Halving the footprint of agricultural products
Suggestions for indicators

Report

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1. INTRODUCTION

1.1 Introduction

WWF's ambition is to halve the environmental impact of the Dutch food baskets by 2030. The aim of this report is to provide WWF with information on possible indicators to measure the environmental impact of food products. The writers of this document accept no responsibility or liability for the outcome of activities undertaken (in part) as a result of this document.

1.2 Selection of themes

In this paragraph the end goals will be discussed. The biggest themes related to agriculture are:

- Climate mitigation: greenhouse gas emissions and energy use
- Air quality: including ammonia emission (nitrogen deposition)
- Water quality: emission of pesticides, nutrients (N and P) and veterinary medicines
- Water quantity: including use of groundwater
- Soil: soil quality, organic matter et cetera
- Biodiversity: biodiversity (on farm and outside the farm) is influenced by many factors, including nitrogen deposition and water quality and quantity

Deforestation is also an issue. However, this is studied separately.

We elaborate on these themes, using a classification based on the influence of key drivers within agriculture: climate, particulate matter, nutrients, chemicals, hydrology and soil health (See Table 1.1). First, we discuss general legislation within the Farm to Fork Strategy, an EU strategy focusing on sustainable food. Then, in the next chapters we will elaborate on this for each theme. 'Biodiversity' will be discussed in a separate chapter, because biodiversity is influenced by the different themes (see table), but there are also measures that directly effect biodiversity.

Table 1.1 Relationship between key drivers related to agriculture and general sustainability themes.

		The key driver influences:					
Key drivers	**Subdrivers**	**Climate mitigation**	**Water quality**	**Water quantity**	**Air quality**	**Soil**	**Biodiversity**
Climate	CO_2						
	CH_4, N_2O						
	Carbon sequestration						
	Peat areas						
Particulate Matter							
Nutrients	Nitrogen (nitrate, NH_3)						
	Phosphate						
Chemicals	Pesticides						
	Veterinary medicines						
Circularity							
Hydrology	Water use						
Soil health							
Biodiversity							

1.3 Farm To Fork Strategy

The EU policies can be viewed as a necessary foundation for achieving environmental goals. The Farm to Fork strategy was introduced to expedite the transition to a sustainable food system. However, the Farm to Fork strategy has not been translated into legislation, and it remains uncertain whether this will occur soon. Nonetheless, we can draw inspiration from this strategy to work towards halving the footprint. The objectives of this strategy include:

- Achieving a neutral or positive environmental impact
- Mitigating climate change and adapting to its impacts
- Reversing the loss of biodiversity
- Ensuring food security, nutrition and public health by guaranteeing access to sufficient, safe, nutritious and sustainable food for everyone
- Preserving the affordability of food while generating fairer economic returns, fostering competitiveness of the EU supply sector and promoting fair trade.

The strategy sets out a number of concrete targets to be achieved by 2030[1]:

- **Pesticides**: Reduce the use and risk of chemical pesticides by 50%, as well as reduce the use of more hazardous pesticides.

[1] https://eur-lex.europa.eu/EN/legal-content/summary/farm-to-fork-strategy-for-a-fair-healthy-and-environmentally-friendly-food-system.html

- **Nutrients**: reduce nutrient losses by at least 50%, while ensuring no loss in soil fertility, and reduce fertilizer use by at least 20%.
- **Antimicrobial resistance**: reduce the use of antimicrobials such as antibiotics by 50% for farm animals and aquaculture.
- **Organic farming**: aim to have at least 25% of farmland under organic farming.

Below the different themes will be worked out in more detail. The Farm to Fork strategy will be taken as a starting point.

2. CLIMATE

2.1 Legislation

The Paris Agreement, also known as Climate Agreement, is a legally binding international treaty on climate change, to which 196 Parties have committed[2]. Its goal is to maximise the increase in the global average temperature to well below 2°C above pre-industrial levels, with efforts to limit the temperature increase to 1.5°C above pre-industrial levels. To achieve this, the Paris Agreement states that greenhouse gas emissions must peak before 2025 at the latest and decline by 43% by 2030 compared to 1990 levels.

At the European level, the Green Deal aims to make Europe climate neutral by 2050[3]. On 29 July 2021, the European Climate Law entered into force to make the objectives legally binding[4]. The Green Deal sets a more ambitious intermediate target for 2030, compared to the Paris Agreement, aiming to reduce net greenhouse gas emissions by at least 55% by 2030 compared to 1990 levels.

In the Netherlands, the implementation of the Paris Agreement falls under the responsibility of the Ministry of Agriculture, Nature and Food Quality (LNV). This is detailed in the Dutch Climate Law (Klimaatwet)[5]. The reduction target for the agricultural sector in 2030 is 3,5 Mton CO_2 equivalents, divided among methane from animal husbandry (1 Mton), smarter land use (Slim Land-gebruik, 1,5 Mton) and Greenhouses as an energy source (1 Mton).

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[2] https://unfccc.int/process-and-meetings/the-paris-agreement
[3] https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/climate-action-and-green-deal_en
[4] https://climate.ec.europa.eu/eu-action/european-climate-law_en
[5] https://www.rijksoverheid.nl/documenten/beleidsnotas/2020/04/24/klimaatplan-2021-2030

2.2 Global Methane Pledge

Participants who join the global Pledge, agree to undertake voluntary actions to contribute to a collective effort to reduce global methane emissions by at least 30 percent from 2020 levels, by 2030. This target is global in scope, rather than specific for individual nations.

2.3 Science Based Targets initiative (SBTi)

The SBTi's FLAG (Forest, Land and Agriculture) Guidance offers the world's first framework for companies in land-intensive sectors to establish science-based targets that incorporate land-based emission reductions and removals. This guidance facilitates companies in reducing the 22% of global greenhouse gas emissions attributed to agriculture, forestry and other land use. FLAG targets encompass emissions up to farm gate and are mandatory for companies engaged in agriculture, animal sourcing, food processing, and food retail, or companies with over 20% of FLAG-related emissions in Scopes 1, 2, and 3. Scope 1 emissions are a company's direct greenhouse gas emissions, while scope 2 emissions are its indirect greenhouse gas emissions, generated by the electricity or power it consumes. Scope 3 emissions, on the other hand, are a company's indirect greenhouse gas emissions, not covered in scope 2. Therefore, emissions resulting from the production of the food basket fall under scope 3 emissions for the retail sector.

2.4 Indicators

In the agricultural sector, the following greenhouse gas emissions are most important[6]:

- CO_2, which originates from 1) fossil fuels in greenhouse horticulture and transportations, cooling of fruit and vegetables on the farm, 2) the production of fertilizers, 3) drainage of peatlands for agricultural purposes, where nitrous oxide and methane also emit, and 4) the decomposition of organic matter in mineral soils.
- CH_4 (methane), which arises from 1) intestinal fermentation of ruminants and 2) storage of animal manure.
- N_2O (nitrous oxide), which results from 1) storage of animal manure, 2) grazing of farm animals and 3) application of animal manure and fertilizers.

[6] https://agrimatie.nl/PublicatieRegio.aspx?subpubID=7281&themaID=7203&sectorID=3534

The importance of different greenhouse gases varies between sectors. For instance, in dairy farming, methane (from enteric fermentation) constitutes the largest emission source, while in greenhouse horticulture, it is CO_2 resulting from energy usage.
The indicator 'Greenhouse gasses per kg product' encompasses all these emissions. Therefore, we suggest using this indicator, which is defined as all emissions from cradle to farm gate.

Within Dutch agriculture, there is currently a discussion underway regarding the expression of greenhouse gas emissions per ha. This arises because companies primarily focus on reducing emissions per kg of product, while other important themes receive less attention leading to unwanted trade-offs, such as the further intensification of livestock production. This emphasis on emission reduction per kilogram of product can have negative impacts on (1) on-farm biodiversity, (2) emissions to water, air and soils (increasing productivity per hectare by using monocultures, increased amounts of fertilizer and pesticides) and (3) increased total CO_2 emissions in a country and/or region, because a decrease in emissions per kg of product can come together with an increase in total CO_2 emissions due to increased production. So, a decrease in emissions per kg of product is preferable, but it should not result in an increase in greenhouse gas emissions per hectare, to make sure that national and regional objectives are accounted for. See box 1 with an explanation why expressing the CO_2 emissions (only) per hectare creates unwanted effects. As such, we propose focusing on CO_2 emission per kg of product (with the precondition that the emission per hectare does not increase) and the importance of having a set of indicators that also focus on other themes, such as biodiversity. An integrated approach is crucial.

The Trias Energetica (see chart 2.1, page 11) is the most widely used strategy for energy saving measures. It consists of 3 steps:

- minimize energy consumption
- use of sustainable energy generation, and
- efficient use of fossil fuel.

This Trias Energetica clearly demonstrates that reducing greenhouse gas emissions is not the only relevant aspect; reducing the use of (sustainable) energy is also relevant, especially in sectors where energy usage is an important part of the total emissions, such as horticulture. It emphasizes that not using any energy is preferable to using sustainable energy because the worldwide availability of sustainable energy is still limited. Therefore, we suggest to include the indicator,' energy usage per kg product on the farm' as well.

We suggest including ‘the share of energy derived from renewable sources’ as an additional indicator.

Box 1: CO_2 emissions per kg of product and / or per hectare?

A high or low score on the indicator ‘emission per hectare’ depends on various aspects. In the table below, we present an imaginary example involving three dairy farms. Farm A encompasses 40 hectares, with a neighboring farmer producing roughage on 10 hectares for this farm. Farm B, on the other hand, owns 50 hectares. Technically, the farms are identical. The sole distinction lies in the ownership of the 10 hectares of roughage. Farm C also owns 50 hectares but has some problems with his own feed production and needs to buy 10 hectare of extra roughage. Due to that, the total farm emissions are higher on farm C.
Consequently, the emissions per kg of milk (from cradle to farm gate) are the same for farms A and B (1250 tonnes CO_2 / farm, or 1,25 kg CO_2 per kg of milk) but higher on farm C (1350 tonnes in total and 1,35 kg per kg of milk). However, the emissions per hectare (under ownership) are the highest for farm A (31 compared to 25 and 27 tonnes CO_2-eq/ha for farms B and C). Nevertheless, there is no climate difference between farms A and B.
This difference in outcome (kg CO_2-eq per ha) can be rectified by incorporating all hectares used for milk production, so also the 10 hectares for production of roughages (farm A and C). If so, there will be no difference between farm A and B in kg CO_2-eq per ha and per kg milk, but now farm C (which faces less feed production at the farm) scores the lowest CO_2-emission per ha (23 tonnes/ha), whereas in practice this farm should score worst.

