Knowledge grows

Yara's roadmap for putting Europe's Farm to Fork Strategy into action

Reducing nutrient losses, increasing yields and producing healthier crops

June 2021

Yara's roadmap for putting Europe's Farm to Fork Strategy into action

The Farm to Fork (F2F) Strategy puts the **European Union as a front-runner in the transformation of the global food industry** by setting several aspirational goals to make food systems fair, healthy, and environmentally friendly. Reducing nutrient losses from agriculture by 50% and increasing the share of EU farmland under organic farming to 25% by 2030 are just two examples of the goals brought forward by the European Union. EU farmers and the agri-food industry are in the spotlight of this transformation.

We need to strengthen current efforts that move us away from inefficient farming practices, which lead to the excessive use of nutrients. Yara supports European farmers in addressing this challenge. **Our core competence lies in empowering farmers to select and manage nutrients in the most sustainable and efficient way** by using digital tools and precision farming to ensure profitability at the farm level. Reducing nutrient losses also means closing nutrient cycles, which requires collaboration throughout the entire food value chain. That's why Yara is also actively engaged in projects that contribute to a more circular economy as another route for reducing nutrient losses to the environment.

Yara backs the EU ambition of transforming the food system in Europe. This transformation will greatly benefit from best practices that are already available today and from the innovative, scientific solutions that are in the pipeline. **One year after the launch of the Farm to Fork Strategy, it is time to put it into action.** Here is our roadmap for how to get there.

Yara's roadmap for putting Europe's Farm to Fork Strategy into action

Nutrient losses: what is at stake?

Collaborative approach needed to improve the environment

Fertilizers provide crops with the nutrients they need to grow so we can responsibly feed a growing global population. However, if weather conditions are not considered when fertilizers are applied, if the nutrient content of manure is not well known by the farmers or if nutrients are applied when crops don't need them, fertilization may lead to excess nutrients that can be released to the wider environment, for instance by runoff into surface water or by leaching into groundwater. Pollution from nutrients (especially nitrogen and phosphorus) has a negative impact on biodiversity in rivers, lakes, wetlands, and seas, as the EU Commission points out in its Farm to Fork Strategy. Thanks to farmers' efforts, **nitrogen losses to the environment on agricultural land have decreased in the EU**[i]. The efficiency of the nitrogen used (expressed by the Nitrogen Use Efficiency indicator) in EU-28 has increased from 56% in 2000, to over 60% in 2005 and 65% in 2014[ii].

The crop nutrition industry, the farming community, policymakers, the scientific community, and society at large, must all collaborate to rise to the challenge created by the F2F target of halving nutrient loss by 2030 while ensuring long-term soil fertility. **Upscaling best nutrient management practices and decision-support tools at farm level** can contribute to reaching the last mile towards the Farm to Fork ambition.

How we can help:

Yara Europe has a broad toolkit of proven solutions already in place that farmers can use today to contribute to reaching the target of halving nutrient losses by 2030. The best way forward is to take a **holistic approach** using a menu of different solutions, including following the principles of balanced plant nutrition, using the right fertilizer and improving nutrient use efficiency.

Yara's sustainable agricultural solutions enable both farmers and food companies to take an active part in the ongoing transformation of the food system. Thanks to the concerted efforts of these players in the food value chain, consumers have access to safe, affordable, and sustainable food choices every day. By using best practices and solutions that exist today, European farmers[iv] can already improve:

- nutrient use efficiency by at least **20%**
- increase yields and incomes by **5-7%**
- reduce their carbon footprint related to mineral fertilization up to **20%**[v].

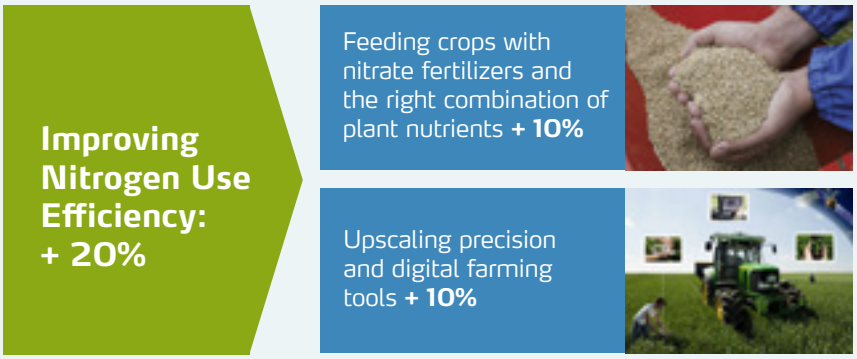


Figure 1: Nutrient losses can be significantly reduced, and the efficiency of nutrients, and especially nitrogen, can be improved by 20% thanks to a broad toolkit of solutions that are already available.[iii]

Fast-track solution 1: using the right mineral fertilizer

By choosing the right mineral fertilizer and the right nitrogen form, such as ammonium nitrate (AN) and ammonium nitrate-based products, farmers can contribute to reducing nutrient losses to the air. Compared to other widely used nitrogen forms based on urea, ammonium nitrate hardly generates any ammonia emissions [see figure 2].

