3 Environmental sustainability

This chapter presents the status and trends in environmental quality in the Netherlands with respect to biodiversity, the effects of excess nutrients on the environment, water quality and climate change. It provides a timeline of environmental policy development and considers the current policy landscape with respect to environmental sustainability. Long-term trends generally follow a pattern of substantial improvement in the 1990s tapering off to slow or backward progress in the most recent decade. Agricultural emissions of nutrients and pesticides are an important factor in most cases where water bodies have failed to reach good status. The agricultural sector is currently not on track to meet its 2030 GHG emissions reductions commitments and biodiversity trends are worse on agricultural lands than on other land types. A court ruling on nitrogen deposition on sensitive landscapes accelerated action to address longstanding issues. Substantial spending to reduce related emissions most strongly affects dairy producers and relies on collaboration with regional governments in an “area-based approach”.

Key messages

- Long term trends in environmental indicators generally follow a pattern of substantial improvement in the 1990s tapering off to slow or backward progress in the most recent decade. The growing dairy herd starting in 2013 coincides with higher nutrient and GHG emissions.
    - Nutrient surpluses have reduced substantially over past decades but are still not at a sustainable level. Agricultural emissions of nutrients and pesticides are an important factor in most water bodies that have failed to reach good status according to the Water Framework Directive (WFD). Current plans will improve the situation but the 2027 objectives of the WFD will be missed.
    - The agricultural sector is currently not on track to meet its 2030 GHG emissions reductions commitments, though planned actions to reduce ammonia emissions are likely to also lead to lower GHG emissions.
    - Trends in biodiversity on agricultural lands are worse than that of other land types. The farmland bird index has continued to decline despite substantial spending to recover these species.
- The increasing emphasis on environmental sustainability in agricultural policy has not progressed quickly enough to resolve longstanding water quality and biodiversity challenges stemming from nutrient emissions.
- A court ruling on nitrogen deposition on sensitive landscapes accelerated action to address longstanding issues. Substantial spending to reduce related emissions by buying-out farm operations most strongly affects dairy producers and relies on collaboration with regional governments in an “area-based approach”.
- The Netherlands plans to use the maximum flexibility in the New CAP to transfer funds from income payments to Pillar 2 and eco-schemes. The use of payments to collective groups of farms for agri-environmental and climate measures is expected to increase.

This chapter covers policies and progress with respect to the environmental sustainability of the agricultural sector, including climate change, biodiversity and natural resource use (air, water, soils). It provides an assessment of the current status and trends and a description of the relevant policies in place. Section 3.1 starts with a general description of the government vision for sustainability that motivates policy design, the major environmental pressures and a short history of policy responses to them. Section 3.2 covers the overall environmental policy setting currently in place. Next, the chapter moves issue-by-issue in greater detail, with sub-sections on biodiversity (Section 3.3), manure and nutrients (Section 3.4), climate change (Section 3.5) and water (Section 3.6).

3.1. The Dutch policy perspective on agriculture and the environment

3.1.1. Government vision of circular agriculture and the nitrogen issue

The most recent vision statement of the Ministry of Agriculture, Nature and Food Quality was published in 2018 and puts environmental issues high on the agenda. It states, *"The Netherlands faces serious social and ecological challenges. We need to prevent depletion of soil, freshwater supplies and raw materials, halt the decline in biodiversity and fulfil our commitments to the Paris climate agreement."*[1] The solution, the vision proposes, is circular agriculture. *"This means closing cycles of minerals and other resources as far as possible, strengthening our focus on biodiversity and respecting the Earth's natural limits, preventing waste and ensuring farmers are paid a fair price for their hard work."*

The government vision statement of 2018 sees an agricultural model based on reducing raw inputs instead of costs, focused on circular principles that should bring about an ecologically and economically viable sector, in balance with nature and appreciated by society. In this circular system, arable farming, livestock farming and horticulture use raw materials from each other's supply chains along with waste flows from the food industry (LNV, 2018[1]).

In most parts of the Netherlands, the most pressing environmental issues for the sector have to do with the undesirable effects of emissions of nutrients (nitrogen and phosphorous) and greenhouse gasses (e.g. methane or CO_2) to air, water, soils and to biodiversity. Matching the quantity of nutrients entering the ecosystem to its absorptive capacity will likely be the most relevant aspect of circular thinking in agriculture.

The OECD PSR framework is designed to help policy makers achieve simultaneous goals of increased productivity, improved environmental sustainability and a more resilient sector. The trade-off between productivity and sustainability is particularly challenging in the Netherlands, a small and densely populated country with the highest agricultural animal density in Europe and with a long history of successful innovation and high productivity. Nitrogen deposition on sensitive landscapes is substantially above safe thresholds in most cases and has impaired the quality and recovery capacity of natural habitats (Adviescollege Stikstofproblematiek, 2020[2]). Increased production intensity has also reduced the amount of biodiversity on farm fields, such that many birds and insects that once cohabited with agricultural production are now found only on the margins of fields and pastures. Persistent nutrient surpluses are detrimental to surface and groundwater quality.

The Fertilizers Act and ammonia regulations from roughly 1990 onwards tried to solve the harmful consequences for nature and people caused by nitrate and ammonia while allowing for continued growth. The high levels of nutrient surpluses that existed in the 1980s and 1990s have been reduced, but the environmental problems surrounding animal manure have not yet been solved. With technology and through solutions such as the *Mineralen Indication System* (MINAS), the environmental impact of ammonia and nitrate decreased by more than half, and phosphorus surpluses have been nearly eliminated. However, surpluses have not further declined since 2010 and the situation is not yet sustainable (PBL, 2020[3]).

Further policy changes were introduced after the cancelling of the MINAS programme. In 2006 a new fertiliser policy based on application criteria for fertilisers was introduced. Nitrogen and phosphorus production derived from manure has also been restricted to 2002 levels as part of the terms of the Netherlands' derogation from the Nitrates directive. Since 2010, various policies were introduced to reduce effects of nitrogen and phosphorus on the environment. Nitrogen and phosphate use standards were introduced in 2006 (*gebruiksnormen*) and tightened over time. Phosphorus Rights (*Fosfaatrechten*) were introduced for the dairy sector after the abolishment of the European milk quota system in 2015 and the Program Approach Nitrogen (*Programma Aanpak Stikstof*, PAS) was implemented in 2015 to allocate nitrogen emission rights for all sectors (PBL, 2020[3]).

3.1.2. Court ruling accelerates action related to ammonia emissions

In 2019 the Council of State ruled that the PAS system in place at the time did not meet the requirements of the Birds and Habitats Directives (BHD) to ensure that threatened or important ecosystems (Natura 2000 sites) achieve good environmental status (Box 3.2 and Box 3.5). This ruling put a temporary halt to all new development activity requiring permits to emit nitrogen, affecting agriculture and construction most strongly but touching many parts of the Dutch economy and placing many projects in limbo. The ruling put in question the amount of available "space" for new nitrogen emissions from human activities and implied an acceleration of efforts to lower existing N emissions to the point where most Natura 2000 sites are no longer threatened by eutrophication. The ruling has made addressing ammonia emissions and resulting N deposition on sensitive habitats the most pressing near-term policy concern, but GHG emissions reductions, water quality and other concerns remain on the agenda with deadlines for improvements approaching.

Before the 2019 Appeals Court ruling, the idea that it was possible to have continued agricultural development along with environmental improvement was a central assumption behind policies. Today, there is new recognition that "not everything is possible" and that nutrient surpluses cannot be solved only with technical measures and increased efficiency, but only with an overall reduction in the quantities of nutrients entering the system (Adviescollege Stikstofproblematiek, 2020[2]). This realisation is bringing management of manure and ammonia into a new phase with plans to restructure the sector, a focus on circular agriculture and amendments to tighten the Fertilizers and Nitrogen Act.

The Environment and Planning Act was amended in December 2020 to provide the legal anchoring of a structural approach to the nitrogen problem. The amendment includes:

- An obligation for the government to achieve results in reducing nitrogen deposition on Natura 2000 areas by establishing three environmental values by law (for 2025, 2030 and 2035).
- An obligation for the Provincial Executive to draw up provincial area plans to implement the nationally required deposition reduction.
- An obligation for the Minister of Agriculture, Nature and Food Quality to establish a nitrogen reduction and nature improvement programme.
- An obligation for the Minister of Agriculture, Nature and Food Quality to establish an additional programme for the legalisation of previously unlicensed projects with low deposition rates.

The Nature Conservation Act of 2021 sets binding targets for the percentage of the hectares of nitrogen-sensitive habitats in Natura 2000 areas on which the nitrogen deposition must be brought below critical deposition values (KDW).[2] In 2025 this should apply to at least 40% of the hectares and 74% in 2030.[3] This represents an approximate 50% reduction in emissions by 2030. This overall target is transposed into provincial equivalents, where depending on their situation, some provinces will have to reduce emissions more than others. Provinces will translate these targets into area-specific objectives based on nitrogen loads (Adviescollege Stikstofproblematiek, 2020[2]). The targeted purchase of peak loader operations that originate an important share of total N deposition is currently the main policy tool to achieve these targets.

In 2020 the government made EUR 5 billion available in the period up to 2030, of which more than EUR 2 billion is for source measures and approximately EUR 3 billion for measures to reduce nitrogen emissions and precipitation and restore nature. From the budget for source measures, EUR 970 million has been reserved for the *National Termination Scheme for Livestock Farm Locations* (*Landelijke beëindigingsregeling veehouderij*, Lbv) and EUR 30 million for a pilot land purchase fund. The budget of the first tranche of the *Livestock Operation Purchase Scheme* (*Maatregel Gerichte Opkoop*, MGO) was EUR 483 million. Improved management measures have been allocated EUR 181 million and EUR 280 million is destined for animal housing measures (Schouten, 2021[4]).

A transition fund (*Transitiefonds landelijk gebied en natuur*) anticipates spending EUR 24.3 billion between 2022 and 2034 to reduce the negative environmental impacts of farming operations, focussed on ammonia emissions but also targeting other environmental concerns. The plans for this fund envision a reduction in the number of livestock in the Netherlands, which likely involves a reduction as well in the number of farm operations. This will especially affect farms that are adjacent to Natura 2000 sites that are sensitive to N deposition and where the current level of N deposition is above a threshold where there is a risk to the quality of nature. The funding will be managed according to an area-based approach where regional governments identify and implement local emissions reduction targets. Regional governments are to provide their plans to achieve emissions reduction goals by the end of 2022 and the legislation for this fund is expected in 2023. A dedicated organisation “Realisation Transition Rural Areas” has been established to manage this process in coordination with regional governments.

Multiple programmes were established in 2022 whose design is yet to be finalised.[4] This includes the following.

- A process to arrive at an agreement on agriculture (*Landbouwakkord*) based on recommendations by a report of mediator Johan Remkes (Box 3.1). Discussions are ongoing as of this writing. This agreement has two purposes:
    - Describe the position of agriculture as a strategically important economic sector, producer of sustainable food and raw materials and essential carrier of a vital countryside.
    - Describe how the agricultural sector will play its part in restoring nature, water and climate.
- The National Rural Area Programme (NPLG - *Nationaal Programma Landelijk Gebied*). It aims to translate country-wide policy objectives to the individual company level. The central government and the provinces are currently working on this, which was also recommended in the Remkes report. A first version is due July 2023, which will emphasise understanding the tasks in each area and making some major strategic choices. It will also select concrete measures for specific locations for the most urgent goals, such as in stream valleys, peat meadows and around nitrogen-sensitive Natura 2000 areas.
- The LBV plus scheme (*LBV plus-regeling*) is a modification of the LBV programme that targets peak loaders for early action (LBV is described in Section 3.4). This scheme is intended to give some 2 000 to 3 000 peak-loaders the opportunity to voluntarily terminate on more attractive terms than would otherwise be the case.

To allow some projects to continue subsequent to the court ruling, the Nature Conservation Act and the Environment Act were amended in April 2022 to create the Nature Compensation Bank (NCB).[5] This bank is designed to provide emissions offsets to compensate for the effects on Natura 2000 areas of nitrogen deposition caused by projects of major public importance. Under Article 6 of the Habitats Directive, the negative effects of such projects on N2000 sites can be compensated for by actions to protect an equivalent amount of nearby nature such that the overall environmental quality is maintained. The NCB does this compensation in advance by building up a stock of land for which additional measures have been taken to enhance natural values. Land in the NCB may subsequently be attached to a project to compensate for its negative effects.[6]

Box 3.1. *Wat Wel Kan* — the Remkes Report

Released in October of 2022, the Remkes Report is an attempt to restart the dialogue between the government and the sector after proposed nitrogen measures led to large farmers' protests in the second quarter of 2022. The report calls for an Agricultural Agreement between the sector and the government to move beyond the current impasse.

The Remkes report makes recommendations along three main lines of action:

- Prevent further deterioration of nature within a year via a targeted, short-term approach that reduces nitrogen deposition by buying out peak loaders. Create room for legalising those in uncertain situations (*PAS-melders*) and allow some new construction to begin.
- Provide a long-term perspective for the agricultural sector and the rural area. Reflecting that not everything is possible, everywhere, clear choices in spatial planning and zoning are needed. A long-term earning model for farmers must be clear and fair.
- Carry out an area-specific realisation of the transition to sustainable agriculture. This must be led by the regions but with a working structure in place at national level. This structure should be led by a person of authority and provide clear frameworks, organise activities and stimulate mutual discussion.

The release of the Remkes report received wide media coverage and is generally well regarded. The government has embraced the recommendations in the report.

Source: Remkes (2022[5]).

3.2. A steady policy evolution towards improved sustainability

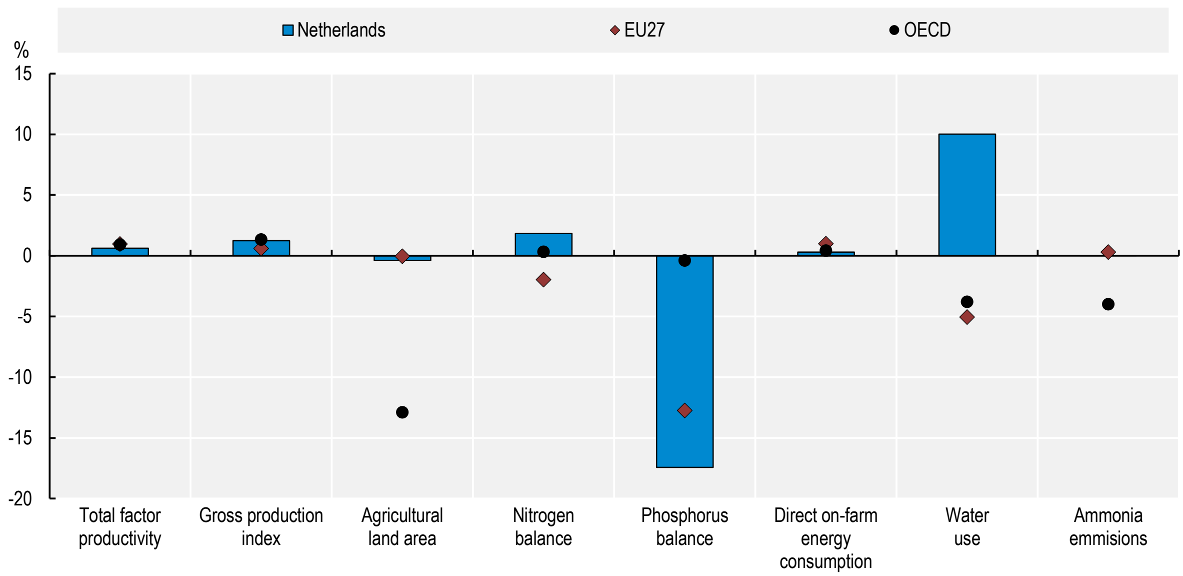
Progress has been made since the 1980s and 1990s in reducing the environmental impact of agriculture, but more remains to be done to put the sector on a sustainable footing. Much of the progress since the 1980s is due to both increased efficiency in the use of nutrients and trends in livestock numbers, themselves influenced by EU policy. The introduction of milk quotas in this period within the European Union caused the number of dairy and calf cows to fall by 42% between 1984 and 2011 to 1.47 million (CBS et al., 2022[6]). Between 1995 and 2020, real agricultural value added grew by 32% while use of inputs such as energy and raw materials decreased over the same period. This has lowered resource use and emissions as expressed per unit of output.