For the impact of dairy on climate, it is relevant how much milk is consumed and how efficient milk is produced. But the simple fact of acreage per ton milk at farm level is not relevant and therefore also the emission of CO_2-eq. per ha.

	Farm A	Farm B	Farm C	
Total milk production	1000	1000	1000	in tonnes of milk
Acreage	40	50	50	hectares
Acreage in neighborhood for roughage	10	0	10	hectares
CO_2-emission total farm	1250	1250	1350	tonnes CO_2-eq
CO_2-emission/kg of milk	1,25	1,25	1,35	kg CO_2-eq/kg of milk
CO_2-emission/ha **at the farm**	31	25	27	tonnes CO_2-eq/ha farm
CO_2-emission/ha in total	25	25	23	tonnes CO_2-eq/ha total

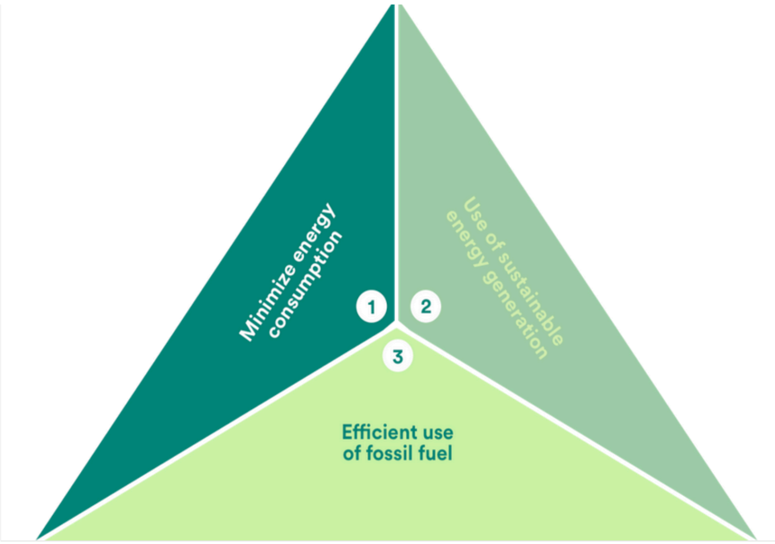

Chart 2.1 Trias Energetica

For the Paris Agreement, the reference year is 1990. However, it is doubtful whether data on the energy usage per kg product are available for this year, especially on a global scale. Therefore, we suggest using 2015 as a reference year. This is the year in which the Paris Agreement was adopted.

2.5 Summary climate

We suggest using the two following indicators for the climate part of halving the footprint:

- The greenhouse gas emissions (in CO_2-equivalents, including CO_2, CH_4, N_2O) per kg product from cradle to farm gate, with (for dairy farms) the precondition that the emission per hectare does not increase. Reference year is 2015.
- Energy usage per kilogram product on the farm (especially important when data are insufficient to use indicator 1).
- When data on greenhouse gas emissions are not available: share of energy derived from renewable sources.

We suggest taking 2015 as a reference year, as it aligns with the adoption of the Paris Agreement.

3. PARTICULATE MATTER

3.1 Legislation

Particulate matter (PM) can have negative health effects. It is referred to as PM_{10} or $PM_{2,5}$. The number indicates the diameter of the particles (in µm). Agriculture is responsible for approximately 23% of particulate matter emissions in the Netherlands (source: infomil.nl). By clustering livestock farms, agriculture can locally contribute to high concentrations of particulate matter. The emission of particulate matter from agriculture can be divided into primary and secondary particulate matter. Primary particulate matter is emitted as particulate matter, secondary particulate matter is created from gases in the air. The main source of secondary particulate matter in agriculture is ammonia. Ammonia is described in the chapter on 'nutrients' and will not be considered in this chapter. Here, we focus on primary particulate matter.

There are various policy rules that are related to particulate matter. For poultry farming, the Dutch law sets maximum values for particulate matter (PM_{10}) emissions in grams per animal place per year. These rules do not apply to stables built before 2015 and to organic farms.

For dairy and pig farming there are no such maximum values per animal place defined in the law, but for each type of stable data on the emission of particulate matter (in gram/animal/year) is available (source: overheid.nl). In general the Dutch law states that the establishment and expansion of livestock farms must not lead to environmental values (PM) being exceeded. Unless this does not (or only slightly) deteriorate the air quality. If the requested activity does not contribute significantly ("niet in betekenende mate"; NIBM) to the concentration of PM_{10} in the air, an environmental permit for this activity can be granted.

3.2 Indicator

Because particulate matter is legally regulated in the Netherlands by various routes, and there is not one indicator that can be applied to different products, we propose not to include a separate indicator for this.

4. NUTRIENTS

4.1 EU policy nutrients

Directives related to the use of nutrients in agriculture, and to the Farm to Fork strategy are as described here after.

4.1.1 Water Framework Directive

The Water framework Directive aims to ensure that water bodies achieve good quality. The Nitrate Directive is a component of this Directive, providing practical implications for agriculture. Therefore, in this report we will focus on the Nitrate Directive.

4.1.2 Nitrate Directive (1991)

This directive aims to protect water quality across Europe, by preventing nitrates from agricultural sources that pollute ground and surface waters, designating nitrate vulnerable zones, and by promoting the use of good farming practices and measures to reduce pollution from nitrates. The Nitrate Directive forms an integral part of the overarching Water Framework Directive. Its horizon is 2027.

To reach this goal, farmers have to apply codes of Good Agricultural Practices (for example limiting the periods when nitrogen fertilizers can be applied, specific conditions for fertilizer application, requirements for a minimum storage capacity for livestock manure, crop rotations, soil winter cover and catch crops to prevent nitrate leaching) and limit the application of nitrogen from manure (to max 170 kg N/ha). However, untill now, the goals of the Nitrate Directive are still out of reach by 2027 in some regions of Europe with these measures, as is described by the European Commission (document 52021DC1000). This indicates that more stringent measures might be needed. This has resulted in the derogation (the exception that the Netherlands receives to apply more than 170 kg of N per hectare) being phased out in the coming years. This will have significant consequences for Dutch agriculture and its environmental effects.

4.1.3 Birds and Habitat Directives

The Birds and Habitat Directives are the cornerstones of EU biodiversity policy, providing a robust legislative framework for all EU countries, to protect the most valuable and threatened biodiversity.
From July 2015 onward, the PAS ('Programma Aanpak Stikstof') commenced in the Netherlands. Under this program, activities with limited nitrogen deposition were allowed to proceed, expecting that reductions of nitrogen by other activities are sufficiently likely. However, in 2019, the Supreme Court ('Raad van State') concluded that the PAS violated the European Habitat Directive, mandating that all projects causing nitrogen deposition must apply for a permit.

4.1.4 NEC-Directive

The National Emissions Ceilings Directive (2016/2284/EU) focuses on air quality. This Directive establishes emission reduction commitments for the anthropogenic atmospheric emissions of sulphur dioxide (SO_2), nitrogen oxides (NO_x), non-methane volatile organic compounds (NMVOC), ammonia (NH_3) and fine particulate matter (PM2,5) in Member States. It sets new emission reduction commitments for each Member State for the total emission of NO_x, SO_x, NMVOC, NH_3 and $PM_{2,5}$ in 2020 and 2030.
The emission goals for the Netherlands[7]:

- NH_3-reduction compared with 2005: 13% for any year from 2020 to 2029 and 21% from any year from 2030 on.

4.2 Implementation in the Netherlands

In the Netherlands the implementation of the Nitrate Directive and the Water Framework Directive has resulted in the following regulation for agriculture:

- Fertilisation standards for crops (maximum kg N and P per hectare).
- Derogation. Since 2006 certain farms in the Netherlands are permitted to use more manure from grazing animals than the amount specified in the Nitrate Directive. This is called 'derogation'. The EU has decided that this derogation will be phased out till 2026.
- Buffer strips. Zones along waterways where fertilization and pesticides are not permitted.
- Designation polluted areas by nutrients, accelerated phasing out of derogation and lower fertilization standards.
- National nitrogen and phosphate ceilings.

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[7] See https://eur-lex.europa.eu/legal-content/NL/TXT/PDF/?uri=CELEX:32016L2284

- Manure application. Obligation to use animal manure with low emissions.
- Licensing of stables/nitrogen: low-emission stables.
- Encourage less protein in animal feed.

Next to that there is legislation focusing on nature quality, related to nutrients: In June 2021, the Nitrogen Reduction and Nature Improvement Decree was published.
Among other things, the Nitrogen Reduction and Nature Improvement Act regulates three result obligations for nitrogen reduction:

- in 2025 at least 40% of the area of nitrogen-sensitive nature in protected Natura 2000 areas must have a healthy nitrogen level.
- In 2030 at least half.
- In 2035 at least 74%.

4.3 Indicators for nutrients

There are different options for indicators focusing on nutrients.

4.3.1 Stoffenbalans/Nutrients balance

Remkes (2022)[8] suggested: "Develop a nutrient balance that allows the farmer to steer". This is not elaborated on further. We discuss different options for a nutrient balance: the Nitrogen Use Efficiency indicator (NUE), and the gross nutrient balance per hectare.

4.3.2 Nitrogen Use efficiency indicator (NUE)

The NUE gives a ration between N applied to soil and N removed by harvested crops:

- NUE = input in kg nitrogen per hectare / output in kg nitrogen per hectare

The optimum value should be between 50 and 90%.

