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FAOSTAT ANALYTICAL BRIEF 27

Inorganic fertilizers

1961–2019

>> FAO Statistics Division

HIGHLIGHTS

→ **Global agricultural use of inorganic fertilizers has risen significantly between 1961 and 2019, from about 10 million to close to 110 million tonnes for nitrogen, from about 10 million to close to 45 million tonnes for phosphorus (as P_2O_5), and from less than 10 million to over 35 million tonnes for potassium (as K_2O).**

→ **A few countries with a high share of the total dominate the global use. In the last decade, China represented almost 30 percent of the global agricultural use. The four largest consumers (Brazil, China, India and the United States of America) represented together almost 60 percent of the world total for nitrogen, and close to 65 percent for phosphorus and potassium.**

→ **The expansion of inorganic fertilizers use since the 1960s has been stronger in Asia. In 1961–1964 it represented less than 20 percent of the world total, compared to over 50 percent of the total, for all three nutrients, in 2015–2019. In the last five years, however, Asia showed no growth overall in inorganic fertilizers use.**

→ **In Africa, use of inorganic fertilizers is much lower than in Asia, the Americas or Europe, although it has expanded over time. In 2015–2019 Africa represented over 3.5 percent of global agricultural use for nitrogen and phosphorus, and over 2 percent for potassium.**

FAOSTAT INORGANIC FERTILIZERS

BACKGROUND

FAOSTAT provides statistics at country, regional and global level on the production, trade and agricultural use of inorganic (mineral or chemical) fertilizers, by nutrient and by product.

The nutrients covered are the three *primary nutrients*: nitrogen, phosphorus and potassium, which are used in large quantities by plants. Oxygen, carbon and hydrogen are also essential elements that plants use in large quantities, but plants obtain those directly from the air and water. Other nutrient categories are the *secondary nutrients* (calcium, magnesium and sulphur), which are required in smaller but still significant quantities, and the *micronutrients*, which are also essential but are required in very small quantities (FAO, 1984).

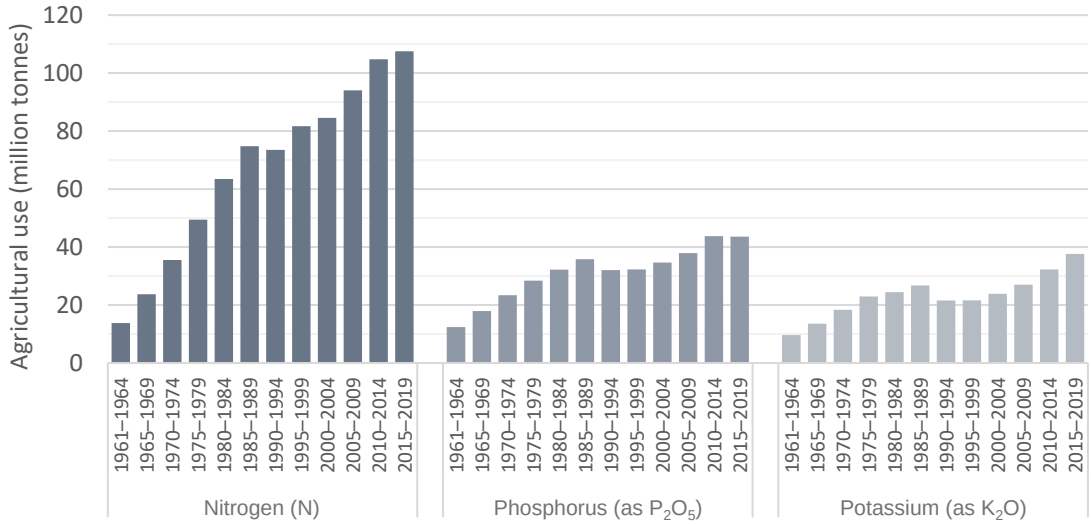
This brief provides estimates of agricultural use of inorganic fertilizers from 1961 to 2019, both globally and by major region (Africa, the Americas, Asia, Europe and Oceania). At country level, it presents the

top producers and top consumers and their share of the world total. The brief also provides maps with the country ratios of fertilizer use with respect to the area of cropland.

