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INTERNATIONAL FERTILIZER ASSOCIATION

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Public Summary
Medium-Term Fertilizer Outlook 2022 – 2026

IFA Market Intelligence Service

This report is a summary of IFA's Medium-Term Outlook, prepared by the Market Intelligence Service to accompany IFA's Medium-Term Outlook Presentation, which is available to IFA members.

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Notes and definitions:

- ✓ All volume data presented in this report is expressed in nutrient metric tonnes, unless stated otherwise. Nutrient tonnes reflect the N, P_2O_5 and K_2O content of nitrogen, phosphate and potash fertilizers respectively, rather than the physical weight of the product being used (product tonnes).
- ✓ The terms nitrogen, phosphate and potash are used to denote groups of nutrient-bearing fertilizers which are produced and traded globally. The terms nitrogen, phosphorous and potassium refer to the nutrients required by the soil.
- ✓ Annual periods refer to the calendar year unless stated otherwise, and when FY precedes a year, it refers to the Fertilizer Year. A detailed definition of IFA's Fertilizer Year can be found at the end of this report.

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BACKDROP TO THE FERTILIZER OUTLOOK

The situation in Ukraine requires a new methodology to assess future fertilizer supply and demand

This Medium-Term Fertilizer Outlook has been prepared in the months following Russia's invasion of Ukraine in February 2022. Beyond the humanitarian impacts, this act triggered widespread disruption in global commodity markets, from energy to grains, to fertilizers.

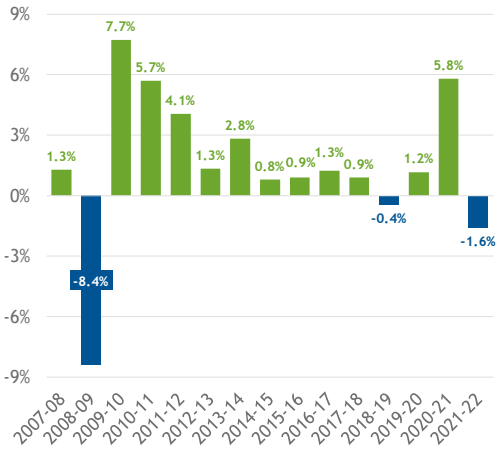
This summary report focuses on IFA's forecast for fertilizer supply and consumption in the next two fertilizer years (FY 2022 and FY 2023), when the impact of recent events is expected to be most severe, and when there is better visibility over potential scenarios. This report also discusses the five-year outlook, noting the significant uncertainty in forecasting this year given the volatile market conditions.

IFA has developed a new forecasting methodology in response to the war in Ukraine, to reflect that short-term fertilizer use is likely to be more heavily dictated by the availability of fertilizers, with less emphasis on underlying crop forecasts and agronomic considerations.

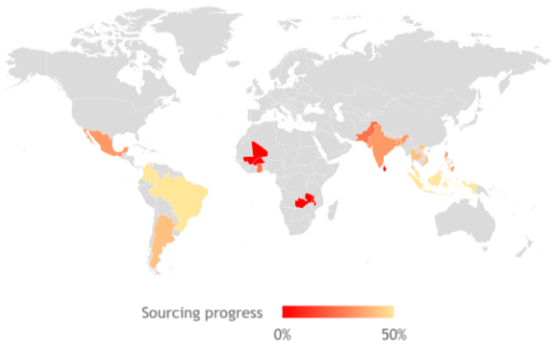
In traditional market cycles, the balance between fertilizer supply and consumption is most often dictated by cost competitiveness and incentive to produce, resulting in market rationalization which plays out at the industry level. In 2022, with supply shortages and high fertilizer prices, IFA expects the balance between supply and consumption to be dictated by farmers' ability to source and afford fertilizers. As a result, market rationalization is likely to play out at the farmer level.

Fertilizer affordability is important in price-sensitive regions, but availability is crucial in 2022

Global fertilizer demand change, 2007/08 - 2021/22 (N + P_2O_5 + K_2O)