The EU Nitrogen expert panel states:
"*We propose an easy-to-use indicator, applicable to all systems. It is based on the mass balance principle, i.e. using nitrogen input and nitrogen output data for its calculation (NUE = output / input). NUE values should always be interpreted in relation to nitrogen surpluses (input – output; see below) and productivity levels (nitrogen output). For estimating NUE, data and*

[8] https://open.overheid.nl/documenten/ronl-4039eee4ed64ecd5574d2c34f1e1fe24fa8e8f18/pdf

information are required about (i) the nitrogen inputs to the farm or to the system and nitrogen outputs in harvested products, (ii) the nature of the system (e.g. farm, crop system, housing system, …)".

Next to these boundaries, it is stated by the EU Nitrogen Expert Panel that it is optimal that the N-output is at least 80 kg N/ha (otherwise the production is rather low, and therefore inefficient) and the N-balance (N-input per ha minus N-output per ha) should be 80 kg N/ha at the max.

This all together makes it a rather complicated indicator, and a hard to establish goal at farm level.

4.3.3 Gross nutrient balance per ha (for N and for P_2O_5)

Another possible indicator is the gross N- and P_2O_5-balance per hectare. This is calculated the following way:

Gross Balance = input per ha minus output per ha.

Where the NUE represents a ratio, here the difference between input and output is calculated. The input per hectare exists of all nutrients that are entering the farm, such as fertilizer and feed. Output can include for instance products, animals and manure. The European Environmental Agency stated in 2018 (in their Environmental indicator report, monitoring of the Seventh Environment Action Program) that the gross nutrient balance for N in agriculture was improving, but it was unlikely that the objective for 2020 would be met. See Chart 4.1 for the Gross Nitrogen Balance in Europe by country (next page). The higher the value, the higher the loss of nitrogen per hectare. Small losses are unavoidable. Therefore, it is not possible to achieve a gross balance of zero.

The pro of the gross nitrogen balance is that it gives direct insight in the amount of nitrogen that is lost (in different forms: nitrate and/or ammonia). In practice, as is the case for the NUE, it can be difficult to gather data on the gross nitrogen balance of a farm, or of a specific crop as well, because it requires data of all input and output.

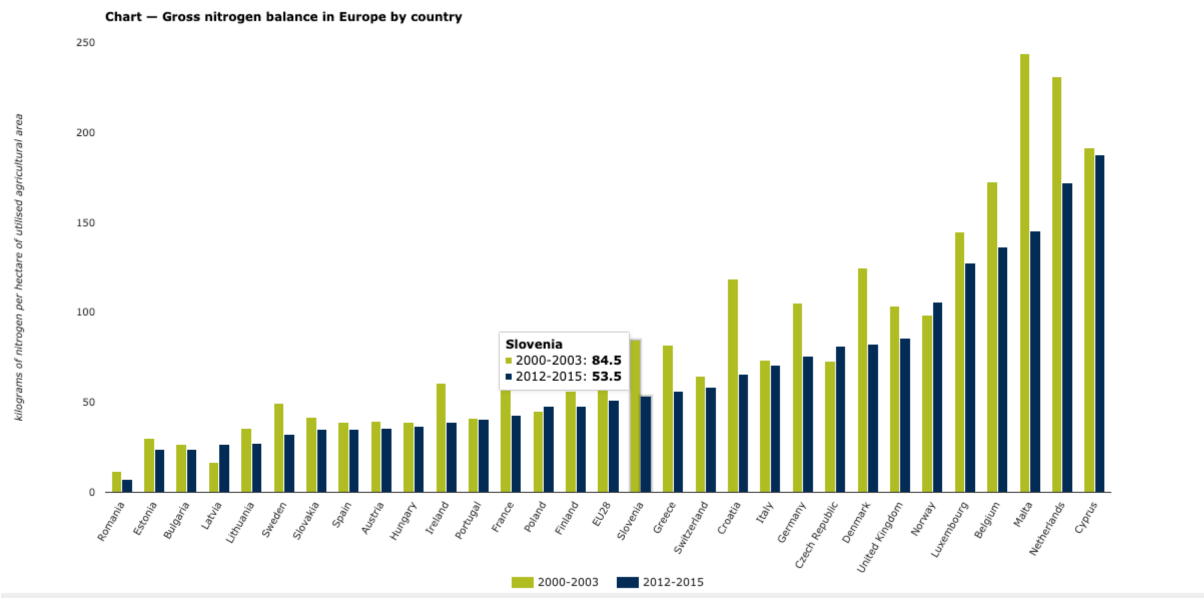

Chart 4.1. Gross nitrogen balance in Europe by country.
Source: https://www.eea.europa.eu/data-and-maps/daviz/gross-nitrogen-balance-by-country-1#tab-chart_3

4.3.4 Fertilizer use (see Eurostat: mineral fertilizer consumption)

The balance-indicators mentioned so far have a high data-density. These data will not always be available. An easier indicator that is mentioned in the Farm to Fork strategy as well is: '*reduced fertilizer use by at least 20% in 2030*'. But fertilizer use is not known per kg of product, it is known at farm level and/or per hectare.
A high level of use of nutrients per hectare gives a high risk of leaching to soil or surface water. An important disadvantage of focusing on fertilizer use as an indicator, instead of the total amount of fertilization is that the effect of the use of animal manure is not directly taken into account.

On farms with many different products (such as vegetable growers) it is not possible to break this down by product (because fertilizer use does not have to be registered at plot level). An absolute amount of N or P_2O_5 fertilizer that is 'good' cannot be set, as this depends on many other factors. It does seem feasible to require a decrease over time. This could then preferably be indicated at sector or country level. Chart 4.2 shows the mineral fertilizer consumption in agriculture within the EU. From an environmental point of view it is most reasonable to express the use of fertilizer in nutrients per hectare.

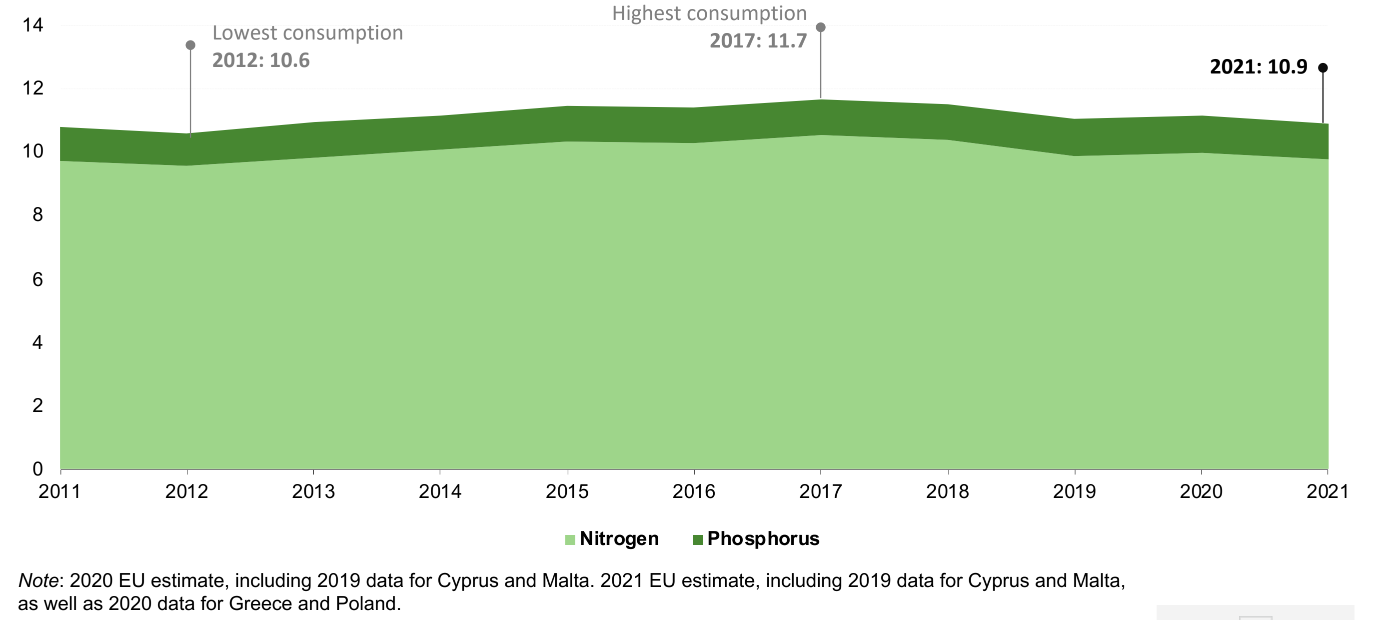

Chart 4.2. Mineral fertilizer consumption in agriculture within the EU in million tonnes (Source: Eurostat)

The Worldbank and the FAO give data on fertilizer consumption in kilograms per hectare of arable land, per country.

The indicator 'fertilizer consumption per hectare' is less accurate than the indicator 'gross nitrogen balance', because it only accounts for one of the N-inputs (the effect of animal manure is not taken into account), and it does not provide insight into the N-output and the efficiency of N-use. However, the advantage of the 'fertilizer use' indicator is that it is a robust system that can also be determined (over time), even in countries where less data are available. However, even then the data may not be completely comparable. Eurostat states "*The comparability of the data is weakened by the lack of harmonization of data sources and (in some cases) of the reference year. Data from production/sales statistics may also overestimate the use of mineral fertilizers due to the inclusion of intermediary goods and of non-agricultural use of fertilizers.*"

4.3.5 Ammonia emission

Ammonia is one of the main sources of nitrogen pollution. An effect of ammonia deposition on biodiversity is the impact of nitrogen accumulation on plant species. Ammonia (NH_3) emits from manure and urine. The indicator 'ammonia emission per hectare' measures the amount of ammonia (NH_3) emissions as a result of agricultural production. This comprises manure management, inorganic N-fertilizers and animal manure applied to soil, urine, and dung deposited by grazing animals. This definition is in line with the Eurostat indicator 'Ammonia emission from agriculture' that gives detailed information on ammonia emission per EU-country. It shows that this is especially a problem in The Netherlands (and Malta). So, no indicator for this seems to be needed for many other countries. Chart 4.3 gives data for the 14 European countries with the highest ammonia emission per hectare. In all other European countries, the ammonia emission is less than 20 kg per ha.

