per cropland area in Africa in 2021 was the lowest among regions at about 25 kilograms per hectare, roughly one-third of the use in the Americas and one-fifth of the use in Europe.
- A large decrease in agricultural use of inorganic fertilizers in China started in 2015, while use in the United States of America and the European Union remained rather stable, counteracting growth in Latin America and the Caribbean and the rest of Asia.

## FAOSTAT INORGANIC FERTILIZERS

### BACKGROUND

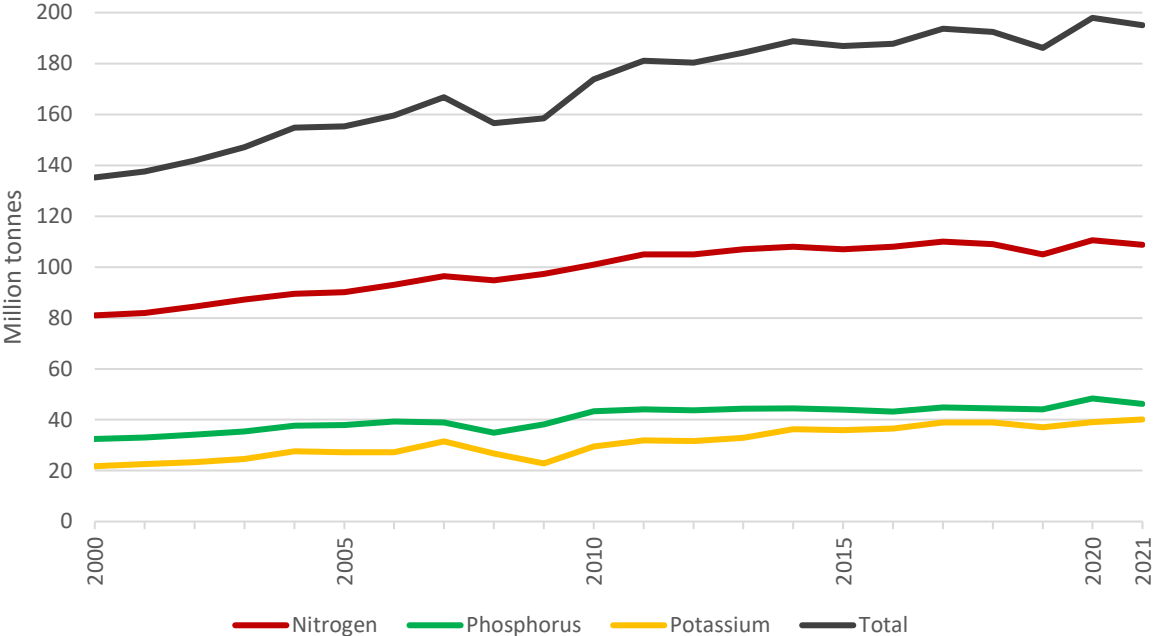
FAOSTAT provides statistics at the country, regional and global level on the production, trade and agricultural use of inorganic (mineral and chemical) fertilizers, by nutrient and by type, for the three *primary plant nutrients*: nitrogen (N), phosphorus (expressed as P<sub>2</sub>O<sub>5</sub>) and potassium (expressed as K<sub>2</sub>O). This brief discusses statistics of agricultural use of inorganic fertilizers and related indicators from 2000 to 2021, both globally and by region.

### GLOBAL

World agriculture used 109 million tonnes (Mt) of nitrogen, 46 Mt of phosphorus and 40 Mt of potassium fertilizers in 2021, amounting to 195 Mt of total inorganic fertilizers (Figure 1). This represented a decrease of 1 percent from 2020, linked to record-high levels in fertilizers prices (FAO and WTO, 2022) due to the disruptions in global supply chains that followed the global COVID-19 pandemic (IFA, 2021).

FAOSTAT data show that global use of total inorganic fertilizers for agriculture has slowed since 2000 compared to the 1961–1990 period, the first 30 years available on record. In the two most recent decades, the mean annual growth rate was  $2.5 \pm 0.6$  Mt per year (mean and 95 percent confidence interval), compared to  $3.7 \pm 0.2$  Mt per year in 1961–1990. Furthermore, the data show a large decrease in total use in China that started in 2015, while agricultural use in the United States of America and the European Union remained rather stable, counteracting growth elsewhere, especially in Latin America and the Caribbean and the rest of Asia.