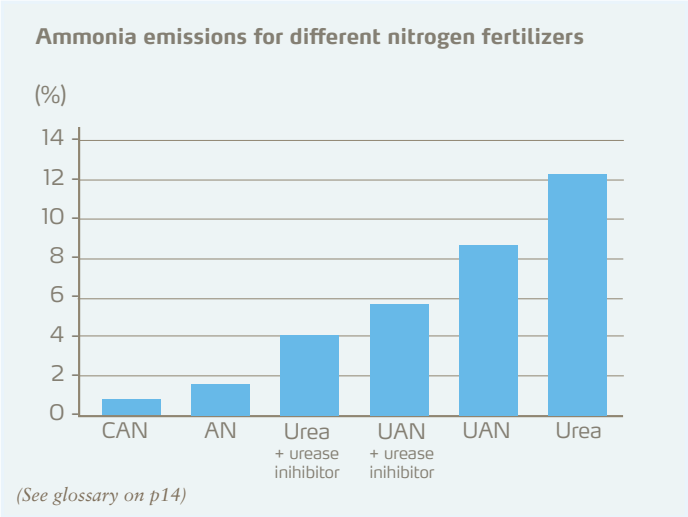


Figure 2: Ammonia emission factors for different nitrogen fertilizers applied to normal soils in Europe (pH≤ 7)[vi]

Therefore, the increase in urea use and imports into the EU (+ 76% in the last 10 years[vii]) is a worrying development, colliding with EU efforts to improve the air we breathe and reduce greenhouse gas emissions. However, ammonia emissions from the use of mineral nitrogen fertilizers, which can significantly deteriorate air quality, can be reduced from the outset if farmers choose a different nitrogen form. **Replacing all urea-based fertilizers with ammonium nitrate could prevent 63% of overall ammonia losses from fertilizer application in Europe.** That would not only contribute to reducing nutrient losses (in the form of ammonia), but also **contribute to cleaner air in Europe.** Switching from urea-based to nitrate-based fertilizers also has **major benefits for climate mitigation.** Less nitrogen needs to be fixated, transported and applied to produce the same amount of food, which has an immediate positive impact on the climate footprint. This is why both the Gothenburg protocol[viii] and the National Emissions Ceiling Directive[ix] encourage farmers to switch from using urea to using ammonium nitrate as a starting point.

FACT BOX 1: Plant nutrients are like pieces of a puzzle

Farmers usually first apply organic nutrients if they are available in their farm or in their area in the form of manure or slurry. This is the very basis of crop nutrition. These organic sources provide nutrients as well as organic matter, which is crucial for soil fertility/health. **Organic and mineral nutrients are complementary, not mutually exclusive.** Used in the right quantities and forms, they are both needed to provide safe, affordable and sustainable food to the end consumer. However, on-farm sources of nutrients are rarely sufficient to meet all crop needs as they generally do not provide the full range of nutrients or lead to soil depletion in the long run. Organic sources of nutrients are rarely sufficient to meet all crop needs as they generally do not provide the full range of nutrients. The nutrients available in manure, composts or food wastes must be used to the maximum effect possible by minimizing losses in storage and transportation, by working them actively into the soils and/or by preprocessing before applying.

Mineral fertilizers are thus an essential complementary product to help close the gap between the nutrient supply from the soil and the plant's nutrient requirement for optimum development and to provide nutrients that can be immediately taken up by the plant. This is best practice for an efficient use of nutrients, where manure and mineral fertilizers are used in combination.

In a nutshell, by following the principles of balanced plant nutrition and by replenishing what is removed by the harvest, European farmers and crop advisors are on the best track for maintaining soil fertility in the long term and not depleting the soils. In addition to being different pieces of the same puzzle, plant nutrients are interlinked with each other. For instance, if there is a lack of phosphorus in the soil or in the crop, it will reduce the ability of the plant to take up other nutrients.

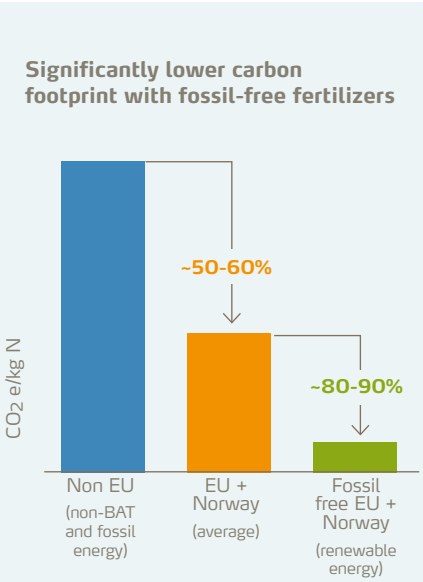
Fast-track solution 2: using fertilizers with the lowest carbon footprint

Taking responsibility for the emissions we release

Yara's nitrate-based fertilizers have one of the lowest carbon footprints, enabling European farmers to harvest quality crops with the lowest possible impact on our climate. Nitrate-based fertilizers, such as ammonium nitrate (AN), are the most common source of nitrogen in Europe. Production of AN releases nitrous oxide (N_2O) and carbon (CO_2). However, **using the best performing catalysts during the production process, can reduce N2O emissions from fertilizer production by as much as 90%.** This technology, developed by Yara, is defined as one of the "best available techniques" for fertilizer production by the European Union. Yara's plants are equipped with this catalyst technology and are rated amongst the most energy efficient fertilizer plants in the world.