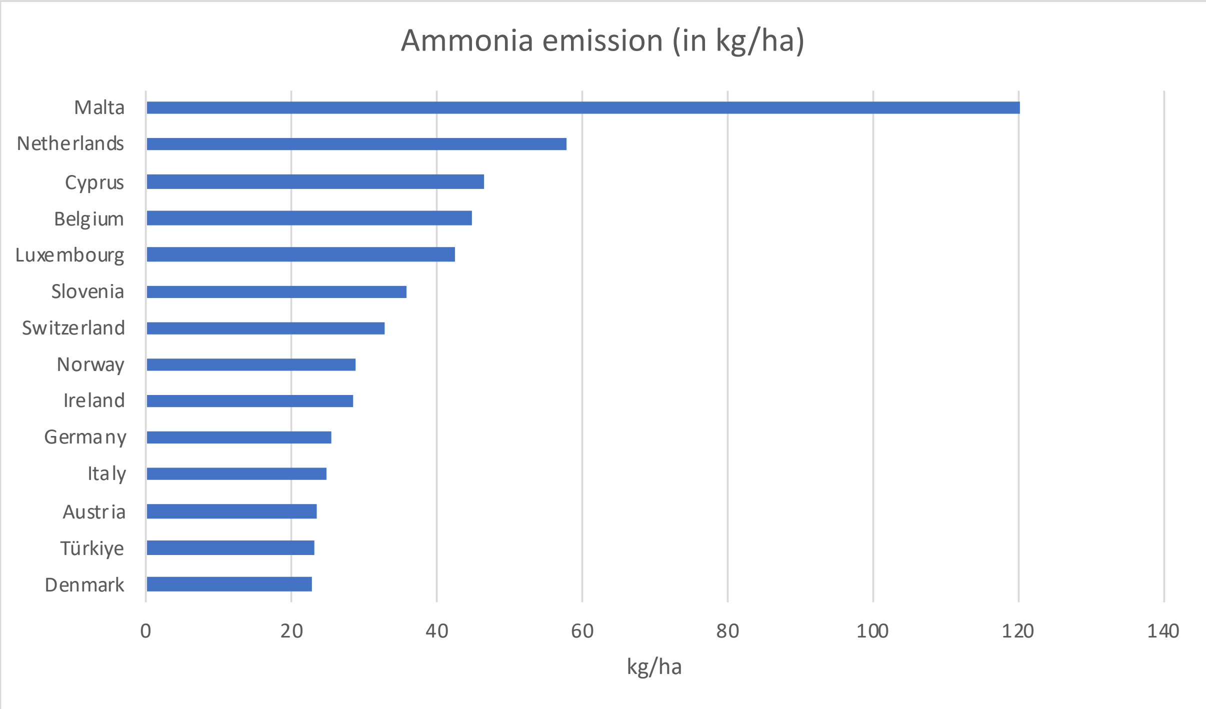

Chart 4.3. Ammonia emission per country in kg per ha. (Source: Eurostat)

For pigs and poultry farms without land, we suggest using the indicator 'ammonia emission per animal'. This includes the emission from the barn and the storage of manure. Ammonia emission due to application manure (elsewhere) is not included.

4.4 Summary nutrients

In the Netherlands high ammonia emissions and nitrate leaching are major problems. Dutch agriculture has accurate data at the farm level, so we suggest the following indicators for Dutch agricultural products:

- Gross nitrogen balance per hectare
- Phosphate balance per hectare

- Ammonia emission per hectare for dairy products
- Ammonia emission per animal for pig and poultry farms.

These data are available from the 'Kringloopwijzer' for the dairy sector in the Netherlands. For meat and eggs the nutrient balances per hectare are relevant for the production of feed. Pig and poultry farms often do not have any land and buy all the feed they need. In that case, the monitoring should in principle focus on the nitrogen and phosphate balance of the land elsewhere, where the feed is produced. In practice, however, this information will be difficult or impossible to obtain (even in the future), because the feed is often a mixture of many different products and partly also consists of coproducts (such as crop residues and food waste). This requires allocation of the environmental burden of the main product and the coproduct.

We suggest using the following indicator for the nutrient part of halving the footprint for other countries where the ammonia emission is less urgent and data gathering is insufficient for calculating the gross nitrogen balance per hectare:

- fertilizer use per ha for N and for P_2O_5.

5. CHEMICALS

5.1 Pesticides

The food system is by far the main contributor to pesticide use. Unfortunately, the chemical pollution associated with imported food and feed consumed in the Netherlands often goes unreported.

5.1.1 Legislation

EU-policy pesticides
Until the mid 1980s pesticide policies in the Member States of the European Union primarily focused on qualitative standards, criteria for the admission of pesticides to the market, codes of practice, and chemical-specific use restrictions. This approach constituted an indirect policy to reduce the use of pesticides. There were two major instruments:

1. Approval of active substances, including Bee Guidance: before being used in European agriculture, every active substance must pass an approval process conducted by one of the EU agencies.
2. Maximum residue levels (MRL) in or on food and feed products: a Maximum Residu Level (MRL) is the highest level of a pesticide residue legally tolerated in or on food or feed, when pesticides are applied according to Good Agricultural Practice.

In June 2022, the European Commission adopted proposals for a more direct reduction policy: the new Regulation on the Sustainable Use of Plant Protection Products, which included the new Sustainable Use of Pesticide Regulation (SUR). This SUR regulation could be considered the first step towards an effective and coherent pesticide reduction policy in the EU.

The regulation entails an EU-wide target to reduce the use and risk of chemical pesticides, as well as hazardous pesticides, by 50% by 2030, in line with the EU's Farm to Fork and Biodiversity strategies. New measures would ensure that all farmers and other professional pesticide users practice Integrated Pest Management (IPM). This is an environmentally friendly system of pest control, that focuses on pest prevention and prioritizes alternative pest control methods, with chemical pesticides only used as a last resort.

The baseline year for reduction is 2015-2017 and the targets would be measured based on two indicators:

- the quantities of active substances contained in the pesticides which are placed on the market (sold), and therefore used, in each Member State, and
- the hazard properties of these active substances.[9]

The use and risk of chemical pesticides in the EU showed an overall decrease in 2021, of 33% from the baseline period of 2015-2017. The use of more hazardous pesticides showed an overall decrease in 2021 of 21%, from the baseline period of 2015-2017. So, the overall downward trends showed that both Farm to Fork targets (i.e. reducing the use and risk of chemical pesticides) can be achieved by 2030 for the EU as a whole. But for the specific Dutch food production, with its input-intensive character, the target will be more difficult to achieve. [10]

However, the SUR-regulation wasn't popular among some Member States. After months of back and forth, the European Parliament attempted to hammer out its final position on the file but came up empty-handed after lawmakers in November 2023 ultimately voted to reject the text entirely, thanks to a series of amendments which scrapped the core elements of the SUR. This included, for example, the procedure for setting national reduction targets and monitoring their implementation, as well as a weakening of restrictions on the use of pesticides in sensitive areas.

Nonetheless, EU ministers decided in December 2023 to proceed with the reduction policy. During the December meeting in Brussels, ministers widely voiced support for pushing ahead and finding a workable compromise on the Commission's proposal. At the same time, many of them deplored the EU Pesticide Reduction Plan which in November not only rejected its own proposed negotiating position on the SUR, but also voted against going back to continue work on the file, effectively leaving the proposal at an impasse.[11]

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[9] https://food.ec.europa.eu/plants/pesticides/sustainable-use-pesticides/farm-fork-targets-progress_en

[10] https://food.ec.europa.eu/plants/pesticides/sustainable-use-pesticides/farm-fork-targets-progress/eu-trends_en

[11] https://www.euractiv.com/section/agriculture-food/news/european-parliament-kills-off-mangled-eu-pesticide-reduction-plan/

With the Commission not yet taking decisive action, all eyes have been on the Council to see whether they will continue to work on the file – and that is exactly what EU agriculture ministers in December 2023 planned to do.[12] However, in February 2024, under pressure of farmers' protests in France, Germany, Belgium and other EU countries, EU Commission President von der Leyen announced the withdrawal of the entire SUR. It must be seen what the response of the Council will be.

National policy
In response to public concern, almost all EU Member States started in the mid 80s some form of pesticide policy, in addition to their authorization programs. In the Netherlands, a pesticide use reduction plan was approved in 1991. No specific tax was imposed (like in Denmark); rather the Dutch farmers' organization (LTO-Nederland) signed an agreement ("covenant") with the government in May 1993 that committed them to achieve a reduction in pesticide use, specifically for crop farming. Applicator training and certification was required for all applicators and since 1996, application equipment testing is required for all equipment.

One important 'aim' for the year 2000 was to halve the use of pesticides in comparison to 1984-1986. Other objectives were to make the agricultural sector in 2000 less dependent on chemicals and to reduce the emission of pesticides into the environment. The agricultural sector itself, however, was allowed to set its own targets on the quantity of pesticides used. Only if the 'aim' would not be achieved, the Ministry of Agriculture, Nature Management and Fisheries would tighten the regulation on the use of pesticides. However, this was never implemented.

Dutch pesticide policy remained defined by objectives that indirectly reduce the use of pesticides, e.g. a maximum-emission of pesticides to water, soil and air, instead of direct objectives such as the quantity of pesticides used.[13] Resulting in the following focus of policy actions:

- resilient plant and cultivation systems
- agriculture connected with nature (nature-inclusive)
- virtually no emissions into the environment
- virtually no residues on products.

The actions taken to achieve these objectives should result, indirectly, in reduced use of pesticides.

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[12] https://www.euractiv.com/section/agriculture-food/news/eu-ministers-determined-to-advance-pesticide-law-despite-uncertainty/
[13] https://food.ec.europa.eu/system/files/2023-08/pesticides_sup_nap_nld_2022-2025_20230804.pdf

Furthermore, approval regulation by the College voor de toelating van gewasbeschermingsmiddelen en biociden (Ctgb) in terms of the pesticide/AS complies with specific requirements. As before, this has not have any direct consequence for the quantity (kgs) used.

