Synthetic Fertilisers:

Addiction, Climate Change and Food Security

AMO.CZ klima

Deteriorating soil fertility and increased reliance on synthetic fertilisers are global challenges to food security.

Synthetic fertilisers were revolutionary in agriculture when they were first introduced in the 20th century, but since 1960, the global use of synthetic nitrogen fertilisers has increased nearly tenfold.

Despite their seemingly numerous benefits, their use has **significant negative environmental impacts**. Specifically, the overuse of synthetic fertilisers disrupts the planetary boundaries related to the biogeochemical nitrogen and phosphorus flows. They also contribute to **ecosystem degradation, pollution, and greenhouse gas emissions**. These, in turn, are directly linked to other crossed planetary boundaries (in particular, climate change, biosphere integrity, and novel entities).

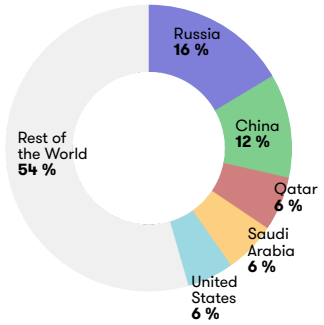
Finally, synthetic fertilisers are produced in a limited number of countries, with **Russia being the only leading exporter of all three main nutrients**.

Given these challenges, **it is vital to reduce the dependence on synthetic fertilisers**.

Top Fertiliser Exporters by Nutrient, 2022

Source: FAO, Inorganic fertilisers 2002-2022

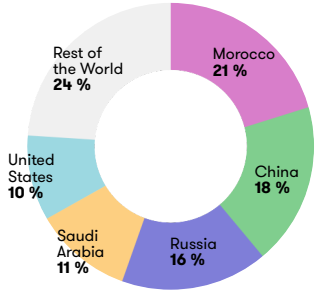
Nitrogen



Nitrogen Fertilisers: Reliance on Fossil Fuels and Russia

→ Nitrogen fertilisers are synthesised using the Haber-Bosch process, which requires large amounts of **natural gas**. A recent study estimated that the **production and use of nitrogen fertilisers contribute to approximately 5 % of global greenhouse gas emissions** – one third of which are emissions from fertiliser production and two thirds from fertiliser use.

Phosphorus

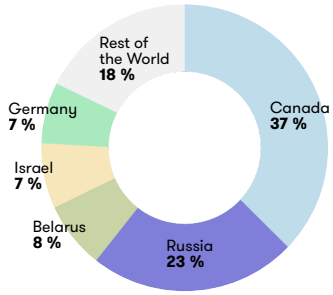


Phosphorus: Dependence on yet Another Non-Renewable Resource

→ Phosphorus comes from phosphate rock. Approximately **85% of global reserves are located in just five countries**.

→ **"Peak phosphorus"** – similar to the concept of "peak oil" signals that in the near future, the reserves of this raw material will **decrease** and the cost of its extraction may increase beyond the profitability limit. Eventually the reserves may become exhausted.

Potassium



Potash (Potassium Fertiliser) and Turbulent World Markets in an Era of Sanctions

→ Potash deposits are also concentrated in a few countries.

→ Between 2021 and 2022, **potash fertiliser exports from Belarus decreased by more than 60%**. This was largely due to geopolitical tensions and sanctions.

Environmental Impacts

A Decrease in Biological Activity in the soil: While synthetic fertilisers provide plants with readily available nutrients, they lack the organic matter needed to feed the soil's microorganisms. As a result, these microorganisms "starve" with the prolonged use of these fertilisers.

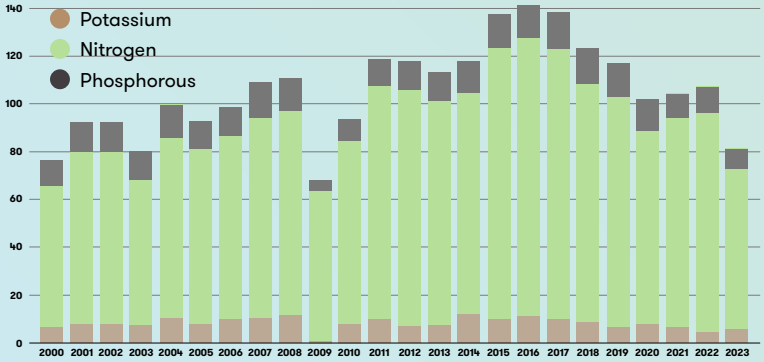
The Eutrophication of Water: Excess nitrogen and phosphorus cause cyanobacteria to overgrow and deplete oxygen. In the deltas of large rivers, synthetic fertilisers can cause extensive "dead zones", a major stressor for marine ecosystems.