In 2015 milk quotas were abolished and the dairy herd subsequently increased by 19% to 1.75 million. As farmers anticipated the quota elimination, between 2012 and 2015 the number of dairy calves increased by 13% (CBS et al., 2022[6]). As a consequence, recent agri-environmental performance of Dutch agriculture has been relatively static (Figure 3.1), with the exception of a significant improvement in the phosphorus balance. Water usage has increased significantly, likely due to increased use of irrigation over this period, but is still low with respect to the EU average.

Livestock production plays a dominant role in Dutch agriculture and sustainability trends still often follow trends connected with livestock numbers. The State of Agriculture and Food report links short-term environmental trends mainly or significantly to changes in livestock numbers (Table 3.1).

Figure 3.1. Dutch agri-environmental performance, 2010-2019

Average annual percentage change, 2010-2019 or nearest available period



Note: Average annual percentage change, 2010-2019 or nearest available period
Source: Authors' calculations based on OECD (2022), OECD Agri-environmental Indicators database, USDA (2019), Economic Research Service, International Agricultural Productivity for total factor productivity.

Table 3.1. Livestock numbers are an important driver of many sustainability indicators

Drivers of changes in sustainability indicators

Indicator	Long-term trend	Main driver of changes	Other important drivers	Notes
GHG emissions	Stable (with reference to 1990)	Reduced application of fertilisers, manure	Fertiliser efficiency, gas consumption in horticulture	Methane from livestock stable, large share of total emissions
Acidifying substances	Improving	Stables, manure storage, spreading of manure	Livestock numbers, feed changes	Half of emissions are from cattle
Input use (materials, energy, water)	Improving	Energy efficiency in greenhouse horticulture	Livestock numbers	Livestock numbers have increased water consumption since 2012
Emissions of Nitrogen	Improving	Fewer grazing livestock	Less manure production	Netherlands among worst N surplus in EU
Emissions of Phosphorus	Stable	Livestock numbers	Feed changes	P surplus largely eliminated, but ground is saturated with P in many places
Emissions of ammonia	Improving	Low-emission application of manure	Livestock numbers	
Plant protection products	Improving	Favourable weather conditions	Introduction of cultivation-free zones, use of low-drift nozzles	Favourable weather conditions are transient phenomenon that were relevant in the most recent year
Fine dust	Improving	Technical improvement in poultry	Livestock numbers, air scrubbers in pig barns	Fine dust from cattle farming tracks livestock numbers
Antibiotic use	Improving	Reduced use for growth promotion	Better monitoring	Use still high in pigs, broilers and veal calves
Biodiversity	Declining	Agricultural intensification	Eutrophication, desiccation, fragmentation, pollution	Positive effects of nature policy measures compensating for the negative effects of environmental pressure

Note: Drivers mentioned here can be part of a longer-term trend or they can explain year-on-year variation in the indicator.
Source: Adapted from Berkhout, Petra, Harold van der Meulen, Pascal Ramaekers (2022) *Staat van Landbouw en Voedsel*, Wageningen Econoimic Research, Wageningen.

Policies and regulations regarding sustainable practices have been evolving at a steady pace. Common Agricultural Policy (CAP) spending has been increasingly targeted towards environmental outcomes (Chapter 1). The regulatory framework is frequently revised (Fertiliser and Nitrogen Act, Environment and Planning Act) and a number of new programmes have been put in place since 2018 to reduce livestock numbers and improve environmental performance (see Manure and Nutrients section for more on these programmes) (Schrijver and Uetake, 2015[7]).

There are three predominant regulatory measures in use. In order of importance, these are regulatory requirements, environmental cross-compliance (which partly incorporates regulatory requirements) and environmental taxes and charges. National regulatory measures (permits or licenses to produce) are used to maintain landscape features such as wooded areas and hedgerows, water quality, water availability, soil quality and air quality, while EU environmental regulations mainly address biodiversity and water quality (Box 3.2).

Box 3.2. EU directives play a strong role in the sustainability of the agricultural sector in the Netherlands

The following directives require that the government of the Netherlands achieve certain results and have been transposed to corresponding Dutch regulation. They are also part of cross compliance component of the CAP.

- The Birds and Habitats Directives (BHD) calls for protecting nature and restoring good status to important habitats and ecosystems. Achieving these aims has led to a substantial amount of planned spending to reduce ammonia emissions leading to deposition on Natura 2000 sites and provoked changes in how permits are approved in the nitrogen accounting system (PAS). Meeting the requirements of the BHD is the most challenging agricultural issue in the Netherlands today.
- The Nitrogen Directive is highly relevant to the Netherlands, as the country has significant nitrogen surpluses. The Netherlands (along with Ireland and Belgium) is one of three countries with a derogation that allows application of manure N in excess of the 170kg/ha allowed by the directive. One condition of the derogation is that total N and P application to soils remain below 2002 levels, a constraint that has been binding or close to binding in many years, but less so recently.
- The Water Framework Directive (WFD) requires counties to return surface waters to “good” status. The WFD works at the river basin level, requiring each to have a plan to restore good status, with associated monitoring and reporting responsibilities. There are four river basins in the Netherlands (the Rhine, Meuse, Scheldt and Ems). The Netherlands has a National Water Plan to help meet the objectives of the WFD. The government objective is to meet WFD requirements by 2027, but significant progress will need to be made to realise this as many water bodies do not yet have good quantitative or qualitative status.

3.2.1. Strategic Environmental Assessment (SEA) is missing in the policy development cycle

While the Netherlands Environmental Agency (PBL) carries out regular analysis of the agricultural sector, the Ministry of Agriculture, Nature and Food Quality (LNV) does not itself make systematic use of strategic environmental assessment (SEA) as part of is policy development cycle. This risks having policies become reactive to short-term issues at the cost of long-term objectives. Strategic planning may have helped avoid the current situation with ammonia emissions, where a court ruling acted as a strong motivator of policy change. The relatively static progress (and some reversals) in environmental performance in the last decade should be seen as a missed opportunity to put the sector on a sustainable footing earlier, with less disruption, and at lower cost. Implementing the lessons of this experience in policy will help ensure that agriculture in the Netherlands is future-proof and ready for any shocks that might come. One such lesson seems clear: a gradual tightening of requirements that does not achieve clear progress towards sustainability in the near term is not a successful strategy.

The current situation, where livestock numbers must be adjusted at substantial cost to the taxpayer, points to the value of preparedness and foresight in policy making. SEA is one tool for this, but it is also important to ensure that all stages of the policy development cycle are reinforced, starting from risk assessment and objective setting through policy design, implementation, review and revision.

Monitoring and enforcement can be strengthened with data

All farmers, whether or not they receive CAP support, must comply with statutory management requirements (SMRs). In the Netherlands there are several enforcement services that check this. Municipalities, provinces, water boards and the police share responsibility for enforcement of different statutory and regulatory requirements relevant to farmers.

Of all farms that apply for CAP support, 1% are selected for an annual check. This is in line with the CAP regulation requirements. In 2021 and 2020, this percentage was reduced to 0.5% as a result of COVID-19. In 2020, 243 farms were inspected with respect to SMR 1 (Nitrates Directive) and 82 were inspected with respect to SMRs 2 and 3 (Birds and Habitats Directives). Of these, seven farms were found in non-compliance in at least one aspect SMR 1 (2% of inspections) (National Administration, 2021[8]).

OECD best practice on regulatory enforcement and inspection emphasises the importance of proportionality; the allocation of resources proportional to the level of risk, and enforcement actions proportional to the seriousness of the violation. This includes criteria to assess the risk of individual businesses and rank them according to assessed risk level; data on all (or at least most) businesses allowing to effectively assess their individual risk level; and planning and resource allocation mechanisms so that inspection visits are effectively planned based on the risk level, and resources are rationally allocated (OECD, 2014[9]). Evidence of significant non-compliance has previously been noted in the context of the Netherlands' derogation under the Nitrates Directive, which also calls for further reinforcement of controls to provide additional safeguards and reassurances of the effectiveness of measures (EC, 2020[10]).

A joint monitoring strategy between LNV, environmental agencies and regional and local authorities can help ensure rapid identification and follow-up of risks, uniform practices through good routines, tools and clear job descriptions, and better and faster communication of inspection results. A systematic approach to inspection can help identify weaknesses in self-reporting systems and help close the "implementation gap" between regulations and outcomes.

The Netherland's new CAP Strategic Plan uses maximum flexibility to strengthen sustainability

The Netherlands will make maximum use of the flexibilities in the CAP 2023-27. Fifteen per cent of Pillar 1 funds will be transferred to EAFRD (Pillar 2) in 2023, gradually increasing to 30% by 2027 (see Chapter 1 for more detail on the new CAP and the CSP).

Twenty-five per cent of the amount remaining in Pillar 1 will be dedicated to eco-schemes. These are new ways to support farmers who wish to contribute to transition to sustainable agriculture. Through eco-schemes, a farmer can choose from a list of eco-activities that fit their business as well as climate and environmental goals. The payment they receive depends on the number of eco-activities they choose, according to three levels of participation.

The Netherlands has taken an innovative approach in the CAP with respect to collective and results-based approaches to protection of farmland birds in the form of the Agricultural nature and Landscape management programme (*Agrarisch Natuur- en Landschapsbeheer, ANLb*) (Box 3.3). While addressing many of the weaknesses of this kind of scheme, it has not yet produced substantial improvements in the farm birds index (Figure 3.4). This approach has been extended to include climate and water issues in the CAP 2023-27.

Box 3.3. Agricultural nature and landscape management programme: A co-operative-based approach

The previous CAP reform (2014-2020) gave the option to organise agri-environmental schemes with a cooperative-based approach, through collective agreements with groups of farmers. The Dutch Government, which had lobbied for this possibility in Brussels, wanted to introduce this approach to management agreements aimed at creating good habitat conditions in habitats for rare species. Agricultural collectives can apply for a subsidy from the province within the *Agrarisch Natuur- en Landschapsbeheer* (ANLb) system. Collectives are the final beneficiaries of the subsidies and are responsible for the implementation of agricultural nature management in their area.

In 2020 there were 40 agricultural collectives. The collectives managed an area of approximately 92 000 hectares in 2019, about 81% of which is for meadow birds. Funding for this programme was EUR 71 million in 2019. Payments are based on the extra costs and the loss of income resulting from the area agreement, plus up to an additional 20% to cover implementation and transaction costs.

The collectives create a multi-year plan for the management of the area and the strategy for the conservation of biodiversity. This focuses mainly on 68 target species of the Birds and Habitats Directives (BHD) that are highly dependent on agricultural area, but also includes fish, amphibians and insects. The collective then contracts individual farmers or land users for various activities to achieve its overall objectives as agreed with the provinces and water boards. That is, agricultural collectives make agreements with provinces and water boards about the performance to be delivered and with farmers and other agricultural land users about the actions to be taken.

The collectives approach offers more flexibility and scope for customisation that takes local circumstances into account. They have the potential for a more effective local mutual monitoring. By co-ordinating the actions of farmers, the different needs of species can be met efficiently at a landscape level. This approach passes many responsibilities from government administrators to farm collectives, which can reduce administrative burden while increasing engagement and ownership on the part of the farming community.

Source: Berkhout, van der Meulen and Ramaekers (2021[11]), *Staat van Landbouw en Voedsel Editie 2021* (State of Agriculture and Food 2021) Wageningen Economic Research, Wageningen.

Organic Action Plan

The Organic Action Plan, released in 2022, is the Dutch implementation of the EU Organic Action Plan, which in turn gives substance to the European Green Deal and the Farm to Fork strategy. The action plan aims to accelerate the growth of the organic agricultural area from 4% (in 2021), to 15% in 2030 (LNV, 2022[12]). That translates to moving from approximately 80 000 hectares to 300 000 acres. Growth will come primarily from dairy farming and arable farming, sectors with a lot of acreage that are land-bound and with conversion can contribute to the major challenges that exist in terms of nature, nitrogen, water, biodiversity and animal welfare. This can also boost circular agriculture and nature-inclusive agriculture, as organic includes some similar concepts and practices (Box 3.4).

Box 3.4. Approaches and practices to produce food in an environmentally friendly way

Since the early 20th century, several approaches have emerged to promote environmentally friendly agricultural practices as part of production systems that are more environmentally sustainable. The concepts and the movements that originated them are strongly intertwined, and the terms are sometimes used synonymously. In fact, a wide set of terms to describe environmentally superior agricultural techniques coexist in public discourse. Alongside organic, circular and regenerative agriculture are terms such as "agroecological farming" "alternative agriculture," "biodynamic agriculture," "carbon farming," "nature inclusive farming," "conservation agriculture," "green agriculture," "organic regenerative agriculture," and "sustainable agriculture" (Newton et al., 2020[13]).

Organic agriculture

Organic agriculture is the most successful example and has been encouraged for a long time by policies in many countries. The FAO-WHO Codex Alimentarius Commission describes organic agriculture as "a holistic production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles, and soil biological activity. This is accomplished by using, where possible, agronomic, biological, and mechanical methods, as opposed to using synthetic materials, to fulfil any specific function within the system" (Joint FAO/WHO Codex Alimentarius Commission, 2001[14]). The main characteristics of organic production are the prohibition of most synthetic inputs, and mandatory crop rotations (FAO Committee on agriculture, 1999[15]).

Organic production standards for processes and production methods have been developed by farmer and consumer associations, charities, certification bodies and governments. They aim at differentiating products and segmenting markets, with claims regarding product characteristics transmitted to consumers through a food label (Rousset et al., 2015[16]). Organic production is not only about sustainability; the price premium obtained by organic products and its market segmentation reflects consumers' interest in the health, safety and quality characteristics they associate with organic food.

Organic agricultural practices have environmental benefits including lower pesticide residues, a richer biodiversity and greater resilience to drought. However, intensive management within organic farming regimes can also impoverish biodiversity and lead to an excessive application of animal manure. Organic systems also frequently have lower yields and require more land to produce a given level of output (OECD, 2003[17]).

