Chapter 13

# Environment and Agriculture

# Environment and Agriculture

## 1. Introduction

### Agriculture in Ireland

**The agri-food sector is Ireland's oldest indigenous industry and continues to play a vital role in Ireland's economy, as well as shaping its landscape and environment.**

Food produced by Ireland's farmers, fishermen and agri-food companies is exported to over 180 countries worldwide. In 2019, agri-food exports were worth €14.5 billion (Bord Bia, 2020), almost 10 per cent of total exports, and accounted for 173,000 jobs, representing 7.7 per cent of total employment (DAFM, 2019a), demonstrating the importance of the sector to the Irish economy. In 2015, the Department of Agriculture, Food and the Marine (DAFM) published a 10-year strategy for the agri-food industry, Food Wise 2025 (DAFM, 2015a), identifying the opportunities and challenges faced by the sector. The strategy outlines ambitious growth targets for the industry, including an 85 per cent increase in exports to €19 billion and the creation of 23,000 additional jobs along the supply chain, from production to high-end value-added product development. These targets are set against a 3-year (2012-2014 inclusive) baseline. A guiding principle of the strategy is that 'environmental protection and economic competitiveness are equal and complementary: one will not be achieved at the expense of the other'. However, significantly increasing food production without depleting the natural resources on which the sector depends remains a fundamental challenge. Evidence now shows that the objective of environmental protection is not being met (EPA, 2019a). Damage to the environment from agriculture activity undermines the credibility of Ireland's clean, green image on which the Food Wise 2025 vision is constructed. Currently, plans for the development of a new 10-year strategy for the period to 2030 present an opportunity to address the negative effects on the environment that have occurred in recent years with respect to water quality, greenhouse gas emissions, ammonia emissions and biodiversity. The EPA has outlined these challenges in its recent submission to DAFM in relation to the strategy.[1]

**Topic Box 13.1 Agriculture in Ireland – past to present**

Ireland's countryside has been shaped by agriculture throughout the last two centuries. Up to the middle of the 1800s, smallholdings of less than 5 acres were prevalent. These produced cereals and raised livestock to generate income to pay landlords, and potatoes to provide subsistence for smallholders, cottiers and labourers. Post famine, the area devoted to cereals more than halved as grassland and cattle numbers increased. This change occurred because of social, political and other factors, including the non-availability of workers for the then labour-intensive cereal production and improved shipping and transport of goods by rail. Improved modes of transport made it easier to move agricultural produce over large distances, leading to a decline in the area devoted to cereal production, not only in Ireland but also across northern Europe. In addition, increased living standards in the UK resulted in a growing demand for meat and dairy products (CSO, 2016). These changes form the basis of the largely grass-based livestock production systems that currently exist in Ireland. Market and policy developments in recent decades have further reinforced the dominance of livestock production.

Agricultural production is not solely associated with the production of food. Farming, when carried out in a manner that is sensitive to the environment, can provide valuable ecosystem services to society, ranging from protecting water from pollution to maintaining nutrient cycles and enhancing biodiversity. These broader ecosystem services need to become an increasingly important part of day-to-day farming in Ireland.

1 http://www.epa.ie/pubs/epasub/epasubmissionontheagri-foodstrategy2030.html

## Irish Agriculture, Climate and Weather

### Ireland's weather and changing climate are key issues for the agricultural sector.

There is a marked diversity of soil types in Ireland, with over 450 soil series identified, each of which has different physical, chemical and biological properties, with series-specific environmental and economic responses as a result. A temperate climate with significant quantities of rainfall makes Ireland naturally suited to grass-based agricultural production. Weather patterns are variable, shown by the extremes that Ireland has experienced in recent years, and can affect grass and crop growth and the ease with which heavy machinery can access land for field operations.