Soil Acidification: The excessive application of nitrogen fertilisers, specifically, the ammonia from urea, leads to soil acidification. This harms plant growth and soil biodiversity.

Greenhouse Gas Emissions: The production and usage of synthetic fertilisers results in emissions of CO_2, CH_4 and N_2O. These account for 5 % of global greenhouse gas emissions, which is – to put things into perspective – a higher percentage than the emissions that result from global aviation.

Heavy Metal Contamination: Synthetic fertilisers can contain toxic metals (e.g. cadmium, arsenic, mercury), which pollute both soil and food.

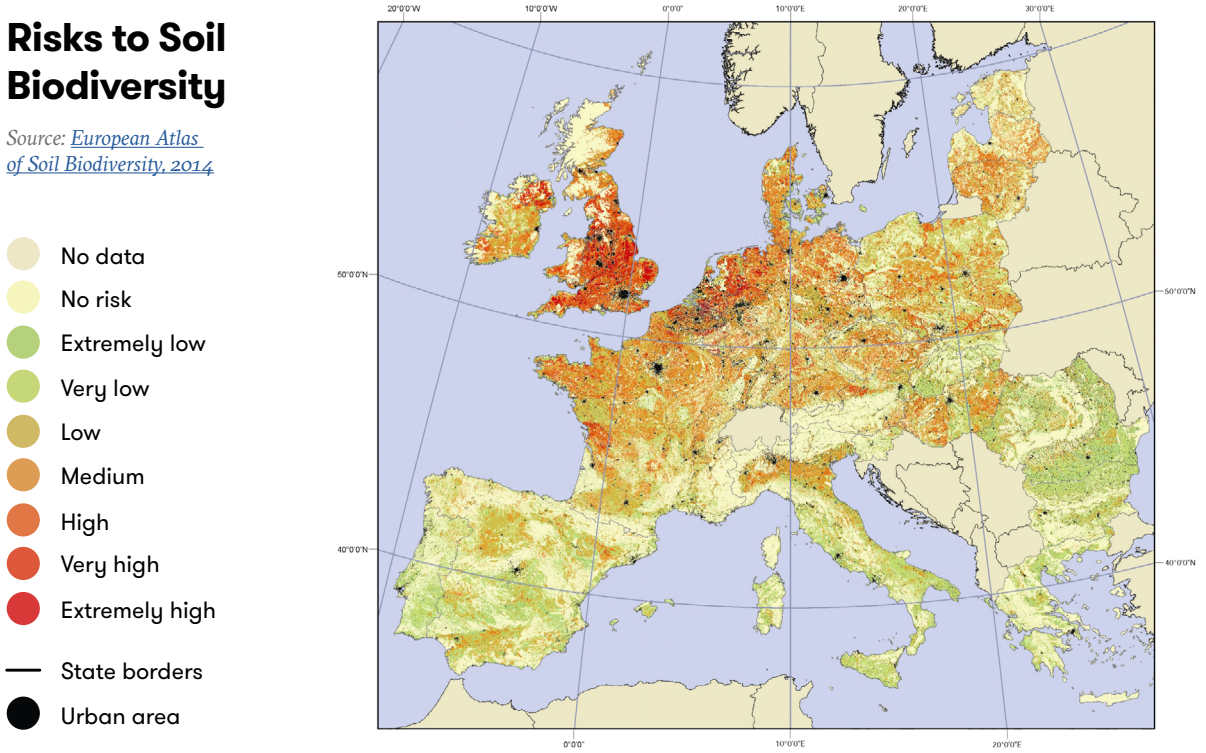
Development of Mineral Fertiliser Consumption in the Czech Republic in 2000—2023, kg of pure nutrients/ha



Source: Czech Statistical Office (CzSO)

Risks to Soil Biodiversity

Source: European Atlas of Soil Biodiversity, 2014



Risk map for soil biodiversity in the EU, based on risks arising from agricultural intensification, soil pollution, soil compaction, erosion, organic matter decline, invasive species and land use change.