Fertilizer sourcing progress as of mid-May 2022



Source: IFA, IFDC, market news sources

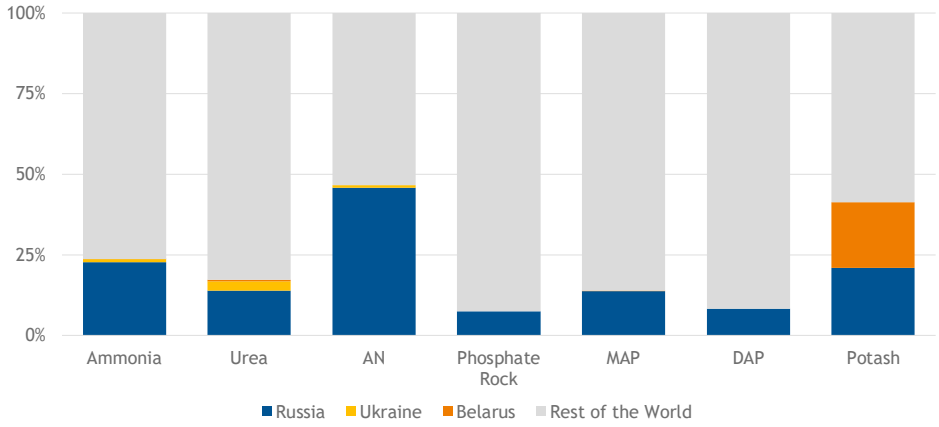
The availability crisis stems primarily from sanctions on two key producing countries. Sanctions were first imposed on Belarus in June 2021 and have since been widened to target the country's potash sector directly. The majority of potash exports from Belarus transit via Lithuania to reach the Baltic Sea, and with rail lines no longer willing to transport product from Belarus through EU territory, exports to the global market are effectively blocked. Following the invasion of Ukraine, sanctions have been placed on a number of Russian individuals, entities and sectors. Fertilizers are not directly targeted, but financial sanctions have had indirect impacts, and coupled with logistical constraints at Russian ports have reduced the flow of fertilizer exports. The nitrogen (N) fertilizer industry in West and Central Europe is

also heavily impacted by reduced natural gas supply from Russia. Other key fertilizer suppliers, namely China, have imposed export restrictions to protect their domestic agriculture in response to the tight global market, which has further reduced supply.

The combined contribution of Russia and Belarus to global fertilizer supply means that there is a distinct probability that there will be a shortfall of certain fertilizers in 2022. Russia and Belarus account for 41% of globally traded potash (K) and are the second and third largest producers respectively. Russia accounts for almost 25% of global N trade, exporting to a diverse number of countries globally. Russia exports smaller volumes of phosphate (P), but the sector is not spared from disruption, because the role of Russia in natural gas and ammonia markets has contributed to record high raw material costs for processed phosphate producers.

Russia, Belarus and Ukraine are major suppliers to global nitrogen and potash trade

(% share of global trade, 2020)



Source: IFA

BUILDING SCENARIOS TO REFLECT UNCERTAINTY

In May 2022, IFA developed three forecast scenarios to reflect the significant uncertainty in how market conditions could evolve. The scenarios are based on five key outlook criteria: 1) the evolution of the war in Ukraine, 2) sanctions on Russia and Belarus, 3) logistical ability of Russia to export to so-called "friendly" countries, 4) protectionist policies from key food and fertilizer exporters and 5) agricultural backdrop, including fertilizer affordability.

The three scenarios presented in this outlook are named: "optimistic," "pessimistic" and "middle ground (mid)." These capture the range of realistic expectations for the next 2-5 years. The optimistic scenario refers to a more positive outcome for fertilizer application and in turn for crop yields, while the pessimistic scenario refers to a deterioration of the drivers behind farmers applying fertilizer in close to their normal volumes in 2022 and beyond. The detailed assumptions under each scenario can be found in the appendix of this report. The three scenarios can be summarized as follows:

Optimistic: Partial recovery of exports, improved affordability, minimal yield impact

Pessimistic: Further deterioration of supply, worsening affordability, chronic shortages

Middle Ground (mid): Pockets of availability and affordability crisis, trade re-routing.

FORECASTING FERTILIZER SUPPLY

As a trade association, IFA is prohibited from forecasting future output levels of the industry. Instead, the Market Intelligence Service forecasts a supply measure known as capability, which combines announced capacity developments and an adjusted effective operating rate based on historical trends. This results in a forecast designed to reflect potential supply based on fixed assumptions. The supply forecast starts by considering projects to build new capacity or expansions at existing sites, collected by surveying IFA members on their capacity investment plans.

The three nutrients have different levels of exposure to new supply from Russia and Belarus, based on investment in these countries. For nitrogen, almost one-third of the forecast capacity expansions between 2022 and 2026 are located in Russia or Belarus. This is similar to the share that was commissioned in the last five years, given the low cost of gas and favorable export positioning of the two countries.

The phosphate industry is the least exposed to capacity expansions in affected countries, because while around a quarter of new capacity between 2017 and 2021 was located in Russia, capacity expansions in the next five years to 2026 are located entirely outside of sanctioned countries (in Africa and East Asia).

