

Fertilisers in the EU

Prices, trade and use

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Throughout human history, manure has been the basic input of nutrients for plant production. With the development of agricultural production and increasing food demand, farmers searched methods to improve efficiency on their fields. Animals were not necessarily held on every farm and manure was not available to fertilise soils. With increasing urbanisation, the circulation of nutrients from animals and humans into the soil became more difficult. With the development of commercial fertilisers, this nutrient gap has been somewhat closed. The application of fertilisers increases the production of biomass in the plant and thus yields. Therefore, it contributes to address the major challenge of feeding a growing world population

The successive reforms of the Common Agricultural Policy with a shift away from price support to decoupled payments has lowered the economic optimal amount of fertiliser to be applied and resulted in a strong reduction in fertiliser use. In the last years, fertiliser use in the EU stabilised. Nowadays, precise fertilisation gives farmers the possibility to adapt the application of nutrients according to plant needs and thereby increase productivity, while reducing fertiliser use. This brief provides facts and figures on commercialised processed fertilisers, an essential input for a vast majority of European farmers.



1. History and production of fertilisers

The production of nitrogen mineral fertilisers is based on a technology invented approximately 100 years ago, called the Haber-Bosch process. The process means fixing nitrogen from air (atmospheric nitrogen) with hydrogen to produce liquid ammonia. The process uses a catalyst and requires a high temperature and high pressure. The hydrogen as well as the energy to heat the process is generally sourced from natural gas (methane).

Approximately 65 % of the natural gas used in the process is needed as a source of hydrogen for ammonia and the remaining 35 % is used for heating the process itself. Due to improving technology, the energy efficiency of the process has enhanced over time. Globally 450 million t of nitrogen fertilisers, measured as commercialised product, are produced with the Haber-Bosch process every year. Three to five per cent of the global annual natural gas consumption is used by the industry to produce nitrogen fertiliser. The cost for natural gas represents 60-80 % of the variable input costs for production of nitrogen fertiliser.

Phosphorous based fertilisers exclusively origin from mined ore. The process to convert the ore into a fertiliser product is done via a chemical extraction with an acid, into a water-soluble salt. Potash based fertiliser is based on mined rock. Since potash is water-soluble, the production method is mainly based on a purification process of the potassium rock. The production of rock-based fertilisers into a product that can be used by farmers is less energy demanding compared to producing nitrogen and the dependence of natural gas is therefore lower.

The total volume of fertiliser produced globally, measured as nutrient weight, was 181 million t in 2016. Of the total volume, nitrogen represented 108 million t (60 %), whereof urea 60 million t, phosphorous 41 million t (23 %) and potassium 32 million t (17 %). According to Fertilizer Europe, the EU production of fertilisers is relatively small measured as share of the global production: 9 % of the nitrogen, 3 % of the phosphate and 8 % of the potash is produced within the EU.

Globally, urea is by far the most used fertiliser expressed in terms of nutrient followed by nitrates. The application of fertiliser differs widely in different parts of the world depending on factors such as crops grown, soil characteristics and annual precipitation.

According to the International Fertiliser Association, the market share of urea in the nitrogen-based fertilisers market is high in Asia while it is lower in the EU and in North America. Due to the crop mix in South America, with a high share of (nitrogen fixing) soya planted, the application of potassium and phosphorus is relatively high in relation to nitrogen.

The use of fertiliser at global level is increasing on an annual basis by around 2 % for phosphorus and potassium. The growth rate for nitrogen-based fertiliser is higher and in particular for urea. Most of newly built capacity for nitrogen production is for urea.

2. Characteristics of the main fertilisers

Fertilisers are commercialised in many different compounds and packaging, which require to define what a certain data refers to. The table below explains the most common fertilisers, their nutrient content, and the technical abbreviation most often used.