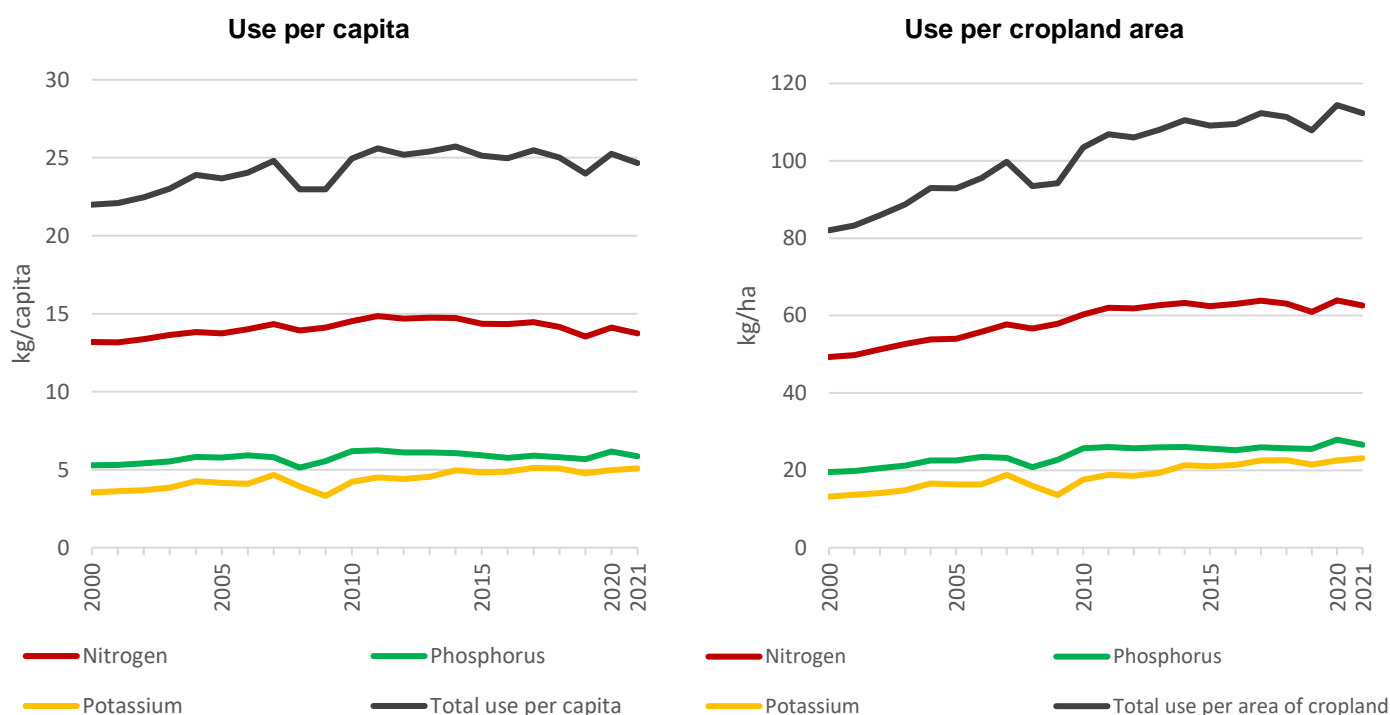
**Figure 1: World agricultural use of inorganic fertilizers by nutrient (as N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O)**



**Source:** FAO. 2023. Fertilizers by Nutrient. In: *FAOSTAT*. Rome. [Cited July 2023]. <http://www.fao.org/faostat/en/#data/RFN>

Between 2000 and 2021, the world’s agricultural use of fertilizers per area of cropland rose from 82 kilograms per hectare of cropland (kg/ha) to 112 kg/ha (Figure 2), signalling an overall intensification of agricultural practices. At the same time, inorganic fertilizer use per value of agricultural production indicated possible improvements in fertilizer use efficiency, decreasing from 51 kg per 1000 constant 2000–2004 international dollar (kg/1000 I\$) to 47 kg/1000 I\$, while fertilizer use per capita remained roughly constant at around 25 kg per capita. The trends in inorganic fertilizers use discussed above contributed to emissions from agrifood systems, via soil emissions of nitrous oxide (N<sub>2</sub>O) that typically follow application of fertilizers in agricultural fields. Additionally, fertilizers manufacturing generates emissions of CO<sub>2</sub> from the combustion of fossil fuels in the production process (FAO, 2022; FAO, 2023b).