Circular agriculture

Circular agriculture focuses on using minimal amounts of external inputs, closing nutrients loops, regenerating soils, and minimising the impact on the environment. It is built on the concept of circular economy, where the reuse and recycling of materials is not only a separate step to close cycles, but an integral part of the choices made in the production and use of products. In circular agriculture, this can be the use of manure as organic fertiliser and the use of wastewater in irrigation. Circular agriculture does not reflect a specific set of farm practices or standards, though it is often associated with mixed crop-livestock production, organic production and agroforestry. Circular agriculture is contrasted to the linear nature of conventional agriculture where intensive application of raw inputs such as fertiliser and chemicals leads to harmful outflows of waste and degraded soil quality in the farm system.

Agroecology

Agroecology is "a holistic and integrated approach that simultaneously applies ecological and social concepts and principles to the design and management of sustainable agriculture and food systems, [seeking] to optimise the interactions between plants, animals, humans and the environment while also addressing the need for socially equitable food systems" (FAO, n.d.[18]). While the concept emerged decades earlier, it gained prominence in the 1990s, in the United States and in Latin America to express a new way of viewing agriculture and its relationship with society (Wezel et al., 2009[19]). It is seen simultaneously as a science, a set of agricultural practices and a social movement (GIZ, 2020[20]).

There are no national or international agro-ecology standards, but the concept is increasingly being incorporated and promoted in policy. In the European Union, the Farm to Fork Strategy refers to "agroecology (including organic farming)" as one of several sustainable practices to be funded by the new CAP eco-schemes. In 15 case studies across Europe, agroecological farms were found to enhance biodiversity and water quality compared to non-agroecological farms (Landert, J et al., 2020[21]). However, no clear patterns were found regarding soil quality or economic performance. The results also suggested that agro-ecological practices could have higher greenhouse gas emissions and fuel consumption.

Regenerative agriculture

Regenerative agriculture encompasses a range of practices (such as using cover crops, integrating livestock, or reduced or no tillage), outcomes (such as improving soil health, carbon sequestration or increased biodiversity), or combinations of both. The use of the term has surged since 2015, which suggests that it is gaining more attention from scholars and practitioners. Regenerative agriculture stresses soil restoration and the interplay of crops and farm animals. The concept of regenerative agriculture is broader and less prescriptive than agro-ecology and organic agriculture, as it accepts a targeted use of modern plant and animal breeding technology, tilling, and inorganic fertilisers or pesticides (EASAC, 2022[22]).

The Special Report on Climate Change and Land by the UN Intergovernmental Panel on Climate Change lists regenerative agriculture as one of the sustainable land management practices (along with agroecology, ecosystem-based approaches and organic farming) that can be effective in building resilience of agro-ecosystems. In the United States, some municipal governments have incorporated regenerative agriculture in their climate action plans (The Climate Reality Project, 2019[23]). While there are no standards developed by national governments or international organisations, private standards such as Regenerative Organic Certified (developed by the Regenerative Organic Alliance, a US-based group of farmers, business leaders and experts) are starting to emerge.

The action plan is based on the recognition that both sides of the market are important for success. Farmers will supply more organic products if the demand is there at the right price. Therefore, the whole food value chain needs to be involved in a successful action plan. The action plan is built along the following three goals.

- More organic consumption and a larger market for organic products via
  - Helping ensure consumers and chain actors are familiar with organic products and the European organic label
  - Ensuring there is an increased supply of organic products in various marketing channels
  - Ensuring that organic products are accessible and affordable.
- More organic production via
  - Encouraging conversion to organic farming
  - Continuing existing organic production
  - Facilitating co-operation and commitment of chain parties
  - Gaining access to suitable and affordable land

  - Having a distinct sustainability brand by having organic take additional steps in the area of sustainability.
- More knowledge and innovation.
  - Establishing a knowledge agenda for organic production and consumption (*Kennisagenda Biologisch*)
  - Knowledge dissemination and education, especially via *GroenKennisnet* (Chapter 4)
  - Keep innovating by making use of field labs, living labs and experimental gardens.

Organic dairy farming might be a solution for dairy farms located near nature reserves, the ammonia emissions from organic dairy can be significantly less than for conventional production. Organic production does not automatically lead to improvements in all environmental factors; organic pig and poultry farming potentially have higher N emissions than conventional farms (Plomp and Migchels, 2021[24]).

Farmers practicing organic farming are younger and more diverse which makes them particularly able to adopt innovative practices and transform the agricultural sector. Younger farmers tend to run more modernised and profitable farms (Zagata and Sutherland, 2015[25]). Moreover, the attractiveness of the agricultural sector as a viable career path is an important concern in the Netherlands, where outside career options are strong. Organic agriculture might have less issues concerning generational renewal and attracting new entrants to the sector.

While the switch to organic agricultural might decrease the environmental pressure per hectare, lower yields associated with organic production can increase pressure per kg of product. Organic potato farms for instance deliver 20-40% lower yields than conventional farms. The lower productivity per hectare can complicate profitability, as land is already amongst the most expensive in the European Union. Converting non-farmland into land for organic agriculture to mitigate the productivity decline can address the yield gap, but at some risk to biodiversity (Berkhout et al., 2021[26]; Koopmans et al., 2021[27]).

Advances in research and education could overcome current drawbacks associated with organic agriculture. Organic agriculture still plays a relatively minor role in these areas. The overall knowledge and innovation system for organic agriculture lags other sectors (Berkhout et al., 2021[26]; Koopmans et al., 2021[27]).

Other programmes

The Sustainable Animal Products (VDP) market programme financially supports parties in the chain with pilot projects and research to accelerate sustainability. This includes setting up new sustainable chains or expanding eco-labelling schemes. For example, the Royal Dutch Butchers’ plan to increase awareness about sustainability and increase the use of a quality mark. The market programme is also intended to facilitate the transition to one star *Better Life* for broiler farmers. All supermarkets and others in the value chain have committed to sell only chicken rated at least one star in the *Better Life* label as of 2023. The market programme is facilitated and co-ordinated for at least three years by the *Alliantie Verduurzaming Voeding* foundation (Schouten, 2021[28]).

Certain banks and green funds can apply for a green certificate under the Green Projects Scheme. This allows them to finance sustainable projects at a lower interest rate along with some additional income tax benefits for citizens. The interest and tax benefits together amount to approximately 3% of the value invested.[7]

The Subsidy Module Agricultural Business Advice and Education (Sabe) is part of a broader framework related to farm-level innovation. In order to help market sustainable products, a component has been added to Sabe that provides EUR 1 million to support collaborative projects focussing on the development of more sustainable animal market concepts. To be eligible for a subsidy, at least one farmer and a processor or trading company in the animal chain must work together. This scheme began on 1 November 2021.The

Sabe scheme also provides vouchers for advice and business planning services (see Chapter 4 for more on Sabe).

Since the beginning of 2020, the Advancing Sustainable Animal Products (ASAP) project has been part of the Sustainable Livestock Farming Programme. This project is aimed at removing international obstacles to sustainability and making the European market for animal products more sustainable. This has resulted in the establishment of a broad group of stakeholders (governments, NGOs and market parties) from Denmark, Germany, Belgium, and France exploring how voluntary harmonisation of sustainability information in the market for animal products could take shape. Under the heading of ASAP, work is being done on a system to harmonise existing animal welfare labels from different countries and clearly organise them. In addition, a sustainability dashboard is being developed that provides insight into how sustainably animal products are produced.

Investors may deduct up to 45% of the cost of environmentally related investments from their taxes via the Environmental Investment Allowance (*Milieu-investeringsaftrek*, MIA). This is to put environmentally friendly alternatives on a more equal cost footing with conventional technologies. A related tax benefit, The Arbitrary depreciation of environmental investments (*Willekeurige afschrijving milieu-investeringen*, Vamil) allows farmers to depreciate up to 75% of eligible investment costs as quickly as they like (the entire amount may be taken in the first year if desired).[8]

While there are many qualifying investments for MIA and Vamil, these are most relevant for investments in buildings such as sustainable barns that are certified under the Sustainable Livestock Farming Measures (*Maatlat Duurzame Veehouderij,* MDV). An MDV barn is a livestock barn with design features that lower its environmental impact and provides for improved animal health and welfare. For example, the investment in a certified MDV dairy barn is eligible for a maximum of EUR 6 250 per animal place under MIA and the owner may depreciate the value of the barn by a maximum of EUR 4 million under Vamil.[9]

The development of agroforestry is considered part of the transition to circular agriculture. Agroforestry combines trees as multipurpose natural elements with agricultural activities. Siting of agroforestry locations in proximity to the Nature Network and Natura 2000 areas can increase connectedness between natural areas and strengthen landscape identity and biodiversity. In this regard it can help synergistically with planned reduction of peak loader farms near Natura 2000 areas. This practice is in its early stages in the Netherlands, but a ten-year strategy for agroforestry has been developed as part of the Dutch Forestry Strategy (LNV, 2020[29]). This strategy is three-fold:

- creating a supporting (policy) environment in the coming years
- stimulating innovative practices (financially)
- stimulating knowledge development and exchange, after which there will be a focus on upscaling.

Part of developing a supporting policy environment for agroforestry is inclusion of this production system in the CAP. Such agroforestry activities may be supported from both Pillar 1 and Pillar 2. This is part of the CAP Strategic Plan for the Netherlands. Agroforestry Nederland is a network of researchers, companies and organisations involved in the development of agroforestry in the Netherlands.[10] This network connects all agroforestry initiatives in the Netherlands to promote knowledge development and exchange. Agroforestry Nederland is a member of the European Agroforestry Federation (EURAF).

3.3. Biodiversity and ecosystem management

3.3.1. Assessment of status and trends

Land reclamation, agricultural intensification and urban development have reduced the size of natural ecosystems. The average ecological quality of all types of terrestrial ecosystems has declined since 1994 but has stabilised in recent years. Major contributors are eutrophication, acidification, lowered water tables leading to drying out of soils, poor water quality and a lack of spatial connectivity, though their effects differ according to the type of ecosystem and between regions. Since 1990, the pressures on the environment in terms of emissions and deposition have declined and land use conditions have improved due to habitat creation in the national ecological network (NEN). However, the situation is not yet sustainable. Suboptimal environmental and land use conditions lead to low and declining ecosystem quality. Local factors are important; ecosystems on nutrient-poor sandy soils are much more sensitive to eutrophication and acidification than those on clay soils (CBS et al., 2021[30]).

The current ecological quality of freshwater ecosystems is on average low. Among the causes of this are the delayed release of nutrients from sediment, run-off and leaching of nutrients from farmland, pollution with sources outside the Netherlands, and the presence of invasive species. About 60% of the nutrient load of regional waters comes from agricultural land (PBL, 2020[3])

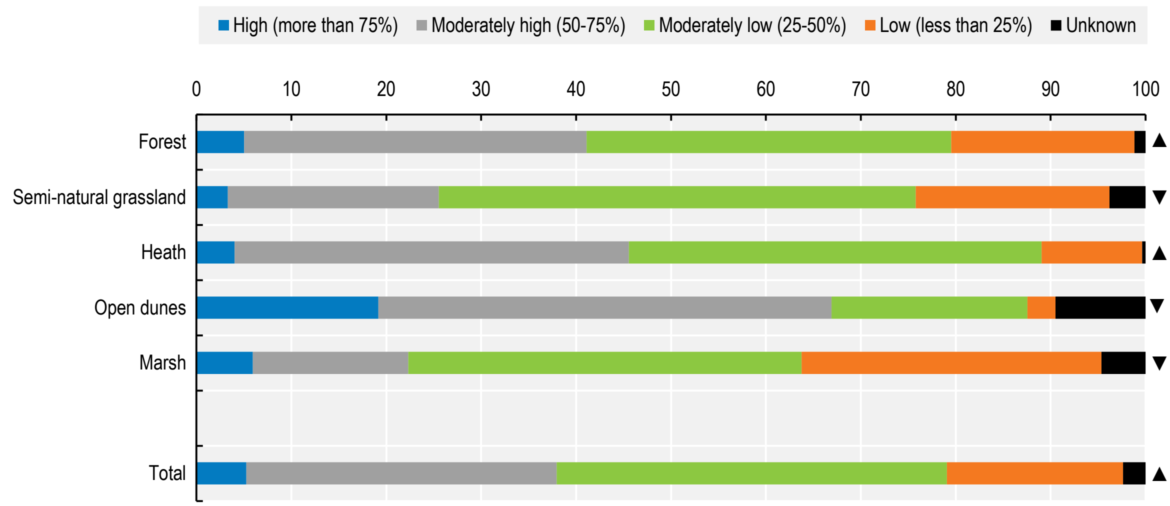
Almost 40% of the area of terrestrial ecosystems has a moderately high to high ecological quality, measured by the presence of qualifying species of breeding birds, vascular plants and butterflies (Figure 3.2). The index shows that semi-natural grasslands and marshes, which are often affected by agricultural activities, are in relatively poor condition and declining, while the condition of forests is improving (CBS et al., 2021[30]). While ecological quality is improving on average, this is due mainly to improvements in forest area; the overall quality of other ecosystems has not improved since the 1994-2001 reference period.

In natural areas, the average numbers of target species of vascular plants and summer birds increased between 1990 and 2005, compared with the 1975-1989 period, but these decreased in agricultural areas (Figure 3.3). An increase in the average number of target species in natural areas does not mean that every species is doing well. Species that make the highest demands on their habitats are becoming increasingly rare. Long term species decline is even more substantial. Since 1900, plants on arable fields have declined by 35%; grassland butterflies by 80%, and characteristic birds of open farmland by 85% (CBS, 2020[31]). Since 1990, the number of farmland birds as measured by the OECD agri-environmental indicator has declined by 54% (Figure 3.4).

In recent decades, spatial and environmental conditions have improved for the target species in natural areas, and their average numbers have improved. This is because of an expansion of natural areas as well as an improvement in their quality subsequent to reduced nitrogen deposition and restoration efforts. In agricultural areas, the number of target species is decreasing because of the increasing optimisation of land for production and harvest efficiency. As a result, fewer species have the space they need to survive (CBS et al., 2014[32]).

Figure 3.2. Semi-natural grassland has the smallest share of high-quality area

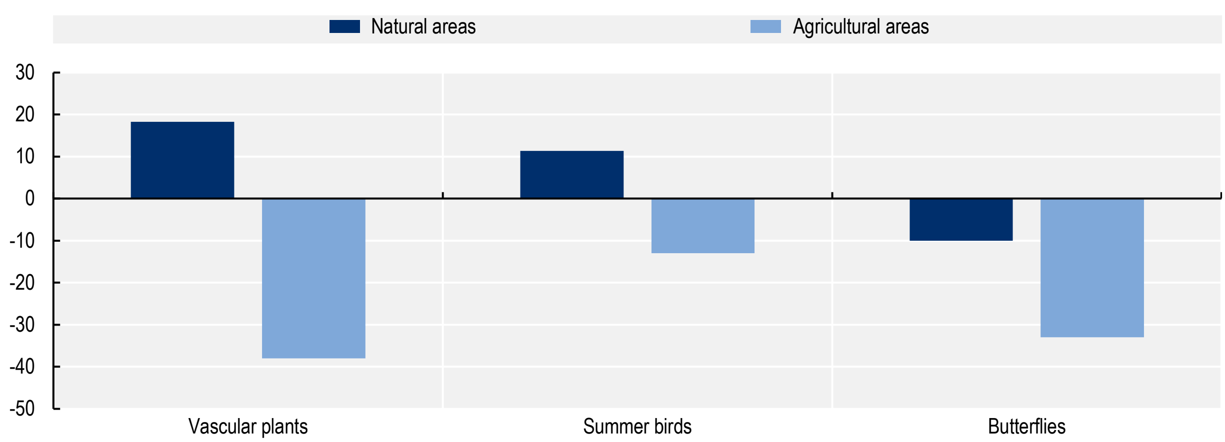
Ecosystem Quality Index, 2010-17, percentage of area



Note: Ecological quality is determined from the number of qualifying species (a selection of butterflies, vascular plants and breeding birds indicative of an ecosystem in a good condition) present in the area. Arrow indicates average improvement or decline since 1994-2001.
Source: CBS, PBL, RIVM, WUR (2021). Ecosystem quality (area) 1994-2017 (indicator 1518, version 03, 10 November 2021), www.clo.nl. Centraal Bureau voor de Statistiek (CBS), Den Haag; PBL Planbureau voor de Leefomgeving, Den Haag; RIVM Rijksinstituut voor Volksgezondheid en Milieu, Bilthoven; Wageningen University and Research, Wageningen.

