Agri-environmental indicator - mineral fertiliser consumption

This article provides a fact sheet of the European Union (EU) agri-environmental indicator mineral fertiliser consumption. It consists of an overview of data, complemented by information needed to interpret these data. This article on mineral fertiliser consumption in the EU is part of a set of similar fact sheets, providing a comprehensive picture of the integration of environmental concerns into the Common Agricultural Policy (CAP).

Key messages

- In 2017, 11.6 million tonnes of nitrogen fertiliser was used in EU agriculture, an increase of 8% since 2007 (10.7 million tonnes).

- In 2017, 1.3 million tonnes of phosphorus fertiliser was used in EU agriculture, a reduction of 9% since 2007 (1.5 million tonnes).

Analysis at EU level

Mineral fertiliser consumption remained at a high level between 2007 and 2017

The consumption volume of the mineral fertilisers nitrogen (N) and phosphorus (P) by agriculture remained high in the period 2007 to 2017 (Figure 1). Fluctuations occurred, most notably during the years 2009, 2010 and 2012 when fertiliser use dropped significantly (Table 1). Fertiliser prices had at that time skyrocketed due to the impact of strong demand for oil on the cost of agricultural inputs (DG AGRI, 2011). Nitrogenous fertilisers (ammonia, urea, ammonium nitrate) are produced from natural gas, the price of which is strongly linked to oil prices. Phosphates are mined outside of the EU, which results in high production and transportation costs, also linked to oil prices. From 2004 to 2010, the average world agricultural prices grew by 50% compared with the average of 1986 to 2003. By comparison, fertiliser prices jumped by 150% over this period and peaked in 2008.
The nitrogen fertiliser consumption per hectare of fertilised utilised agricultural area (UAA) increased during the period 2007 to 2017 in the EU-28, from 67.9 kg/ha in 2007 to 75.9 kg/ha in 2017 (Table 2). The highest increases in nitrogen consumption per hectare were reported for Bulgaria (125 %), Hungary (48 %), Romania (45 %) and Latvia (42 %). The largest reductions were found in Greece and Malta (both -16 %) and Croatia (-15 %).
The fact that nitrogen fertiliser use is increasing, is in stark contrast to the period from 1990 to 2000. Following the introduction of the Nitrates Directive (ND) in 1991 and the introduction of the national action programmes for designated nitrate vulnerable zones (NVZs), nitrogen fertiliser consumption was reduced significantly in the 15 Member States of the EU at that time EU-15. The Water Framework Directive (WFD) was introduced in 2000. These developments contributed to a decrease in nitrogen mineral fertiliser consumption between 1990 and 2010 by 19 %, according to Fertilizers Europe (aei_fm_manfert).

The total consumption of phosphorus has declined by 9 % from 2007 levels, but also here the 2009, 2010 and 2012 levels were the lowest over the period from 2007 to 2017 (Table 3). An increase has since kept the levels at around 1.3 million tonnes P per year. The use of phosphorus fertiliser per hectare of fertilised UAA decreased by almost 6 % in the EU-28 from 2007 to 2017 (Table 2). Belgium (-50 %) and the Netherlands (-66 %) recorded the largest decreases in the estimated amount of phosphorus spread per hectare of fertilised UAA between 2007 and 2017 (Table 2). At the other end of the scale, a high increase in kg phosphorus/hectare was reported in Bulgaria (161 %), followed by Hungary (48 %), Denmark (45 %), Cyprus (42 %) and Romania (41 %).
Table 3: Phosphorus fertiliser consumption by agriculture, EU-28, NO, CH and TR, 2007-2017 (1000 tonnes)

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Source: Eurostat (aei_fm_usefert)

Fertiliser application rates

There is broad recognition that above-optimal applications of fertiliser nutrients such as nitrogen and phosphorus lead to an enhanced risk of pollution to watercourses, and associated problems with water quality. Different crops receive different application rates of nitrogen and phosphorus fertiliser. In particular, wheat, grass, barley, grain maize, potato, sugar beet, oilseed rape, vegetables and industrial crops have high application rates of nitrogen fertiliser. To identify areas at risk of nutrient surplus, the actual area fertilised should be taken into account.

Source data for tables and graphs

• Mineral fertiliser consumption statistics

Data sources

Indicator definition

Mineral fertiliser consumption is indicated by the evolution of the consumption of the nutrients nitrogen (N) and phosphorus (P) in mineral fertilisers by agriculture over time.