Table 1 – Composition and name of main fertilisers

Fertiliser	Abbreviation	Nutrient content
Ammonium Nitrate	AN	33.5 % Nitrogen
Calcium Ammonium Nitrate	CAN	27 % Nitrogen
Ammonium Nitro Sulphate	ANS	26 % Nitrogen, 14 % Sulphur
Calcium Nitrate	CN	15.5 % Nitrogen
Ammonium Sulphate	AS	21 % Nitrogen, 24 % Sulphur
Monoammonium Phosphates	MAP	11 % Nitrogen, 52 % Phosphorus
Diammonium Phosphates	DAP	18 % Nitrogen, 46 % Phosphorus
Urea	Urea	46 % Nitrogen
Urea Ammonium Nitrate (liquid)	UAN	30 % Nitrogen
NPK 15-15-15	NPK	15 % Nitrogen, 15 % Phosphorus, 15 % Potassium
Triple Super Phosphate	TSP	48 % Phosphorus
Muriate of Potash	MOP	60 % Potassium

Nitrogen, phosphorous and potassium are the main components of fertilisers but compound fertilisers often contain secondary macronutrients such as calcium, sulphur and magnesium. In many compounds, micronutrients are also added (i.e. copper, iron, manganese, boron). The compounds are therefore often complex and tailor made for the end user. The value of the secondary nutrients and micronutrients can be high and therefore they can represent a significant share of the value of certain compounds.

3. Fertiliser prices are linked to energy prices

Fertiliser prices are determined by their physical characteristics (defined by the blending) and the logistic costs for delivery to the farm-gate. For nitrogen-based fertilisers, the price is highly related to energy prices, as the process is dependent upon natural gas. By contrast, the price of rock-based fertilisers (phosphate and potassium) is less correlated to energy prices.

Table 2 – Example of production costs for urea

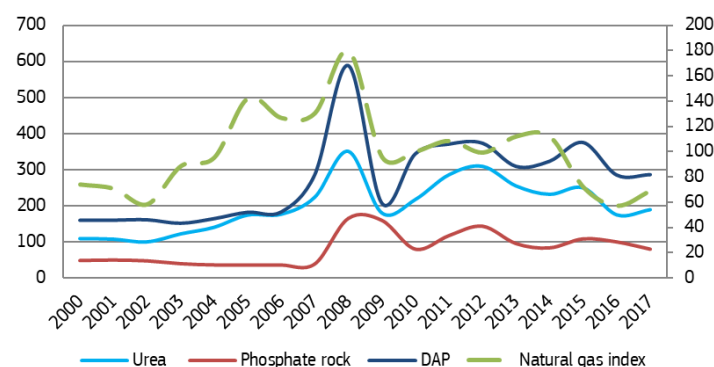
Natural gas price	4 USD/MMBtu
x Gas consumption	36 MMBtu/t ammonia
= Gas cost	144 USD/t ammonia
+ Production costs	29 USD/t ammonia
= Cost for ammonia	173 USD/t ammonia
*Ammonia use for conversion to urea	0.58 t ammonia/t urea
= Ammonia cost for urea	100 USD/t urea
+ Process gas	21 USD/t urea
+ Other production costs	25 USD/t urea
= Total cost for urea	146 USD/t urea

Source: Example from Yara international
Note: example from a mid-size plant in the US in 2016

Fertiliser import prices peaked in 2007-2008, due to historically high energy prices. In 2018, prices were 40 % higher than before that price peak, similar to oil prices¹. In the meantime, volatility in energy and fertiliser prices has been high. Due to specificities and structures of individual markets, prices of similar fertiliser products can differ widely between various geographical and local markets, also within the EU.

¹ World Bank Commodity prices (urea), monthly data (Pink Sheet)

Figure 1 – World fertilisers prices (left axis, EUR/mt) compared to natural gas price index (2010=100)