Figure 2: Inorganic fertilizers agricultural use indicators by nutrient

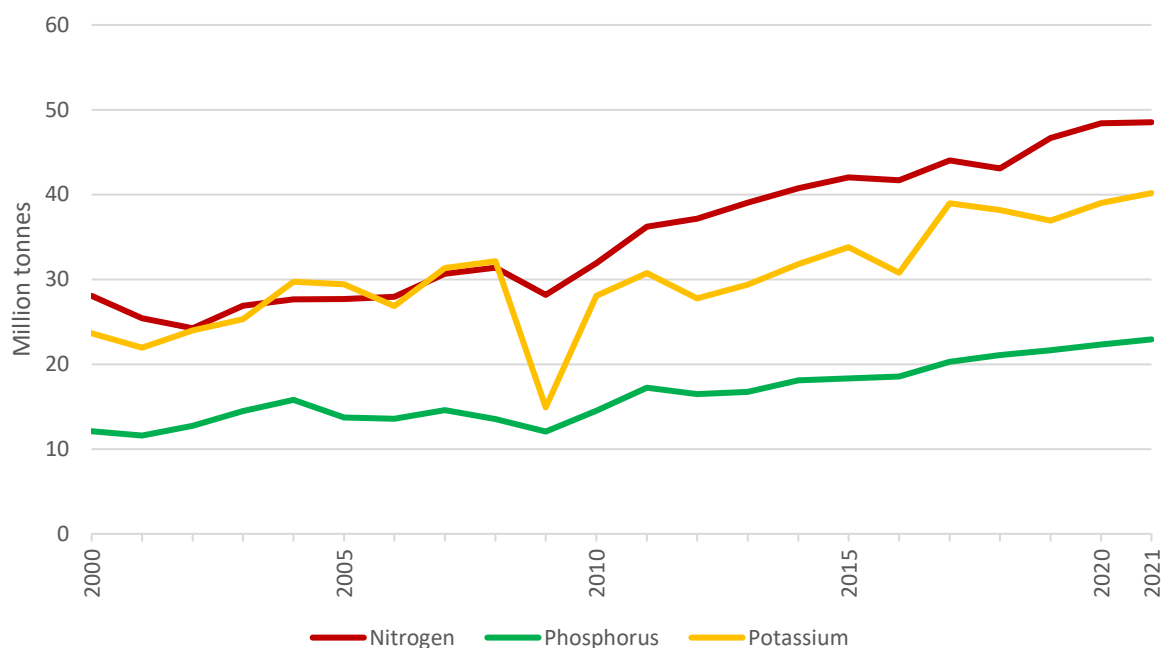


**Source:** FAO. 2023. Fertilizers by Nutrient. In: *FAOSTAT*. Rome. [Cited July 2023]. <http://www.fao.org/faostat/en/#data/RFN>

The production of inorganic fertilizers increased by 70 Mt between 2000 and 2021, just shy of 50 percent, from 143 Mt to 213 Mt. Most of this increase took place between 2000 and 2010. Nitrogen fertilizers, which accounted for 56 percent of the total volumes produced, increased from 85 Mt in 2000 to 119 Mt in 2021. Phosphorus and potassium fertilizers each represented 22–23 percent of the total production in 2021.

Global fertilizers imports (used here as a proxy for fertilizers trade) grew by 75 percent between 2000 and 2021, to 112 Mt, representing 52 percent of global agricultural use. Global nitrogen fertilizers imports remained stable between 2020 and 2021, while those of phosphorus and potassium fertilizers increased by 3 percent (Figure 3).