Climate change is altering weather patterns, with different areas of the world affected in different ways. This has implications for food production and biodiversity globally, and Ireland is no exception to this. Projections of temperature and rainfall by Met Éireann and Climate Ireland[2,3] suggest that Ireland will see an increase of between 1°C and 1.6°C in mean annual temperatures by mid-century, with the largest increases in the east of the country. The number of frost days is projected to decrease by between 50 per cent and 62 per cent and the growing season length to increase by 35-40 days by mid-century.

Rainfall amounts are projected to decrease significantly, with the frequency of heavy rainfall events increasing by approximately 20 per cent, most notably in winter. This will lead to extended dry periods in the summer months. These changes to our weather system will have wide-ranging effects, from extended periods of drought-like conditions leading to potential water shortages to increased water run-off volumes during intense rainfall events. Ireland has experienced changes in weather patterns in recent years and further changes will potentially lead to increased environmental impacts and the emergence of plant and animal diseases that have not been prevalent in Ireland before. Research funded by the Environmental Protection Agency (EPA) and Met Éireann has noted that three high-impact events have occurred since 2000, which is equal to the total number of high-impact events observed in the previous century (Chapter 2).

2 https://www.met.ie/climate/climate-change

3 https://www.climateireland.ie/

## 2. The Structure of Irish Agriculture

Farms in Ireland vary in size and production type, covering almost 68 per cent of the country's land area, with most farmers involved in livestock farming.

Land cover data from 2018 (Chapter 5) show that, of Ireland's 7.04 million hectares, 4.76 million hectares is used for agriculture (67.6% of the land area) and 672,085 hectares is used for forestry (9.5% of the land area). Approximately 25,000 farmers (17% of the total) manage over 2 million hectares on farms of over 50 hectares (CSO, 2018). A further 1.8 million hectares are managed by 55,000 farmers on holdings of between 20 and 50 hectares, and nearly half of all farmers (60,000) work the remaining 0.6 million hectares, on farms averaging 10 hectares in size. Pasture, silage and hay accounted for 80.6 per cent of the area farmed in 2019, with 11.5 per cent devoted to rough grazing and 7.9 per cent to crop production (CSO, 2020).

In 2016, there were 137,500 farms in Ireland (CSO, 2018). In total, 20 per cent of farms (28,100 farms) had an output greater than €50,000 per year, with 12 per cent having an output greater than €100,000. These economically larger farms produced 75 per cent of the agricultural output using 44 per cent of the total farmed area. Of the remaining 80 per cent, 43,800 farms produced less than €8,000 output per annum, demonstrating the large number of small farms in Ireland producing outputs of between €8,000 and €50,000. More than half of all farms were in the Border, Midland and Western (BMW) region. The average farm size nationally was 32.4 hectares. Farms in the Southern and Eastern region were 41.3 per cent larger than those in the BMW region, with an average farm size of 38.3 hectares compared with 27.1 hectares in the BMW region. More than 55 per cent of farmers in Ireland were aged 55 years and older, with only 5 per cent aged less than 35 years.

Specialist beef production was the most common type of farming system, with 72,400 (52.7%) farms in this category. Mixed grazing livestock and specialist dairying were the next most common types, with 16,900 (12.3%) and 16,700 (12.1%) farms, respectively. There were 15,200 (11.1%) specialist sheep farms. The remainder was made up of specialist tillage farms, mixed crop and livestock farms, mixed crop farms, and intensive pig, poultry and horticulture enterprises.

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Approximately **25,000** farmers (17% of the total) manage over **2 million** hectares on farms of over **50 hectares** (CSO, 2018).

A further **1.8 million** hectares are managed by **55,000** farmers on holdings of between **20** and **50** hectares.

Nearly half of all farmers **60,000** work the remaining **0.6 million** hectares, on farms averaging 10 hectares in size.