Yara is well-positioned to meet the EU target for cutting greenhouse gas (GHG) emissions by at least 55% by 2030. We've reduced our total direct GHG emissions (scope 1) by about 45% and in Europe by 55% since 2005. We aim to reduce our global emissions (scope1 and scope 2) by a further 30% by 2030*), bringing the total reduction to around 60% versus 2005.

However, Yara doesn't stop there since the transformation towards a fossil-free food chain starts in the field. Crop nutrition, which is essential to ensuring yield and quality, will play a key role in the transition to more climate-friendly food production. **Yara is now piloting the production of mineral fertilizer using renewable energy, which could lead to lowering the carbon footprint of nitrogen fertilizer production by 80% to 90%.**



Source: Hoxha, A. & Christensen, B. (2019). The Carbon Footprint of Fertilizer Production: Regional Reference Values. International Fertiliser Society, 2-20.I; not applicable for the production of urea

- Mineral fertilizers produced in EU + Norway already have a significantly lower carbon footprint (~50-60%) compared to most non-EU fertilizers, thanks to the use of the N_2O abatement catalyst.
- This catalytic abatement technology was first developed by Yara and then shared with other providers to reduce emissions during nitric acid production.
- By transforming the production process of ammonia, which is the base of most mineral fertilizers, using renewable energy (solar, wind, hydro) we can achieve a fossil free production process for nitrate fertilisers
- With this transformation, we expect to reach an additional 80-90% reduction of the carbon footprint of the nitrate fertilizer production process

Figure 4: Fossil-free fertilizers have a significantly lower carbon footprint than conventional fertilizers[xi], not applicable for the production of urea.

**Baseline year 2019. Scope 1: direct GHG emissions; Scope 2: indirect emissions from purchased electricity*

Fast-track solution 3: increasing efficiency to reduce nutrient losses

Reducing negative impact of excess fertilization on biodiversity and ecosystems

Nutrient losses can be further reduced by increasing efficiency and making sure that the different nutrients applied by farmers to nourish their crops end up in the harvest and not in the environment. Therefore, **reducing nutrient losses and improving nutrient use efficiency are two sides of the same coin.** Throughout the crop season, farmers have several possibilities for reducing the losses of nutrients, especially nitrogen. By optimizing the combination of different nutrients, farmers can avoid that the crop underperforms due to missing secondary or micronutrients.

Optimizing nutrient use during the wheat growing cycle

Soil analysis
Soil testing provides the information farmers need to ensure crop nutrition decisions are accurate and cost effective.

Balanced Plant Nutrition
The 17 plant nutrients must be used in combination to deliver optimal crop yield and quality.

Weather
As weather conditions change rapidly, farmers must review and fine tune their fertilization plans during the season.

Split application
Applying nitrogen several times during the season, instead of just once, reduces ammonia emissions.

Decision support tools
Farmers can already use digital tools today to optimize fertilization and reduce nutrient losses.