**Figure 3: World inorganic fertilizers imports by nutrient**



**Source:** FAO. 2023. Fertilizers by Nutrient. In: *FAOSTAT*. Rome. [Cited July 2023]. <http://www.fao.org/faostat/en/#data/RFN>

## REGIONAL

Inorganic fertilizers use in Africa has exhibited the strongest growth among all regions between 2000 and 2021 (95 percent), although from a very low base, from 3.9 Mt in 2000 to 7.6 Mt in 2021. Nitrogen fertilizers dominated the region's consumption, representing 63 percent of the total. Phosphorus fertilizers contributed 23 percent and potassium fertilizers 14 percent (Figure 4).

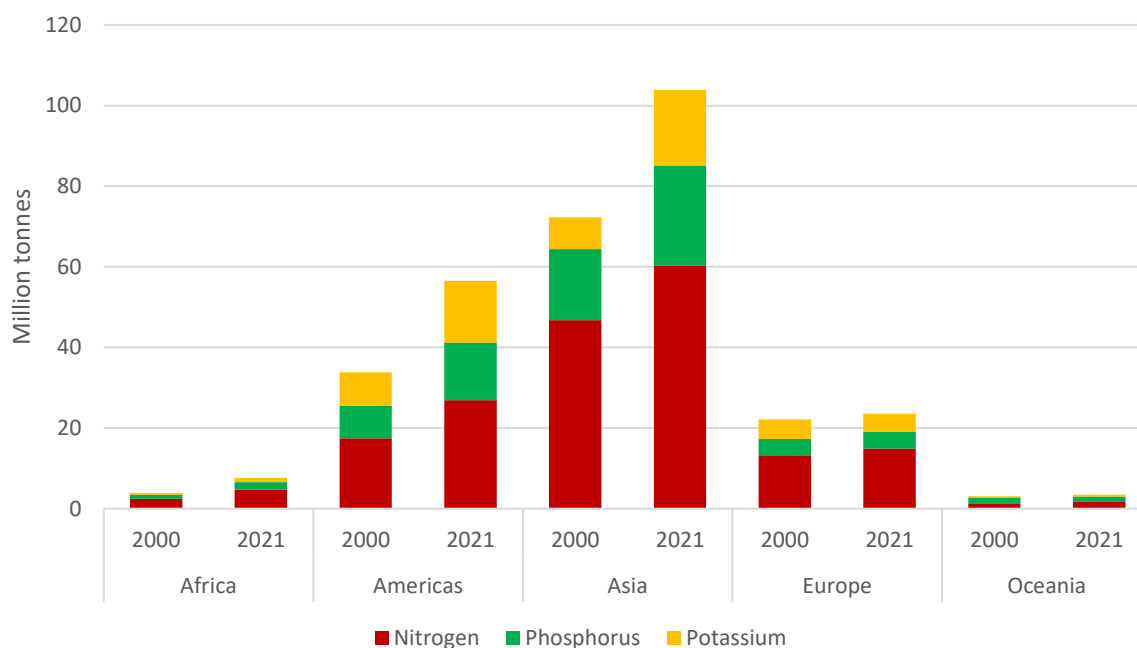
The use of fertilizers in the Americas also experienced a substantial rise (68 percent), increasing from 34 Mt in 2000 to 57 Mt in 2021. The region is the only one where nitrogen fertilizers accounted for less than 50 percent of total use (47 percent) in 2021, while phosphorus and potassium fertilizers each represented 26–27 percent of the total.

Agricultural use in Asia increased by 45 percent since 2000, from 72 Mt to 104 Mt in 2021. The data nevertheless show a strong downward trend since 2010, driven by reductions in China. Nitrogen fertilizers accounted for 59 percent of total applications, followed by phosphorus fertilizers (24 percent) and potassium (14 percent).

In Europe, the application of fertilizers increased less strongly between 2000 and 2021, by 9 percent from 22 Mt to 24 Mt. Nitrogen fertilizers contributed 62 percent of the total applications, with phosphorus and potassium fertilizers contributing 18–20 percent each.

Oceania used for agriculture 3.5 Mt in 2021, up 11 percent from the 3.1 Mt used in 2000. Nitrogen fertilizers accounted for 51 percent of the total use, while phosphorus fertilizers had the highest share among all regions (35 percent) and potassium fertilizers accounted for the remaining 15 percent.