5.1.2 Indicators for use of pesticides

The following indicators can be used for halving the Dutch footprint of pesticide-use in food production:

- the use in terms of kilograms active substance per kg product or
- the use in terms of environmental impact, expressed per hectare (according to the CLM-Environmental Yardstick for Pesticides[14] or the upcoming Environmental Indicator Crop Protection[15]).

Looking at the availability of data, the use in terms of kilograms active substance is directly distractible from the obligatory spraying registration that every farmer has to keep record of. However, farmers are not required to deliver their spraying registration to any public body, unless the enforcing Nederlandse Voedsel- en Warenautoriteit (NVWA) claims it during a farm control.
Therefore, general data on pesticide use are aggregated by selected polls among farmers and by sales figures of the pesticide industry. Year by year, the farmers' polls result in a remarkable lower number than the sales figures of the industry.

The use in terms of environmental impact is much more significant for the footprint, as it takes not only the quantity used into account, but also the toxicity , the used spraying technique, doses, period of application, and so on. However, at farm level these data are scarce and not obligatory. In specific cases, the Environmental Yardstick is used to monitor the impact, as for example the KPI-systematic and the "Beter Voor" program of Albert Heijn.

Outcome: halving the footprint 2018-2030?

Considering the aforementioned limitations regarding data availability, the best available indicator of the pesticide footprint is the total amount of active substance used, measured in kilograms. Referring to official statistics derived from sales figures provided by the pesticide industry, Chart 5.1 is presented.

[14] https://www.pesticideyardstick.eu
[15] https://www.wur.nl/en/project/environmental-indicator-crop-protection.htm

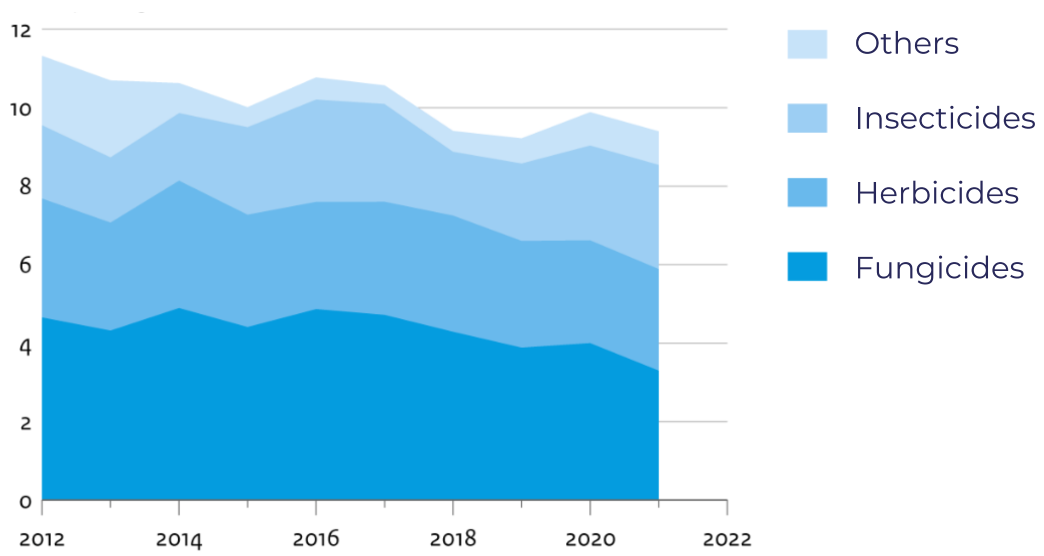


Chart 5.1 Sales of pesticides on the Dutch market in million kg of active substance (source: CBS)

So, if we take the whole period 2012-2018 as a baseline, the footprint was far from halved in 2021. There are no indications that this trend has changed substantially in the last two years.

5.2 Veterinary medicine

5.2.1 Legislation veterinary medicine

The goal of the EU, as described in the Farm to Fork strategy, is halving the total sales of antimicrobials for farm animals and aquaculture by 2030, compared with 2018. By 2022 EU Member States had achieved just over half of the reduction target set for 2030. Chart 5.2 and Table 5.1 show the development of the use of veterinary medicines over time in the EU and detailed information on the use in 2022 per country (both from European Medicines Agency (EMA)).

5.2.2 Indicator for use of veterinary medicine

The data of the EU are expressed in mg per Population Correction Unit (PCU). The PCU is applied as a proxy for the size of the food-producing animal population (including all horses and excluding companion animals)[16] and serves to normalise the sales data by the number of animals that could be potentially treated with antibiotics in each country.

[16] This is an official definition and more of less the total amount of farm animals held for human consumption.

In the Netherlands another indicator is used: 'dierdagdoseringen' (DDD); 1 unit is the amount that is needed to treat an animal during 1 day. This is a better indicator than PCU, because there are large differences in the amount of active component within an antibiotic for a treatment. For a treatment with tetracyclines for instance 140 mg per kg of animal is needed, whereas for a treatment with fluoroquinolones only 2 tot 5 mg per kg of animal is needed. When expressed in 'dierdagdoseringen' both treatments are 1 unit. This system makes different types of antibiotics comparable.

However, not all countries have data available to calculate the 'dierdagdoseringen' (source: Frank de Vries[17]. In 2022 the use of antibiotics in the Netherlands was reduced with 77,4% compared to 2009, based on 'dierdagdoseringen' (DDD).

Chart 5.3 gives an overview of the amount of DDD for each sector in the Netherlands.

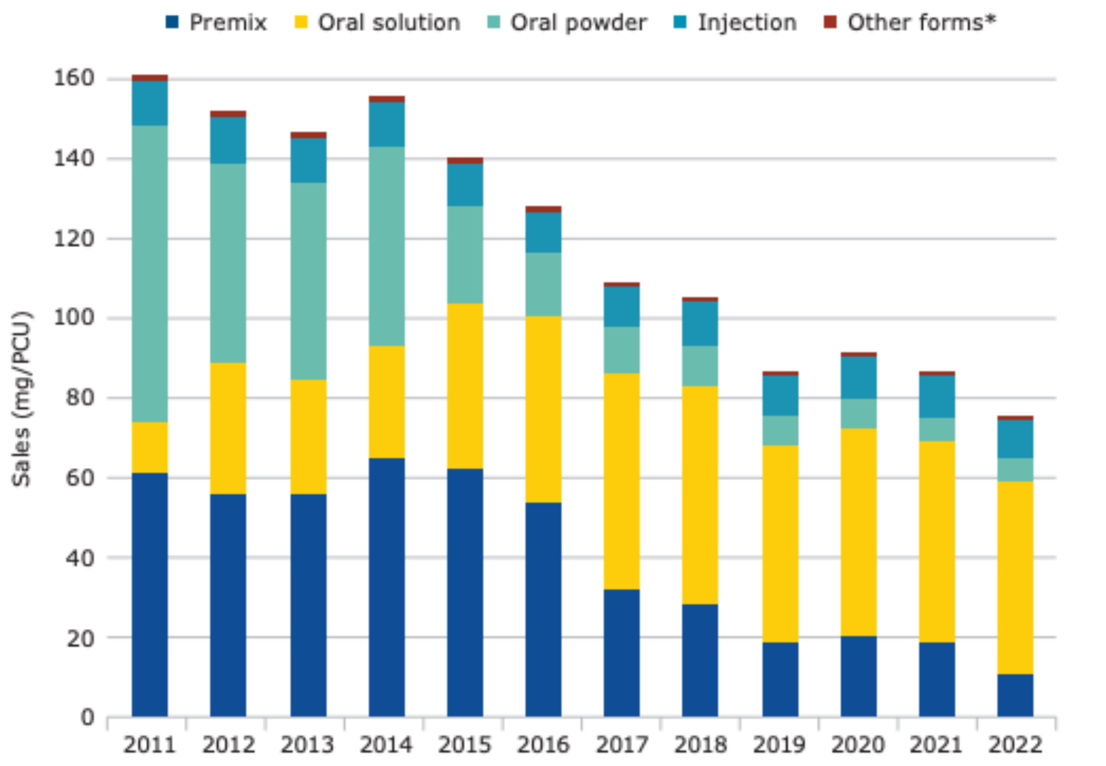


Chart 5.2 Sales of veterinary medicine in mg/PCU (population correction unit) by product form in 25 European countries from 2011 to 2022 (source: EMA).

[17] https://edepot.wur.nl/285028

Table 5.1 Sales for food producing animals, in mg/PCU, by antibiotic class in 31 European countries in 2022 (source: EMA).