Soil Condition and Fertiliser Use Within the EU

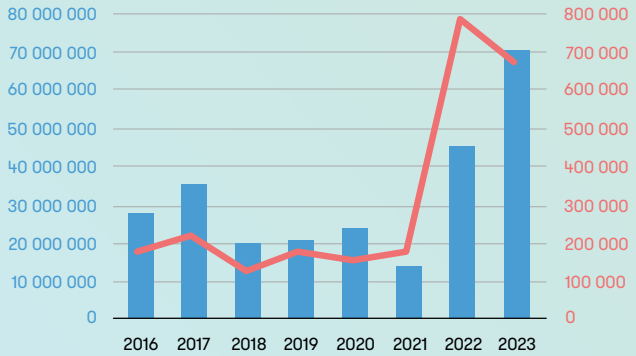
- **Soil contamination by cadmium** is a significant problem, mainly associated with phosphate fertilisers. Values are particularly high in Ireland and Poland.
- France, Germany, Poland, Spain and the UK have the largest annual consumption of **synthetic nitrogen fertilisers** (57 % of total European consumption). Urea in fertilisers is one of the main sources of NH_3 emissions in the atmosphere in at least 16 EU countries. Excessive ammonia pollution leads to the formation of the greenhouse gas N_2O, soil acidification and water eutrophication.
- 14 of the 27 EU countries surveyed have more than 40 % of their soils at high to medium **risk for soil biodiversity** and its functions, which is linked to agricultural intensification and the excessive long-term use of synthetic fertilisers.

Fertilisers and Sanctions

- International **sanctions do not apply to food and agricultural commodities, including fertilisers**, due to the risk to global food security.
- However, **potash** (a fertiliser containing potassium) **plays a key role in the Belarusian economy** (it makes up 10 % of all exports). In 2021, due to the continued violation of human rights and fundamental freedoms in Belarus, the EU imposed **special sanctions on potash and companies involved in its production**, banning imports into the EU and restricting Belarus' ability to use EU territory for transit. Sanctions were also imposed on the country's sole producer of urea.
- However, due to insufficient tools to control the origin of goods, **Belarus managed to circumvent the sanctions** and in 2022 and 2023 was able to import large quantities of urea into the EU, including into the Czech Republic.

The Imports of Nitrogen Fertilisers from Russia

Quantity in kg and Value in Thousands of CZK



Although the Czech Republic imports most of its fertilisers from neighbouring countries, the increase in imports from Russia following the Russian invasion of Ukraine is worrying. The total value of fertilisers imported from Russia to the Czech Republic between March 2022 and September 2024 exceeded **CZK 2.3 billion** *(EUR 91 million).*

Source: CzSO

Geopolitics and Power Interests

- Between 2021 and 2023, Russia increased its exports of almost all major types of fertiliser.
- As a major exporter, Russia is in an advantageous position. Fertilisers are not subject to sanctions, but Russia itself can restrict their exports at any time.

Since November 2021, Moscow has imposed **quotas on fertiliser exports** in an attempt to prevent shortages and rising prices on the domestic market. These quotas, initially set for 6 months, have since been extended and are now in place until the end of May 2025. Given the importance of Russian exports, such measures have an impact on food prices worldwide.

Since October 2023, Russia has imposed **export duties on fertilisers** of up to 10 %.