Figure 3.3. Target species doing worse in agricultural areas compared to natural areas

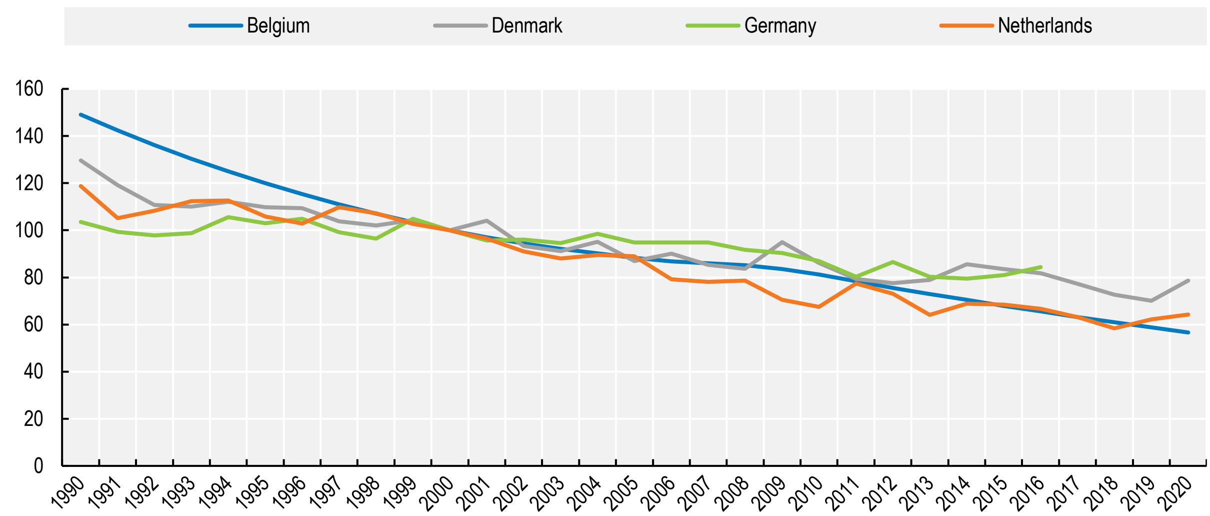
Numbers of target species, 1990–2005 compared with 1975–1989 for natural areas larger than 100 ha



Source: CBS, PBL, RIVM, WUR (2014). Change in species numbers in natural and agricultural areas, 1975-2005 (indicator 1543, version 01, 20 May 2014) www.environmentaldata.nl. Statistics Netherlands (CBS), The Hague; PBL Netherlands Environmental Assessment Agency, The Hague; RIVM National Institute for Public Health and the Environment, Bilthoven; and Wageningen University and Research, Wageningen.

Figure 3.4. The number of farmland birds has been declining

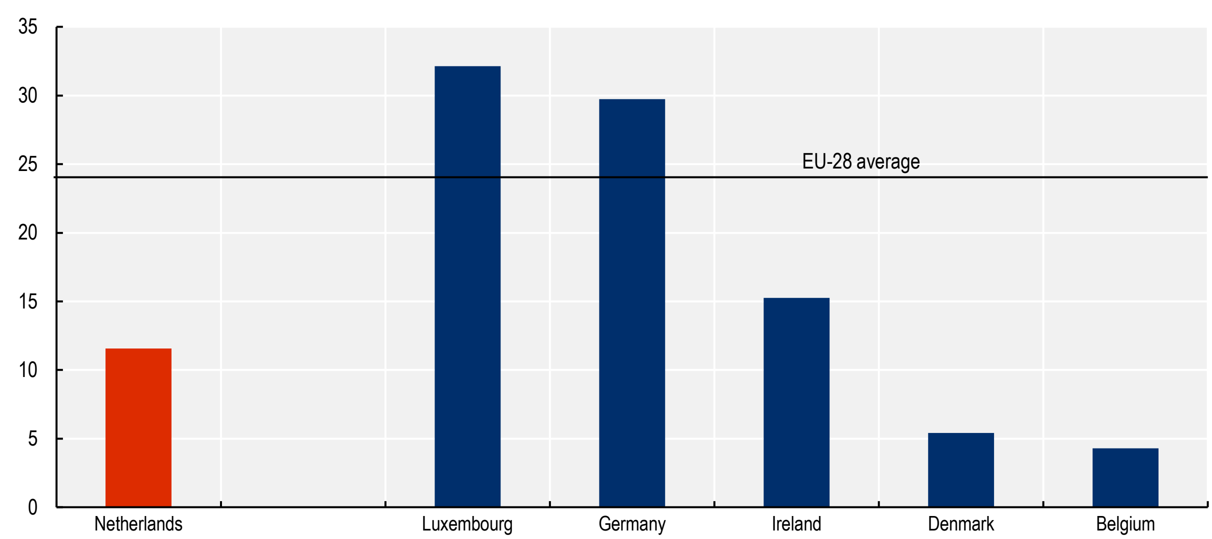
OECD Farmland Birds Index, year 2000=100, 1990-2021



Note: There are 23 species: European Turtle Dove (Streptopelia turtur), Northern Lapwing (Vanellus vanellus), Eurasian Wryneck (Jynx torquilla), Common Kestrel (Falco tinnunculus), Red-backed Shrike (Lanius collurio), Woodlark (Lullula arborea), Eurasian Skylark (Alauda arvensis), Marsh Warbler (Acrocephalus palustris), Common Whitethroat (Curruca communis), Common Starling (Sturnus vulgaris), Fieldfare (Turdus pilaris), Whinchat (Saxicola rubetra), European Stonechat (Saxicola rubicola), Northern Wheatear (Oenanthe oenanthe), Eurasian Tree Sparrow (Passer montanus), Tree Pipit (Anthus trivialis), Water Pipit (Anthus spinoletta), Common Linnet (Linaria cannabina), European Goldfinch (Carduelis carduelis), European Serin (Serinus serinus), Corn Bunting (Emberiza calandra), Yellowhammer (Emberiza citrinella)
Source: OECD (2022), OECD Agri-environmental Indicators database.

Figure 3.5. The number of habitat types with a favourable conservation status is below the EU average, but similar to some regional peers

Conservation status of habitat types relative to EU and regional peers, 2013-18, % habitat types with favourable status



Source: CBS, PBL, RIVM, WUR (2021). Conservation status and trends in species and habitat types under the Birds and Habitats Directives, 2013-2018 (indicator 1483, version 05, 9 November 2021) www.environmentaldata.nl. Statistics Netherlands (CBS), The Hague; PBL Netherlands Environmental Assessment Agency, The Hague; RIVM National Institute for Public Health and the Environment, Bilthoven; and Wageningen University and Research, Wageningen.

About 10% of the habitat types in the Netherlands have a favourable conservation status. About a quarter of the Habitats Directive species have a favourable conservation status. The number of species and habitat types with a favourable conservation status is lower than the EU average but higher than in Belgium and Denmark, where the situation is close to that of the Netherlands (Figure 3.5). The trends in habitat types and population sizes of species with an unfavourable conservation status in the Netherlands show a strong improvement compared with other EU Member States. However, more species show worsening trends than those showing improvement (CBS et al., 2021[33]).

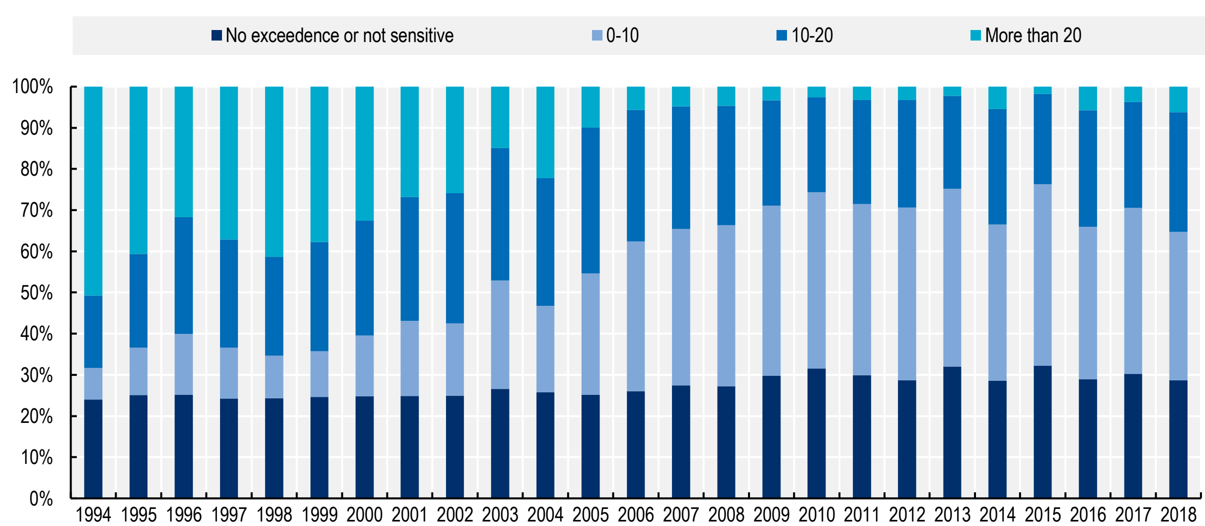
The Netherlands is currently far from the Birds and Habitats Directives (BHD) target to achieve and maintain a favourable conservation status for all BHD species and habitat types and to restore bird populations. Indeed, reaching the European Commission's interim target of 30% in the EU Biodiversity Strategy would require considerable improvement. Across all the EU28 Member States, 24% of the habitat types and 31% of the Habitats Directive species have a favourable conservation status. In the Netherlands just 12% of the habitat types have a favourable conservation status. Of the Habitats Directive species in the Netherlands, 26% have a favourable conservation status (CBS et al., 2021[33]).

Of the 161 Dutch Natura 2000 areas, 130 are sensitive to an excess of nitrogen precipitation from the air, or nitrogen deposition, which is caused by nitrogen emissions from, for example, agriculture, traffic, industry or sources abroad (PBL, 2020[34]). Nitrogen deposition causes eutrophication (excess nutrients), and also makes soil more acidic When nitrogen deposition exceeds the critical load, vulnerable species will disappear. The higher the exceedance and the longer the period of exceedance, the greater the impacts. Nutrient-poor ecosystems are especially sensitive to nitrogen deposition.

The area with no exceedance of nitrogen deposition has doubled but remains relatively small at about 10% of land area (Figure 3.6). In many ecosystems the environmental pressure from nitrogen deposition is still too high and has not decreased in recent years. In forest, open dune, and heath ecosystems in particular, nitrogen deposition is responsible for moderate to bad conditions throughout almost the entire area. Considerable progress has been made in reducing the worst cases of excessive N deposition, but progress has been slow after the mid-2000s.

Figure 3.6. About 70% of land area has some level of excessive N deposition

Exceedance rate of critical deposition of N by percentage of land area, kg per ha1994-2018

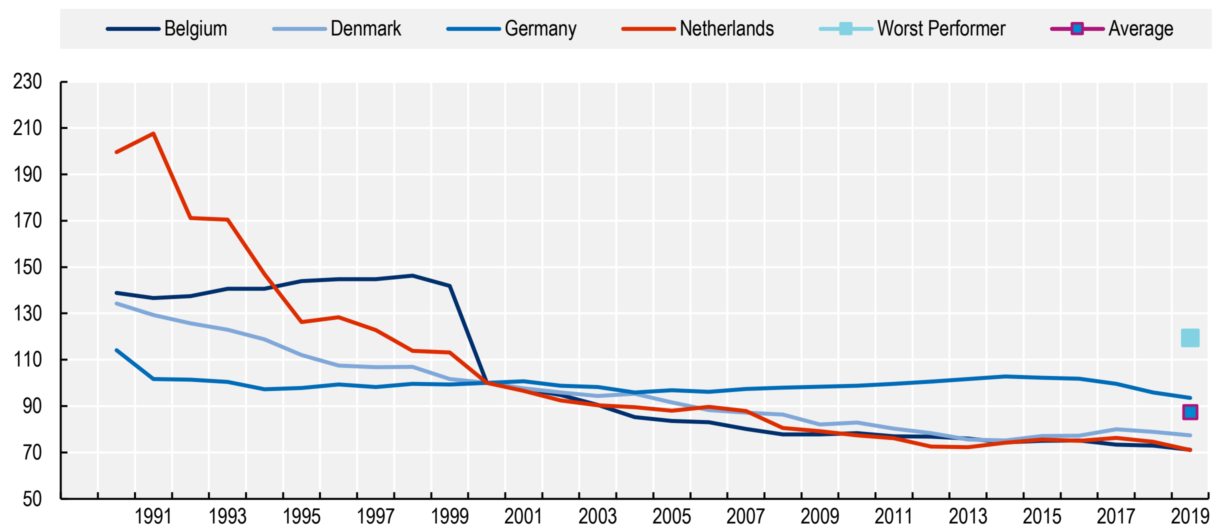


Source: CBS, PBL, RIVM, WUR (2021), *Ecosystem quality and trends in nitrogen availability, 2018*, (indicator 1592, version 03, 9 November 2021), www.environmentaldata.nl. Statistics Netherlands (CBS), The Hague; PBL Netherlands Environmental Assessment Agency, The Hague; RIVM National Institute for Public Health and the Environment, Bilthoven; and Wageningen University and Research, Wageningen.

The environmental pressure from nitrogen deposition has reduced since the 1990s and the Netherlands has had the most rapid ammonia emissions reductions in the OECD (Figure 3.7). The 1999 Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (Gothenburg Protocol) sets national ceilings for 2010/2020 for ammonia and three other pollutants. The ceilings were negotiated and agreed to on the basis of scientific assessments of pollution effects and abatement options. Under the Protocol, the Netherlands has committed to reducing ammonia emissions by 14% by 2020 relative to 2005. This commitment is less than recently set domestic targets for reductions.