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## Economic Situation

**Farm type, market volatility, weather conditions, increased production costs and direct payments all contribute to different and changing farm incomes.**

The principal measure used in Teagasc's annual National Farm Survey is Family Farm Income, representing the economic return secured by the farm family from labour, land and capital (Teagasc, 2020a). The average Family Farm Income across the 92,720 farms represented by the survey was approximately €24,000 in 2019, a 2 per cent increase on 2018. Family Farm Incomes vary from year to year and are reflective of inherent volatility, weather conditions and increased production costs. Income levels on tillage farms, however, showed a decrease of 15 per cent, with increased income levels for dairy and livestock farms. For the dairy sector, milk production increased by 5.3 per cent in 2019 with average income increasing by 9 per cent to €66,570 in 2019. In general, farm incomes continue to be highly reliant on direct payments. In 2019 the average total direct payment received was €18,452 per farm and this accounted for 77 per cent of average farm income. In terms of individual schemes, agri-environmental schemes were more important on cattle rearing farms than on dairy and tillage farms accounting for up to 12 per cent of total payments on such farms. Of particular importance is that, although direct payments were lowest on cattle-rearing farms, their overall contribution to farm income, at 160 per cent is the highest recorded. Furthermore, when comparing farm systems in terms of their market income, it is evident that income from cattle rearing and sheep farms is less than zero, indicating that on average these farms are loss-making.

## Food Wise 2025

**The significant pressures on the environment as a result of agriculture growth resulting from FoodWise 2025 need to be mitigated urgently, and resolved to meet the EU legislative requirements.**

Food Wise 2025 is a 10-year strategy agreed by a range of stakeholders, both public and private, and adopted by government as an overarching strategy for the Irish agri-food sector. Food Wise 2025 identified significant growth opportunities across all subsectors of the Irish agri-food industry. It predicted that growth would be driven largely by an expansion in dairy, beef, seafood and consumer food and drinks products and that, cumulatively, there was the potential for projected growth in gross value added of 70 per cent for the sector by 2025. However, by early 2020 these growth projections were largely met. Such rapid expansion has presented a significant challenge for the sector as it seeks to realise opportunities without damaging the environment on which it depends.

Halfway through the implementation of the strategy, there is evidence of significant environmental challenges arising from agricultural activities that must be addressed. Contributions from the sector's activities in relation to a wide variety of environmental pressures and targets and adaptation challenges are discussed in this report in relation to climate (Chapter 2), air quality (Chapter 3), nature/biodiversity (Chapter 6) and water quality (Chapters 7 and 8). Specific significant environmental pressures that require immediate and concerted action are discussed in the following sections of this chapter. Ireland has a reputation for high-quality natural food production and critical to this reputation is that food produced in Ireland has a low environmental footprint, in conjunction with adherence to strict traceability and animal welfare criteria. However, this reputation is now at risk as a result of current trends in air pollutant emissions (most importantly ammonia), greenhouse gas emissions, water quality and biodiversity decline. More fundamentally, these important issues, if not addressed, have the potential to undermine the ability of agriculture as we know it to continue to produce food and other products.

# 3. Current Trends

## Greenhouse Gases and Agriculture

**On-farm agricultural practices accounted for 32.7 per cent of national total greenhouse gas emissions in 2018, with emissions mainly consisting of methane and nitrous oxide.**

The United Nations Framework Convention on Climate Change reporting guidelines on annual inventories for Parties included in Annex I to the Convention (UNFCCC, 2014) describe the scope and reporting of greenhouse gas emissions inventories. They specify the methodologies and procedures to be followed for submitting consistent and comparable data on an annual basis in a timely, efficient and transparent manner to meet the needs of the Convention.

On farm agricultural practices accounted for 35.3 per cent of national greenhouse gas emissions in 2019, with emissions mainly consisting of methane from livestock and nitrous oxide from the management of manures, the application of manures to soil, the deposition of excreta by grazing animals and synthetic nitrogen fertiliser application to soils. In addition, carbon dioxide emissions arise from the application of urea and lime to soils (EPA, 2019b). Agricultural emissions are included in Ireland's Effort Sharing Decision emissions reduction target for 2020 (EU, 2009) and the Effort Sharing Regulation target for 2030 (EU, 2018a). Both pieces of legislation govern only emissions from non-emissions trading scheme sectors, with agriculture currently accounting for up to 45 per cent of this total.