Country	Tetracyclines	Amphenicols	Penicillins	1st- and 2nd-gen. cephalosporins	3rd- and 4th-gen. cephalosporins	Sulfonamides	Trimethoprim	Macrolides	Lincosamides	Fluoroquinolones	Other quinolones	Aminoglycosides	Polymyxins	Pleuromutilins	Others*	Total mg/PCU
Austria	16.7	0.4	8.5	0.1	0.2	3.4	0.7	2.7	0.1	0.4	0	1.4	1.2	0.3	0.1	36.2
Belgium	14.7	1.9	30.0	0.3	0.1	11.7	2.3	5.3	1.6	0.2	0.2	2.3	0.6	0.1	2.1	73.5
Bulgaria	37.2	3.3	22.8	0.04	0.2	5.9	0.7	12.2	2.0	7.8	0.01	5.3	3.9	1.3	0.5	103.2
Croatia	16.9	1.5	19.1	0.04	0.2	2.7	0.6	4.2	0.2	2.6	0	1.7	5.6	0.5	0.3	56.2
Cyprus	68.5	1.7	49.1	0.02	0.4	45.0	9.0	11.6	40.7	1.8	0	5.5	6.3	14.5	0.6	254.7
Czechia	11.2	0.4	16.7	0.1	0.5	6.8	0.8	2.2	0.1	1.6	0	2.5	0.6	2.5	0.3	46.4
Denmark	4.9	0.7	9.7	0.02	<0.01	3.0	0.6	5.0	0.8	<0.01	0.2	5.8	0	2.5	1.0	34.1
Estonia	13.2	0.6	11.1	0.1	0.5	3.3	0.7	1.5	0.4	0.8	0	2.3	0.4	10.2	0.6	45.8
Finland	2.6	0.2	8.2	0	<0.01	2.9	0.6	0.2	0.05	0.1	0	0.0	0	0	0	14.9
France	11.4	0.8	7.4	0.2	0.02	6.6	1.2	3.1	0.3	0.1	0.2	5.5	1.1	0.3	0.6	38.9
Germany	11.8	0.7	29.1	0.1	0.1	7.2	1.0	6.5	1.5	0.6	0	2.7	5.8	1.1	1.6	69.9
Greece	42.6	0.9	16.2	0.01	0.2	7.3	0.8	5.2	0.9	3.0	0.7	7.9	1.7	1.1	0.6	89.0
Hungary	36.6	3.2	32.6	0.1	0.3	6.3	1.3	4.5	1.8	6.6	0	3.6	5.8	7.8	0.8	111.2
Iceland	1.5	0	2.2	0	<0.01	0.1	0.02	0	0	<0.01	0	0.6	0	0	<0.01	4.4
Ireland[2]	12.2	1.1	8.8	0.5	0.1	5.3	0.3	1.9	0.4	0.2	0	2.5	0		0.3	33.6
Italy	35.6	6.4	54.6	0.1	0.1	21.8	1.9	8.0	13.4	0.9	0.4	7.3	0.6	4.3	2.2	157.5
Latvia	3.4	0.1	5.9	0.7	0.4	0.5	0.1	3.3	0.1	0.8	0	3.9	0.3	1.2	0.1	20.8
Lithuania	4.2	0.3	13.5	0.2	0.4	1.7	7.7	8.0	0.2	1.5	0	3.8	5.8	0.5	0.3	48.2
Luxembourg	5.0	1.1	6.6	0.2	0.5	4.5	0.9	1.0	0.6	0.9	0	3.2	0.2	0.01	0.5	25.1
Malta[3]	20.6	0.9	9.5	0.04	0.3	12.2	2.3	3.5	0.3	12.6		4.7	0.3	4.7	2.5	74.4
Netherlands	10.7	1.4	9.4	0.03	<0.01	6.4	1.1	6.1	0.1	0.03	0.8	0.5	0.3	0.1	0.1	37.0
Norway	0.03	0.2	1.2	0	<0.01	0.5	0.1	<0.01	<0.01	<0.01	0.01	0.04	0	0.02	<0.01	2.1
Poland	39.0	2.4	69.1	0.2	0.4	8.9	1.7	28.8	3.8	11.8	<0.01	9.3	10.2	7.7	2.5	196.0
Portugal	25.7	1.5	17.6	0.06	0.2	2.8	0.6	7.4	5.8	5.2	0	3.6	1.8	4.5	0.6	77.1
Romania	10.7	2.4	8.7	0.01	0.1	1.9	0.4	7.5	1.3	5.5	0.1	5.1	2.7	1.9	0.6	48.8
Slovakia	9.2	0.2	10.6	0.3	0.5	5.3	0.9	0.6	0.2	3.2	0.01	4.2	1.6	3.5	0.9	41.1
Slovenia	5.9	2.4	8.5	0.05	0.2	2.3	0.5	0.3	0.02	0.9	0	4.0	0.1	0.5	0.02	25.7
Spain	28.1	5.4	44.2	0.03	0.2	9.8	1.9	5.2	15.6	3.3	0.02	9.7	0.4	1.3	2.2	127.4
Sweden[4]	0.7		6.8		<0.01	1.5	0.3	0.4	0.05		0.02	0.6			0.1	10.6
Switzerland[5]	5.6	0.8	10.3	0.1	0.1	6.3	0.6	0.8		0.2		2.6	0.1		0.03	27.3
United Kingdom	8.3	0.5	7.3	0.1	0.02	1.9	0.4	2.3	0.7	0.1	0	2.6	0	1.0	0.5	25.7
Total sales for 31 countries (mg/PCU)[6]	**17.4**	**2.0**	**24.2**	**0.1**	**0.1**	**6.9**	**1.1**	**6.3**	**3.9**	**2.1**	**0.1**	**4.8**	**2.1**	**1.8**	**1.1**	**73.9**
Median of 31 countries (mg/PCU)[7]	**11.4**	**0.9**	**10.3**	**0.1**	**0.2**	**5.3**	**0.7**	**3.9**	**0.4**	**0.9**	**0.01**	**3.6**	**0.6**	**1.1**	**0.6**	**45.8**

* The class 'Others' includes the following subclasses: imidazole derivatives (metronidazole), nitrofuran derivatives (furazolidone) and other antibacterials (bacitracin, furaltadone, novobiocin, rifaximin and spectinomycin). Of note, some sales could be for non-food-producing animals such as companion animals, fur animals, exotic birds and racing pigeons.

1 For the countries where injectable 3rd- and 4th-generation cephalosporins are solely or also marketed for dogs and cats, the data provide a considerable overestimate for food-producing animals.

2 For commercial confidentiality reasons, pleuromutilins are aggregated with 'Others'.

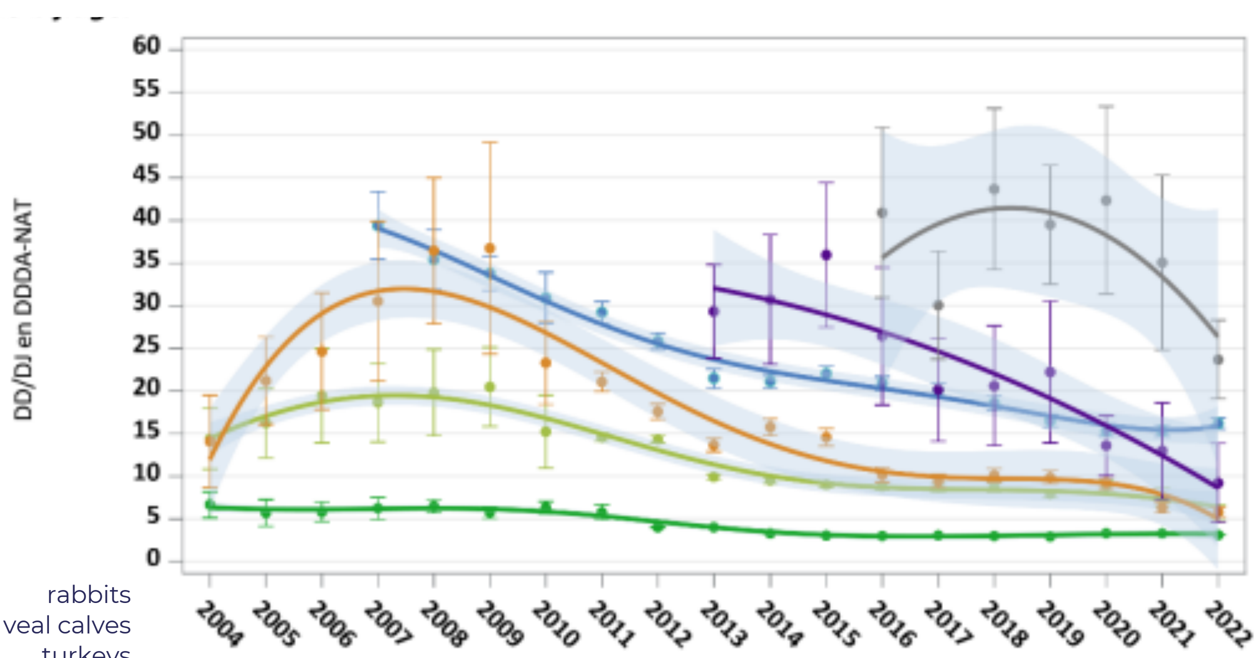
3 For commercial confidentiality reasons, other quinolones are aggregated with fluoroquinolones.

4 For commercial confidentiality reasons, amphenicols, polymyxins and pleuromutilins are aggregated with 'Others', 1st- and 2nd-generation cephalosporins are aggregated with 3rd- and 4th-generation cephalosporins, and fluoroquinolones are aggregated with other quinolones.

5 For commercial confidentiality reasons, pleuromutilins are grouped with 'Others' and lincosamides are grouped with macrolides.

6 Total aggregated sales expressed in mg/PCU consist of the total quantity of antibiotic active substances sold (mg) divided by the total PCU (kg) for 31 countries.

7 Median shows the 16th value ranked from smallest to largest out of 31 observed values for each antibiotic class.



	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
rabbits	.	.	.	.	.	.	.	.	.	.	.	.	40,9	30,1	43,7	39,5	42,4	35,1	23,7
veal calves	.	.	.	39,4	35,4	33,8	30,9	29,2	25,9	21,5	21,2	22,1	20,9	20,1	18,6	16,5	15,3	15,4	16,2
turkeys	.	.	.	.	.	.	.	.	.	29,4	30,7	35,9	26,4	20,2	20,6	22,3	13,6	13,0	9,2
broilers	14,1	21,2	24,7	30,5	36,5	36,8	23,3	21,1	17,6	13,7	15,8	14,6	10,2	9,4	10,1	9,9	9,3	6,3	5,8
pigs (Varkens)	14,4	16,2	19,5	18,7	19,8	20,5	15,2	14,6	14,3	10,0	9,5	9,0	8,9	8,7	8,7	8,0	8,8	7,6	5,8
dairy cows (Melkvee)	6,7	5,7	5,9	6,3	6,5	5,8	6,3	5,8	4,1	4,0	3,3	3,1	3,0	3,1	3,0	3,0	3,3	3,3	3,2

Chart 5.3 Long term development of use of antibiotics with estimated per year per animal (with 95% confidence interval)
Source: SDA 2023

Focusing on the methodology that is described within the Farm to Fork Strategy for the situation in the Netherlands, we see the following development: the mg/PCU for the Netherlands was 57,5 in 2018 (source EMA)[18] and reduced to 37,0 in 2022 (see chart 5.1). This is a reduction of 36%. Differences between countries are large: Cyprus scored 466,3 mg/CPU in 2018, whereas Norway 2,9 mg/CPU.

5.2.3 Summary Veterinary Medicine

We suggest the following indicators for halving the footprint of the use of veterinary medicines:

- in the Netherlands: 'number of dierdagdoseringen'. Data of the Autoriteit Diergeneesmiddelen (see chart 5.3) can be used to compare data over time.
- other countries: mg/PCU.