Figure 4: Inorganic fertilizers agricultural use by nutrient and region

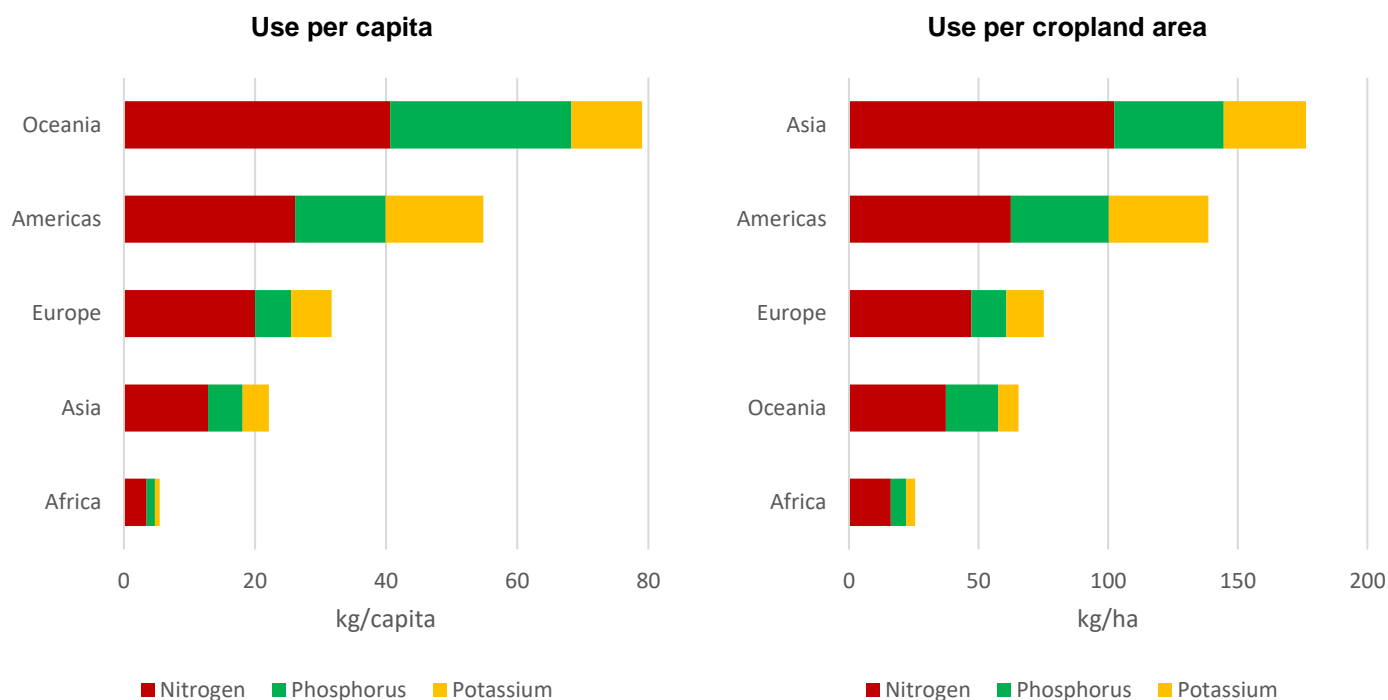


**Source:** FAO. 2023. Fertilizers by Nutrient. In: *FAOSTAT*. Rome. [Cited July 2023]. <http://www.fao.org/faostat/en/#data/RFN>

Agricultural use of inorganic fertilizers per person ranged from as low as 5 kg per capita in Africa to as high as 79 kg per capita in Oceania in 2021 (Figure 5). The low values in Africa could be related to affordability and availability of inorganic fertilizers, and a heavy reliance on traditional farming practices that do not incorporate the use of inorganic fertilizers. The Americas had the second highest use per person (55 kg per capita), followed by Europe (32 kg per capita) and Asia (22 kg per capita). These intermediate values point to a more efficient use of fertilizers in these regions, which could be a result of advanced and diverse agricultural practices in these regions along with environmental regulations to improve sustainability.