The trend in greenhouse gas emissions from agriculture (EPA, 2020a) is, as is the case for all gaseous emissions from the sector, largely determined by the size of the national cattle herd and application rates of nitrogen fertilisers. In 1990, greenhouse gas emissions from the sector were 19.3 million tonnes of carbon dioxide equivalent (Mt $CO_2$ eq), which increased to 22.0 Mt $CO_2$ eq in 1998 in line with growth of the national cattle herd from 6.82 million animals in 1990 to 7.59 million animals in 1998. Over the same period nitrogen fertiliser application increased from 379,311 tonnes in 1990 to 431,999 tonnes in 1998. Emissions subsequently decreased to 18.5 Mt $CO_2$ eq in 2011, with an associated decrease in the national cattle herd to 6.42 million animals and a decrease in nitrogen fertiliser application to 295,795 tonnes. Since then emissions have been on an upward trajectory as a result of the removal of milk quotas and the implementation of Food Wise 2025 and its predecessor Food Harvest 2020. In 2019 the national cattle herd included 7.11 million animals and 367,364 tonnes of nitrogen fertiliser were applied; in the same year the national greenhouse gas emissions from the sector were 21.2 Mt $CO_2$ eq.

Under the Kyoto Protocol Ireland has elected to account for emissions and removals associated with the carbon pools in soil and biomass, which occur through the management of forests, grazing land and croplands. These estimates are dominated by significant carbon dioxide emissions from the drainage of organic/peaty soils, mainly in grasslands. The area involved is approximately 330,000 hectares and accounts for 8 per cent of the land area devoted to grassland. This means that, overall, Irish grassland is a net source of carbon dioxide to the atmosphere when it could and should be a net sink. Up to 2030, this will become a major focus because of European legislation on emissions and removals from land use, land use change and forestry (EU, 2018b). Hedgerows and non-forest woody features and the biomass contained therein are currently receiving a lot of focus. Estimates suggest, however, that their inclusion in national emissions inventories is far outweighed by existing emissions sources, such as the drainage of organic/peaty soils in grasslands, which will need to be tackled through a programme of work to convert them to net carbon sinks. Hedgerows are, however, important for biodiversity and the Irish landscape and for these reasons alone their protection is warranted.

Projections for the agriculture sector in the absence of any abatement measures suggest that greenhouse gas emissions will continue to grow steadily, mainly because of continued increases in the size of the dairy herd, and that by 2030 the contribution of agriculture to non-ETS emissions will be 50.0 per cent (EPA, 2020a) as efficiency gains and the effects of policies and measures are seen in other economic sectors. However, implemented and planned policies and measures are unlikely to change the status of the agriculture sector as a significant contributor to national emissions. It is forecast that dairy cow numbers will increase by 10.2 per cent between 2020 and 2030, reaching 1.64 million head, with a concurrent increase in nitrogen fertiliser use of 8.8 per cent over the same period.

## Ammonia and Other Air Pollutants Emanating from Agriculture

The agriculture sector is almost exclusively responsible for the largest source of ammonia emissions in Ireland, accounting for 99 per cent of the national total in 2018. Significant implementation of on-farm abatement measures is needed to bring Ireland back into compliance with the current national emission ceiling and to meet the 2030 emission ceiling for this air pollutant.