[18] https://www.ema.europa.eu/en/documents/report/sales-veterinary-antimicrobial-agents-31-european-countries-2018-trends-2010-2018-tenth-esvac-report_en.pdf (page 24)

The year 2018 can be used as a reference year. This is the reference that was suggested for the Farm to Fork strategy. The average in Europe can be used as a reference (103,2 mg/CPU in 2018 for 31 European countries. Source EMA), or specific reference values per country.

6. CIRCULARITY

6.1 Legislation circularity

There is currently no legislation specifically addressing circularity in agriculture, aside from laws concentrating on nutrients, and reducing nutrient losses, which indirectly contribute to circularity. However, in 2018, a 'Grondgebondenheid' committee worked on recommendations regarding how 'land-based dairy farming' could be defined and integrated into Dutch agriculture. These recommendations also emphasized circularity. According to the advice, a dairy farm should be capable of fulfilling at least 65% of its own protein requirements, and both feed supply and manure sales should occur within a 20-km radius. CLM (2023) investigated the pros and cons of different indicators for 'land-based dairy farming'. The two criteria "Livestock Units per hectare (in Dutch: Grootvee-eenheden, GVE) in combination with milk production per hectare" and "estimated manure production per hectare (in kg N and/or phosphate)" turned out to be the most favorable. These indicators are not expected to have negative side effect for other sustainability themes.

6.2 Indicator for circularity

The main principle of circular agriculture is to close the circular system as much as possible, focusing on the smallest possible scale. Next to that, no more land and raw materials for agriculture should be used than necessary, ensuring that the environment remains healthy and there is room for nature. Reduction of losses can be achieved by closing feed-manure cycles, (re-)using coproducts (such as crop residues, food waste, etc.) within the system, for instance as feed. This minimizes the need for inputs from outside the system. A useful classification is the 'Moerman's ladder', which demonstrates how food and resources can be used in the most high-quality manner possible. See chart 6.1.

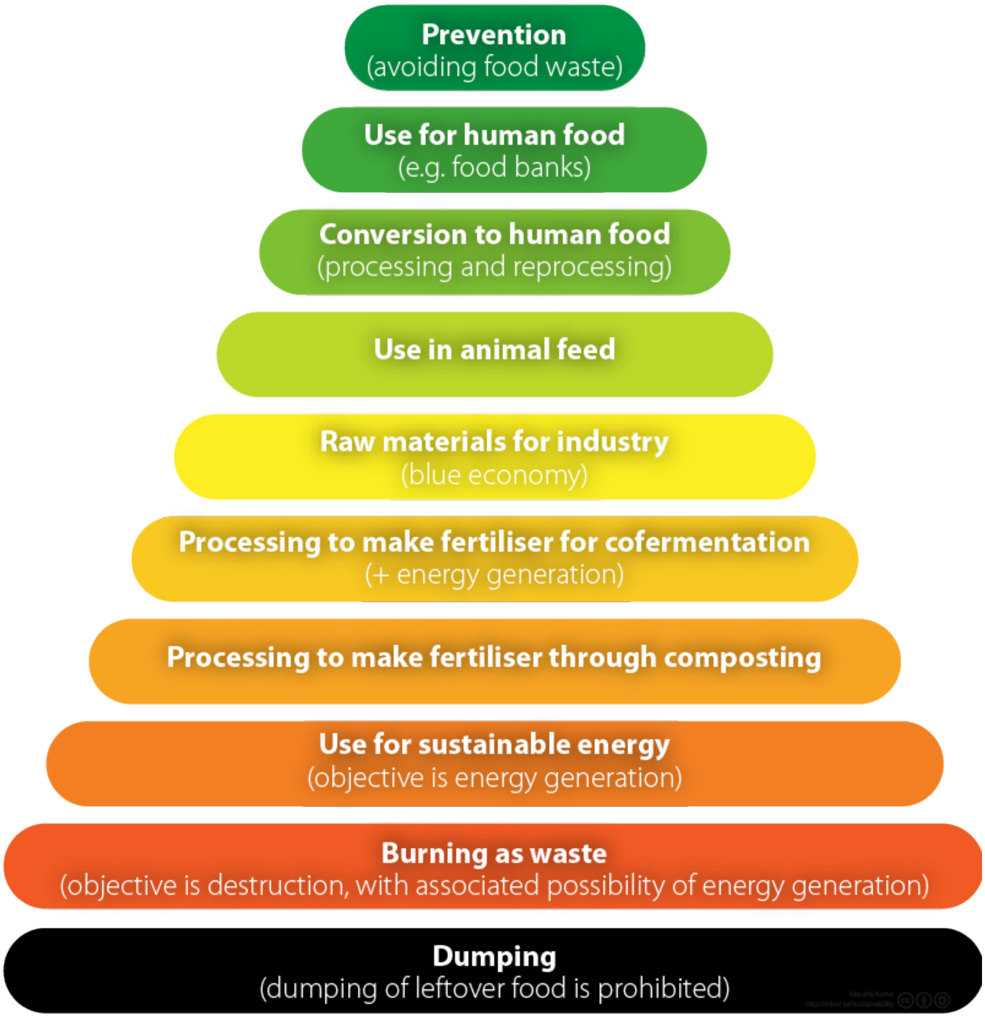


Chart 6.1 Moermans' Ladder

We suggest using the following indicators:

- for dairy farms: livestock units (GVE) per hectare, in combination with milk production per hectare. A maximum allowable value has to be set for both aspects to prevent extreme milk production levels per cow.
- Use of circular raw materials for feed (percentage of the feed).
- Animal manure stays within the area (percentage of the animal manure that is produced less than 20 km of the farm).
- Feed production within the area (percentage of the feed produced within x km from the farm).

7. WATER QUANTITY

7.1 Legislation water quantity

Most of Europe has adequate water resources, but water scarcity and droughts are increasingly frequent and widespread in the EU. In some regions, the severity and frequency of droughts can lead to water scarcity situations. The overall objective of EU water policy is to ensure access to good quality water in sufficient quantity for all Europeans, economic sectors, and the environment, and to ensure the good status of all water bodies across Europe. Therefore, policies and actions are set up to prevent and to mitigate water scarcity and drought situations.
The Water Framework Directive, adopted in 2000, provides a suitable framework to address water scarcity and drought. The directive promotes sustainable water use via the long-term protection of available water resources and the mitigation of the effects of droughts, contributing to guaranteeing a sufficient supply of good quality surface water and groundwater and protecting territorial and marine waters.
For greenhouse horticulture in the Netherlands there is a purification obligation for wastewater as of 1 January 2018.

7.2 Indicator for water quantity

As an indicator, we suggest the water use, expressed per kg product or per hectare. In the best case, water use is monitored per (kg of) product for vegetal products at farm level or per hectare at dairy farms. For pig and poultry farms, the water use to produce feed (in amount of water per hectare) is relevant. However, as is discussed in paragraph 4.4, this information will be difficult or impossible to obtain (even in the future), because the feed is often a mixture of many different products and partly also consists of coproducts (such as crop residues, food waste). An alternative option is making use of fixed values for water use per product group (for instance 'soy'). The question, however, is whether this encourages sustainability and thereby has added value. If this isn't the case, efficient water management is monitored with specific measures taken at farm level, like drip irrigation, rainwater collection, et cetera.

So, the indicators are:

- water use (for irrigation, drinking water, cleaning etc.) per hectare for dairy farming.
- Water use for irrigation per kg product for fruit, potatoes and vegetables.
- If available and useful: water use to produce feed for pig and poultry farming.

Next to this, wastewater from horticulture should be purified. In the Netherlands this is already mandatory, but if products are imported from abroad, they must also comply with this requirement.

8. SOIL MANAGEMENT

8.1 Legislation soil management

On the 5th of July 2023, the EU proposed a new Soil Monitoring Law, to protect and restore soils and ensure that they are used sustainably. The EU soil strategy for 2030 provides the framework and concrete steps towards protecting and restoring soils, and ensuring that they are used sustainably. As part of this, a new Soil Monitoring Law has been proposed to ensure a level playing field and a high level of environmental and health protection.
This new Soil Monitoring Law should exist of a monitoring framework for all soils across the EU and make sustainable soil management the norm in the EU. Therefore, member states will have to define which practices should be implemented. At the moment the focus is primarily on standardized and regular data collection in all member states. In near future the EC plans to tighten the law based on all data collected.

8.2 Indicators for soil management

Good soil management is crucial for biodiversity, soil carbon sequestration (with positive climate effects), water retention capacity, and optimal plant growth. Additionally, it can contribute to reducing pesticide use. Therefore, soil health is a significant factor, albeit a complex one. How can we measure soil health? Which indicators can we use? There is a set of indicators available to assess soil quality (source: 'Bodemindicatoren voor Landbouwgronden in Nederland', BLN versie 1.1.). Experts selected these indicators as the most relevant characteristics for agricultural soil quality in terms of carbon, soil physics, soil chemistry, and soil biology. These are target indicators:

- 3 indicators on organic matter: organic matter (%), C% of the soil, biodegradable fraction
- 4 indicators on physical aspects: water retention capacity, aggregate stability Penetration resistance dry bulk density
- 5 chemical aspects: pH, N total, potentially mineralizable nitrogen, phosphate stock and availability, potassium stock and availability

- 5 biological aspects: nematodes (2 indicators), bacterial biomass, fungal biomass and earthworms
- Visual aspects: soil structure, soil life, roots.

Another option is to assess whether measures are taken to improve soil quality; for instance by these relevant measures:

- change in arable crop rotation (crop diversity)[19]
- Use of cover crops.
- Permanent pasture.
- Non-inversion tillage.
- Crop residues remain on the field.
- Use of solid manure and/or compost.
- Soil coverage all year round.

It is complicated to include all these indicators or measures.

Crop diversity is important to keep the soil viable. It encompasses different aspects, such as crop species diversity, varietal diversity within crop species and genetic diversity within crop species. A high diversity helps to develop a resilient agricultural cropping system. The Hill Shannon index can be used as an indicator for diversity of crops. This index pertains to the cultivated area and is a measure of the diversity of crops and the area per crop within a calendar year. This indicator is worked out in more detail for the KPI system. See 'Van Doorn e.a. 2021'.