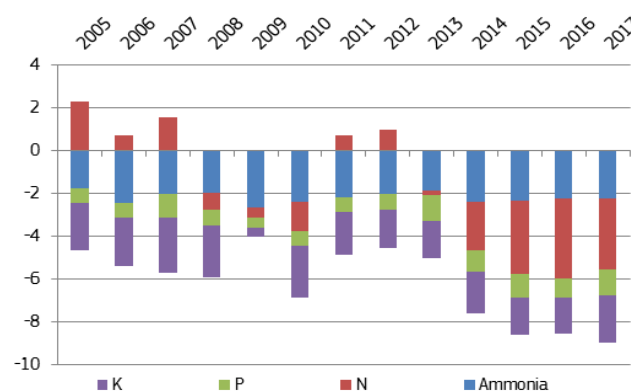


Source: DG AGRI, based on World Bank¹

4. Fertiliser trade is dominated by few producing countries

The EU is largely dependent on imports for most of mineral fertilisers. Over time, nitrogen-based fertilisers have been the most traded products between the EU and third countries. More than 3 million t are imported annually into the EU since 2015. When ammonia is included, the level of imports reaches 6 million t of nitrogen based products each year. Phosphate fertilisers (as mono/di-ammonium phosphate) were the least traded, at around 1 million t annually. EU imports of potassium fertilisers are around 2 million t.

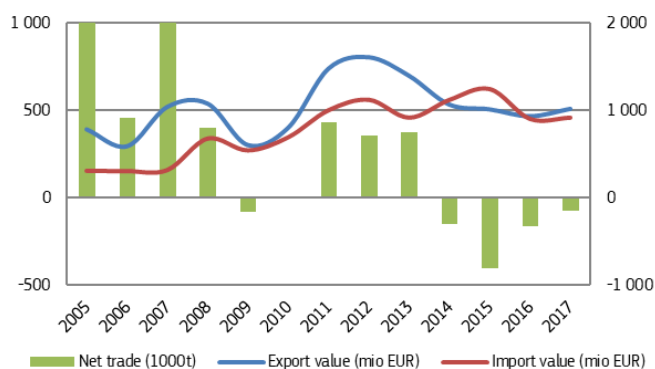
Figure 2 – EU net trade for ammonia, nitrogen, potassium and phosphate (million t of product)



Source: DG AGRI, based on Comext - Eurostat

The EU used to be a net exporter of ammonium nitrates (both AN and CAN), but since 2014 the net trade balance reversed and the EU became a net importer. In 2017, EU net imports reached 153 000 t. The US decreased significantly their imports from the EU, while Brazil increased them and passed the US as the biggest importer of EU products. Mexico and Canada have also increased their imports of AN from the EU, and more recently Serbia and Ukraine.

Figure 3 – Ammonium-nitrate net trade volume (thousand t - right axis) and value (million EUR – left axis)



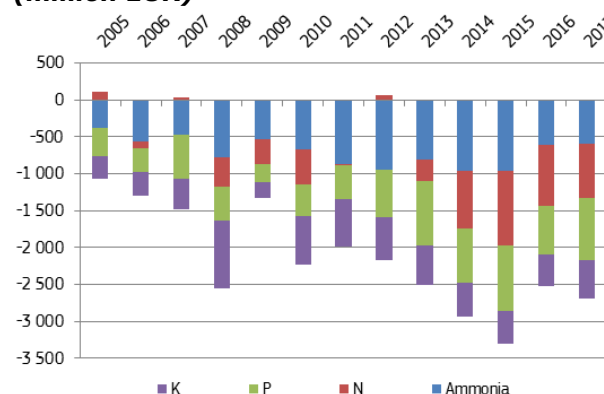
Source: DG AGRI, based on Comext - Eurostat

The main producing countries of nitrogen fertilisers close to the EU are located in North Africa (Egypt, Algeria) and in Eastern Europe (Belarus, Russia and Ukraine). EU imports of nitrate-based fertilisers originate mainly from Russia, Egypt and Algeria. Since 2010, ammonia is largely imported into the EU from Russia (50 % of total EU imports on average) but Algeria's exports to the EU have been increasing and Algeria became the biggest EU supplier in 2017. Egypt has also gained some market shares, increasing its exports of urea in the recent years.

Phosphate-based products are mainly sourced from Morocco (22 % of total EU imports). Exports of di-ammonium phosphates (DAP) from Morocco and Russia to the EU increased significantly and reached 70 % of total DAP EU imports in 2017.

Potassium chloride imports are mainly coming from Russia and Belarus (about 70 % of total EU imports). Compounds of NPK are mostly imported from Russia and Norway. Since 2015, Russia has taken over Norway's historically first position as largest exporter to the EU.