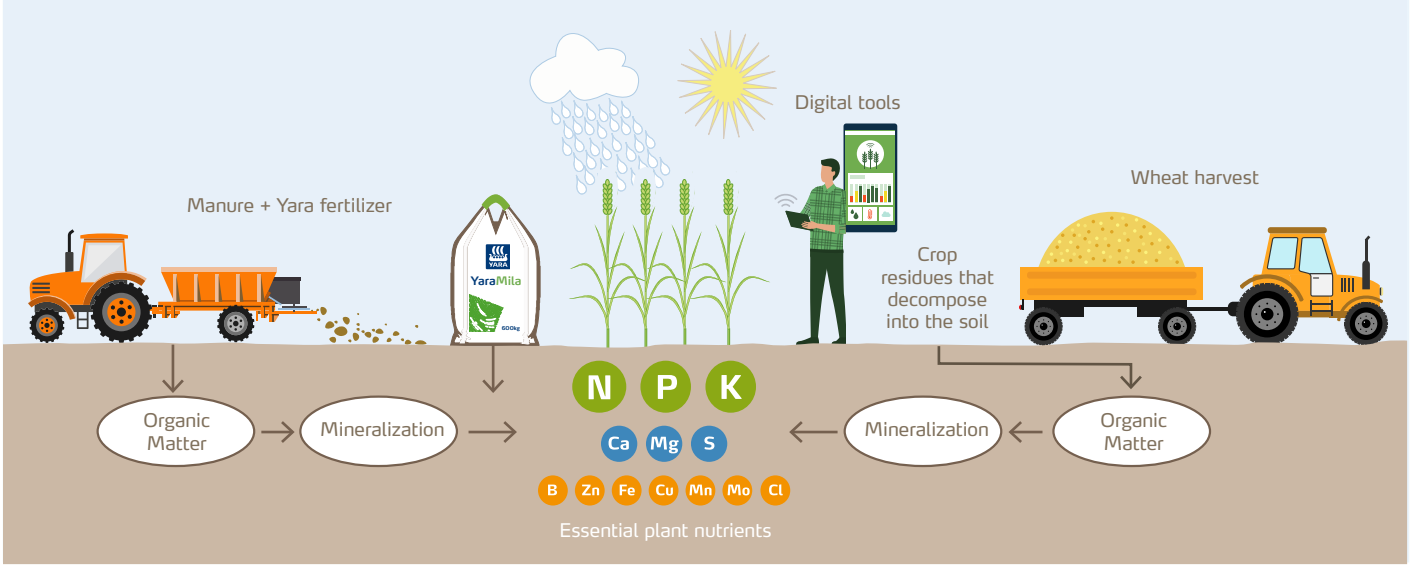


Figure 5: Factors effecting the nutrient cycle through one harvest year, taking the example of a farmer aiming to harvest about 8,000 kg wheat per hectare (ha)

FACT BOX 2: How precision and digital tools can make a difference for the environment

As weather conditions change rapidly throughout the growing season, farmers must review and fine tune their fertilization plan during the season. Here the use of advisory services and recommendation systems that take such changes into account are essential to minimize environmental pollution and to guarantee economic profitably by harvesting high quality, healthy crops. For this reason, Yara has developed different and complementary **tools, which are already available today to farmers at an affordable price,** to help them optimize fertilization over the growing season.

Precision agriculture refers to using new technology, such as in-field sensors and satellites, to provide advice on the preferred action that can be taken in the field, improving both fertilizer efficiency at farm level and the impact on the environment by reducing nutrient losses and GHG emissions. In addition, as the climate is already changing, it leads to more dynamic weather situations so that the need of farmers to adapt fertilization, especially for nitrogen, during the season will increase.

AtFarm – how a mobile app can make a difference. AtFarm is an **affordable tool for farmers to monitor crops' growth** and create variable-rate application maps based on satellite images. In this way different zones in a field can be fertilized differently according to the yield potential and crop need. In simple steps, farmers start with the N-Tester measurement and then create an application map, helping them to monitor the growth of their fields with satellite images and to adapt their nutrient planning to existing variability. AtFarm covers key crops for the different EU countries and helps farmers to identify areas of their field that are behaving in an unexpected way. This is a **powerful tool that can be combined with existing farm equipment** to empower variable rate fertilization. It helps to reduce nutrient losses by giving crops just what they require at the different stages of the season in different areas of the field.

FACT BOX 2 (continued): How precision and digital tools can make a difference for the environment

- Applying "usual" nitrogen rates from one season to the other is not the way forward as nutrient supply will not meet crop demand. Nitrogen use efficiency in particular will be sub-optimal, leading to a poorer carbon footprint, potential leaching, additional costs and lower crop yield and quality when growing conditions are better than anticipated. This is where the **N-sensor** helps farmers by removing the guesswork since nitrogen supply from the soil and nitrogen uptake from the plant vary from year to year. The **Yara N-Tester** is a handheld device, which determines nitrogen requirements in real-time by measuring the chlorophyll content of the leaf, supporting farmers' nutrient planning for split applications, i.e. applying nitrogen several times during the season instead of just once.

- **The N-Sensor** technology, which was developed in 2000 with Yara's expertise in precision fertilization and years of field trials, is the technology behind AtFarm. Mounted on the tractor roof and directly connected to the fertilizer spreader, it adjusts fertilization rates instantaneously as nitrogen needs vary significantly across an individual field. Measuring actual crop needs in real-time and adapting fertilization rates accordingly during spreading is the most advanced form of precision farming available today. The Yara N-Sensor™ is an optical device. It measures light reflectance from the crop canopy in different spectral ranges with built-in light sources.

The potential of precision and digital farming tools is backed up by recent research. A study prepared by France's new National Research Institute for Agriculture, Food and Environment (INRAE) confirmed that **optimizing fertilizer use by using several precision farming solutions together can reduce fertilizer use by 10%**[xxi].

Did you know that removing more of the applied nitrogen from the crop is better for the environment?