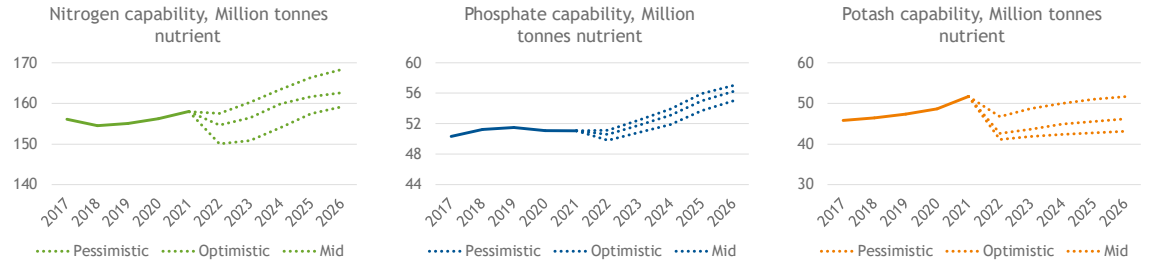
Potassium is by far the most exposed nutrient to capacity disruptions, with more than 80% of forecast expansions located in Russia. There are some largescale projects not yet included in IFA's forecast, such as BHP's Jansen mine in Saskatchewan, Canada, but even in a best-case scenario, these projects are likely to become operational in 2026 at the earliest.

In order to generate supply scenarios for each nutrient, the following adjustments were made. Nitrogen capability was adjusted in Russia, Ukraine and Belarus, based on the ability of these countries to export amid international sanctions on Russia and Belarus, and logistics issues from Ukraine. Capability of West and Central Europe was also adjusted based on disrupted natural gas supply from Russia. In the optimistic scenario, a modest decline in nitrogen capability of 0.3 Mt N is forecast in 2022, while the pessimistic scenario suggests a 5.7 Mt N reduction. The middle ground scenario results in a capability forecast 2.4 Mt N lower than in 2021. Between 2023 and 2026, global capability is forecast to improve across all scenarios, ranging from 113.4 Mt N to 120.0 Mt in 2026, up from a base of 112.6 Mt N in 2021.

Phosphate capability was adjusted based on Russia's ability to export, and in Europe based on ammonia raw material costs, and the operational ability of the Russian-owned Lifosa plant in Lithuania. In the optimistic scenario, global phosphate capability is forecast to be stable compared to 2021. In the pessimistic scenario, a decline of 1.2 Mt P_2O_5 is forecast, while the middle ground scenario results in a 0.4 Mt P_2O_5 reduction in 2022. In the medium-term, phosphate capacity growth was already forecast outside of the Eastern Europe and Central Asia (EECA) region. Global capacity is forecast to increase across all three scenarios, growing from 48.9 Mt P_2O_5 in 2021 to between 50.7 Mt and 52.7 Mt P_2O_5 across scenarios in 2026.

Potash capability was adjusted in Russia and Belarus based on ability to export, including a view on overland trade from Belarus to China and via Russia. In the optimistic scenario, potash capability is forecast to be 4.1 Mt K_2O lower than in 2021, the middle ground scenario is 7.6 Mt K_2O lower, and the pessimistic scenario is almost 9 Mt K_2O lower in 2022. Potash capability is forecast to remain below 2021 levels in all scenarios over the next five years, due to the high exposure to Russia and Belarus, and the relatively slow process to wind down sanctions even in an optimistic case. This results in global potash capability forecast at between 36.0 Mt and 43.2 Mt K_2O in 2026, compared to a capability measure of 43.2 Mt K_2O in 2021. As a result, nitrogen fertilizer consumption is expected to be dictated by a mix of availability and affordability constraints. Phosphate consumption is forecast to be constrained by affordability, while potash consumption is likely to be heavily constrained by availability.

Potash capability is forecast to be most constrained, followed by nitrogen, and then phosphate



Nitrogen
Wide-spread scenarios based on gas economics and ability to trade with "friendly" countries

Phosphate
Narrow-spread scenarios with more upside in the medium-term from capacity expansions

Potash
Scenarios skewed to the downside based on sanctions and likely ability to export

Source: IFA, May 2022

FERTILIZER CONSUMPTION FORECAST

Assuming fixed pools of global supply in the next two fertilizer years (FY 2022 and FY 2023), two groups of factors most likely to influence fertilizer demand were taken into account:

- **Underlying market factors**: major crops consuming fertilizers, access to crop export markets, government support to fertilizer purchases, farmers' access to input credit, fertilizer import dependency and weight in global fertilizer imports.
- **In-season / short-term factors**: crop prices, crop area expectations, weather, currency strength, fertilizer affordability, special government support to fertilizer purchases, so-called "friendliness to Russia," fertilizer carryover stocks and other factors such as local economic conditions.

These factors were assessed and exposure scores were given to the 22 largest fertilizer consuming countries, as well as regional groupings for West and Central Europe, Sub-Saharan Africa and North Africa ("Africa"). Smaller consuming countries were aggregated into six residual "rest of" groups.