Figure 3.7. Substantial reduction in ammonia emissions since 1990 but not yet sustainable

Ammonia trends in the Netherlands and peers, 1990-2019 Index 2000=100

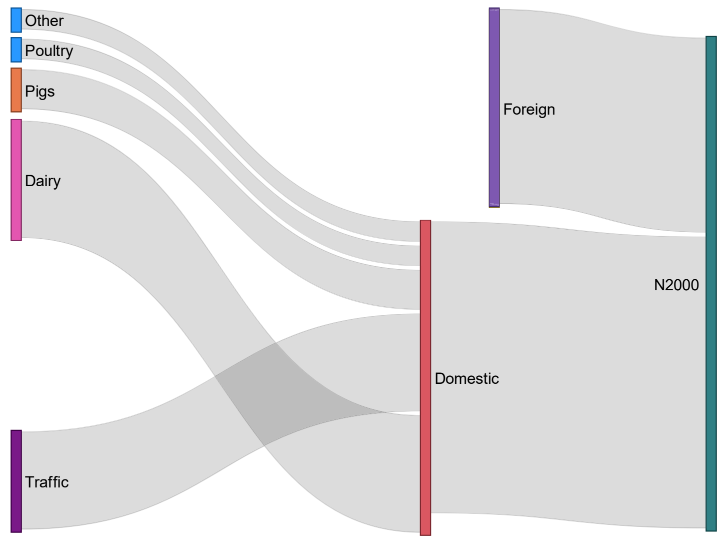


Note: Worst performer and OECD average shown only in 2019 to aid clarity. The Netherlands is the best performer in ammonia reduction over the time period.
Source: OECD AEI database.

Atmospheric deposition of nitrogen comes from sources outside the country, domestic transport, and agriculture. The national contribution to nitrogen deposition in Nature 2000 areas is around 60%. Of this, around 20% comes from traffic, industry, and consumers. The other 40% comes from livestock farming. Nitrogen deposition from livestock farming is around 65% from cattle farming, 20% from pig farming and 10% from poultry farming (Figure 3.8).

Figure 3.8. About 40% of N deposition on N2000 sites is from domestic agriculture

Nitrogen flows onto Natura 2000 sites



Source: https://www.wur.nl/en/Dossiers/file/Nitrogen.htm.

3.3.2. Policies and regulations

The Netherlands has made international commitments to meeting the goals of the Convention on Biological Diversity, the Birds and Habitats Directives (Natura 2000) and the EU Biodiversity Strategy. Policies cover reducing emissions of nutrients and acidifying substances, nature restoration, expansion of the protected area network, and farmland bird protection. Nature restoration projects for natural areas have been carried out since 1989, initially under the *Subsidy scheme for effect-oriented measures (Effectgerichte Maatregelen, EGM)* and in recent years under the *Quality initiative for nature and landscape (Kwaliteitsimpuls natuur en landschap, SKNL)* and the PAS.

The national government is responsible for setting policy with respect to biodiversity and ecosystems. Since 2007, the Dutch provinces are responsible for most landscape and biodiversity policies, including land acquisition for new nature reserves within the ecological network (Schrijver and Uetake, 2015[7]). The division of responsibilities are described in the *Agreement on decentralization of nature policy* of 2011 and the *Pact for Nature* of 2013. Since 2014, the transformation of the National Ecological Network (EHS) into the Netherlands Nature Network (*Natuurnetwerk Nederland*) is the responsibility of regional governments. Current plans are to improve the size and connectivity of natural areas and add 80 000 hectares to the Network by 2027.

In the *Pact for Nature*, the national and provincial governments have agreed to maintain ecological quality within the national ecological network through conservation management and to raise ecological quality by intensifying efforts for temporary or permanent restoration measures aimed at improving water quality and environmental conditions (EZ and provinces, 2013[35]). Many restoration measures are designed to remove nutrients and combat acidification and reduced groundwater levels. (CBS et al., 2021[30]).

To prevent the effects of eutrophication and acidification, policy focuses on reducing emissions of eutrophying and acidifying substances in the Netherlands and surrounding countries. In 2015 the government introduced the Integrated Approach to Nitrogen (PAS) with the aim of reducing nitrogen deposition, improving ecological quality in natural areas and at the same time permitting economic development. This system however did not meet the requirements of the Habitats Directive, and has since been amended (Box 3.5).

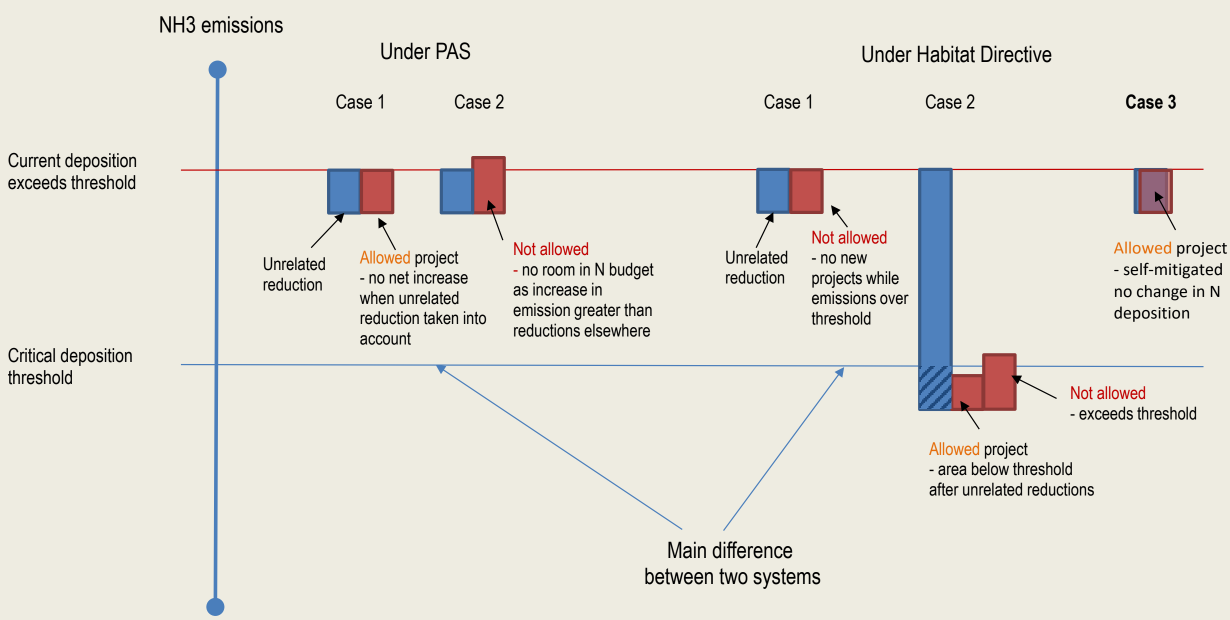
Box 3.5. The court ruling regarding the Habitats Directive and the PAS

In 2019 the Council of State ruled that the PAS system does not meet the requirements of the Habitats Directive to ensure that threatened or important ecosystems (Natura 2000 sites) achieve good environmental status. The PAS allows the new N emission permits when N emissions are forecasted to be reduced elsewhere, perhaps from unrelated activities (thereby "creating space" for new activities that emit nitrogen). In this way, new projects could perpetuate emissions at a level that exceeds critical deposition thresholds and thus prevent achieving good conservation status of relevant landscapes.

There are three problems with this:

- Emissions reductions were counted in PAS even when they are expected, not confirmed
- Unrelated emissions reductions could offset a new project's emissions
- A project with new emissions could be approved when the critical threshold is already exceeded.

Figure 3.9. Project approval under PAS versus rules of Habitats Directive



Note: Amber bars represent potential projects that increase emissions, blue bars are projects or other outcomes that reduce emissions.

Under the Habitats Directive, new projects must not pose a threat to sensitive landscapes. That means in practice that when the threshold is exceeded in an area, no project with net new emissions can be allowed. Indeed, it is necessary to reduce emissions below the critical threshold above which they can harm landscapes. A project can still be approved if it also includes mitigation actions that result in the project as a whole having no net emissions. That is, a project can self-mitigate but cannot benefit from unrelated N reductions, unless those reductions bring emissions below the critical threshold

Source: Adviescollege Stikstofproblematiek (2020[2]).

The BHD imposes obligations on the Member States with the aim of maintaining or restoring bird populations to sufficient levels and maintaining or restoring a favourable conservation status of habitat types and other species. The national ecological network is an important part of this. Most Natura 2000 sites are part of this network which is also essential for achieving the required favourable conservation status for the protected plant and animal species and habitat types listed in the Birds and Habitats Directives (CBS et al., 2021[33]).

Since 2014, the Netherlands uses an innovative cooperative-based approach to farmland bird conservation and commits significant funding to improving the conditions for birds on working farmland (Box 3.3). While this approach has been more effective than past measures, bird populations have done better in protected areas despite higher expenditures on conservation in farmland areas (Batáry et al., 2015[36]). Furthermore, birds show positive trends in protected areas but negative trends in agricultural areas (Figure 3.3). This suggests that, for some species, protected areas are more effective than agri-environmental schemes that make payments to farmers to improve conditions for biodiversity on their land.

Dutch policy for restoration of Natura 2000 sites has concentrated on emissions of eutrophying substances from agriculture, transport and industry. Among these, reducing ammonia emissions from agriculture are usually less costly than reducing NOx emissions from other sectors, and agriculture accounts for the largest share of deposition (40%) on Natura 2000 sites. However, the large amount of deposition originating from outside the country (30%) means that even if agricultural emissions were to be completely eliminated, some areas would still have deposition rates above critical thresholds. Restoration efforts are likely to be ineffective or even counterproductive while deposition exceeds critical thresholds. Tightening emission limits under the NEC Directive can help with cross-border NOx, but it is uncertain whether anticipated eventual international emission reductions will be sufficient to bring deposition below critical thresholds.

Nature Implementation Programme

The Nature Implementation Programme (*Uitvoeringsprogramma Natuur*) of 2021 aims to make natural areas more robust and resilient helping to meet the objectives of the BHD and promote general biodiversity recovery. The central government and the provinces, in co-operation with other organisations, form joint plans for nature restoration up to 2030. The Nature Programme is an integral part of the structural approach to nitrogen (described above). This programme allocates EUR 3 billion to restore and strengthen vulnerable nature areas. The programme includes measures for the restoration of natural areas as well as source reduction of pollutants with a negative impact on those areas.

The Nature Implementation Programme elaborates on the joint ambition document *Netherlands Nature Positive (Nederland Natuurpositief)*[11] and on the existing agreements between the provinces and the national government in the Nature Pact (2013). The programme targets an improved state of conservation through the coherent deployment of measures aimed at reducing nitrogen emissions, improving nature and increasing nature-inclusive acreage.

The programme unrolls in phases. The first phase started in 2021 and focuses on projects that can be implemented quickly while at the same time carrying out analysis and evaluation of approaches to support the second phase, which runs from 2023 to 2030. Measures funded under the programme are evaluated according to a set of criteria designed to elicit maximum cost-efficiency and timeliness (LNV, 2020[37]).

Provinces also set out their nature conservation objectives for the size and quality of nature types over a timeframe of five to ten years. Funding for these objectives is available under the 'quality initiative for nature and landscape' (*Kwaliteitsimpuls natuur en landschap* or *SKNL*) and the subsidy scheme for converting agricultural land to nature and improving the ecological quality of existing natural or semi-natural areas (*inrichtingssubsidie*) (CBS et al., 2021[38]).

3.4. Manure and nutrients

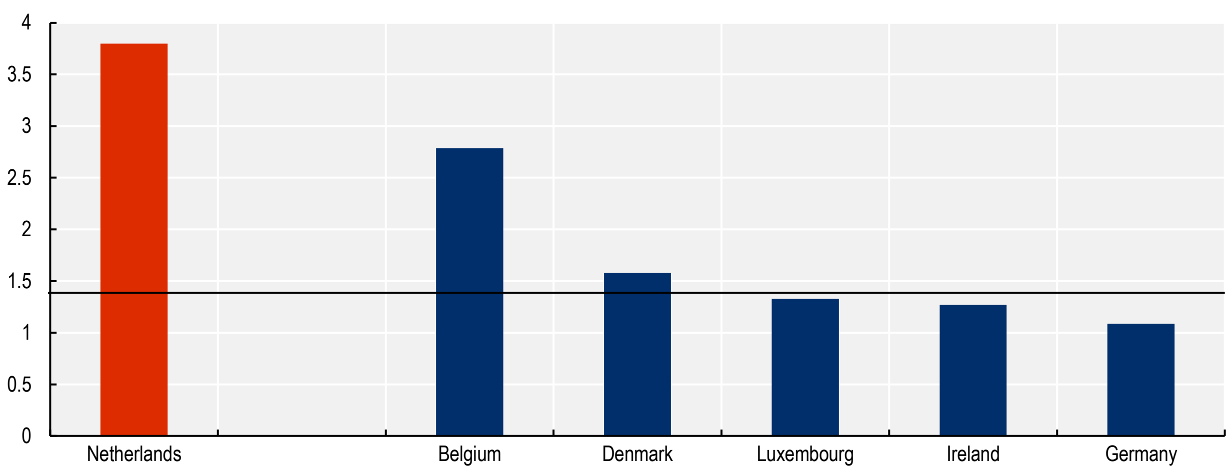
3.4.1. Assessment of status and trends

The Netherlands has the highest livestock density in the European Union in terms of animal units per hectare (Figure 3.10). At the NUTS2 region level, five of the ten highest density regions in Europe are located in the Netherlands.[12] With a total land area of 41 543 km^2 including water bodies, there were an average of 14 goats, 93 cattle, 298 pigs and 2 372 poultry and 414 persons per km^2 in 2018. Managing the resulting manure is perhaps the most important challenge facing policy makers. The Netherlands is one of four EU countries with a derogation from the requirements of the Nitrates Directive. The Directive normally restricts N application from livestock manure to a rate of 17 0kg/ha but this derogation allows Dutch farmers with grassland farms (>80% grassland) to apply up to 230 or 250 kg N/ha from manure, depending on soil type. For the period 2022-25 the Netherlands received a renewed derogation that gradually reduces the level N-application from livestock manure to the generic rate of 170 kg N/ha.

The nitrogen surplus reached a maximum in 1986 and has been trending downward since that time, though increases are seen after 2014 (Figure 3.11). In 2019, nitrogen use efficiency on cropland was 62%, an increase from 47% in the 1990s (CBS et al., 2021[39]). The application of inorganic fertilisers and manure production have been reduced considerably from peak levels.

Figure 3.10. The Netherlands has a high livestock density compared with its regional peers

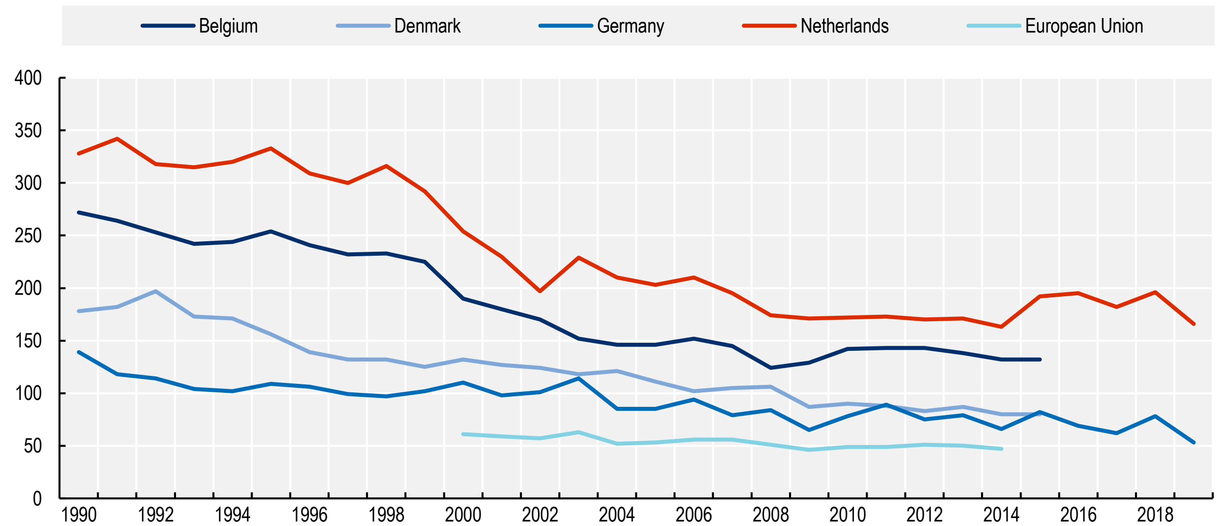
Livestock units per hectare UAA



Note: Horizontal bar indicates EU average.
Source: Eurostat (online data codes: ef_lsk_main, ef_lus_main).