Introducing a key metric to guide farmers' decisions for better profitability and performance

The concept of Nitrogen Use Efficiency (NUE) describes the relationship between nitrogen supply to a crop and nitrogen removal from the field by the harvest. NUE can be described as the percentage of the nitrogen contained in the crop (kg) of the nitrogen applied (kg). The nitrogen applied is essentially composed of mineral and organic fertilization, biological nitrogen fixation, the nitrogen deposition and nitrogen residues from cultivation in the previous year. The European Nitrogen Expert Panel , a network of European scientists, decision makers, and representatives from the agricultural sector and industry, does not recommend a general reduction in nitrogen quantities as a solution to effectively prevent nitrogen losses. In fact, less is not always more. It is seen as **more appropriate to optimize the ratio between crop yield and nitrogen supply.** A high rate of nitrogen fertilization that produces a high yield can be just as efficient and have limited losses compared with a low amount of nitrogen with a low yield.

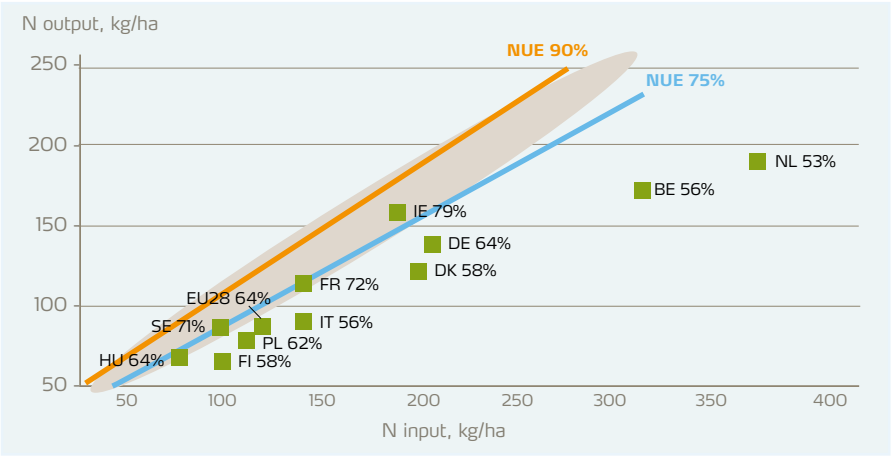


Figure 6: Nitrogen Use Efficiency for selected EU countries[xv]

The European Nitrogen Expert panel recommends a NUE target of between 75% and 90%[xv].

A permanent value of more than 90% indicates that:
- too much nitrogen is removed with the harvest
- too little nitrogen is supplied to the field via fertilization
- soil fertility is deteriorating, leading to soil depletion over time

On the other hand, if the NUE is below 75%:
- too much nitrogen is lost in the environment
- too little nitrogen is taken up by the plants, leading to reduced farm profitability

FACT BOX 3: Thriving for a lower environmental and climate footprint by choosing the right fertilizer from the start

The consolidated summary of 59 annual and long-term trials carried out by Yara's research and agronomy teams in 39 different plots between 2011 and 2017 demonstrated a significant difference in agronomic efficiency in favor of ammonium nitrate fertilizer and at the expense of urea. Let's take the case here of winter barley.

Higher yields: + 3% additional yield

Higher protein content in the grains: + 0.3 pt

Higher total amount of nitrogen absorbed by the crop: + 16 kg nitrogen (N)/ ha for 141 kg N supplied or nearly 8% of additional nitrogen absorption, so not lost to the environment.

Higher quantities of nitrogen absorbed by the grains: + 7 kg N / ha for 158 kg N supplied

Higher Nitrogen Use Efficiency: 85% against 80%

Investing in disruptive innovative technologies for a sustainable future

Yara's initiatives responding to the EU Green Deal

Alone or through partnerships, Yara is investing in innovative solutions that actively contribute to the EU objective of climate neutrality. Yara takes its responsibility for its climate footprint very seriously. We have already reduced our greenhouse gas (GHG) emissions in Europe by 55% since 2005. But we cannot stop there. We aim to become climate neutral by 2050. We have set a target for reducing the CO_2 intensity of our operations by 10% by 2025, with 2018 as a baseline. To reach this ambition, **we're developing innovative solutions to contribute to protecting the planet while sustainably feeding the world.**

- **On the road to providing climate-neutral fertilizers:** Yara is investing in **green ammonia** and **hydrogen** with the goal to offer **carbon-free fertilizers**, which would greatly contribute to further lowering agriculture's climate footprint. Through collaboration with several renewable energy focused companies, including Engie, Statkraft and Aker Horizons, pilot projects are being developed to produce ammonia with renewable energy sources, called green ammonia. This innovation will be essential to decarbonizing the food chain.
- **Increasing the use of recovered and organic nutrients:** Yara believes that the circular economy will change agriculture and will require a shift in the entire food industry. Through our **strategic partnerships with waste management and food companies such as Veolia**, Yara works to find the best avenues to close the nutrient loop and provide more organic fertilizers by improving the recycling of urban waste. Nutrients appearing as waste through or at the end of the cycle can be assessed for re-use either directly or by processing as long as food safety and farm value can be proven. While much attention is directed at wastewater and other secondary raw material sources, Yara believes it is equally important for society to continue reducing food waste and not least providing farmers with better tools to lower on-field losses of crop nutrients.
- **Unleashing the potential of carbon farming:** By adopting climate-positive practices, European farmers can produce Farm Carbon Credits or climate-smart certified crops and help to decarbonize food supply chains. The **Agoro Carbon Alliance**[xvi], recently launched by Yara International, puts farmers at the center of the solution by incentivizing and enabling them to change practices and connecting them to the growing number of businesses looking for ways to achieve their climate pledges. This will in turn enable high-quality, third-party certified carbon credits and increase farmers' income. Farmers who join Agoro Carbon can therefore generate an additional sustainability income from carbon cropping while maintaining or even increasing crop yields. Farmers can make the transition to the climate-positive practices that best fit their operation and can choose the amount of acreage to enroll in the program.