Government support to fertilizer purchases strongest in Africa and Asia

Farmers are usually able to obtain credit to purchase inputs in regions such as North and South America, Europe and Oceania. In Africa and Asia, where such credits can be more difficult to obtain, some governments support agricultural production by smallholder farmers, and in some cases contribute to the cost of fertilizer purchases directly.

The level of government support to fertilizers varies by country, crop, nutrient and over time. Cereal crops are often targeted for food security purposes and nitrogen fertilizers, which greatly contribute to cereal yields, are often prioritized over sources of phosphorous and potassium.

In some countries, election years tend to coincide with stronger government support to smallholder farmers. Overall, government support can have a significant effect on national fertilizer consumption.

Fertilizer price increases over the course of 2021 and the first half of 2022 triggered some changes in government support. In Turkey, the government announced higher support payments for fertilizers to cereal farmers. In India, the DAP subsidy was raised for the 2022

Kharif season. In Pakistan, the government announced direct fertilizer subsidies in May 2022. In Russia, retail fertilizer prices have remained capped since July 2021. In China, fertilizer export controls were imposed in order to limit domestic price rises.

For many countries the level of increased government support has still been insufficient to protect farmers from the recent increases in fertilizer prices. A notable exception is in India, where the urea maximum retail price has been kept stable for many years and was 10 times lower than international prices in Q2 2022.

Import exposure is strongest for potash, with most countries reliant on trade

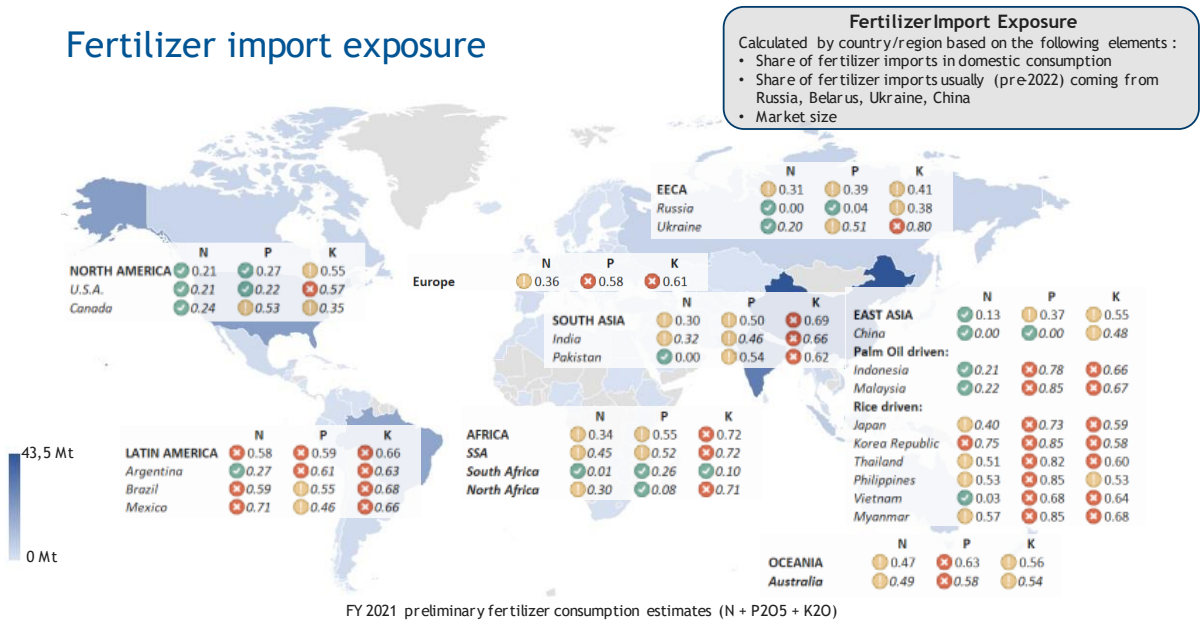
Another factor considered in the supply allocation methodology is the exposure of countries and regions to fertilizer imports, particularly to imports coming from countries where exports were significantly limited in H1 2022. An index of fertilizer import exposure was developed based on the following elements: the share of fertilizer imports in domestic or regional consumption; the share of fertilizer imports sourced from Russia, Belarus, Ukraine and China in 2020 and the share of fertilizer imports in the world total.

Many countries are entirely reliant on imports of potash, given the concentrated nature of production in a handful of countries, driven by the global distribution of mineral deposits.

Phosphate import exposure is more varied across the world. North America and North Africa produce most of their phosphate fertilizer needs domestically, whereas Latin America, East Asia (excluding China) and Oceania are more exposed to imports.