GLOBAL

Inorganic fertilizer use strongly increased between 1961 and 2019, particularly for nitrogen (Figure 1). World agricultural use of nitrogen (N) was about 10 million tonnes in 1961, rising to close to 110 million tonnes in 2019. For phosphorus (expressed as P_2O_5), the data show an increase from about 10 million tonnes in 1961 to close to 45 million in 2019, and for potassium (espressed as K_2O), from less than 10 to over 35 million tonnes. Cropland area also expanded during the 1961–2019 period, but at a much more limited pace, about 15 percent (FAO, 2021c).

Figure 1. World agricultural use of inorganic fertilizers (by nutrient, as N, P_2O_5 and K_2O)

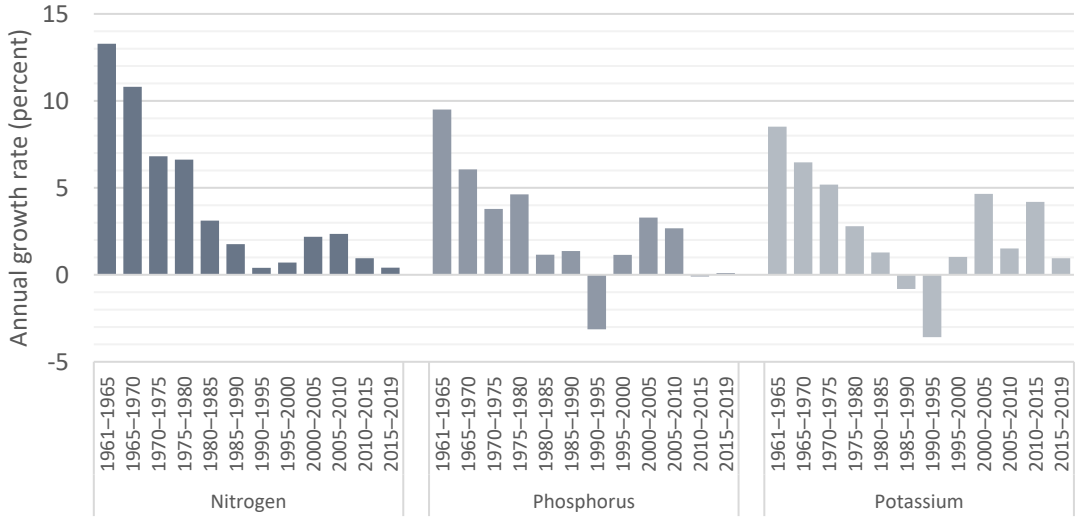


Source: FAO, 2021a.

The global growth rates[1] in use of inorganic fertilizers are shown in Figure 2, by nutrient. They were especially low around 1990–1994, led by a contraction in fertilizer use in Europe at the time of the dissolution of the former Union of Soviet Socialist Republics (USSR). The total growth rates have also been low in the last five years, 2015–2019, particularly influenced by Asia, which shows no growth overall in this period. Determining the exact level of growth at these low values is however limited by the data uncertainty. The International Fertilizer Association (IFA, 2021) provides estimates on fertilizer use, which are also considered in the quality control and the imputation of the Food and Agriculture Organization of the United Nations (FAO) data. The global values from IFA are close to the FAO estimates presented here, but they show for instance some growth in the agricultural use of phosphorus during the last decade.

[1] Annual growth rates calculated as geometric averages: $[(X_n / X_0)^{(1 / n)} - 1] * 100$ (ESCAP, 2015).

Figure 2. Annual growth rate of agricultural use of inorganic fertilizers (by nutrient)



Source: FAO, 2021a.

REGIONAL

The expansion of the agricultural use of inorganic fertilizers during the last six decades has been stronger in **Asia**, as shown in Figures 3 and 4. Nitrogen consumption in this region represented less than 20 percent of the world total in 1961–1964, and it has risen to almost 60 percent in 2015–2019. For phosphorus, the share of the region has risen from close to 10 percent in 1961–1964 to over 55 percent of the world total in 2015–2019, and for potassium from less than 10 percent to over 50 percent. During the last five years, however, the estimates show no growth in the use of inorganic fertilizers (for about a decade in the case of nitrogen and potasium). This is driven mainly by the data for China, which during the last decade represented about 50 percent of the values for the region in all three nutrients.