What can the EU do to promote innovation?

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FACT BOX 4: Improving land use efficiency in Europe and beyond

The environmental ambition of the European Green Deal and the Farm to Fork Strategy are also reflected in Yara's mission of responsibly feeding the world and protecting the planet. The different targets set by the Farm to Fork Strategy may reduce the productivity of the EU farming sector and lead to our food needs as Europeans being covered by production in other parts of the world with lower climate and environmental standards. This can also accelerate land-use change in third countries and make Europe more dependent on imports from the rest of the world. Agricultural land use and land use change are today, however, already a significant driver of climate change, being responsible for 9.2% of the global greenhouse gas emissions[xix].

Research and innovation must be encouraged to bridge the gap between the Green Deal ambition, food security and science-based decision-making. Yara strongly recommends not increasing additional arable land, but instead focusing on more efficient use of existing cropland. **More efficient land use enables the production of more crops on the same amount of land with less environmental impact**, together with a higher crop diversity, which is overall **positive for biodiversity**. This approach is particularly suited for Europe, where different competing uses "urbanization", bioeconomy, nature restoration…) for agricultural land in the EU increase the overall pressure on farmland availability. Here mineral fertilizers help optimize the yield and quality of the crops that farmers nurture every day.

Boosting sustainable nutrient management via EU's agricultural policy

Yara's strategy for putting Farm to Fork into action

- With **only nine growing seasons left until 2030**, key opportunities must be taken at the European and national levels via the new Common Agricultural Policy (CAP). A mix of pilots, collaborative approaches, targeted incentive mechanisms and knowledge exchanges will be needed to support farmers and the food value chain in scaling up current efforts to halve nutrient losses by 2030.

Support farmers' profitability and sustainability via the CAP Strategic Plans:

- Upscale **best nutrient management practices** at farm level beyond the current baseline by focusing interventions on the need to improve nitrogen use efficiency.
- Include **targeted nutrient management programs** supported by the deployment of affordable precision farming and digital tools to increase the share of agricultural land committed to improving nutrient management.
- Undertake a **comprehensive impact assessment** of the cumulative effects of the different F2F targets.

Reward famers for sustainable nutrient management practices beyond the baseline:

- Ensure that eco-schemes can be adopted by a sufficiently high number of farmers and cover a large area of land by being **simple and avoiding further administrative burdens for farmers.** This can be best achieved by including an incentive component to encourage farmers who want to transition towards more sustainable farming practices.
- Create an **eco-scheme to support the implementation of Soil Management Plans** (SMPs), which include a clear nutrient management plan component (via the concept of balanced plant nutrition), address concerns like erosion, compaction, soil health, water status, nutrient losses and ammonia volatilization.
- **Reward low-emitting farm activities that contribute to climate mitigation**, for instance by financing farms that have lower GHG emissions (CO_2 equivalents per ton of product) than the national mean or median. The **Cool Farm Tool,**[xvii] an online greenhouse gas calculator, could be used to assess the climate impact of the various farm practices.
- Offer an eco-scheme supporting farmers' efforts to transition towards a more sustainable way of farming via the use of **precision farming tools** that can demonstrate the efficient management of natural resources, primarily water and nutrients, e.g. improvement in water use or nitrogen use efficiency. Here, the use of decision-support and digital tools should be recognized as an acceptable approach to support the efficient use of nitrogen by basing the nutrient management plans on the recommendation resulting from such tools.

Boost peer learning via Rural Development funds:

- Offer **investment support** to encourage farmers to adapt their fertilization practices so that they lead to less ammonia emissions by investing in the necessary equipment to switch from the use of liquid to solid mineral fertilizers. This could build on the voluntary recommendation of the National Emissions Ceiling Directive (NECD), which encourages farmers to switch from urea-based products to ammonium nitrate-based fertilizers.
- Set up demonstration and **pilot farms** to increase farmers' knowledge about nutrient flows and the economic and environmental benefits of adopting sustainable nutrient management plans.
- Support productive investments that could be undertaken by **machinery rings** or farm contractors. This scheme could be used to offer precision farming tools and specialized equipment (like variable rate fertilization). It would accompany growers in the uptake of best nutrient management practices.