The widespread production of nitrogen fertilizers means that fewer countries and regions are dependent on imports compared to potash and phosphate fertilizers. In addition, many countries produce at least part of their needs in nitrogen fertilizers. Overall, Latin America is the most exposed region to nitrogen imports based on IFA's index.

In the West of Suez, N and P import exposure tends to be linked to Russia. In the East of Suez, N and P import exposure tends to be linked to China.



FY 2021 preliminary fertilizer consumption estimates (N + P2O5 + K2O)

Note: IFA generates maps using Microsoft tools and does not claim a view on international boundaries, which may be subject to unresolved claims by multiple jurisdictions

Source: IFA, May 2022

Note: Red scoring denotes the highest exposure to imports by nutrient, orange denotes medium exposure, and green denotes lowest exposure to imports.

Export crops are less at risk in periods of high input prices

Countries with access to crop export markets have a different relationship with affordability in a high fertilizer price environment than farmers working the land for subsistence or domestic food markets. This is due to exposure to foreign currency, ability to access credit and international crop prices.

Examples of regions that do not benefit from widespread access to export markets include Africa for cereals, West Asia for wheat, China and some rice-producing countries in East Asia. On the other hand, North America, Latin America, Europe and East Asian oil palm producing countries usually have good access to export markets for their major crops.

Recent events have led to changes in the level of access to crop export markets for some countries. In Ukraine, the war caused significant damage to storage and transport infrastructure, which results in significant delays to shipping grains and oilseeds outside of the country. In Russia, wheat exports are subject to quotas and a partial export ban to selected countries, as well as the impact of financial sanctions. In India, an export ban on wheat was implemented in mid-May 2022 to protect the domestic market. In Argentina, in addition to the existing export taxes on soybeans (33% vs 12% for maize and wheat), the government set up export limits for wheat and maize starting in December 2021.

The nutrient requirements of different crops are important to the level of exposure a farmer has to higher input prices. For example, nitrogen is the nutrient applied in the largest quantity on cereal crops. Farmers sometimes forego application of phosphorous and potassium in low affordability years if the soil content of their fields allows such short-term flexibility. For example, farmers in Europe and North America temporarily reduced their fertilizer application rates for phosphorous and potassium in 2008, the last time fertilizer affordability was very low. However, a large reduction in phosphorous application is not possible in P-fixing soils without affecting crop yields.

Global planted area is expected to contract in 2022/23

As of June 2022, the global area planted to maize and wheat in 2022/23 was expected to decline due to the war in Ukraine, weather issues and high input prices. Global rice area is forecast to expand slightly, and global soybean area is forecast to increase significantly. These forecasts are dependent on developments in the second half of 2022, as a large share of the soybean and maize area will be planted in Latin America in the second half of the year.

Such changes in the global crop mix will impact global fertilizer use. Cereal crops account for half of global fertilizer use, and maize and wheat together account for one third.

Global fertilizer use estimated to have declined by 1.6% in FY 2021

Global fertilizer use is estimated to have declined by 1.6% to 200.6 Mt in FY 2021[1] after a 6% jump to 203.8 Mt in FY 2020. The decline in FY 2021 is driven by lower fertilizer affordability (and associated changes in crop mixes), the war in Ukraine and some advance fertilizer purchases made in the previous year.

According to latest IFA estimates, potassium consumption decreased by 4% after an 11% surge in FY 2020. Phosphorous consumption contracted by 2.5% after a 5.5% increase. Nitrogen consumption was almost stable (-0.2%) after a 4% increase.

The 1.6% reduction in global fertilizer use in FY 2021 is led by South Asia (particularly India after a bumper year), Europe and North America. East Asia and West Asia are also estimated to have reduced their consumption. Fertilizer consumption in Africa is seen as stable in FY 2021 due to a strong increase in Nigeria.

[1] FY 2021/22 extends to April 2022 for countries in South Asia, and June 2022 for countries in North America and West & Central Europe.