Agriculture is the source of a number of transboundary air pollutants, including ammonia, nitrogen oxides, non-methane volatile organic compounds (NMVOCs) and particulate matter, which have local, regional and transboundary effects. National emissions reduction targets exist for each of these pollutants, as outlined in Chapter 3. Similar to other European Member States, the agriculture sector is the largest source of ammonia in Ireland, accounting for 99 per cent of the national total in 2018 (EPA, 2020b). As with other gaseous emissions from the sector, the trend in ammonia emissions is largely determined by the size of the national cattle herd and extent of nitrogen fertiliser application. Emissions of ammonia from agriculture peaked in 1998 at 122.2 kilotonnes (kt), having increased by 12 per cent since 1990. Emissions subsequently reduced to 102.6 kt in 2011 before returning to an upward trajectory in response to growth plans for the sector as a result of Food Harvest 2020, Food Wise 2025 and the removal of milk quotas in 2015. Projections of ammonia emissions suggest that they will continue to grow in line with further anticipated growth in the national dairy herd (EPA, 2020b). Total national emissions in 2018 were 119.4 kt, which is above the current national emissions ceiling limit of 116 kt (Chapter 3). This was the third consecutive year in which Ireland breached its emissions target for this pollutant.The latest projections suggest that unless there is significant implementation of abatement measures at the farm level Ireland will continue to be in breach of national emissions ceiling targets up to 2030 and beyond (Topic Box 13.2).

**Topic Box 13.2 Teagasc marginal abatement cost curve analysis for ammonia emissions**

Similar to greenhouse gases, Teagasc has also produced marginal abatement cost curve analysis for ammonia emissions (Teagasc, 2015, 2020b). The most recent analysis published in September 2020 identifies 13 abatement measures with 80 per cent of the total abatement potential being met by the use of protected urea fertiliser and the use of low-emission slurry spreading techniques for cattle slurry. The report further suggests that under two of the future growth scenarios for the agriculture sector that target emission levels for 2030 will be met if the measures identified are implemented in full.

As is the case for measures identified in the greenhouse gas marginal abatement cost curve analysis, the measures identified require widespread adoption and on-the-ground verification of their efficacy to be included in national emissions inventory and projection estimates. Ireland's emissions reduction target for 2020 is a 1 per cent reduction on 2005 emission levels, with a 5 per cent reduction by 2030 from the same base. In 2020, however, emissions are projected to be 4.6 per cent above 2005 levels and, in 2030, 8.0 per cent above 2005 levels without the adoption of significant abatement measures. Every effort must now be made to implement the measures identified in the marginal abatement cost curve analysis to bring Ireland onto a pathway towards compliance with its ammonia emission target for 2030.

Agricultural emissions of nitrogen oxides and NMVOCs are not accounted for in terms of compliance with agreed emissions reduction targets for these pollutants (Chapter 3). The sector is, however, an important source of emissions of both of these pollutants. Agriculture is the second largest source of nitrogen oxide emissions in Ireland (contributing 32.4% of the 2018 total), with emissions mainly associated with synthetic fertiliser application, urine and dung deposited by grazing animals and the application of manures to soils. Agriculture is the largest source of NMVOC emissions, accounting for 39.4 per cent of the national total in 2018; emissions are associated with manure management and fertiliser application to soils.

With respect to particulate matter, agriculture is responsible for 7.4 per cent of total national emissions of particulate matter < 2.5 µm in size, 31.7 per cent of emissions of particulate matter < 10 µm in size and 18.9 per cent of emissions of total suspended particulates. Furthermore it is estimated that up to 15 per cent of particulate matter < 2.5 µm in size in Ireland is derived from ammonia emissions from agriculture (DCCAE, 2020).

National emissions reduction targets are in place for particulate matter < 2.5 µm in size for 2020 and 2030 under the National Emission Ceilings Directive (2016/2284/EU). Emissions from agricultural sources are included in the compliance assessment. Emissions of particulate matter from agriculture arise from manure management, fertiliser application to soils and both on-farm and off-farm handling and transport of bulk agricultural products.

Finally, the use of pesticides is the major contributor to hexachlorobenzene emissions to air in Ireland (EPA, 2020b). Hexachlorobenzene is present as an impurity in or a by-product of some pesticides, such as chlorothalonil. A ban on the use of this pesticide came into effect in May 2020.