Data for **Europe,** in contrast, showed a strong reduction in agricultural use levels around 1990–1994, the time of the dissolution of the former USSR.[2] Use of inorganic fertilizers in Europe remained quite flat overall since then, at about 14 million tonnes for N and about 4 million tonnes each for P_2O_5 and K_2O. These levels represent about 14 percent, 9 percent and 11 percent of the world total in 2015–2019 (for N, P_2O_5 and K_2O, respectively).

The **Americas** have remained, during most of the period 1961–2019, the region with the second highest levels of inorganic fertilizers use (with Europe initially in the first position and currently Asia). Growth in the Americas, however, has been less intense than in Asia, and in 2015–2019 use levels in the Americas were about 35 percent of those in Asia for nitrogen, about 50 percent for phosphorus, and about 65 percent for potassium.

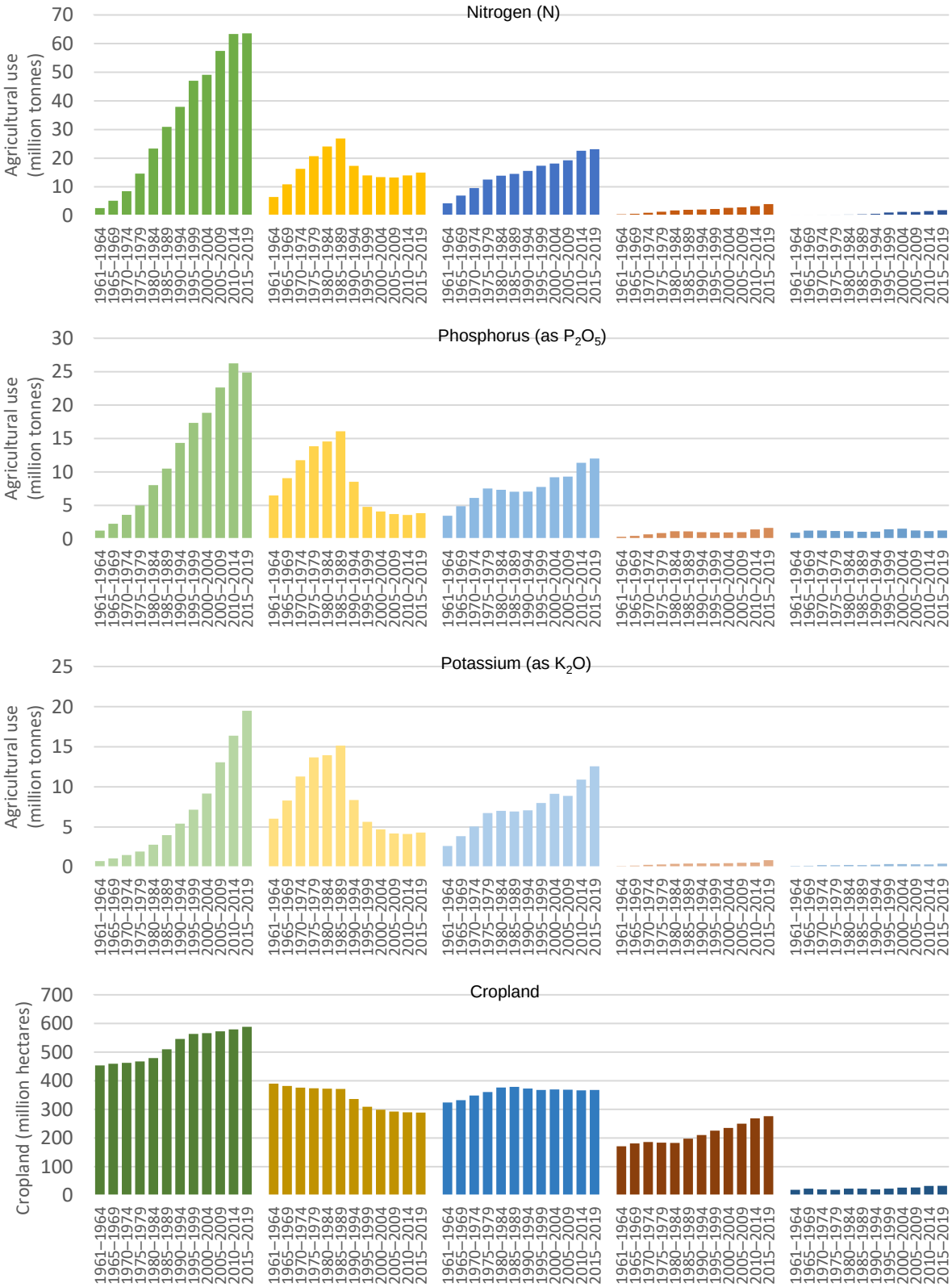
[2] In FAOSTAT, Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan are classified in Asia, whereas the former USSR is classified entirely in Europe. This reallocation of areas explains most of the increase in cropland area for Asia around 1990 shown in Figure 3, and the corresponding decrease in Europe. However, this reallocation from Europe to Asia contributes very little to the reduction in fertilizer use observed for Europe at that time (the reallocation represents 5 percent or less of the decrease, for each nutrient).