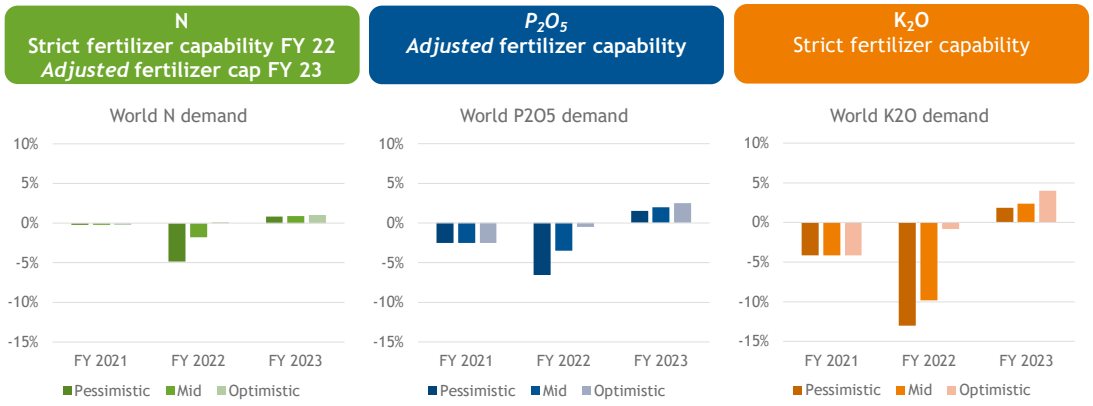
Consumption is estimated to have increased in Latin America, EECA and Oceania.

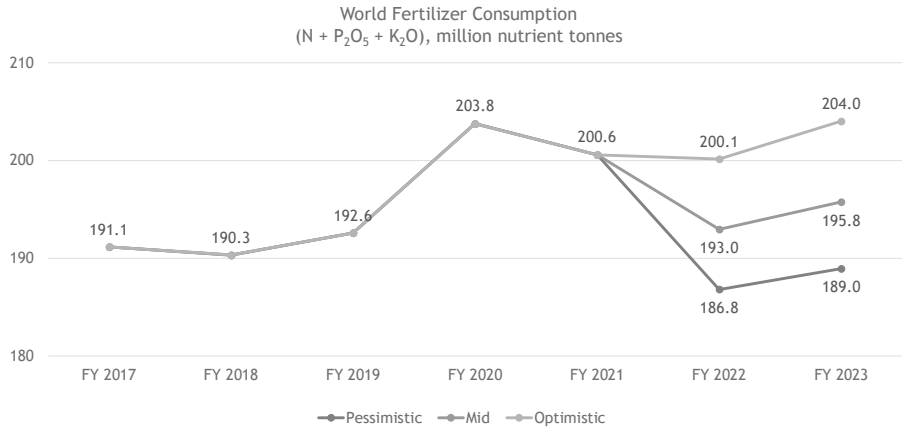
Supply allocation methodology suggests strongest decline in K_2O consumption in FY 2022

The FY 2022 forecast is based on adopting the capability scenarios for N and K, and a P scenario adjusted for affordability. Global N consumption is forecast to decline by between 0 and 5%, P consumption is forecast to contract by between 0 and 7% and K consumption is forecast to drop by between 1 and 13% in FY 2022. The combined decline in global mineral fertilizer use in FY 2022 is forecast at -7% in the pessimistic scenario, which would be the largest annual decline since FY 2008 (-8%).

In FY 2023, both the N and the P scenarios were adjusted to account for lower affordability, while the K scenario is expected to directly follow availability. This translates into a partial recovery for all three macronutrients in both the pessimistic and the mid scenarios, and a full recovery in the optimistic scenario.

Our supply allocation methodology suggests a reduction in global fertilizer use in FY 2022 & partial recovery in FY 2023





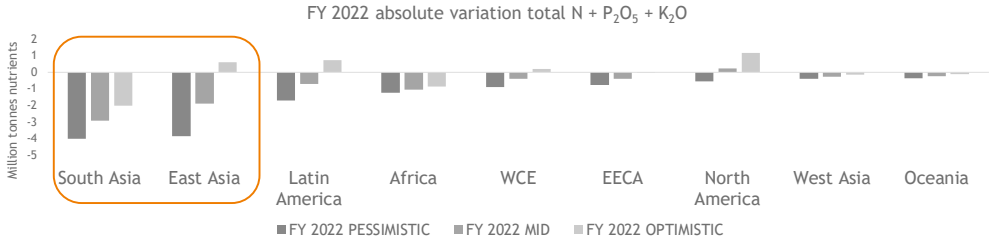
Source: IFA, May 2022

South Asia and East Asia are forecast to drive the decline in global fertilizer use in FY 2022, but in relative terms, Africa would face the most severe shortfall. Sub-Saharan Africa is expected to be most impacted, with a regional decline of between 18 and 23% forecast in FY 2022.