## Biodiversity and Agriculture

**Changes in and intensification of agricultural practices have impacted on biodiversity. There are, however, locally led projects that the sector could learn from, in which farmers are working to restore specific habitats and conserve species on their farms.**

Agriculture depends on biodiversity, with Irish agriculture having a particular advantage in that grassland is the majority land cover in Ireland. Our landscape has been shaped by millennia of agricultural activity, with intensification of agriculture in recent decades leading to a loss of biodiversity, with significant implications for flora and fauna. Since 1994 it has been compulsory for every EU Member State to have agri-environmental schemes in place in an effort to halt the decline in biodiversity. This is the primary way that farmers are rewarded for farming in an environmentally friendly manner. In Ireland, these voluntary schemes have evolved from the four iterations of the Rural Environmental Protection Scheme (REPS) to the current GLAS scheme. The value of these schemes to biodiversity has, however, been difficult to ascertain and there would be benefits from planning such schemes at a landscape scale. Additionally, there has been limited success in attracting higher value sectors, such as the dairy sector, into these schemes.

The most recent report under the EU Habitats Directive (92/43/EEC) (DCHG, 2019a) suggested that 57 per cent of listed species have a 'favourable conservation status', 15 per cent have an 'inadequate status' and 15 per cent have a 'bad status'; 72 per cent of species demonstrate a stable or improving status, while 15 per cent demonstrate ongoing declining trends. Functioning habitats are key to species survival; however, 85 per cent of listed habitats were assessed as having an 'unfavourable conservation status', with 46 per cent in a declining condition and 2 per cent in an improving condition. Agriculture and other activities are having negative effects on a wide range of habitats and species, such as wetlands, fish, molluscs, terrestrial mammals and vascular plants. Drainage of land, fertiliser application, clear-felling, undergrazing and abandonment of land are known pressures that, although local in extent, may influence a much wider area, especially if they affect groundwater supplies or nearby watercourses. Other studies have indicated a decline of 14 per cent in bee species (NPWS, 2014). Bumblebees are especially affected, with 7 out of 20 species at risk of extinction. Among bird species, 19 per cent had increased in number, but 18 per cent of breeding species and 16 per cent of wintering species were in decline. Of the 10 per cent of species on the Red List, 24 per cent are regarded as 'threatened' and 15 per cent are 'critically endangered'.