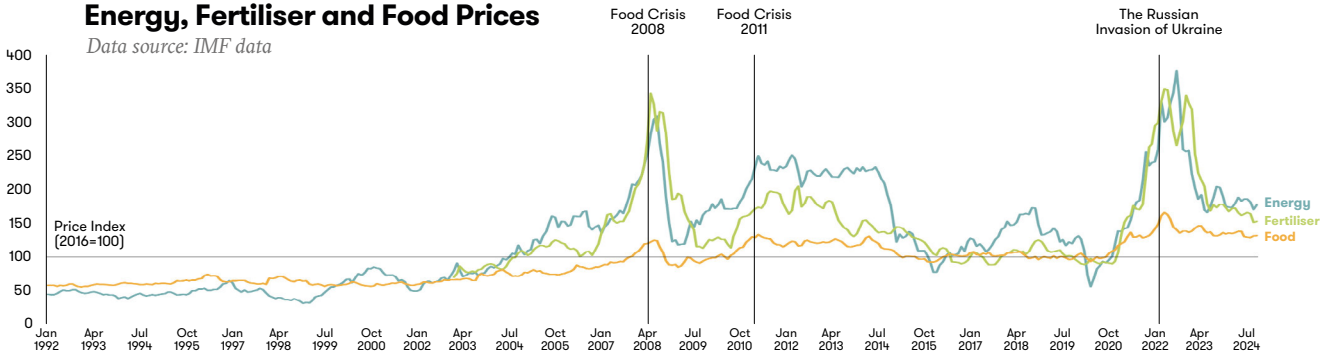
- **Export duties and taxes on fertiliser producers are helping Russia finance its war against Ukraine** at a time when its revenues from oil and gas exports are falling.

The Role of European Agribusiness

- Since 2022, the EU has sought to improve the conditions for importing intermediate products and support domestic fertiliser production. However, the **rise in gas prices** has led **many European fertiliser producers to reduce or stop production**, especially in the summer of 2022. European fertilisers have since been replaced by **cheaper imports from Russia**.
- In the summer of 2022 EU agrochemical companies declared themselves victims of the energy crisis. However, the real problem is their **over-reliance on natural gas supplies and their vulnerability to fluctuations in the fossil fuel market**. Synthetic fertilisers make food production dependent on fossil fuels.

Energy, Fertiliser and Food Prices

Data source: IMF data



- At the same time, the Czech company **Lovochemie**, like other global fertiliser companies, **reported a very successful year in 2022**. Although the volume of fertiliser sales fell by 13.3 %, the company reported an 87.5 % increase in revenue from the sale of products and services.

Model Study: A Pan-European Food Systems Transformation

The sustainability of agriculture and food systems is not just a matter of curbing the excessive use of synthetic fertilisers. The challenges of ensuring sustainable and healthy food, protecting biodiversity and natural resources, and mitigating and adapting to climate change require a **conceptual shift in the entire agri-food system** that addresses several of these challenges at once.

The TYFA scenario models the transition of EU agriculture to agroecological management by 2050. It is based on the **phasing out of pesticides and synthetic fertilisers, the restoration of natural grasslands and the expansion of landscape features**. It also assumes the widespread **adoption of healthier diets** with fewer animal products and a higher intake of fruit and vegetables.

Despite a 35 % decrease in production (in kcal) compared to 2010, this scenario **meets Europe's food needs** (mainly due to a reduction in non-food use of agricultural production) while **maintaining export capacity** for cereals, dairy products and wine. The scenario leads to a **40 % reduction in greenhouse gas emissions from agriculture** by 2050 compared to 2010.

Conclusions

- The current reliance on synthetic fertilisers poses **safety, environmental and economic risks**. It is vital to gradually reduce and eventually eliminate their use.
- We will need synthetic fertilisers in the short term (we cannot simply stop using them from one day to the next, or even from one year to the next without restoring previously degraded soil first), but a **long-term plan is needed to minimise their use**.

The Benefits of Switching to Agroecological Farming Without Synthetic Fertilisers:

Recommendations for the Czech Government

- Set **binding targets and a plan for a gradual but effective reduction** in the use of synthetic fertilisers
- **Prevent the further weakening** of environmental requirements and conditions within the current EU's Common Agricultural Policy and agricultural subsidies, e.g. in relation to landscape features
- **Update national dietary recommendations** to reflect **healthy and sustainable diets**, taking into account new evidence from international institutions such as the WHO, FAO or the EAT Lancet Commission
- Promote ambitious targets in the upcoming EU negotiations on the **Soil Monitoring Law**
- Support the **allocation of sufficient financial resources** in the negotiations to help shape the next EU Multiannual Financial Framework **so that it supports a socially just transition to sustainable and resilient agriculture**, e.g. as part of the next reform of the Common Agricultural Policy.

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