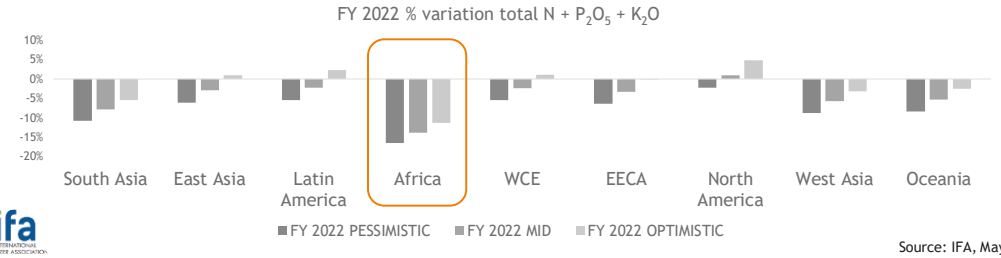
Due to availability issues, global potassium consumption is expected to experience the

largest reduction, regardless of the scenario. Four regions in particular would face major reductions in FY 2022, even in the optimistic scenario: South Asia, Africa, Oceania and West Asia. Such reductions could reach between 30 and 40% in South Asia and in Africa. Only a partial recovery would take place in the following year in these four regions, even under the optimistic scenario.

South Asia & East Asia are forecast to contribute the most to the global fertilizer use decline in FY 2022



But Africa could experience the sharpest drop in fertilizer use



Source: IFA, May 2022

Medium-term outlook determined by severity of supply shortages in the short-term, plus return to agronomic fundamentals

In the medium-term (FY 2024 to FY 2026), global fertilizer demand is expected to continue its recovery, differentiated by scenario:

- In the pessimistic scenario, global fertilizer demand reaches 194.6 Mt nutrients in FY 2026, 2 Mt above FY 2019 but 9 Mt below the FY 2020 level.
- In the mid scenario, global fertilizer demand reaches 202.1 Mt, 9.5 Mt above FY 2019 but 1.7 Mt below FY 2020 level.
- In the optimistic scenario, global fertilizer demand would reach 211.1 Mt, 7.4 Mt above the FY 2020 level.

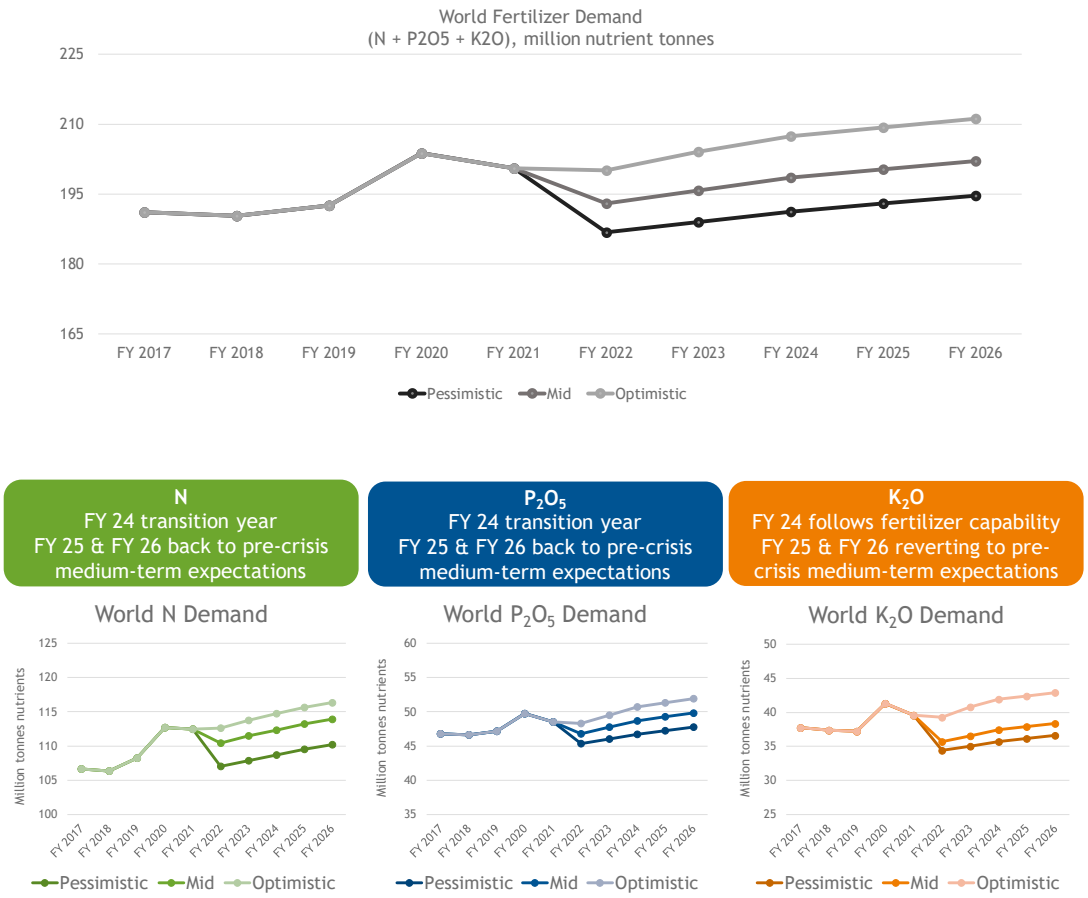
Trends in potassium consumption are expected to slow the recovery of total fertilizer use. Under the pessimistic scenario, global potassium consumption would reach only 36.6 Mt in FY 2026, or just above the level reached 10 years before (36.2 Mt in FY 2016) and well below the FY 2020 record level of 41.3 Mt. Under the mid scenario, global potassium consumption would reach 38.3 Mt in FY 2026, above the FY 2019 level (37.2 Mt) but still well below the FY 2020 record level. Only under the optimistic scenario would global potassium consumption exceed the FY 2020 level by the end of the outlook period.