Figure 3.11. Nitrogen surpluses stable after a period of decline

Kg N surplus per hectare 1990-2019



Source: OECD (2021) "Nitrogen Balance" OECD Agri-Environmental Indicators (database), https://stats-2.oecd.org/Index.aspx?DataSetCode=AEI_NUTRIENTS.

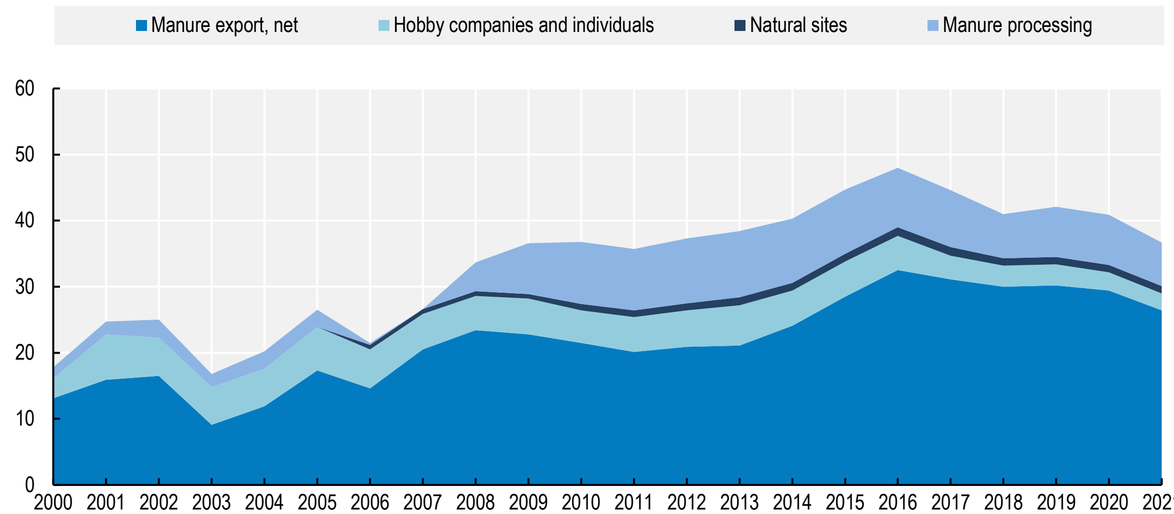
Around 80% of the feed requirement (measured in calories) for cattle production in the Netherlands comes from domestic sources, but only about 15% for pigs and 5% for chickens. Most feed grains (wheat and barley) for pig production are imported from Germany, France, and Belgium, with about 10% supplied domestically (mainly wheat). Soy is mainly imported from North and South America (CBS et al., 2022[40]).

The nutrients in imported feed not retained in the animal or lost to the atmosphere will remain in the manure. Excess nutrients above the carrying capacity of Dutch farmland must be disposed of by other means. About 18 million kg of phosphate in pig manure is exported to Germany, France, and Belgium, each year, 35-45% of the manure produced. Some of this manure is also sold in retail garden markets or applied to natural areas (Figure 3.12).

The load of nutrients from agriculture on surface waters is monitored by the Nutrient Monitoring Network for Agricultural Specific Surface Waters (MNLSO). The results of the MNLSO show that the water quality in agriculture-specific waters is improving, but that in the period from 2014 to 2017 approximately 40-60% of the measuring locations did not yet comply with the water authority standard for total N or total P. This suggests that current agricultural practice of fertilisation according to agricultural advice and economically optimal crop choices is not sufficient to achieve WFD targets for water quality (Berkhout et al., 2019[41]).

Figure 3.12. Most surplus phosphate in manure is exported

Million kg P_2O_5



Note: Only a small amount of manure from cattle is exported. On a phosphorus basis, exports are about equally divided between pig and poultry sources.
Source: CBS, PBL, RIVM, WUR (2022). Manure disposal outside agriculture, 2000-2020 (indicator 0403, version 21, 9 March 2022), www.clo.nl. Central Bureau of Statistics (CBS), The Hague; PBL Netherlands Environmental Assessment Agency, The Hague; RIVM National Institute for Public Health and the Environment, Bilthoven; and Wageningen University and Research, Wageningen.

3.4.2. Policies and regulations

There are four major policy thresholds to be achieved with respect to manure and nutrient use. These are:

- Ammonia (NH_3) emissions should remain below the level that would lead to N deposition above critical thresholds (overall target of -50% by 2030).
- Nitrate (N_3^-) emissions should remain below the level that would lead to degradation of surface and groundwater quality (WFD directive targets, 50 mg/l).
- N and P application within the Good Agricultural Practice, and N from livestock manure should remain below the limit set in Nitrates Directive (170, 230 or 250 kg N/ha, total N and P manure-production below 2002 quantities).
- Methane (CH_4) emissions should be below GHG targets (total GHG emissions of sector to be reduced by 49% by 2030).

All of these thresholds are closely related to livestock production, specific animal husbandry or other farming practices. Success requires meeting all four of these thresholds sustainably over time. Effective policy packages for manure and nutrients would ideally take a holistic view of how to jointly meet these thresholds. In principle, one threshold will be binding with respect to livestock numbers and the others met either as a consequence of that binding limit or with some additional management changes.

These thresholds have a strong local element, except for total N and P application limits and GHG emissions. Therefore, which threshold binds on animal numbers and the degree of adjustment required to meet thresholds will likely differ by region. To what extent local factors are taken into account will depend on local capacity to measure and monitor effects, and the point at which increasing administrative and transactions costs outweigh the benefits of a more precise local optimisation.

The Netherlands has an extensive policy on the use of fertilisers. The Nitrate Action Plan requires farms to develop and follow nutrient management plans. Other requirements of the plan include restricting fertiliser use to the growing season (1 February – 15 September), animal manure must be spread on fields using low-emission application techniques and cover and catch crops are promoted (National Administration, 2021[8]) and in some cases required.

Current polices to reduce the number of livestock operations create significant policy uncertainty. The Council for the Environment and Infrastructure suggests that one way to give future prospects to farmers who wish to operate sustainably is to clarify the sustainability criteria for farms on the basis of measurable and enforced standards that are sufficient to meet targets (RLI, 2021[42]). This would reduce policy uncertainty faced by farmers, which is an important component of perceived risk.

The Environment and Planning Act will come into effect in 2022, as a result of which municipalities will have to deal with new procedures, requirements and work processes when assessing applications from livestock farmers to withdraw or change their environmental permit and to change the destination of their production location.

The EU Nitrates Directive aims to reduce water pollution caused or induced by nitrates from agricultural sources and to prevent further such pollution.[13] The Netherlands has designated the entire territory as a vulnerable zone and implemented the Nitrates Directive through:

- The Fertilizers Act, its Implementing Decree (*Uitvoeringsbesluit Meststoffenwet*, Ubm) and its Implementing Regulations (*Uitvoeringsregeling Meststoffenwet*, Urm). This covers, among other things, ceilings for the production of animal manure, animal and phosphate rights and application standards for fertilisers.
- The Activities Decree (*Activiteitenbesluit*, Ab) based on the Environmental Management Act and the Water Act, which includes cultivation and manure-free zones, among other things.
- The Decree on the Use of Fertilizers (*Besluit gebruik meststoffen*, Bgm) based on the Soil Protection Act, which provides regulations for the use of manure, including when manure may not be spread and how manure must be used to reduce ammonia emissions into the air.
- The Nitrate Action Plans, the 7th of which covers 2022-25.

7th Nitrate Action Plan

The measures in the action plan also contribute to the objectives of the Water Framework Directive (WFD) insofar as agricultural practice is responsible for emissions of nitrogen and phosphorus to ground and surface waters (including coastal and transitional waters) that affect WFD targets. The 7th Action Plan sharpens the focus on problem areas and problem crops with regard to nutrient leaching. The action programme is built on five pillars and contains a mix of mandatory and supporting measures that are either nationally applicable or area-specific. These pillars are:

- *Sustainable construction plans* to improve water quality and soil quality, for both livestock and arable farms. The focus is on a clear transition from a growth path to sustainable path. The transition is facilitated with support from the Common Agricultural Policy and the Delta Plan for Agrarian Water Management.
- An *area-specific approach* in areas where the water quality of groundwater or surface water is less than good. The basic principle is that the entrepreneur takes the initiative and responsibility for the immediate vicinity of their operation.
- *Other regulatory measures* as needed to achieve the necessary improvement in water quality. This includes wider integrated buffer strips and an update of the nitrogen application standards and measures that broaden the options for applying manure and organic matter-rich fertilisers.
- *Knowledge, communication and pilots*. Knowledge development emphasises on manure policy as a means of achieving good water quality.

- *Control and enforcement*. The Reinforced Enforcement Strategy will be pursued in co-operation with local authorities. A process with the sector will be undertaken to gain more insight into the use of artificial fertilisers, with tighter enforcement for misapplication of fertilisers (LNV, 2021[43]).

In addition to these five pillars, the existing regulations from the 6th Action Plan will be continued.[14]

Programmes to terminate livestock activities

The Livestock Operation Purchase Scheme (*Maatregel Gerichte Opkoop*, MGO) was established in 2020 with a budget of EUR 483 million and targets livestock farms that cause a deposition of at least 2 mol N/ha/year on average on nitrogen-sensitive hectares on which the critical deposition value is exceeded, located within a distance of 10 km. According to the RIVM, there are more than 800 livestock farms that can be classified as peak loaders under these conditions. Together, these companies emit approximately 5 kilotons of ammonia. This is approximately 4% of the total ammonia emissions in the Netherlands (Kamerstuk 35334 no. 170).

To implement this programme, the central government provides funds to the provinces that can be used to purchase livestock farms based on their market value. These purchases are also subject to cost-effectiveness ceilings for reducing nitrogen deposition. In the second and third tranche of the MGO, provinces will buy out those peak loaders in a targeted way to create space for housing and MIRT trajectories and legalising activities, in addition to nature conservation, restoration and improvement.

In addition to the MGO which is focused on reducing deposition in sensitive areas, the National Termination Scheme for Livestock Farm Locations (*Landelijke beëindigingsregeling veehouderij*, LBV) is designed to achieve maximum nitrogen reduction. Both schemes complement each other. LBV is a voluntary subsidy scheme for livestock farmers who want to discontinue their business or a location of their business. Eligible farmers keep animals requiring production rights; dairy cattle, pigs or poultry and whose nitrogen emissions exceed a threshold value. The programme budget is EUR 970 million. If the full subsidy amount is used, a nitrogen reduction of 16 to 35 mol is expected.[15] The LBV focuses on reducing nitrogen precipitation as efficiently as possible and applications are ranked according to cost-effectiveness.

Uptake of these programmes by farmers has been less than anticipated, and the parameters of the schemes. A version of LBV, called LBV+ will be available for a limited time to farmers with high ammonia emissions near sensitive areas. LBV+ provides a higher payment and is designed in part to increase early uptake and achieve significant progress in reducing ammonia emissions in 2023. This concept of higher payments available for a limited duration was proposed in the Remkes report, with the additional incentive that measures would be increasingly mandatory in nature over time and if objectives were not met through voluntary measures (Remkes, 2022[5]).

An important question is what happens to the land once a livestock operation is terminated. A pilot project has allocated EUR 100 million for purchasing land from participants in the LBV. This is intended to help address challenges in rural areas. For example, purchased land can be used to enhance nature or to extensify agricultural land. The land fund will come into effect as soon as the first tranche of the LBV goes into operation.

The Subsidy Scheme for the Remediation of Pig Farms (*Subsidieregeling sanering varkenshouderijen*, Srv) programme provides a subsidy for the irreversible closure of a pig farming location if the odour from the location is above a certain level and it is located within an area with a high concentration of farms. The programme payment compensates for the value of the production rights (100%) and the value of the loss of production capacity as result of the closure of the location (65%). The budget for the programme is EUR 450 million, but some of this has been transferred to the MGO due to low uptake.

On-farm improvements to reduce ammonia emissions

In addition to the purchase scheme, a number of technical adaptations are to be put in place as part of the overall plan for ammonia emissions reductions. The most important of these are:

- The crude protein content in the dairy feed ration is to be gradually reduced at sector level to a maximum of 160 gr RE/kg ds in 2025. This should reduce ammonia emission by 3.5 kilotons per year in 2025.
- Increase in the average number of grazing hours by 180, calculated for all dairy cows in the Netherlands (grazing and non-grazing), compared with 2018. This will be done in steps, with an increase of 90 extra hours by 2022 and 180 hours from 2023. This should reduce ammonia emissions by 0.7 kilotons per year.
- By 2025, half of the manure that is applied to sandy soil with a sod injector in grassland should be diluted in a 2:1 ratio (2 parts manure to 1 part water). This should reduce ammonia emissions by 0.4 to 1 kiloton per year.

3.5. Climate change

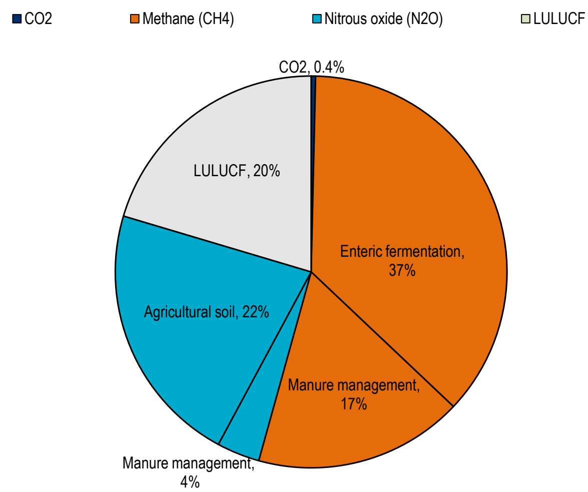
3.5.1. Assessment of status and trends

In 2021, agriculture contributed 16.1% of the national GHG emissions in comparison with 14.9% in 1990.[16] However, this sector is a major contributor to both national total Methane (CH_4) and Nitrous Oxide (N_2O) emissions. In 2019 agriculture accounts for 76% of the total CH_4 emissions and for 73% of the total N_2O emissions. The main source of agricultural GHG emissions is enteric fermentation, followed by manure management and agricultural soils (Figure 3.13). A trivial amount comes from liming of soils to adjust acidity.