A relatively straightforward indicator is '% of soil coverage'. This indicator is important for preventing run-off of nutrients and pesticides, as well as soil erosion. Maintaining soil cover on agricultural land can improve soil fertility and help mitigate the effects of climate change, by preserving and increasing the sequestration of soil organic carbon. Chart 8.1. illustrates the share of soil cover in arable land during winter in the EU-27 and UK in 2016.

On top of the soil coverage share, the variety of coverage is important for soil health. Deep-rooted cover crops are beneficial for healthy soils.

[19] This measure has to be defined precisely to be effective. There are big differences between countries in 'regular crop rotation'. In the Netherlands is increasing the share of cereals in crop rotation seen as an important measure to increase soil quality and soil organic matter.

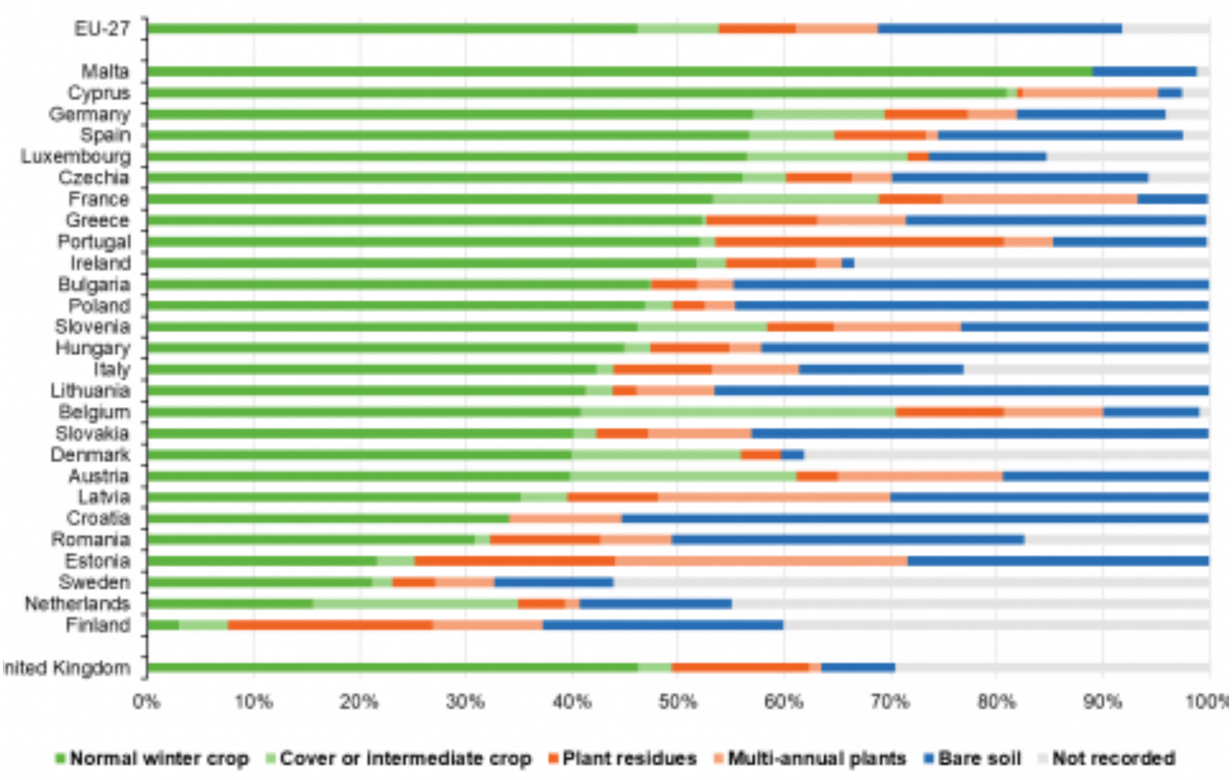


Chart 8.1 Share of soil cover in arable land during winter, EU-2027 and UK, 2016 (source: Eurostat)

We suggest using the following indicators for soil management:

- percentage cover crops
- crop diversity (Hill Shannon Index)
- percentage soil conserving crops.

For pig and poultry farms, these indicators are relevant when focusing on the production of feed. However, as is discussed previously, this information will be difficult or impossible to obtain (even in the future), because the feed is often a mixture of many different products and partly also consists of coproducts (such as crop residues, food waste).

9. BIODIVERSITY

9.1 Legislation biodiversity

Within the European Biodiversity Strategy , 6 targets are set for 2030[20]. Of these many targets the following are most relevant for agricultural practices:

- Target 1: legally protect a minimum of 30% of the EU's land area and a minimum of 30% of the EU's sea area, and integrate ecological corridors.
- Target 4: habitats and species show no deterioration in conservation trend and status.
- Target 6: the use of chemical pesticides is reduced by 50% (see chapter 'Pesticides').
- Target 7: at least 10% of agricultural area is under high-diversity landscape features.
- Target 8: at least 25% of agricultural land is under organic farming management, and the ecological practices is significantly increased.
- Target 13: the losses of nutrients from fertilizers are reduced by 50%, resulting in the reduction of the use of fertilizers by at least 20%.

All indicators mentioned in the previous chapters, relate (more or less) to biodiversity. Next to that, we suggest using indicators that are focusing more directly on biodiversity on the farm:

- percentage acreage under nature and landscape management: part of the farm that is not in use for production, but for nature and landscape. This also relates to 'Aanvalsplan Landschap'; a Dutch initiative aiming to contribute to meeting the European obligations regarding biodiversity (Birds and Habitats Directives), the climate challenge (Paris Agreement), and clean water (Water Framework Directive). Additionally, it enhances the landscape quality and diversity of the Dutch landscape.
- For dairy farms: percentage acreage under productive management with pasture that is rich with herbs.
- Crop diversity. This variable is already accounted for in the previous chapter focusing on soil.

[20] https://dopa.jrc.ec.europa.eu/kcbd/EUBDS2030-dashboard/?version=1

10. OVERVIEW OF INDICATORS

Table 10.1 shows an overview of the suggested indicators, and a description of these indicators. With '*' and '**' is shown which indicators are also part of the KPI methodology[21]. The column 'Preferred' shows what indicators are preferably used for each key driver. The column 'Back-up' shows what indicator can be used, if this preferred indicator is not available.

The products are produced within a supply chain. Indicators can be applied to the primary agricultural farm or to multiple steps within the chain. This choice is somewhat arbitrary. Data regarding all parts of the chain are not always available. We choose to evaluate the indicators throughout the entire chain, except for the indicator 'circularity'.

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[21] Information is based on: https://wiki.groenkennisnet.nl/space/kpikll/36372551/KPI+-+Algemeen (revised Feb 16th, 2023)

Table 10.1 Indicators for halving the footprint

Key drivers	Indicator	Description	Preferred	Back-up
Climate*	GHG emission per kg product	The greenhouse gas emission (in CO_2-equivalents, including CO_2, CH_4, N_2O) per kg product from cradle to farm gate. Reference year is 2015		
	For dairy farms: GHG emission per ha at the farm	Precondition: GHG emission per hectare at the farm does not increase over time		
	Energy usage per kg product	The usage of energy in MJ per kg product at the farm level. Reference year is 2015		
	Share of energy from renewable sources	Proportion of the energy use at the farm that is renewable.		
Nutrients	Nitrogen balance per ha**	$N_{input} – N_{output}$ per ha, at farm level		
	Phosphate balance soil**	$P_2O_{5\ input} – N_{output}$ per ha, at farm level		
	Ammonia emission per ha**	For the dairy sector		
	Ammonia emission per animal	For pig and poultry farming		
	Fertilizer-N use per ha			
	Fertilizer-P_2O_5 use per ha			
Chemicals-Pesticides*	Active substance used per kg product	The amount of pesticides used per kg product, expressed in kg active substance		
Or:	Environmental impact of the use of pesticides	Environmental impact of use of pesticides per ha, calculated by (for instance) the CLM-environmental yardstick or the upcoming environmental indicator Crop Protection.		
Chemicals–medicines	Use of antibiotics in 'DierDag-Doseringen'			
	Use of veterinary medicine in mg / PCU	Average amount of the use of veterinary medicine, expressed in active substance per population correction unit		

Key drivers	Indicator	Description	Preferred	Back-up
Circularity*	Livestock units (LU) and milk-production per ha	Maximum allowable value for LU/ha and milk production/ha for dairy farms		
	Use of circular raw materials for feed	Use of circular raw materials for feed (percentage of the feed)		
	Manure < x km	Application of manure within the area (a certain percentage of the manure is applicated within x km from the farm where it is produced)		
	Feed < x km	The feed production within the area (percentage of the feed produced within x km from the farm)		
Water quantity	Water use	Use of water per ha (for dairy farms)		
		Use of water for irrigation per (kg) product (for vegetal products)		
	Water management measures			
	Waste water	Waste water in horticulture should be purified before	Obligatory in the Net-herlands	
Soil	Soil coverage (%)			
	Crop diversity**	Hill Shannon index		
	Soil conserving crops (%)			
Biodiversity	% Acreage under nature and landscape management**			
	% Acreage with (productive) herb-rich pasture	For dairy farms		

* This theme of indicator will also be part of the KPI system but has not yet been elaborated.

** This indicator is also part of the KPI system.

11. QUICKSCAN OF SCHEMES

The WWF Basket focuses on the most impactful environmental issues in the food system. Agriculture, horticulture and livestock farming represent priority areas for intervention to drive change.

To define this Blueprint, CLM has examined the main environmental issues in these farming sectors, indicators and target values. Additionally, a ‘quick scan’ assessment was done, to give insight into the extent to which three predominant environmental schemes in The Netherlands (Organic, Beter Voor and PlanetProof) contribute to reducing the footprint of food production. It was concluded that all these schemes address several environmental issues, but that they do not fully address them or set performance criteria. Based on the CLM analysis of April 2024, the current schemes in The Netherlands need to be adjusted to measure progress on performance towards halving the footprint.

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