Enhance Farm Advisory Services and knowledge exchanges and information:

- Offer farmers the possibility of doing nutrient planning via the **Farm Sustainability Tool for Nutrients (FaST)** (or a similar tool) to encourage a more efficient use of fertilizers and to monitor progress towards the F2F target by embedding the Nitrogen Use Efficiency (NUE) indicator as an additional metric.

- Use **advisory services** as a platform for farmer-to-farmer exchanges and events to disseminate information and expertise on the uptake of new practices such as sustainable nutrient management or carbon farming to a broader number of farmers (i.e. beyond a specific scheme).

Pilot innovative farming practices:

- Make use of the possibilities for allowing **piloting and testing of new types of schemes** by using the EIP-AGRI Operational Groups (OGs), which are supported under the Rural Development Pillar of the CAP Cooperation measure.
- Facilitate **carbon farming practices**, such as conservation agriculture, soil cover with cover crops, afforestation and grassland management, via such a pilot scheme. This could take the form of a result-based system for CO_2 equivalents removed or emissions avoided, and would offer a potential new source of revenue, either in the form of CAP payments or from private sector players seeking to offset their emissions.
- Develop pilot/testing schemes to **improve soil quality** by encouraging farmers to use new CE-marked fertilizing products (such as micronutrients, recycled fertilizers, biostimulants), whereby scientists, farmers and the private sector would together carry out experimental tests to improve and restore soil structure together with soil analysis.

Transforming Europe's food system is a shared responsibility

Transforming the food system in Europe, while securing long term profitability for EU farmers, can only be successful if supported via collective efforts. If the Farm to Fork vision is to become tomorrow's reality, the entire food chain needs to share responsibilities for improving the environment by halving nutrient losses. Yara will do its part and empower farmers to rise to the challenge. EU policy measures also have an essential role to play to lift barriers, which today impede the implementation of best practices and the upscaling of precision and digital farming tools.

FACT BOX 5: Enhancing phosphorus efficiency to protect water and biodiversity

Next to nitrogen, **phosphorus** is the other essential plant nutrient covered by the Farm to Fork target of halving losses by 2030. This is **particularly relevant for reducing excess nutrients' surface runoff from fields, which pollute rivers and oceans**. A strategy to minimize phosphorus losses at field level is the proper incorporation into soils. The application method of mineral phosphorus sources, combined with a better utilization of phosphorus in on-farm organic sources, contributes to increasing phosphorus use efficiency and to reducing losses. Yara's R&D hubs in Germany and Finland have conducted field trials comparing different application methods. Banding phosphate containing fertilizers close to seeds at planting increases phosphorus use efficiency, in comparison with surface application (followed by soil incorporation).

Placement of phosphorus in a band can reduce losses by reducing its exposure to soil microorganisms and processes that lead to leaching.

Banding of phosphorus fertilizer is a widespread practice for growing corn in the United States and was recently tested in our field trials for spring cereals in Finland[xx]. Benefits for the crops, the soil and the environment were improved availability of the different nutrients, which are thus not lost in the environment; and higher phosphorus use efficiency, which means more phosphorus captured in the crop and lower costs for the farmers.

FACT BOX 6: Organic farming — Increasing production and sustainability

At present, about 8.5% of EU agricultural area is farmed organically, and the trends shows that with the present growth rate, the EU will reach 15-18% by 2030. The recent EU Action Plan for organic farming[xxii] provides a toolkit for reaching the Farm to Fork target of 25% EU farmland under organic by 2030. The EU countries can decide – depending on the current starting point – to identify the further development of organic farming as one of their priorities under the future CAP Strategic Plans. The focus could be set on **conservation practices**, such as crop rotation, reduced tillage, mulching and cover cropping, which are good ways of reducing nitrogen losses to the environment while improving soil health and productivity. This is relevant, regardless of whether growers are using organic or mineral fertilizers.

Yara's solutions and knowledge related to best nutrient management practices and improving land use efficiency are relevant for all farming systems, including organic farming. To meet the goal of the Farm to Fork Strategy and to avoid soil depletion in the long run, **greater research on suitable nutrient sources for organic farming will be needed.** Several studies[xxiii] show that organic farms often have negative balances for phosphorus and potassium, particularly in specialist arable organic farms (without livestock). In addition, inefficient use of sulphur is usually linked to inefficient use of phosphorus (P) and potassium (K), making it difficult to follow the principles of balanced plant nutrition. Farms that rely largely on biological nitrogen fixation have more negative P and K balances. For instance, 14% of soils across one sample of organic farms showed soil phosphorus below agronomic optimal levels, which reduces crop production. This would ultimately increase the risk of soil depletion and also decrease soil health.

The principle of **recycling from waste in organic farming should be more widely implemented for recycled sources of nutrients**, especially phosphorus, to avoid long-term nutrient deficits. Otherwise, these would increasingly handicap organic farming in Europe and prevent the realization of the Farm-to-Fork target. Further recycled materials, containing phosphorus, but also potassium or even nitrogen, should therefore be assessed for future addition to the EU organic farming Regulations list of input materials in coherence with organic farming principles, quality, safety and consumer confidence. This could be the case, for instance, for other sources of recycled nutrients such as ammonium sulfate, ammonium nitrate and other ammonium salts, originating from physico-chemical (stripping) processes of organic streams (especially wastewater and digestate out of non-factory farming substrates).