Main indicator:

• Application rates (kg/ha) of N and P

Supporting indicators:

• Absolute volumes (tonnes) of N and P
• Application rates of organic fertilisers (kg/ha) of N and P

Links with other indicators

The consumptions of nitrogen and phosphorus fertilisers are linked to several other agri-environmental indicators.
Data used

Eurostat publishes two data sets on inorganic fertilisers: (aei_fm_usefert) and (aei_fm_manfert). The first one is collected from Member States and is an estimate of the nitrogen (N) and phosphorus (P) use in agriculture. The other data set is estimated consumption based on the sales of mineral fertiliser in the EU from Fertilizers Europe. The figures estimated by the trade association Fertilizers Europe based on sales of mineral fertiliser mostly correspond with the estimates of nitrogen and phosphorus use reported by countries (Figure 2) although they cannot be directly compared due to methodological differences.

Figure 2: Statistics on nitrogen fertiliser, EU-28, 2017 (1000 tonnes)
Source: Eurostat

Data on UAA was taken from the annual crop statistics data collection from 2017 (2016 for EU-28, Italy and Norway as data were not available for 2017). Not all agricultural area is fertilised, but there is no data collection covering this issue. Therefore, areas which are usually not fertilised - areas covered by rough grazing and fallow land - were removed from the UAA, using data collected in the Farm Structure Surveys (FSS) 2007 and 2013 to calculate the "fertilised UAA" for 2007 and 2017 respectively (more recent FSS data was not available). The size of these areas do not vary to such a high degree that this would be misleading.

Data on fertiliser consumption is not only needed for this indicator but also for other AEI such as AEI 15 - Gross nitrogen balance, AEI 16 - Risk of pollution by phosphorus, AEI 18 - Ammonia emissions and AEI 19 - GHG emissions. Although data on fertiliser consumption is of high importance for many policies and indicators, harmonised statistics do not exist at EU-level.

Methodology

The data sources used in the assessment of this indicator are:

- Data from countries. Tonnes of N and P inorganic fertiliser consumption for year t are transmitted annually each t + 1 at NUTS 0 level. This data source is however not harmonised; data have been derived from different types of data sources in Member States, such as farm surveys, production/trade statistics, sales statistics, administrative records etc. Official statistics on mineral fertiliser use are lacking in some countries. The reference period is the calendar year; data collected for crop years (t-1/t) can be reported in calendar year t, no corrections are made.

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• Data from Fertilizers Europe. This is a harmonized data source. Data are available at NUTS0 for EU (excluding Croatia) and Norway. Data from Fertilizers Europe relate to crop years (t-1/t) which are reported under year t-1. Data were originally received in kilo tonnes of nitrogen (N), phosphate (P2O5) and potash (K2O). Phosphate and potash were transformed into phosphorus (P) and potassium (K) by multiplying the data with 62/142 and 78/94 respectively.

Limitations of data

Data from production/sales statistics may overestimate the use of mineral fertilisers due to the inclusion of intermediary goods and non-agricultural use. Data from Fertilizers Europe cannot be directly compared with data received from countries, due to differences in reference periods, data sources and methodology (see data sources).

A more detailed data collection on mineral fertiliser use in agriculture would be useful for several policies such as water, soil and air emission/greenhouse gas inventories. Collecting data in a geo-referenced sample survey would allow the use of these data for modelling environmental impacts at finer spatial scales. To identify areas at risk, not only data on applications are needed but also data on fertilised areas.

The EMEP/EEA Guidebook 2016 (NH3 and NO emissions) and the IPCC Guidelines 2006 (GHG emissions) do not directly require fertiliser data to be available by crop. However, the EMEP/EEA Guidebook notes that where spatially disaggregated inventories of fertilised culture emissions are required, information on the spatial distribution of different crop types and average N fertiliser inputs to each crop type may be used.

The IPCC Guidelines 2006 note that if sufficient data are available, fertiliser use may be disaggregated by fertiliser type, crop type and climatic regime for major crops. These data may be useful in developing revised emission estimates if inventory methods are improved in the future.

Eurostat is working together with Member States to improve the data collection on mineral fertiliser use in agriculture.

Context

Nutrients, such as nitrogen (N) and phosphorus (P), are absorbed from the soil by plants for their growth. Mineral, or inorganic, fertilisers are widely used in agriculture to optimise production, and organic fertilisers are a significant additional source of nutrient input. Organic farmers do not apply synthetic mineral fertilisers. Nitrogen and phosphorus fertilisers greatly enhance crop production, but losses of nitrogen and phosphorus from agriculture contribute to environmental pollution. N and P behave differently in terms of their availability for loss from the agricultural system. N is highly soluble with limited build-up in the soils, and research shows a positive relationship between application rate and nitrate loss from the soil root zone. P losses from land occur due to soil erosion and agricultural run-off. Historic over-fertilisation of P can build up soil P reserves to high levels and under such conditions it is possible for significant pollution to take place even with negligible new fertiliser inputs. However, the main focus of losses is related to the timing and loading of inputs of N and P either from fertiliser or organic manure applications.

