Production of mineral fertilizers

Nitrogen, phosphate and potash fertilizers are produced from naturally occurring components which are transformed so the nutrients they contain can be easily absorbed by crops. The production process depends on the respective nutrients they contain while the availability of the underlying raw materials impacts on the geographic location of supply.

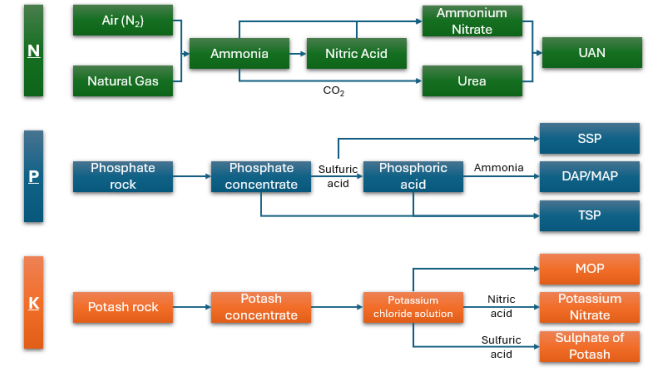
How are mineral fertilizers produced?

Nitrogen-based fertilizers: Nitrogen (N) is the main component of the Earth's atmosphere[1]. Ammonia is synthesized by mixing nitrogen from the air and hydrogen from natural gas or coal, under high temperature and pressure. Ammonia can be directly applied to fertilize but is predominantly used as a precursor to produce other fertilizers. It is mixed with carbon dioxide to produce urea, the most widely used N-fertilizer. Ammonia can also be used to make nitric acid, with which it is mixed to produce nitrates. Finally, Urea Ammonium Nitrate (UAN) results from mixing a heated solution of dissolved urea with a heating solution of dissolved ammonium nitrate.

Phosphorus-based fertilizers: Phosphorus is extracted from phosphate rock, which can be treated with sulfuric acid to produce phosphoric acid, and mixed with ammonia. This process results in the most widely used phosphate fertilizers: diammonium phosphate (DAP) and monoammonium phosphate (MAP).

Potassium-based fertilizers: Potassium is mined from potash ore, which is refined to obtain muriate of potash (MOP). Potassium nitrate and sulphate of potash are obtained by adding acid treatment to the process.

Mineral fertilizer production process[3]



Nitrogen, phosphate and potash fertilizers can be applied as such. However, it is common to blend them or to produce compound fertilizers by chemical reaction[2], so that the end fertilizer will provide several nutrients to the plant in a single application.

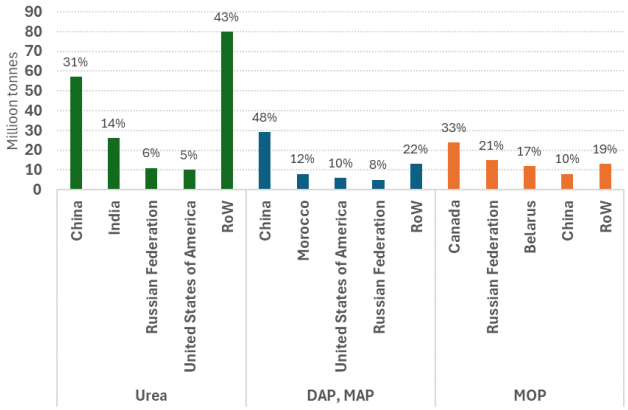
Who are the main suppliers of fertilizers globally?

Fertilizer production requires access to abundant natural resources, as well as financial and technical capabilities and infrastructure[4].

Since nitrogen is captured from the atmosphere, N-fertilizers could potentially be produced anywhere in the world. However, in view of the need for large amounts of energy, production is particularly strong in countries that have access to natural gas or coal resources. China, India, the Russian Federation, and the US are the biggest urea producers and account for about half of global supplies. Urea production averaged close to 180 million tonnes per year over the 2018-2022 timeframe.

By contrast, phosphate and potash resources are concentrated in just a few countries. China, Morocco, the US, and the Russian Federation accounted for almost 80 percent of total DAP and MAP production of 65 million tonnes p.a., in 2018-2022. Over the same period, Canada, the Russian Federation, Belarus, and China represented more than 80 percent of global potash production of about 70 million tonnes p.a.

Production (MT, left axis) and share of total production by country for each fertilizer category (%, labels), 2021[5]



Fertilizer production relies on the availability of raw materials and industrial facilities, driving the geographic distribution of supply. Demand for fertilizers, on the other hand, is driven by crop production factors, which explains why fertilizers trade is highly globalized.

1. Yara, 2022. Fertilizer Industry Handbook https://www.yara.com/siteassets/investors/057-reports-and-presentations/other/2022/fertilizer-industry-handbook-2022-with-notes.pdf
2. European Fertilizer Blenders Association, 2016. Handbook of solid fertilizer - Code of Good Practice for Quality
3. Fertilizers Europe. https://www.fertilizerseurope.com/fertilizers-in-europe/how-fertilizers-are-made/
4. See also: UNCTAD Commodities at a glance: Special issue on phosphate (in French) https://unctad.org/publication/commodities-glance-special-issue-phosphate
5. Source: AMIS data based on FAOSTAT, IFA, CRU