Yara's roadmap for putting Europe's Farm to Fork Strategy into action

About Yara

Yara grows knowledge to responsibly feed the world and protect the planet. Supporting our vision of a world without hunger and a planet respected, we pursue a strategy of sustainable value growth, promoting climate-friendly crop nutrition and zero-emission energy solutions. Yara's ambition is focused on growing a climate positive food future that creates value for our customers, shareholders and society at large and delivers a more sustainable food value chain.

To achieve our ambition, we have taken the lead in developing digital farming tools for precision farming, and work closely with partners throughout the food value chain to improve the efficiency and sustainability of food production. Through our focus on clean ammonia production, we aim to enable the hydrogen economy, driving a green transition of shipping, fertilizer production and other energy intensive industries.

Founded in 1905 to solve the emerging famine in Europe, Yara has established a unique position as the industry's only global crop nutrition company. We operate an integrated business model with around 17,000 employees and operations in over 60 countries, with a proven track record of strong returns. In 2020, Yara reported revenues of USD 11.6 billion.

www.yara.com

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References

[i] *EEA (2018), Briefing - Agricultural land: nitrogen balance*
[ii] *EUROSTAT*
[iii] *Yara field trials in Germany*
[iv] *Yara estimations based on cereal trials in France and Germany*
[v] *The carbon footprint considers mineral fertilizers produced with Best Available Technology (BAT), as mineral fertilizers without BAT may have around +30-40% carbon footprint. It does not consider the potential of using carbon sequestration farming practices*
[vi] *Hutchings N, Webb J, Amon B (2016): EMEP/EEA air pollutant emission inventory guidebook; Bittman S, Dedina M, Howard CM, Oenema O, Sutton MA (2014): Options for Ammonia Mitigation. Guidance from the UNECE Task Force on Reactive Nitrogen, chapter 8, Centre for Ecology and Hydrology, Edinburgh, UK*
[vii] *EUROSTAT*
[viii] *the 1999 Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (Gothenburg Protocol)*
[ix] *Directive (EU) 2016/2284 of the European Parliament and of the Council of 14 December 2016 on the reduction of national emissions of certain atmospheric pollutants, amending Directive 2003/35/EC and repealing Directive 2001/81/EC (Text with EEA relevance*
[x] *scope 1: direct GHG emissions; scope 2: indirect emissions from purchased electricity*
[xi] *Hoxha, A. & Christensen, B. (2019). The Carbon Footprint of Fertilizer Production: Regional Reference Values. International Fertiliser Society, 2-20.I*
[xii] *Yara Hanninghof*
[xiii] *Potash and Phosphate Institute*
[xiv][xv] *wwww.eunep.com*
xvxv EU Nitrogen Expert Panel (2015) Nitrogen Use Efficiency (NUE) - an indicator for the utilization of nitrogen in agriculture and food systems. Wageningen University, Alterra, PO Box 47, NL-6700 Wageningen, Netherlands; M. Quemada, L. Lassaletta, L.S. Jensen, O. Godinot, F. Brentrup, C. Buckley, S. Foray, S.K. Hvid, J. Oenema, K.G. Richards, O. Oenema, Exploring nitrogen indicators of farm performance among farm types across several European case studies, Agricultural Systems, Volume 177, 2020, 102689, ISSN 0308-521X, https://doi.org/10.1016/j.agsy.2019.102689
[xvi] *EUROSTAT, average for the period from 2009 to 2015, including all inflows and outflows of agricultural soils*
[xvii] *Yara Agoro Carbon Alliance | Yara International]*
[xviii] *Cool Farm Tool | An online greenhouse gas, water, and biodiversity calculator*
[xix] *FAOSTAT (2020)*
[xx] *University of Minnesota Extension, Using banded fertilizer for corn production (umn. edu)*
[xxi] *Guyomard, H., Bureau J.-C. et al. (2020), Research for AGRI Committee – The Green Deal and the CAP: policy implications to adapt farming practices and to preserve the EU's natural resources. European Parliament, Policy Department for Structural and Cohesion Policies, Brussels*
[xxii] *Organic Action Plan | European Commission (europa.eu)*
[xxiii] *"Reliance on Biological Nitrogen Fixation Depletes Soil Phosphorus and Potassium Reserves", M. Reimer, Nutr Cycl Agroecosyst 2020, https://doi.org/10.1007/s10705-020-10101-w*
[xxiv] *Regulation (EU) 2018/848 of the European Parliament and of the Council of 30 May 2018 on organic production and labelling of organic products and repealing Council Regulation (EC) No 834/2007*

Glossary

CAN - Calcium Ammonium Nitrate
AN - Ammonium Nitrate
UAN - Urea Ammonium Nitrate