Africa represents a much lower share than Asia, the Americas or Europe in the global agricultural use of inorganic fertilizers. In 1961–1964, it represented about 3 percent of the world total for nitrogen, close to 2.5 percent for phosphorus, and slightly over 1 percent for potassium. However, fertilizer use has been rising in this region over time and Africa has increased its share in the three nutrients, reaching over 3.5 percent of the world total for nitrogen and phosphorus and over 2 percent for potassium in 2015–2019.

Oceania in 1961–1964 represented less than 0.5 percent of the global use of inorganic fertilizers in terms of nitrogen and less than 1.5 percent in terms of potassium. For phosphorus, in contrast, data show a much higher share at the time, about 7.5 percent of the world total. The levels of phosphorus use have remained quite stable over time, but this implied a decline of the global share, to below 3 percent of global agricultural use in 2015–2019. The share for nitrogen has risen instead, to over 1.5 percent of the world total in 2015–2019. For potassium, use levels have increased slightly but the global share declined, although remaining over 1 percent in 2015–2019.

Figure 3 also shows the area of **cropland** for these five regions. Cropland is the sum of arable land (temporary crops, temporary meadows and pastures, and land with temporary fallow) and permanent crops. In Figure 3, the level of fertilizer use in each reagion can be compared with the extension of cropland, and it can be observed, for instance, that at present the share of global fertilizer use in Asia is higher than its cropland share, whereas fertilizer use in Africa is much lower than its global cropland share.

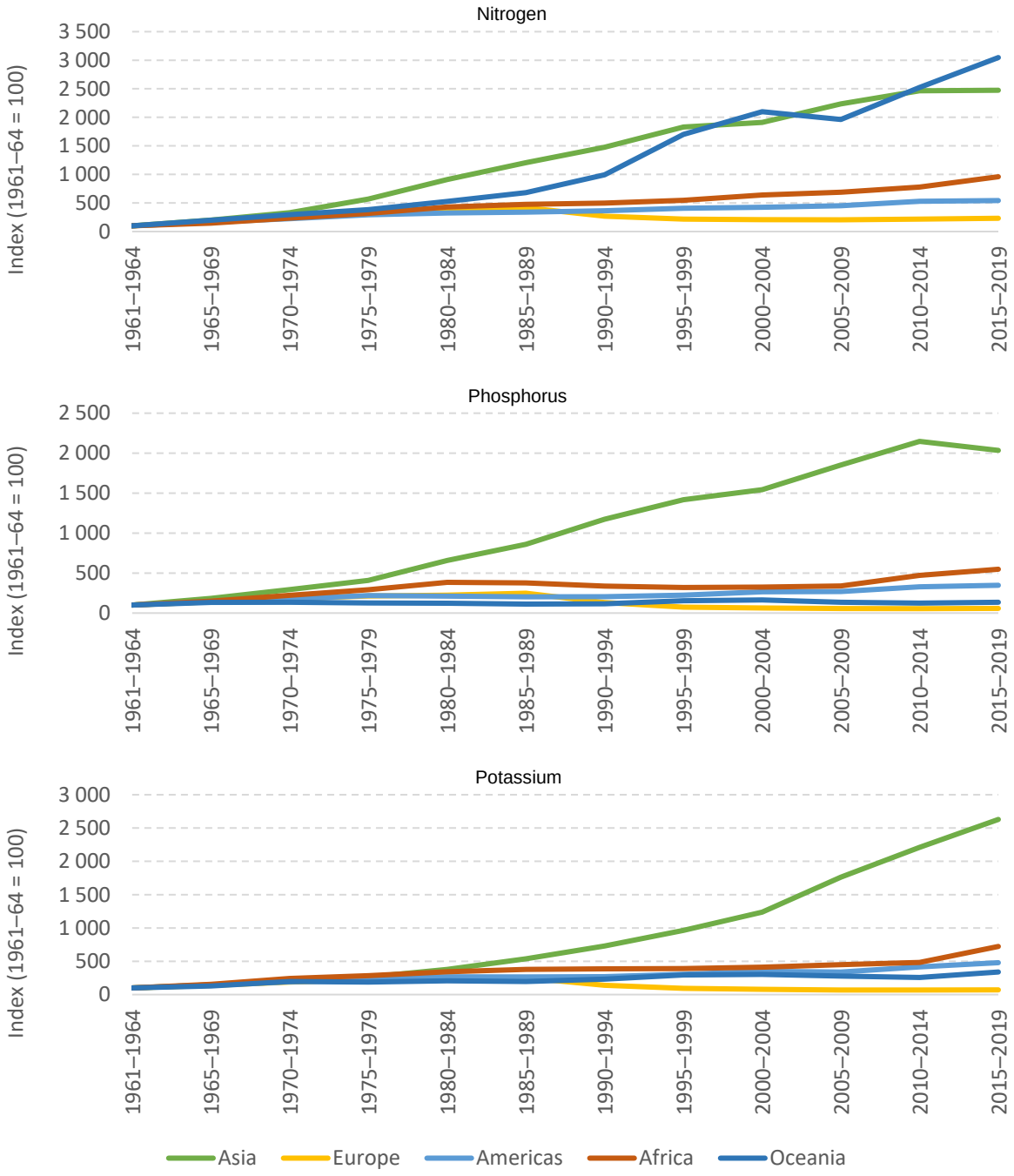
Figure 3. Fertilizer use (N, P_2O_5 and K_2O) and cropland area, by region