Figure 4 – EU net trade for ammonia, nitrogen, potassium and phosphate based products (million EUR)ⁱ

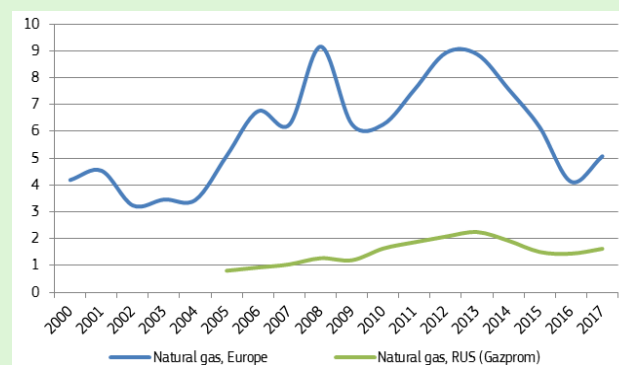


Source: DG AGRI, based on Comext - Eurostat

EU import tariffs on fertilisers

Domestic producers supply 90 % of the EU market². The EU is applying a tariff of 6.5 % on imports of nitrogen, phosphorus and potassium. Further, anti-dumping duties are applied on ammonium nitrate imports from Russia since 1994. The duties have been adjusted in 2002 to reach 47 EUR/t due to the asymmetric pricing of Russian gas in the EU and in Russia. An adjustment was made in 2018 to reach 32 EUR/t.³ Provisional anti-dumping duties are also applied since April 2018 on UAN originating from Russia, Trinidad and Tobago and the US, with ad-valorem duties ranging from 16.3 to 34 %.

Figure 5 – Gazprom natural gas prices in Europe and Russia (EUR/mmbtu)



Source: DG AGRI, based on World Bank, Gazprom annual reports

² Implementing Regulation (EU) 2018/1722 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2018.287.01.0003.01.ENG&toc=OJ:L:2018:287:TOC

³ Implementing Regulation (EU) 2018/1722

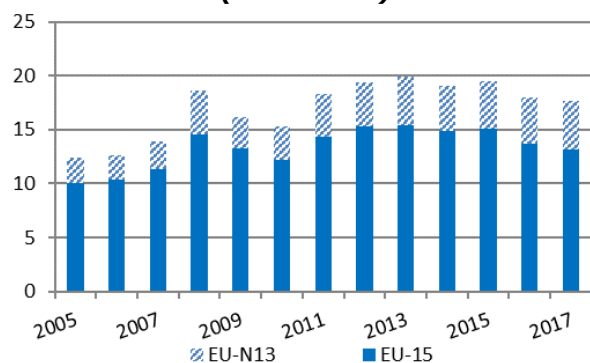
5. Fertiliser use

Overall stabilisation of the consumption in the EU in the last years

After a strong reduction in fertiliser use in the 1990's and 2000's, linked to reforms of the Common Agricultural Policy, the overall fertiliser use stabilised in the past decade.

Since 2005, the EU market value of fertilisers has been increasing by 3 % annually, though slightly declining towards the end of the period. In 2017, the value of the fertiliser market reached EUR 17 billion. France, Germany and the UK, represent 40 % of the market. The volume of fertilisers used in the EU, represents 10 % of the total use at global level.

Figure 6 – Fertilisers and soil improvers market value in the EU (billion EUR)



Source: DG AGRI, based on Economic Accounts of Agriculture-Eurostat

Nitrogen-based fertilisers are the most commonly used

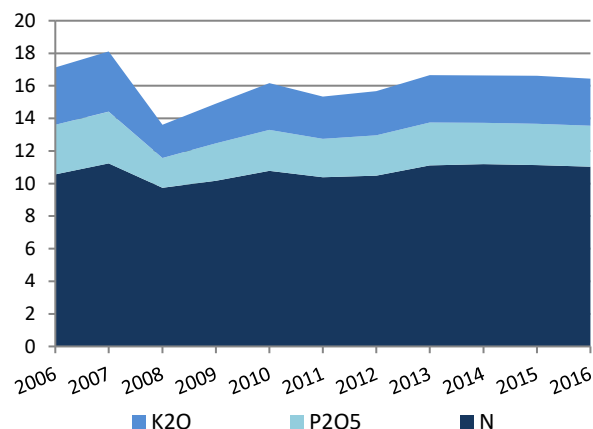
Nitrogen is by far the most used nutrient in the EU in volume. It represents more than two-thirds of the total use of the three main nutrients (N, P and K).