Food production has become highly dependent on mineral P fertilisers. Some 80% of phosphorus use is in agriculture. The main source of P in the world is phosphate rock; a non-renewable resource. The majority of phosphate rock reserves in the world are concentrated in a few countries, none of them EU Member States. Phosphate rock is on the list of critical raw materials for the EU. It means that phosphate rock is a high supply-risk and of a high economic importance. Therefore the European Commission is monitoring the situation to identify priority actions, such as trade agreements.

Organic fertilisers may consist of manure, composts and sewage sludge. These organic fertilisers are important sources of N and P, especially on livestock farms and farms near urban areas. Increasing the effectiveness of organic fertiliser use will contribute to decreased use of mineral fertiliser.

Policy relevance and context

Application of fertilisers is a major factor contributing to losses of nutrients such as nitrate and phosphate from agricultural soils into ground and surface water bodies. This loss can occur via run-off along the soil
surface or as sub-surface loss via leaching and drainflow. As a consequence, legislative initiatives through the Nitrates Directive and the Water Framework Directive have sought to limit nutrient losses to water bodies through more careful management of agricultural land. In the case of the Nitrates Directive, this has included the designation of nitrate vulnerable zones (NVZs), establishment of Code(s) of Good Agricultural Practice to be implemented by farmers on a voluntary basis, establishment of Action Programmes to be implemented by farmers within NVZs on a compulsory basis, and national monitoring and reporting.

The Codes of Good Agricultural Practice include measures limiting the time when fertilisers can be applied on land in order to allow N availability only when the crop needs nutrients. Measures also limit the conditions for fertiliser application (steeply sloping ground, frozen or snow covered ground, near water courses). The Action Programmes are based on Action Standards contained in the Code of Good Agricultural Practice which become binding for farmers in NVZs. Other measures apply such as limitation of fertilisers to be applied taking into account crops needs, all N inputs and soil supply, maximum amount of animal manure to be applied (corresponding to 170 kg N organic/hectare/year). In the legislative text of the Water Framework Directive, an indicative list of pollutants includes organophosphorus compounds and substances that contribute to eutrophication (in particular nitrates and phosphates). Measures suggested in this context are aimed at reducing the influx of nutrients, such as nitrogen and phosphorus to the groundwater and surface waters and include the reduction of nutrient application, the modification of cultivation techniques, proper handling of fertilisers, and the prevention of soil erosion through erosion minimising soil cultivation.

Other agri-environmental policies that affect the consumption of nitrogen and phosphorus fertilisers, directly or indirectly include:

- United Nations Framework Convention on Climate Change (UNFCCC). Countries report on their progress in limiting greenhouse-gas emissions by submitting annual emission inventories and national reports. The application of mineral nitrogen fertilisers by agriculture is one of the items to be reported.

- National Emissions Ceiling Directive (NEC Directive). This Directive sets national reduction commitments for the five pollutants (sulphur dioxide, nitrogen oxides, volatile organic compounds, ammonia and fine particulate matter) responsible for acidification, eutrophication and ground-level ozone pollution which leads to significant negative impacts on human health and the environment. Targets are set for the years 2020 and 2030. Each EU Member State is required to produce a National Air Pollution Control Programme by 31 March 2019 setting out the measures it will take to ensure compliance with the 2020 and 2030 reduction commitments. The inventory data can be viewed in the EEA National Emission Ceilings Directive emissions data viewer.

- UNECE Convention on Long-range Transboundary Air Pollution Gothenburg protocol. For the EU Member States, the emission ceilings in the protocol are transposed into the NEC Directive (see above).

- Common Agricultural Policy (CAP). The EU’s agriculture policy encourages environmentally friendly farming practices through greening, rural development payments, and cross-compliance.

- Natura 2000, the Birds Directive and the Habitats Directive. The main purpose of the Habitats Directive is to ensure biological diversity through the conservation of natural habitats and of wild flora and fauna within the European territory, while taking into account economic, social, cultural and regional requirements. Depending on the specific conditions of a certain area, these include measures to reduce the use of pesticides and fertilisers, measures to mitigate the effects of soil compaction, e.g. limitations on the use of machinery or the setting of stocking limits, or measures aiming to regulate the irrigation of agricultural land. Farmers who have agricultural land in Natura 2000 sites and face restrictions due to the requirements of the Habitats Directive are eligible to receive payments for the management of these sites by the Rural Development Regulation, which helps promote environmental-friendly farming.

Agri-environmental context

The intensity of fertiliser use has implications for agricultural production and the potential environmental

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impacts of nutrient run-off from farmland. Agricultural research shows that nutrient requirements (and hence consumption) vary for different crop types and yield expectations and are influenced by previous land management, soil type and climatic factors. The Rural Development Programmes 2014-2020 (RDPs) finance actions to better manage the use of nutrients in agriculture. Various measures with a nutrients’ management component – non-productive investments, agri-environmental-climate (AEC) or organic farming – make reference to Nutrient Management Plans (NMPs).