Global nitrogen and phosphorous consumption would also lag behind under the pessimistic scenario and remain below the FY 2020 record levels by the end of the outlook period. However, under the mid and optimistic scenarios, global nitrogen and phosphorous consumption would grow more quickly and exceed the FY 2020 record levels by FY 2026.

Under the pessimistic scenario, East Asia and South Asia are forecast to drive the global decline between FY 2021 and FY 2026. Under the mid and the optimistic scenarios, Latin America is set to drive global growth over the five-year period.

Compared to IFA's previous medium-term demand forecast (published in July 2021), South Asia slipped down the list of contributors to global growth due to an expected sharp decline in FY 2022. Africa would also be a much smaller contributor to global growth than expected in the past.

Medium-term fertilizer demand expectations



Source: IFA, May 2022

IMPLICATIONS FOR FOOD SECURITY

The short-term impact of reduced fertilizer consumption is the threat of a significant reduction in crop yields in the next harvest, prompting lower food production and ultimately increasing the number of people at risk of hunger and starvation. Modelling by Gro Intelligence conducted in July 2022 implies that in IFA's pessimistic scenario, reduced nitrogen fertilizer application would result in a 1.4% decline in global maize production, a 1.5% reduction in rice production and a 3.1% reduction in wheat production. The yield impact of reduced application of phosphorous and potassium is also likely to be significant, especially if sustained in the medium-term. The outlook for food security will be underpinned by the success of actions to prioritize fertilizer application in line with nutrient requirements.

APPENDIX I: SCENARIO ASSUMPTIONS

Scenario overview

	Scenario criteria					
	1. Evolution of conflict in Ukraine	**2. Sanctions on Russia and Belarus**	**3. Logistical ability to export to "friendly" countries**	**4. Protectionist policies in other fertilizer exporters**	**5. Agricultural backdrop including fertilizer affordability**	
Optimistic	Resolution in 2022, no land-bridge between Russia and Crimea, Ukraine regains control of Black Sea ports.	Economic sanctions soften, Russian exports mostly recover, Belarusian exports partially recover	Short-term freight bottlenecks resolve, "friendly" countries import maximum volumes	Supply shortage fears ease, exporting countries stop stockpiling of food and fertilizer	Crop price growth outpaces fertilizer price growth, improving affordability	*Enough supply, affordability improves*
Pessimistic	Extended conflict, blocking food and fertilizer exports from Black Sea, Russia stops gas supply to Europe	Western sanctions grow, US$ sanctions spread even to some "friendly" countries	Exports to "friendly" countries capped by secondary sanctions, seaborne exports from Belarus blocked	Key food and fertilizer exporters restrict exports on shortage fears, government tenders increase	Fertilizer price growth outpaces crop price growth, worsening affordability	*Severe global demand shortfall*
Middle Ground	Russia occupies large parts of Eastern Ukraine, exports resume from a shared Black Sea coast	All current sanctions stay in place, but some "friendly" countries restart / continue partial trade with Russia	Partial volumes exported to "friendly" countries, but not enough to return to normal volumes	Key exporters hold back, some H2 2022 improvement, fragile regions hardest hit	Product-specific affordability vs availability squeeze	*Trade reroutes & affordability squeeze*

Source: IFA

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APPENDIX II: WHAT IS A "FERTILIZER YEAR"?

The reference period used to report fertilizer consumption varies depending on the country. Countries report fertilizer consumption statistics in 12-month periods that start either in January or in another month (most often April and July). In this report, "fertilizer year" (FY) refers to all 12-month periods. FY 2021 refers to the year starting in January 2021 for most countries in Latin America, Africa, East and Southeast Asia and EECA. For other regions including North America, West and Central Europe and South Asia, FY 2021 started in early to mid-2021 and ended in early to mid-2022. Fertilizer years do not always match crop marketing years used to report statistics on crop area, yield and production.

Note: in this report and the related presentation, a simplified terminology is used: "FY 2021/22" was shortened to "FY 2021."

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