Phosphate and potassium are applied in lower quantities on EU agricultural land, and represent less than 20 % each of the overall use in volume.

Fertilizers Europe estimates that, out of the 179 million ha of agricultural land available in the EU, 134 million ha (75 %) are fertilised with mineral fertilisers. Around half of the fertilisers used is applied on cereals (26 % on wheat, 25 % on coarse grains), 16 % on grassland and 11 % on oilseeds. The total volume of fertilisers applied on specialised crops (potatoes, sugar beet, permanent crops) is relatively low. The application rate per hectare varies considerably between different crops. For example, wheat is grown on 15 % of the EU agricultural land but represents

26 % of the fertiliser use, oilseeds are grown on 6 % of the agricultural land but represents 11 % of the fertiliser use, while fertilised grassland represents 18 % of the land use and 16 % of the fertiliser use.

Figure 7 – Consumption estimates of manufactured fertilisers in the EU (million t)

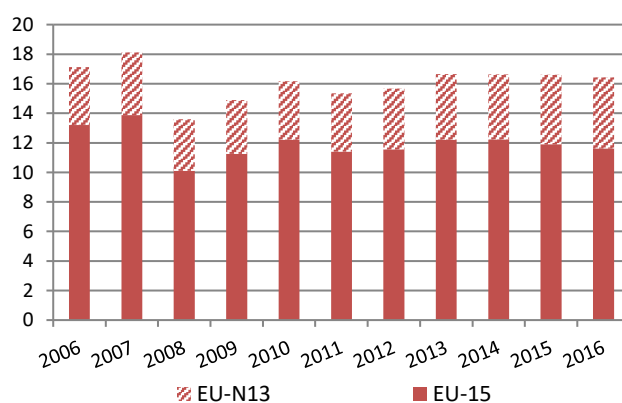


Source: DG AGRI, based on Eurostat

Consumption decreases in the EU-15 and grows in the EU-N13

Consumption estimates of manufactured fertilisers are stable across the EU while diverging trends are occurring in the EU-15 and the EU-N13. In Member States which joined the EU after 2004 (EU-N13), a rising trend is observed but starting from a relatively low level compared to the other Member States.

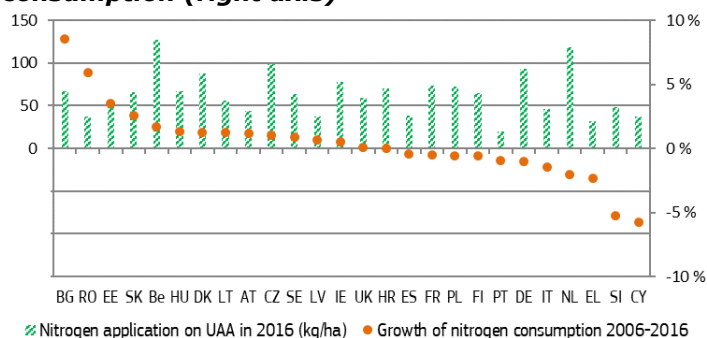
Figure 8 – Consumption estimates of manufactured fertilisers NPK (million t)



Source: DG AGRI based on Eurostat

During the period 2006 to 2016, the biggest increase of fertiliser applied per hectare occurred in Bulgaria (8.5 %) and Romania (5.9 %) but starting from a relatively low level compared to the EU average.