Source: FAO, 2021a and 2021b.

Figure 4 shows the evolution by region of each nutient as an index, with the same starting point (average use in 1961–64 as 100). Africa, with much lower starting levels, shows a higher growth in relative terms than Europe and the Americas, up to 2019. This growth strenghens in the last decade. Similarly, Oceania shows a strong growth in use of nitrogen in relative terms. This is led by Australia (which represented 75 percent of nitrogen use in the region in 2015-2019) and to a lesser extent by New Zealand (which represented 24 percent of the regional total in the same period).

Figure 4. Agricultural use of inorganic fertilizers by region (as index, 100 = 1961–64 average)



Source: FAO, 2021a.

COUNTRIES

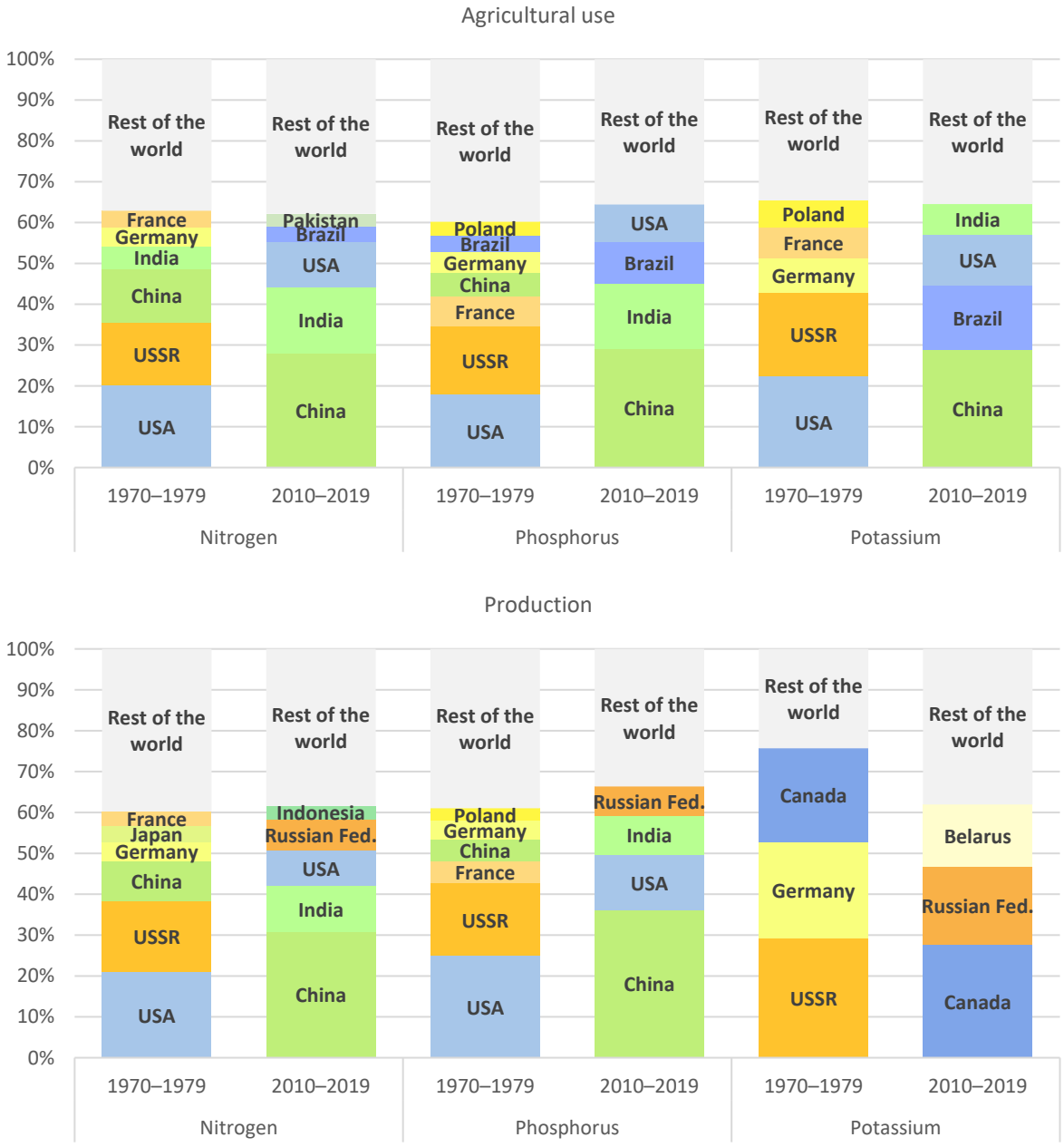
A few countries representing a high share of the total dominate the profiles observed in Figures 1 to 4. Figure 5 shows that, for all three nutrients and for both production and agricultural use, the top seven countries represent at least 60 percent of the world total.

At present, China, India, the Russian Federation and the United States of America are the largest producers of inorganic fertilizers for nitrogen and phosphorus (representing together close to 60 percent and over 65 percent of the world total, respectively). Canada, the Russian Federation and Belarus are the largest producers for potassium (they represent together over 60 percent of the world total).

Regarding agricultural use, Brazil, China, India and the United States of America are the largest consumers of inorganic fertilizers, representing almost 60 percent of the world total for nitrogen and almost 65 percent for phosphorus and potassium.

The difference between production and use in their distribution by countries provides an indication of the magnitude of trade. In Figure 5 these differences are the largest for potassium, and indeed potassium is the nutrient with the highest share of trade over total agricultural use. Data on production, agricultural use and trade by country are available in the ‘Fertilizers by Nutrient’ domain in FAOSTAT (FAO, 2021a).

Figure 5. Countries that jointly represent over 60 percent of the world total for production and agricultural use in 1970–1979 and 2010–2019, by nutrient[3]