Since 1990, the agricultural and horticultural sector has reduced greenhouse gas emissions by roughly 17%. However, GHG emissions from agriculture have stabilised in the last ten years. GHG emissions intensity as a share of value of production has improved and this is expected to continue with the application of new technologies and growth in total output. However, the reduction in intensity has slowed down from -2.54% per year in 1991-2000 to -0.65% in 2011-19 (Chapter 1). The Netherlands has the highest GHG emissions (CH_4 and N_2O) per hectare of agricultural area in the European Union, more than four times the EU-27 average. This reflects the intensive nature of Dutch agriculture (EC, 2020[44]). Horticultural production processes in greenhouses account for more than 10% of total natural gas consumption in the Netherlands, but the related CO_2 emissions are not included in reporting for agriculture.[17] Progress in agricultural GHG emissions reductions is nevertheless in line with OECD and EU averages, if less than that in Belgium and Denmark (Figure 3.14). Nitrous oxide emissions have shown the greatest reduction, with methane reductions relatively flat. The sector will need to draw on many different mitigation measures such as carbon capture in soils, forests and materials, production of biomass and generation of renewable energy to reach its emissions reductions objectives (Government of the Netherlands, 2019[45]).

Figure 3.13. Methane from enteric fermentation or manure management is the largest source of agricultural GHGs

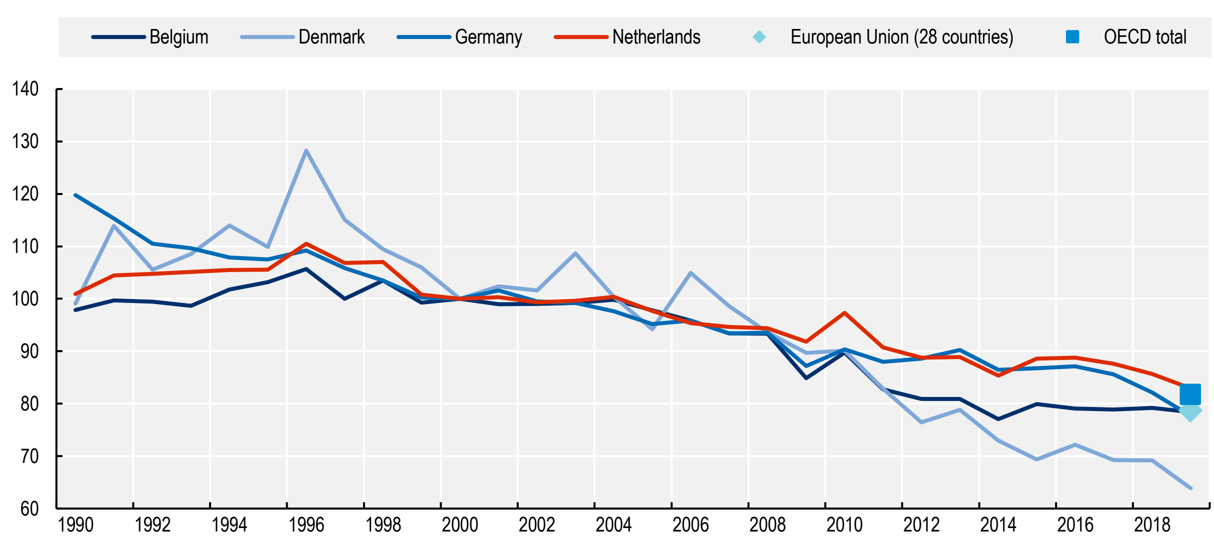
Total greenhouse gas emissions by source, 2019



Note: CO_2 emissions from liming of soils and application of urea are too small to see clearly on this chart.
Source: OECD AEI Database.

Figure 3.14. Agricultural GHG emissions have declined by 17% since 1990

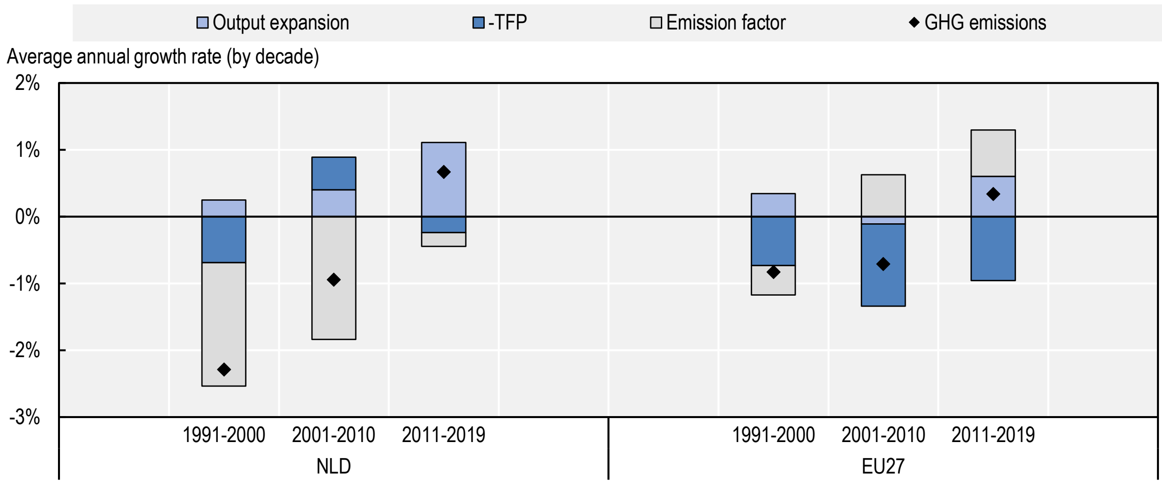
Agricultural GHG emissions, 1990-2019, CO_2eq, index year 2000=100



Note: For clarity, only last year values for EU-28 and OECD average are shown. Excludes emissions from LULUCF.
Source: OECD AEI Database.

The main contributor to the reduction of emissions has been the improvement in the emission intensity of production factors, which has been more pronounced than in EU27 (Figure 3.15). That is, production technology has shifted towards less emitting inputs. In the most recent decade, expanding output was not counteracted by the effects of improved productivity and emission factor, resulting in higher GHG emissions.

Figure 3.15. Evolution of changes in GHG emission intensity in the Netherlands, EU and OECD (1991-2019)



Source: Authors calculations based on USDA ERS (2021), International Agricultural Productivity database.

Emissions from enteric fermentation, and to a lesser extent manure management are driven by livestock numbers. CH_4 emissions from enteric fermentation decreased from 9.2 Mton CO_2eq. to 8.1 Mton (-12%) between 1990 and 2019, which is almost entirely explained by the decrease in CH_4 emissions from cattle. Cattle accounted for the majority (89%) of CH_4 emissions from enteric fermentation in 2019 (RIVM, 2021[46]).

The majority of emissions from manure management is CH_4, mainly related to cattle and swine. Emissions from swine manure have been declining steadily, while emissions from cattle manure have been increasing since the mid-2000s. With an increasing percentage of cattle kept indoors, a larger proportion of the manure is excreted inside animal housing facilities. This has a higher emission factor than excretion on pasture.

Inorganic fertilisers are the main source of emissions from agricultural soils, and these emissions have been steady over the last decade. Emissions from organic nitrogen have been increasing in recent years, but emissions from urea and manure from grazing are lower.

Net emissions from land use, land-use change and forestry (LULUCF) including sources and sinks was 4.5 Mt CO_2eq in 2019. Land use in the Netherlands is dominated by agriculture (approximately 55%), followed by settlements (15%) and forestry (9%); 3% comprises dunes, nature reserves, wildlife areas, heather and reed swamp. The remaining area (18%) is open water. Since 1990, agricultural land area has decreased by about 5%, mainly because of conversion to urban or natural functions. Organic soils (peat) have received increasing attention Because emissions of CO_2 from the decrease in carbon stored in peat soils were the major source in the LULUCF sector and total 5.5 Mt CO_2 in 2017 (7.6 Mt CO_2 in 1990). This peat oxidation is due to agricultural and water management. The major sink is the storage of carbon in forests, which was -1.8 Mt CO_2 including forest land and land converted to forest land.

3.5.2. Reducing GHG emissions

The Dutch Government targets GHG emissions reductions of 49% by 2030, compared to 1990 levels, and a 95% reduction by 2050. These goals are set out in the Climate Act of 28 May 2019. The Climate Plan,[18] the National Energy and Climate Plan (NECP) and the National Climate Agreement contain the policy and measures to achieve these climate goals. The Climate Act provides a framework for the development of policies on greenhouse gas emission reductions. The national government plans to allocate

EUR 970 million between 2020 and 2030 to realise the 6 Mt ambition, of which EUR 330 million will come from the Climate Budget. (Government of the Netherlands, 2019[45]).

The National Climate Agreement, which was concluded in June 2019, specifies what the agricultural sector will do to help achieve the climate goals. Targets are set for different sub-sectors: livestock farming, greenhouse horticulture, peatlands, agricultural soils and forests and nature areas. To increase the sense of ownership, the execution of the agreed measures is assigned to working groups for each sub-sector, consisting of representatives of the sub-sectors and LNV (National Administration, 2021[8]). For the agriculture and land use sector as a whole, the emissions reduction target has been set at -3.5 MtCO_2-eq by 2030, on top of existing policy which called for -1 MtCO_2-eq in methane emissions and -1 MtCO_2-eq from reduced energy demand in greenhouses. Land use does not count towards the 49% reduction target in the Climate Agreement, but actions in land use change and forestry (LUCF) are expected to reduce GHG emissions by 1.5 Mt by 2030.

The current efforts to reduce ammonia emissions below critical thresholds for nature restoration is expected to also help reduce GHG emissions by as much as 5 Mt CO_2-eq, easing somewhat the path to emissions reductions to 2030 and beyond. That is, the investment subsidy for low-emission animal housing and corresponding tightening of standards, along with the national cessation scheme for livestock farms (see section on manure and nutrients) will be major contributors to the reduction targets for agriculture. There are other potential synergies between climate policy and other environmental objectives. Reducing emissions from peatlands are also likely to improve biodiversity values on those landscapes, for example. Actions that have multiple benefits can be more cost-effective, a point for consideration when designing and evaluating policy choices. Many of the investment policies mentioned in the section on Sustainable production, below, are relevant for GHG emissions reductions with some being adapted to focus more on climate.

The national climate agreement contains a goal of emissions reductions of 1 Mt CO_2eq from peatlands. The Peatland programme brings together national and regional governments as well as nature and agricultural organisations. The initial phase of the programme is focused on research, pilots, monitoring, awareness, area-oriented planning and specific measures for regions with opportunities for higher ground water levels.

The Stimulation of Sustainable Energy Production and Climate Transition (*Stimulering Duurzame Energieproductie en Klimaattransitie*, SDE++) scheme focuses on the large-scale roll-out of technologies for renewable energy production and other technologies that reduce carbon dioxide (CO_2) emissions. For agriculture, this includes production and combustion of bioenergy, such as from manure. The SDE++ is an operating subsidy that makes payments during the operating period of the project. An SDE++ subsidy compensates for the difference between the cost price of the sustainable energy or the reduction in CO_2 emissions and the revenue (if any) (RVO, 2021[47]).

The *Integrated approach methane and ammon*ia is a research programme, with its accompanying network of companies, helps to identify and evaluate the effectiveness of measures to reduce emissions of methane and ammonia. Differences in effectiveness between different soil types is taken into consideration. Measures which have proven to be effective will be implemented on a larger scale. The main challenge is that the majority of livestock farmers is not aware of the methane emissions of their farms and that measures to reduce methane emission are relatively costly (National Administration, 2021[8]).

The Netherlands is part of the Global Research Alliance (GRA) on agricultural GHG emissions, which provides an international framework for voluntary action to increase co-operation and investment in research activities to help reduce the emissions intensity of agricultural production systems. Members of the GRA aim to deepen and broaden mitigation research efforts and to co-ordinate cross-cutting activities, including promoting synergies between adaptation and mitigation efforts. Research Groups address these areas of work, through work plans that bring countries and partners together in research collaborations, knowledge sharing, use of best practices, and capacity building among scientists and other practitioners.

The Dutch contribution to the GRA is co-ordinated by the Ministry of Economic Affairs which links these contributions to other actions concerning food security, sustainability and climate change. Given that Dutch farmers work with limited space and expensive resources, the Netherlands has developed experience in "sustainable intensification" in agriculture and food chains. The framework of the GRA enables the sharing of this experience and offers an opportunity to learn from others.

3.6. Water

3.6.1. Assessment of status and trends

About one-third of the Dutch land area lies below sea level. This unique geographical delta location is particularly vulnerable to ocean and weather. The Dutch relationship with its coastline and catastrophic storm surges in the past has led the Netherlands to develop one of the world's most sophisticated water management systems. Climate change will likely put these systems under pressure with rising sea levels and a higher frequency of extreme weather events.[19] Subsequently, rising sea levels and intruding ocean water could also lead to an increasing salinisation of ground water which not only endangers drinking water supply and industrial production but sets new challenges to the agricultural sector as well. Agriculture will need to become more resilient to longer droughts during the summer months, and adapt to flooding rivers during the remaining seasons. (Baptist et al., 2019[48])

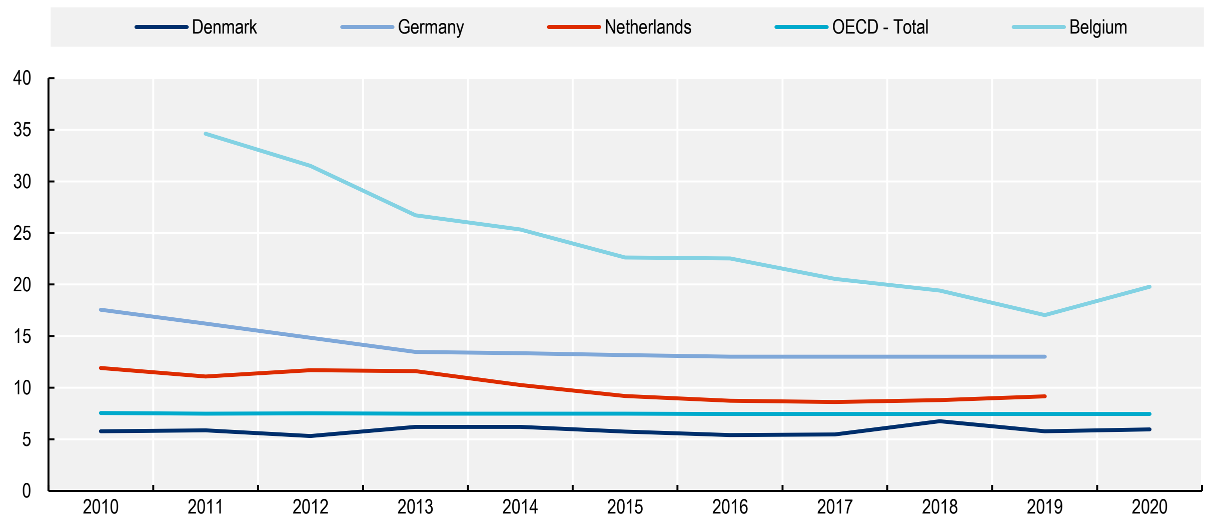
While all groundwater bodies are in good quantitative status, 13% of groundwater bodies do not have good chemical status. The situation is worse for surface waters where all surface water bodies were in less than good ecological status and 52% of surface waters do not have good chemical status. Diffuse pollution from agriculture is the most significant pressure on surface waters and second most significant pressure on groundwater. The average nitrogen surplus in the Netherlands, at 200 kg N per hectare per year, is four times the EU average (EC, 2020[44]). The chemical quality in most water bodies is insufficient and the ecological quality ranges from moderate to poor (CBS et al., 2021[49]). Water quality objectives are set at the EU level with respect to both drinking water quality and the status of water bodies.