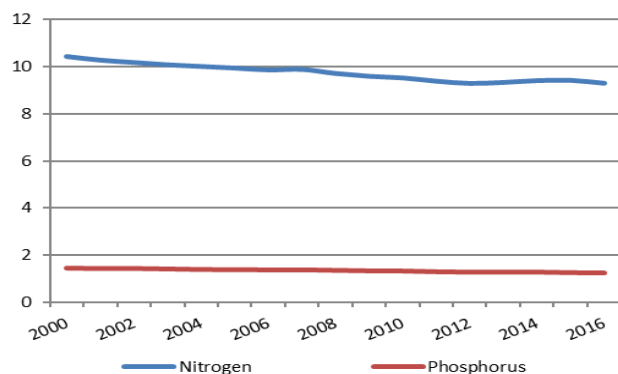
Figure 9 – Manufactured nitrogen application across the EU in 2016 (in kg/ha) and growth in consumption (right axis)



Source: DG AGRI, based on Eurostat
Note: Be stands for Benelux

Fertilisation is also done through application of organic matter, such as manure. When produced on livestock farms, manure (or slurry) is applied on crops and pastures both in conventional and organic production systems. Since 2000, the dairy production has slightly increased but the total number of cattle has decreased and thereby affected the amount of manure produced, which has fallen across the EU.

Figure 10 – Nitrogen and phosphorus input via manure application in the EU (million t)



Source: Eurostat

Fertiliser costs are slightly increasing

According to FADN data, fertiliser costs account for around 10 % of the intermediate consumption (2016 data).

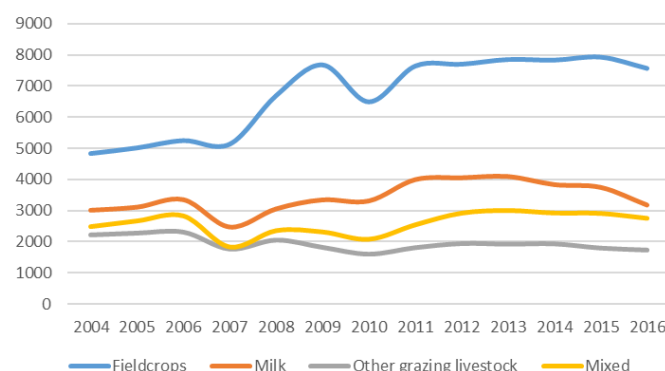
Large differences between Member States can be observed, from 2 % in the Netherlands to 21 % in Lithuania. Between 2006 to 2016, the share remained stable at EU-level but significantly increased in certain Member States, particularly in the EU-N13.

Field crop farms have the highest fertiliser costs, with a share in intermediate consumption of 19 % on

average between 2006 and 2016. Fertiliser costs, at 7500 EUR/farm in 2016, increased by 4 % annually throughout the period across the EU. However, in some Member States (PL and LU), field crop farms have reduced their fertilising costs during the same period.

On dairy farms, the cost per hectare of fertilisers has grown by 1.7 % annually between 2006 and 2016. Other grazing livestock farms (mainly sheep and goats) have decreased their costs for fertilisers in the same period.

Figure 11 – Fertiliser costs for various farming sectors in the EU (EUR/farm)



Source: DG AGRI, FADN database.
http://ec.europa.eu/agriculture/rca/database/database_en.cfm

6. Environmental impacts related to fertilisers use

Fertiliser production and application has an impact on the agriculture and on the environment. Under most conditions, the application of fertiliser increases the production of biomass, and therefore increase potential yield and facilitate capturing of additional carbon dioxide.

Fertiliser production and use:

The production of nitrogen-based fertiliser uses high amounts of, predominantly, fossil fuel (natural gas and coal) and therefore has a negative impact on the Green House Gas (GHG) balance of the agricultural sector, when included in the measurement.

However, the use of fertilisers makes the plant production more efficient. A higher quantity of output (i.e. grain, grass etc.) can therefore be produced on a smaller surface, which limits the agricultural area needed.

The average energy efficiency for European fertiliser production plants is higher than the global average

due to the use of relatively modern technology and reduced use of coal as main energy supply. The emissions differ between different types of products. Urea, which is the most used fertiliser at global level, emits less carbon dioxide during the production phase than nitrate based products. However, when a plant absorbs nitrogen from urea, carbon dioxide is released during the nitrification process. On the contrary, a nitrate-based product releases less carbon dioxide when absorbed by a plant, since it is applied directly in form of nitrate. Negative environmental impacts can origin from losses of ammonia in gaseous form through volatilisation or from an ammonium-based fertiliser like urea. Throughout the life cycle, urea is claimed to be less efficient in terms of emissions of greenhouse gases than nitrate based fertilisers. The climate performance of different types of products depends on several factors such as how the product is applied, temperature, availability of moist for the product to be dissolved etc. Therefore, a general Life Cycle Analysis and a net GHG balance is difficult to make.