Agricultural use of fertilizers per cropland area highlights differences in agricultural systems across regions: in 2021, the use per area of cropland ranged from 26 kg/ha in Africa to 176 kg/ha in Asia. Africa's low fertilizer use per hectare indicates challenges in terms of access to inorganic products, though they may be complemented in some countries by larger amounts of organic manure (FAO, 2018). Conversely, the high values in Asia and the Americas suggest a predominance of intensive agriculture and high-yielding agricultural cropping systems. With 65 kg/ha and 75 kg/ha, respectively, Oceania and Europe had intermediate values among regions.

**Figure 5: Inorganic fertilizers agricultural use indicators by nutrient and region (2021)**



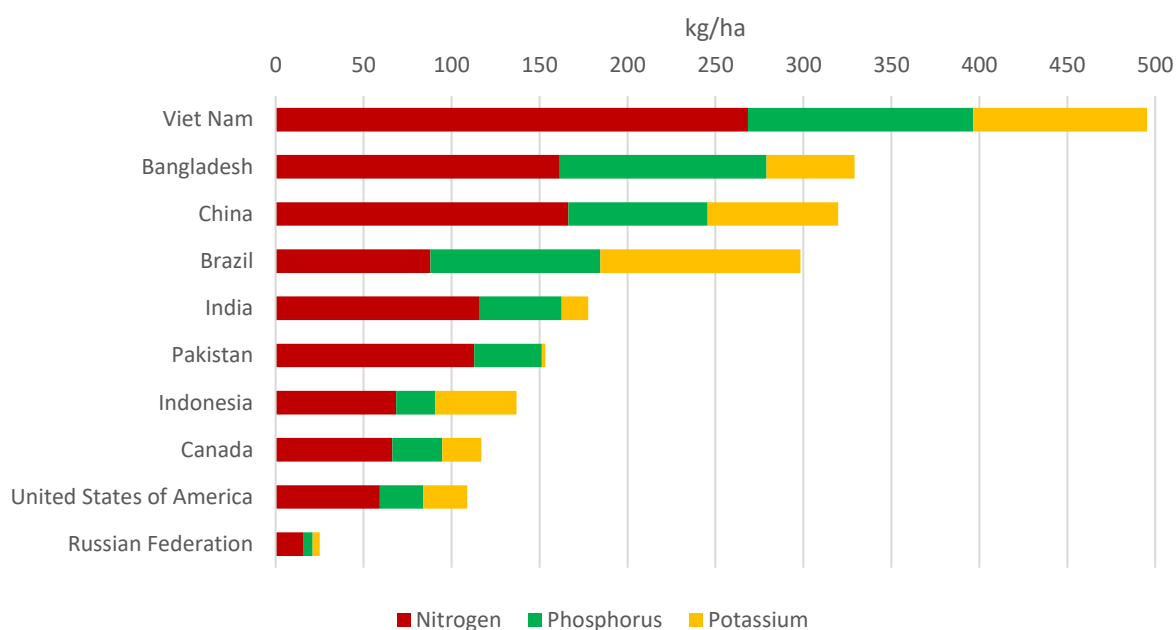
**Source:** FAO. 2023. Fertilizers by Nutrient. In: *FAOSTAT*. Rome. [Cited July 2023]. <http://www.fao.org/faostat/en/#data/RFN>

## COUNTRY

The range of inorganic fertilizers use per cropland area varied significantly among the top ten users of fertilizers, from 25 kg/ha in the Russian Federation to 495 kg/ha in Viet Nam (Figure 6). The high values in Viet Nam, Bangladesh and China may reflect use for multiple cropping cycles, especially for rice, while those in Brazil reflect the strong intensification of production in recent decades, especially maize. India, Pakistan and Indonesia had similar applications of fertilizers per cropland, between 137 kg/ha and 178 kg/ha. This was also the case for Canada (117 kg/ha) and the United States of America (109 kg/ha), reflecting similar farming practices in these countries.

Among the top users of inorganic fertilizers, Pakistan had the largest share of nitrogen fertilizers (74 percent), while Bangladesh had the largest share of phosphorus fertilizers (36 percent) and Brazil the largest share of potassium fertilizers (38 percent).