In some cases NMPs are pre-requisites for access to non-productive investments or to specific environmental measures (e.g. in Finland and Ireland). In the Finnish Rural Development Programme (RDP), for example, all farmers participating in the AEC measures must subscribe to the agri-environment-climate operation "Balanced use of nutrients". The commitment applies to the entire UAA of the farm. The farmers must set up a multi-annual system for planning, recording and monitoring environment management (cultivation plan, parcel specific notes, soil fertility analyses, parcel records, a soil quality test). There is also an obligatory training and advisory module paid for by the RDP. In Ireland, participants in Measure 10 – Green Low-Carbon Agri-Environment Scheme (GLAS) must prepare an NMP for the whole farm. Participants in Measure 1 Knowledge Transfer Groups also have to complete a Farm Improvement Plan which usually includes either a Nutrient Management Plan or a Carbon Navigator Plan. Many French RDPs also connect nutrient management tools with emission reduction tools. In Hungary, in the case of two horizontal schemes (arable and plantation) and one zonal (drought prone areas) the preparation of an NMP based on soil testing, with the involvement of a soil expert is obligatory. Both commitments are paid through the RDP.

In other cases NMPs are supported as paid commitments (e.g. Italy, Hungary) under types of operations that are wider in scope (integrated farming, conservation agriculture, minimum tillage, etc.), or more precisely targeted to a specific environmental problem (e.g improving soil organic matter – Italy, Emilia Romagna). In Lithuania, also, annual soil analyses and NMPs are compulsory requirements for the Measure 10 sub-measure Environmentally friendly systems for fruit and vegetable production.

This indicator is strongly linked to the indicators AEI 15 - Gross nitrogen balance, AEI 16 - Risk of phosphorus pollution, AEI 18 - Ammonia emissions, AEI 19 - GHG emissions and AEI 27.1 - Water quality - nitrate pollution, and more information can be found on the agri-environmental context in the fact sheets of these indicators.

This indicator represents partial nutrient inputs to the agricultural system (the other main inputs being applications of manures and slurries, other organic fertilisers, biological nitrogen fixation and atmospheric nitrogen deposition). The total inputs and outputs of nitrogen and phosphorus of agricultural land are considered in AEI 15 and AEI 16. Excessive use of nitrogen fertiliser can lead to an increase of nitrate levels in water (see AEI 27.1) and hereby cause eutrophication, which can lead to toxic algal blooms and loss of aquatic life. Excessive use of phosphorus mineral fertilisers can lead to water pollution by phosphorus, contributing to eutrophication. With the application of nitrogen fertilisers to the land N-emissions can occur, contributing to acidification (see AEI 18) and climate change (see AEI 19). Nitrogen mineral fertilisers are produced using high amounts of energy (gas), and therefore contribute to GHG emissions and fossil fuel depletion. Some environmental pollution due to the production of phosphorus mineral fertilisers are related to the contamination of phosphate rock with heavy metals and other elements, once released to the environment or transferred to soils these may pose a risk to ecosystems and humans.

Other articles

- Agri-environmental indicators - fact sheets
- Agri-environmental indicators - overview of articles in Statistics Explained

Database

- Agriculture (agr)

Agriculture and environment (aei)

Sales of manufactured fertilizers (source: Fertilizers Europe) ( aei_fm_manfert )
Consumption of inorganic fertilizers (aei_fm_usefert)

Farm structure (ef)
  Farm structure - 2008 legislation (from 2005 onwards) (ef_main)
    Overview - farm land use (ef_olu)
      Land use: number of farms and areas of different crops by type of farming (2-digit) (ef_oluft)

Agricultural production (apro)
  Crops (apro_crop)
    Crop production (apro_cp)
      Crop production in EU standard humidity (from 2000 onwards) (apro_cpsh)
      Crop production in EU standard humidity (apro_cpsh1)

Dedicated section

- Agri-Environmental Indicators
- Agriculture - Overview

Publications

- Agriculture, forestry and fishery statistics - 2018 edition

Methodology

- Sales of manufactured fertilizers (source: Fertilizers Europe) (aei_fm_manfert_esms)
- Consumption of inorganic fertilizers (aei_fm_usefert_esms)
- Farm structure (ef_esms)
- Crop production (apro_cp_esms)

Legislation

- Commission Communication COM(2006)508 final - Development of agri-environmental indicators for monitoring the integration of environmental concerns into the common agricultural policy
- Commission Staff working document accompanying COM(2006)508 final

External links

- European Commission - Common Agricultural Policy (CAP)
- European Commission - Reduction of national emissions of atmospheric pollutants
- European Environment Agency (EEA) - Agricultural land: Nitrogen balance
- Fertilizers Europe
- United Nations Framework Convention on Climate Change (UNFCCC)
- EU Nitrogen Expert Panel