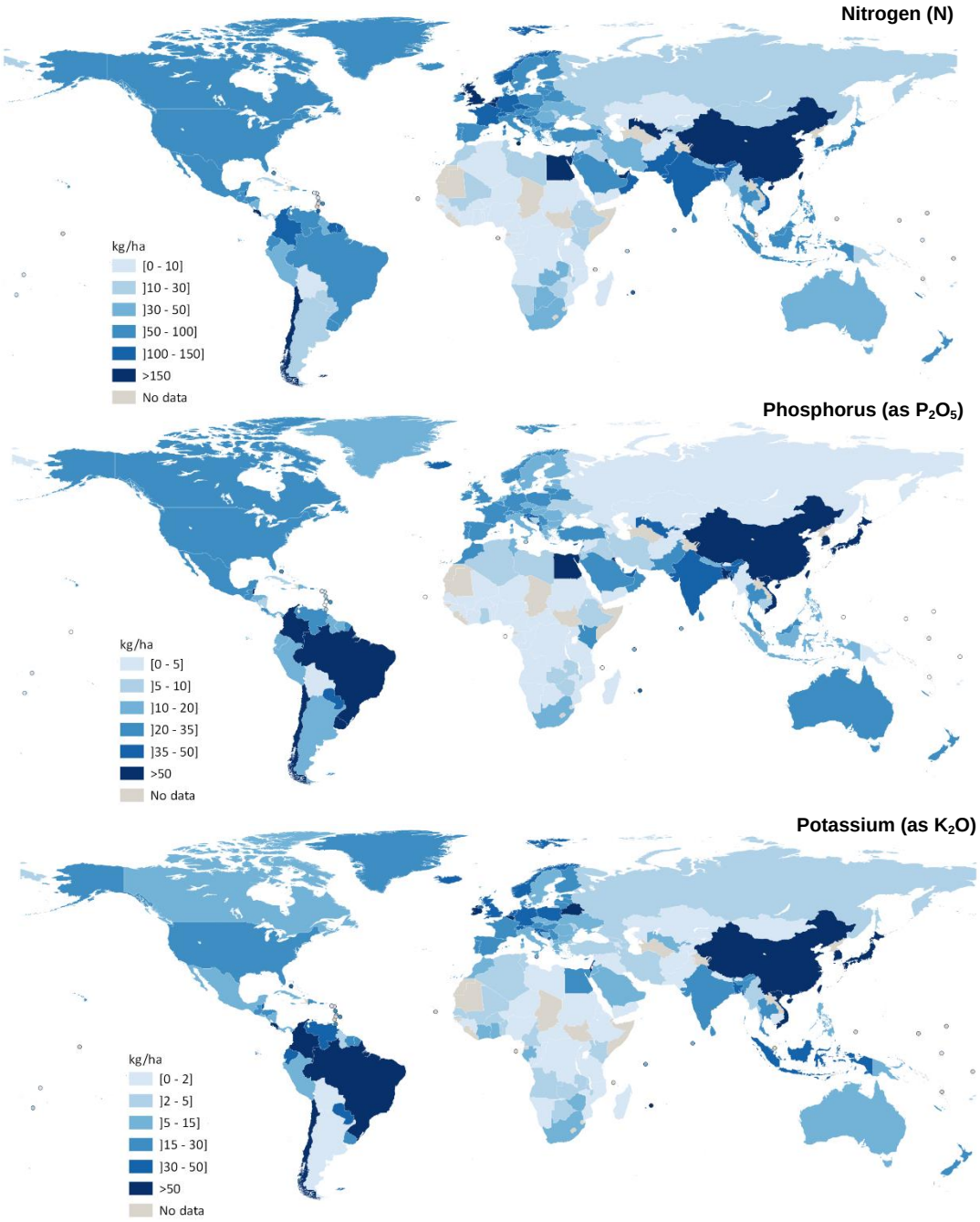
Source: FAO, 2021a.

[3] Russian Fed.: Russian Federation; USSR: Union of the Soviet Socialist Republics; USA: United States of America.

The amount of fertilizer used can also be analysed with respect to the size of each country or region. This information is provided in FAOSTAT with respect to the area of cropland, which is the sum of arable land and permanent crops. The ratio between total use of inorganic fertilizers (by nutrient) and area of cropland is available in the ‘Fertilizers indicators’ domain as ‘use per area of cropland’ (FAO, 2021c).

The geographic distribution of those values are presented in Figure 6. Africa, for instance, shows in general lower levels in this ratio, but there are differences within the region. Among the four main consumers (Brazil, China, India and the United States of America), China and India show higher ratios for nitrogen, and China and Brazil for phosphorus and potassium.

Figure 6. Fertilizer use per area of cropland (2010–2019 average for N, P_2O_5 and K_2O, in kg per hectare of cropland)



The boundaries and names shown and the designations used on these maps do not imply the expression of any opinion whatsoever on the part of FAO concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers and boundaries. Dashed lines on maps represent approximate border lines for which there may not yet be full agreement. Final boundary between the Republic of Sudan and the Republic of South Sudan has not yet been determined. Dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties.