Figure 6: Inorganic fertilizers agricultural use per cropland area in top users (2021)



**Source:** FAO. 2023. Fertilizers by Nutrient. In: *FAOSTAT*. Rome. [Cited July 2023]. <http://www.fao.org/faostat/en/#data/RFN>

## EXPLANATORY NOTES

### Data sources

The main data source for the *production* and *agricultural use* of inorganic fertilizers is the Food and Agriculture Organization of the United Nations (FAO) fertilizers questionnaire (FAO, 2023c). Trade data (*imports* and *exports*) were also obtained via questionnaire for the period 1961–2001, but from 2002 onwards they are obtained from the United Nations Commodity Trade Statistics (UN Comtrade) database (UNSD, 2023).

Imputations to fill gaps, due to missing or non-usable data, are based mainly on the aggregation of product data converted to nutrients, on balances based on the equation “production + imports = exports + agricultural use + other uses”, or on additional data (from associations, publications, etc.). In the process of imputation and quality control, data are also discussed with industry experts as part of an ongoing collaboration with the International Fertilizer Association (IFA), within the scope allowed by its confidentiality obligations. IFA provides fertilizer statistics through IFASTAT (IFA, 2023).

### Data structure in FAOSTAT

The data on inorganic fertilizers in FAOSTAT are organised in the following domains or datasets:

- > **‘Fertilizers by nutrient’** provides data on the production, import, export and agricultural use of inorganic fertilizers, expressed by total content in tonnes of the primary nutrients: nitrogen (N), phosphorus (expressed in equivalent quantity of the oxide form P<sub>2</sub>O<sub>5</sub>) and potassium (also



expressed in oxide form, as K<sub>2</sub>O). The domain also provides the ratio between the agricultural use of inorganic fertilizers, in total by nutrient (for N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O), and the area of cropland (the sum of arable land and permanent crops), population and value of agricultural production. It currently covers the period 1961–2021.

- > **'Fertilizers by product'** and **'Fertilizers archive'** provide information on the production, imports, exports and agricultural use of different types of inorganic fertilizers products. Some of these are *straight fertilizers*, which means that they have a declarable content of only one of the three primary nutrients (e.g. N: urea, ammonium sulphate, ammonium nitrate; P: superphosphates; K: potassium chloride). Other fertilizers are *compound fertilizers*, which means that they have a declarable content of more than one of the three primary plant nutrients (e.g., NP: diammonium phosphate, NK: potassium nitrate; all three nutrients: NPK fertilizers). The domain 'Fertilizers archive' covers the period 1961–2001 and contains data expressed in nutrients but disaggregated by product, whereas the domain 'Fertilizers by product' currently covers the period 2002–2021 and contains data expressed in tonnes of product. The conversion from tonnes of product to tonnes of nutrient can be estimated using default conversion factors (concentrations), e.g. for urea: 46 percent N. A list of conversion factors is provided in the 'related documents' section of the 'Fertilizers by Nutrient' domain.

FAOSTAT also provides estimates for agricultural use of some organic fertilizers (which represent the other main category of fertilizers, comprising residues of plants and animals and human wastes). In particular, data on nitrogen inputs from livestock manure to agricultural soils are provided in the FAOSTAT domain **'Livestock manure'**. Those estimates are compiled using FAO statistics on animal stocks and applying the Guidelines of the Intergovernmental Panel on Climate Change (IPCC, 2006), as discussed in detail in the FAOSTAT brief on 'Livestock and environment statistics' (FAO, 2020).

The present analytical brief, however, is focused on inorganic fertilizers, and therefore on the FAOSTAT domains listed above. Additional documentation for the data provided in this brief, regarding methodology and specific country notes, is provided in the 'related documents' section of the corresponding FAOSTAT domains.

Each domain also has a section on 'definitions and standards', which provides an explanation of the different terms and categories used. It includes a description of the flags used, which are short codes provided next to each value to indicate the type of data source. Flags allow distinguishing official data, provided via questionnaire or reported in official publications, from data calculated by balance or imputed with other methods.

These FAOSTAT domains are updated annually. Each update is aimed at continuously improving the data and their usefulness for users. Comments, doubts and suggestions may be provided by writing to [faostat@fao.org](mailto:faostat@fao.org) or by filling out the brief questionnaire available through the "help us improve this site" button at the right-hand side of the FAOSTAT website (<http://www.fao.org/faostat/en>).



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