Ammonia production as such requires large amounts of energy and thereby the process emits carbon dioxide, as well as the next step in the process when ammonia is transformed into urea.⁴ Ammonia is a relatively easily transportable and storable product and can therefore also be used as an energy storage of hydrogen. Research is ongoing on how to improve technology in order to broaden the use of ammonia as alternative power source or energy carrier in the automotive sector for example. The technology and the share of renewable energy used to produce ammonia will be crucial for the overall climate impact of the production of nitrate-based fertilisers.

Fertiliser application:

Application of low amounts of either organic or mineral fertilisers can have an impact on the environment. Ammonia, when released into the atmosphere, can combine with other air pollutants and contribute to airborne particular emissions. More than 90 % of EU ammonia emissions are coming from agriculture, of which 80 % is coming from manure and 20 % from mineral fertiliser. While, GHG have a long atmospheric residence time and therefore can have an equal impact irrespective of emission location, ammonia mostly lands in a short distance from the

emission source. This often results in high concentration of airborne emissions in regions with intensive farming and animal breeding.

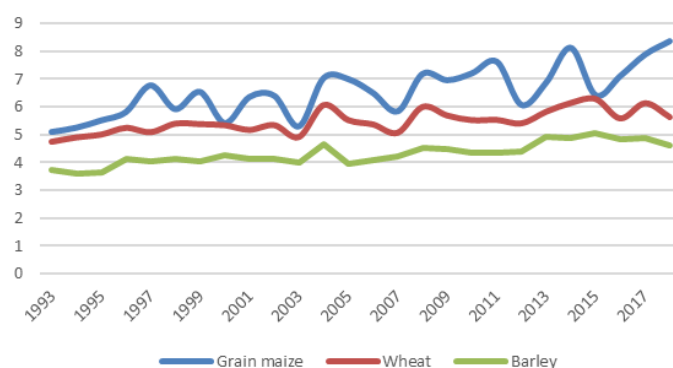
Leaching and run-off of nitrogen into the environment is often associated with unsustainable farming practices. When applied in quantities based on the need of a plant, either as organic or mineral fertiliser, the plants absorb the nitrogen. If any surplus remains, this can lead to run-off into watercourses as well as losses to the atmosphere. Excessive losses of nutrients in a short period can also disturb the equilibrium of the surrounding ecosystem and lead to a significant impact on biodiversity.

As part of the Circular Economy package (2016),⁵ the Commission adopted a proposal for a regulation on availability of fertilising products. The legislators reached an agreement on the regulation by the end of 2018 and the act was adopted and will enter into force in 2019. The regulation includes a gradually decreasing permitted level of maximum content of cadmium in fertilisers marketed.

Yield gains together with a reduction of nutrient content in soils

The application of fertilisers on crops has increased the average yields for the main cereal crops leading to a higher agricultural output and reduced prices.

Figure 12 – Evolution of yields in the EU (t/ha)



Source: DG AGRI based on Eurostat

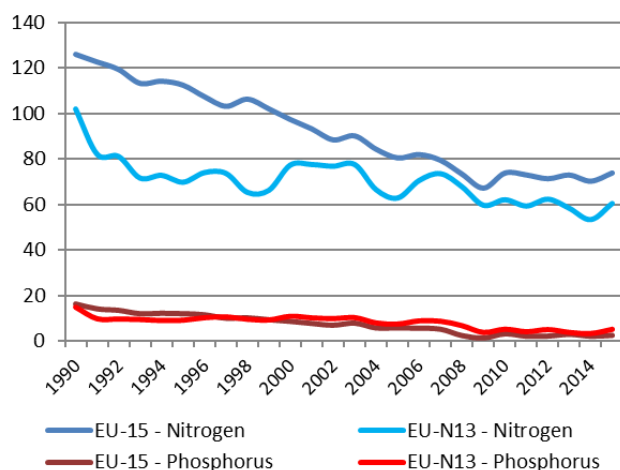
The increase of average yields is not solely due to the use of fertiliser and does not necessarily mean increasing quantities applied. Several other factors are relevant for the yield such as seed breeding, plant protection products, technology used etc. Furthermore, analysing the nitrogen and phosphorus balances in the soil, the nutrient content in soil from

⁴ The fertiliser industry is searching different ways of producing ammonia and ammonium nitrate with hydrolysis, which would not emit any CO₂. A high energy-consuming process would require development of other and cleaner energy to reduce emissions.