Source: FAO, 2021c based on UN Geospatial, 2020.

EXPLANATORY NOTES

Data sources

The main FAO data source for the *production* and *agricultural use* of inorganic fertilizers is the fertilizers questionnaire (FAO, 2021d). Trade data (*imports* and *exports*) were also obtained via questionnaire for the period 1961–2001, but from 2002 onwards they are obtained from UN Comtrade (DESA/UNSD, 2021).

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, 2021).

Data structure in FAOSTAT

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

- **'Fertilizers by nutrient'** (FAO, 2021a) 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_2O_5) and potassium (also expressed in oxide form, as K_2O). This domain currently covers the time period 1961–2019.
- **'Fertilizers by product'** (FAO, 2021e) and '**Fertilizers archive'** (FAO, 2020c) provide information on the production, import, export 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' covers currently the period 2002–2019 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 (FAO, 2021a).
- **'Fertilizers indicators': use per area of cropland** (FAO, 2021c) provides the ratio between the agricultural use of inorganic fertilizers, in total by nutrient (for N, P_2O_5 and K_2O), and the area of cropland (the sum of arable land and permanent crops).

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'** (FAO, 2020a). 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, 2020b).

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 (FAO 2021a, 2021b and 2021c).

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 distinguising 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 and questions may be provided by writing to faostat@fao.org or by filling out the brief questionnaire available throught the "help us improve this site" button at the right-hand side of the FAOSTAT website (http://www.fao.org/faostat/en).

REFERENCES

DESA/UNSD. 2021. United Nations Comtrade database. Available at: https://comtrade.un.org/. (See disclaimer about the coverage and limitations of UN Comtrade data at: http://comtrade.un.org/db/help/uReadMeFirst.aspx).

ESCAP. 2015. *Average growth rate: Computation methods*. Stats Brief. Issue No. 07. April 2015.United Nations Economic and Social Comission for Asia and the Pacific. Available at: https://www.unescap.org/resources/stats-brief-april-2015-issue-no-07-average-growth-rate-computation-methods.

FAO. 1984. *Fertilizer and plant nutrition guide*. FAO Fertilizer and plant nutrition bulletin 9. Land and Water Development Division. Available at: http://www.fao.org/3/a-aq355e.pdf.

FAO. 2020a. FAOSTAT: Livestock Manure. In: *FAO.org* [online]. Available at: http://www.fao.org/faostat/en/#data/EMN.

FAO. 2020b. *Livestock and environment statistics: manure and greenhouse gas emissions. Global regional and country trends 1990–2018*. FAOSTAT Analytical Brief Series. Available at: http://www.fao.org/3/cb1922en/cb1922en.pdf.

FAO. 2020c. FAOSTAT: Fertilizers Archive. In: *FAO.org* [online]. Available at: http://www.fao.org/faostat/en/#data/RA.

FAO. 2021a. FAOSTAT: Fertilizers by Nutrient. In: *FAO.org* [online]. Available at: http://www.fao.org/faostat/en/#data/RFN.

FAO. 2021b. FAOSTAT: Land Use. In: *FAO.org* [online]. Available at: http://www.fao.org/faostat/en/#data/RL.

FAO. 2021c. FAOSTAT: Fertilizers indicators. In: *FAO.org* [online]. Available at: http://www.fao.org/faostat/en/#data/EF.

FAO. 2021d. Fertilizers questionnaire. FAO Statistics Division. In: *FAO.org* [online]. Available at: http://www.fao.org/statistics/data-collection/en/

FAO. 2021e. FAOSTAT: Fertilizers by Product. In: *FAO.org* [online]. Available at: http://www.fao.org/faostat/en/#data/RFB.

IFA. 2021. *IFASTAT.Consumption database.* International Fertilizer Association. [Cited 10 June 2021]. Available at: https://www.ifastat.org/databases/plant-nutrition.

IPCC. 2006. *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. Prepared by the National Greenhouse Gas Inventories Programme, Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (eds). Published: IGES, Japan. Available at: https://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html.

UN Geospatial. 2020. *United Nations Clear Map* [online]. Cited June 2021. https://geoservices.un.org/Html5Viewer/index.html?viewer=clearmap

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