In many areas the water table has been lowered for agricultural and residential land uses or is drawn down by drinking water abstraction, which can lead to lower groundwater levels in natural areas as well, resulting in desiccation. Reduced groundwater levels in the spring is a major reason for the loss of rare species in ecosystems, and impairs the water-buffering capacity of land to store and slow excess rainfall.

Gross abstractions of freshwater taken from ground or surface waters is about 12% of total available renewable freshwater resources. Water stress in the Netherlands is above the OECD average, but low in absolute terms (Figure 3.16). While average water stress has been improving in the Netherlands, climate change is expected to increase risk of drought and may become a driver of increased water stress in the future.

Figure 3.16. Water stress in the Netherlands is low but above OECD average

Freshwater abstraction as % of renewable supply



Note: Missing values for Germany interpolated.
Source: OECD Environment Database – Freshwater abstractions (million m3).

3.6.2. Policies and regulations

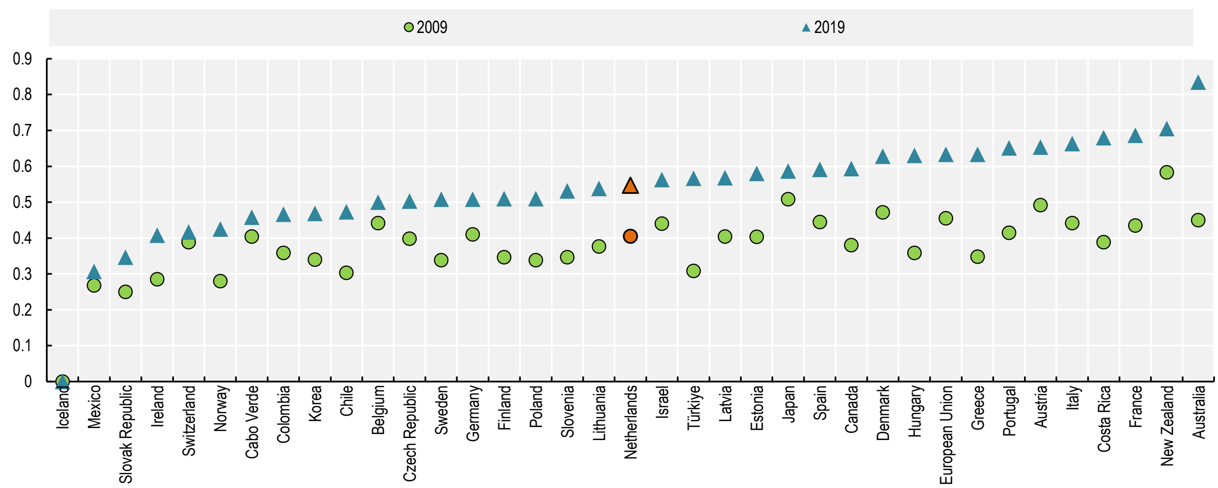
The load of nutrients and plant protection products on surface water in the Netherlands has improved in recent years, but this improvement has not been enough to achieve the goals of the WFD and policies will have to be strengthened if WFD goals are to be achieved. Level-controlled drainage, buffer strips, catch crops and soil improvement, improved manure management and integrated pest management are all measures that could potentially improve the situation (ten Brinke et al., 2021[50]).

The effects of policies on water bodies will manifest only after a certain period of time. The age of groundwater at different depths and in different soil types can vary significantly, as can the amount of time for nutrient-rich water to enter surface waters. Increased frequency of severe drought or excessive rainfall can also affect N concentration and the rate of transport of nutrients into in the water system. The effects of excess nutrients are difficult to reverse in the near term. This is also true for persistent chemicals, which may affect water quality for decades.

Water policies in the Netherlands are only partially aligned with the OECD Council Recommendation on water (Figure 3.17). The most progress in water policy has been with respect to the recommendations of Chapter 3 on water quantity, and policies in this area are most aligned with the recommendation (Gruère, Shigemitsu and Crawford, 2020[51]).

Figure 3.17. Water policies are increasingly aligned with OECD recommendations, more progress possible

Average alignment of agriculture and water policies with the Council Recommendation on Water by country, 2009 and 2019



Note: Average indices have been adjusted to cope with the heterogeneity in response rates for each chapter. Chapter 8 indices of alignments were adjusted to account for text caveats, but they remain imperfect and should be subject to cautious interpretation. The EU score is based on partial data as policies are primarily defined at member state level.
Source: Gruère, Shigemitsu and Crawford (2020[51]), "Agriculture and water policy changes: Stocktaking and alignment with OECD and G20 recommendations", http://dx.doi.org/10.1787/f35e64af-en.

Water Management and the National Water Program 2022-2027

Responsibility for water management in the Netherlands lies with the executive branch of the Ministry of Infrastructure and Water Management (*Rijkswaterstaat, RWS*) and the regional water management boards. Their duties are:

- RWS is responsible for the management of the major waters, such as the sea and the rivers. It ensures that the government authorities responsible are alerted in good time to floods or stormy seas. In addition to maintaining dykes, dams, weirs, and storm surge barriers, RWS protects the coast and river navigation, for example, by deepening floodplains and constructing secondary channels.
- District water boards are responsible for regional waters, such as canals and polder waterways. They ensure that the water quality does not harm fish stocks. The district water boards also protect the country from flooding and ensure that farmers have sufficient water for their crops. Furthermore, they are responsible for wastewater purification.[20]

The National Water Program 2022-2027 (NWP) was adopted on 18 March 2022. The NWP describes the main features of national water policy and its implementation in national waters and waterways. The NWP has three main components: river basin management plans (RBMPs), Flood risk management plans (FRMPs) and the North Sea programme, which all take the form of annexes to the NWP. Of these three elements, the RBMPs are most relevant to agriculture, which is an important non-point source of nutrient and chemical pollution.

Under the EU Water Framework Directive (WFD), RBMPs are produced every six years, the latest covering 2022-27. They RMBPs identify increasing concentrations of nitrates from agricultural sources as a cause for concern amid otherwise generally improving water quality status and anticipate continued improvements in status as the effects implemented programmes are felt over time. The current RBMPs aim to put in place by 2027 a final set of measures sufficient to restore water bodies to good status as per the WFD, but these measures are expected to need some extra time beyond 2027 to fully meet their objectives (Ministerie van Infrastructuur en Waterstaat, 2022[52]). As a rule, measures are often part of projects that serve multiple purposes and are often jointly financed.

Regarding plant protection products, RBMPs are aligned with the 2030 Vision for Crop Protection. The Environmental Management Activities Decree contains rules for farmers to reduce surface water pollution. In addition, there are non-statutory emission reduction plans that are drawn up and implemented by the sector if measurements show that water quality requirements for pesticides are exceeded.

The EU Floods Directive requires that Member States produce flood risk management plans (FRMPs) every six years, following an approach similar to the WFD. FRMPs evaluate flood risks, identify areas most at risk, map the consequences of flooding in at-risk areas and define goals and measures to manage flood risks in the designated areas. The 2016-21 FRMP set out seven objectives and 17 measures, almost all of which have been implemented. Nevertheless, flood risk management is a continuing process; many goals require ongoing attention and many measures have a cyclical character (Ministerie van Infrastructuur en Waterstaat, 2022[53]).

Partnership programmes for water quality

In 2013 the Dutch agricultural and horticultural organisation (LTO Nederland) and the Dutch regional water authorities began a collaboration to reduce emissions from farms to water: the Delta plan for agricultural water management (*Deltaplan Agrarisch Waterbeheer*–DAW). In addition to the water boards, the provinces and drinking water companies have joined this initiative over the years, as well as the Ministry of Infrastructure and Water Management (*IenW)*, and the LNV. The ambitions of the Delta plan were to:

- Solve 80% of the remaining water quality problems in a motivating and stimulating manner by 2021 and 100% by 2027.
- Use water sparingly at company level, conserve water at area level and use smarter distribution and buffering at national level to make the agricultural water supply sustainable by 2021.
- Increase the agricultural production potential at regional level by 2% per year through area processes, new spatial instruments and innovative techniques (Ministerie van Infrastructuur en Waterstaat, 2022[52]).

Since 2014, the number of farmers participating has grown to 15 000 taking part in nearly 500 projects across the country. The Delta programme focuses on impacts of increased rainfall, droughts, sea level rise and heat. To address these risks, the programme targets restoration of the water-retention capacity of natural areas and agricultural land, improved agricultural practices such as grassland management to enhance carbon sequestration and appropriate use of lowland peatland/wetland and the of risk salinisation of delta areas due to sea level rise, to be addressed through the development or enlargement of fresh water lenses (EC, 2020[44]).

IenW and LNV jointly operate the Programmatic Approach Large Waters (Programmatische Aanpak Grote Wateren, PAGW) investment programme. The aim of this programme is to improve water quality and nature in large water bodies by expanding and connecting them as well as improving their habitat values. Projects under the PAGW are carried out with companies, social organisations and other government levels. A national programme team supports partners in preparation, planning and implementation of projects. PAGW supports targets for ecological water quality and nature in large waters stemming from the WFD and BHDs. The measures are intended to provide space for natural processes and flows of water, sand and silt where former hydraulic works impede them (Rijkswaterstaat, 2017[54]).

3.7. Conclusions

Putting the agricultural sector on a sustainable footing has become an urgent task since the 2019 Court of Auditors ruling with respect to the PAS and the BHD. While the ammonia crisis is a strong impetus for action, the sector has many longstanding sustainability issues that require attention. These too will become more urgent over time, due to international commitments such as with respect to the EU Green Deal, GHG emissions and the WFD, and also because environmental problems such as declining farmland biodiversity are becoming more serious and costly to reverse.

Past progress in reducing emissions from agriculture and putting production on a more sustainable footing has slowed in the last decade. While environmental programmes and regulations have been continually strengthened, the pace of improvement has been insufficient to fully address environmental problems. The result is a stagnating situation with respect to environmental quality. The pressure on Dutch ecosystems increased after EU dairy quotas were eliminated in 2015 and the size of the dairy herd subsequently increased considerably. In fact, the agriculture sector was allowed to grow beyond the carrying-capacity of the environment, which precipitated the current situation with excessive ammonia emission that now must be reduced at great cost. EUR 24.3 billion has been allocated for a transition fund for the sector by 2030, in addition to EUR 5 billion already in place for emissions reductions measures (mainly restructuring through buy-outs). Current objectives are to reduce nitrogen deposition on 74% of sensitive habitats in Natura 2000 areas below critical thresholds by 2030.

Current problems have their root in past policy assumptions that it was possible to have continued agricultural development along with environmental improvement driven by higher productivity and nutrient efficiency. Long-term strategic planning was either absent or failed to identify the risks of continued missed objectives with respect to nutrient emissions and water quality.

This model is changing, and 2018 saw the introduction of the Circular Agriculture Vision which set out long term objectives of a sector more in balance with nature. While the Vision provides guidance regarding the future shape of the sector, it is not specific enough to inform strategic planning processes. A more elaborated vision combined with a more strategic approach to sector development that takes into account environmental limits can help ensure that undesirable consequences are avoided and objectives are met.

The CSP (described in Chapter 1) shows potential to increase the effectiveness of policies aimed at improving the environmental performance of agriculture. The multi-dimensional eco-scheme, where farmers gain higher payments for taking on more and more challenging actions on farm, can help improve the quality of implementation by giving producers incentives to choose more effective actions. AES in Pillar 2 extends the application of objective-based and community-based approaches to include climate and water issues.

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Notes

[1] See https://www.government.nl/ministries/ministry-of-agriculture-nature-and-food-quality/vision-anf.

[2] Enacted 1 July 2021.

[3] In 2022 the government agreed to bring forward the 74% objective to 2030 from 2035. The prior goal was 50% by 2030.

[4] These were laid out in a series of three letters to parliament (*Kamerbrief*) released simultaneously on 25 November 2022.

[5] The future of this programme is uncertain as a letter to Parliament mentions it may be eliminated and funding transferred to other programmes. See the Kamerbrief LGS / 22558512 of 22/11/2022 on the Porthos ruling.

[6] In a recent development, it has been proposed to cancel the NCB and redirect the allocated funds elsewhere.

[7] See https://zoek.officielebekendmakingen.nl/stcrt-2017-169.html.

[8] See https://www.rvo.nl/subsidies-financiering/mia-vamil/milieulijst/wijzigingen-milieulijst.

[9] See https://www.maatlatduurzameveehouderij.nl/over-mdv/.

[10] See https://www.agro-forestry.nl/.

[11] The Netherlands Nature Positive document was presented at the 2019 Nature Summit. https://www.rijksoverheid.nl/actueel/nieuws/2019/10/02/nederland-natuurpositief.

[12] Eurostat (online data code: ef_lsk_main for LSU, ef_m_farmleg for UAA total).

[13] See https://www.eea.europa.eu/archived/archived-content-water-topic/water-pollution/prevention-strategies/nitrate-directive.

[14] See 7th Action Plan at this link: https://www.rijksoverheid.nl/documenten/publicaties/2021/11/26/7e-nederlandse-actieprogramma-betreffende-de-nitraatrichtlijn 6th action plan at this link: https://www.tweedekamer.nl/kamerstukken/detail?id=2017Z18918&did=2017D38906

[15] A mol is a measure of nitrogen deposition. 500 mol represents deposition of approximately 7 kg N/ha/year. The national average nitrogen deposition is about 1 500 mol.

[16] Comprehensive data on GHG emissions in the Netherlands available here: https://www.emissieregistratie.nl/data/overzichtstabellen-lucht/broeikasgassen.

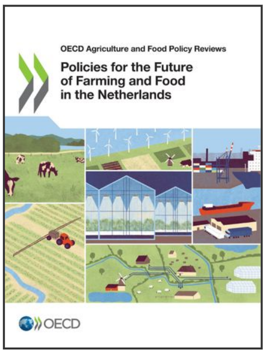
[17] Horticulture producers use natural gas to generate electricity, using co-produced waste heat and CO_2 to heat and enrich greenhouses.

[18] The draft climate policy programme produced in June 2021 proposes to raise the target to a 55% reduction in 2030 and to reduce the net greenhouse gas emissions to zero in 2050. This also contained a

revised estimate of the reduction of emissions from peatland to 0.7 MtCO2-eq from the current anticipated 1 Mt.

[19] See https://www.knmi.nl/klimaat.

[20] See https://www.government.nl/topics/water-management/water-management-in-the-netherlands.



From:

Policies for the Future of Farming and Food in the Netherlands

Access the complete publication at:

https://doi.org/10.1787/bb16dea4-en

Please cite this chapter as:

OECD (2023), “Environmental sustainability”, in *Policies for the Future of Farming and Food in the Netherlands*, OECD Publishing, Paris.

DOI: https://doi.org/10.1787/f2bd7c31-en