⁵ https://ec.europa.eu/commission/priorities/jobs-growth-and-investment/towards-circular-economy_en

agricultural land has decreased since the 1990's. The successive reforms of the Common Agricultural Policy in 1992 and 2003 with a shift away from price support and coupled support to production to decoupled payments has lowered the economic optimal amount of fertiliser to be applied.

Figure 13 – Gross Nutrient Balance for N and P in the EU (kg/ha UAA)

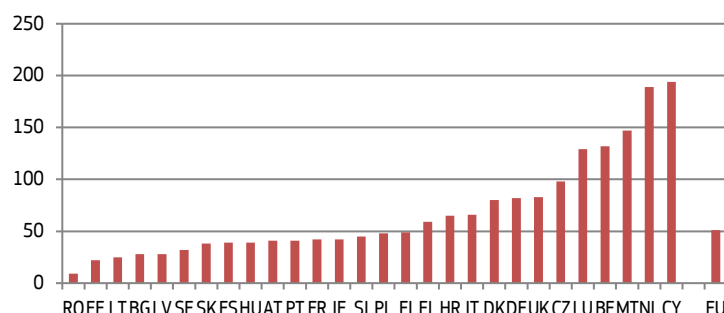


Source: DG AGRI, based on Eurostat

Note: UAA stands for Utilised Agricultural Area

The average gross nutrient content for nitrogen is approximately 50 kg/ha (2015, latest available data) and only five countries have declared to have levels of nitrogen, above 100 kg/ha (BE, CY, LU, MT, NL).

Figure 14 – Gross Nutrient Balance for Nitrogen in the EU in 2015 (kg of nutrient per hectare of UAA)



Source: DG AGRI CAP indicators dashboard

https://agridata.ec.europa.eu/extensions/DataPortal/cmef_indicators.html

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http://ec.europa.eu/agriculture/markets-and-prices/index_en.htm

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ENDNOTES

¹ Trade data are coming from Comext (Eurostat). The corresponding names and codes for each products are:

Ammonia:	2814	Ammonia, anhydrous or in aqueous solution	P (phosphate) (cntd)	310559	Mineral or chemical fertilisers containing the two fertilising elements nitrogen (excl. nitrate) and phosphorus but not nitrates (excl. ammonium dihydrogen orthophosphate "mono ammonium phosphate", di ammonium hydrogen orthophosphate "di ammonium phosphate" in tablets or similar forms, or in packages with a gross weight of <= 10 kg)
N (nitrogen)	3102	Mineral or chemical nitrogenous fertilisers (excl. those in pellet or similar forms, or in packages with a gross weight of <= 10 kg)		310560	Mineral or chemical fertilisers containing the two fertilising elements phosphorus and potassium (excl. those in tablets or similar forms, or in packages with a gross weight of <= 10 kg)
K (potassium)	3104	Mineral or chemical potassic fertilisers (excl. those in tablets or similar forms, or in packages with a gross weight of <= 10 kg)		310530	Diammonium hydrogenorthophosphate "diammonium phosphate" (excl. that in tablets or similar forms, or in packages with a gross weight of <= 10 kg)
P (phosphate)	3103	Mineral or chemical phosphate fertilisers (excl. those in tablets or similar forms, or in packages with a gross weight of <= 10 kg)			
	310540	Ammonium dihydrogenorthophosphate "monoammonium phosphate", whether or not mixed with diammonium hydrogenorthophosphate "diammonium phosphate" (excl. that in tablets or similar forms, or in packages with a gross weight of <= 10 kg)			