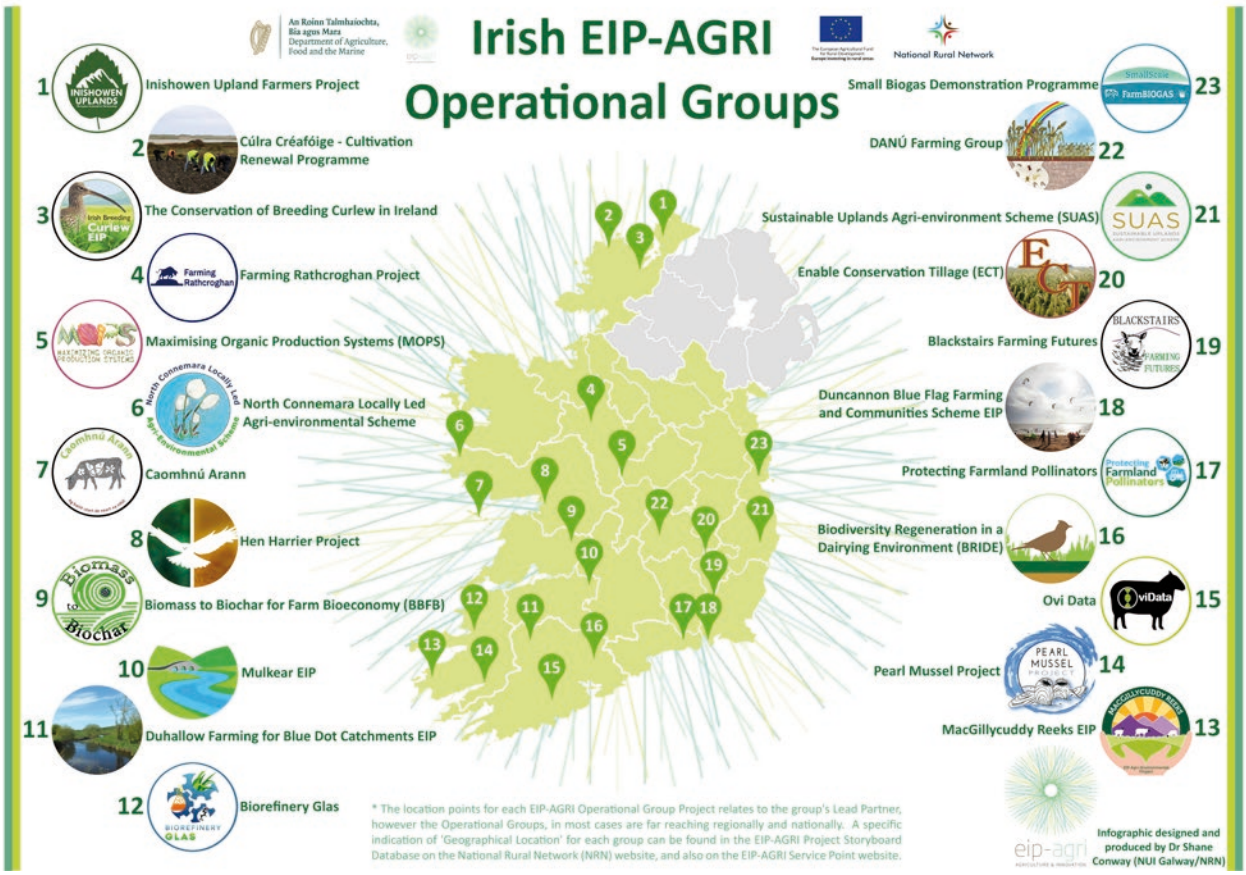
The *6th National Report to the Convention on Biological Diversity* (DCHG, 2019b) describes the decline in farmland bird species, such as the corncrake and yellowhammer, as indicative of changes in agricultural practices and a nationwide reduction in mixed farming with small-scale cereal growing, with a move instead to specialisation and livestock production. The decline in bees, butterflies and other insects is stated to be largely the result of monoculture and the drive for ever-increasing levels of productivity, characterised by a loss or neglect of hedgerows, farmland edges and scrub.

The National Biodiversity Action Plan 2017-2021 (DCHG, 2017), developed by the National Parks and Wildlife Service, includes 119 targeted actions under seven strategic objectives. The Plan specified 'enhanced appreciation of the value of biodiversity and ecosystem services amongst policy makers, business, stakeholders, local communities, and the general public' as one of its seven key objectives. It includes a vision 'that biodiversity

and ecosystems in Ireland are conserved and restored, delivering essential benefits for all sectors of society and that Ireland contributes to efforts to halt loss of biodiversity and the degradation of ecosystems in the EU and globally'. There is currently a growing recognition of the importance of biodiversity and 'greening' measures in agricultural policy; for example, the contribution of natural capital[4] was included in Food Wise 2025 and Bord Bia's Origin Green initiative.

The introduction of locally-led and results-based projects in which farmers input into the design of on-farm projects should provide useful information for the future design of agri-environment-climate measures. In April 2020, the National Parks and Wildlife Service and Teagasc published a book on the role of result-based payments in agri-environmental projects and programmes (Teagasc and NPWS, 2020). In particular, EU LIFE and European Innovation Partnerships (EIPs) have been developed to support specific habitats and species. The EIPs are a new initiative that began in 2016. They are funded by the DAFM under the Rural Development Programme, with total funding of €59 million available. There are currently 23 projects/operational groups in place across Ireland (Figure 13.1). One such project, the BRIDE project,[5] which runs until 2022, aims to design and implement a cost-effective, results-based approach to conserve, enhance and restore habitats in lowland intensive farmland.

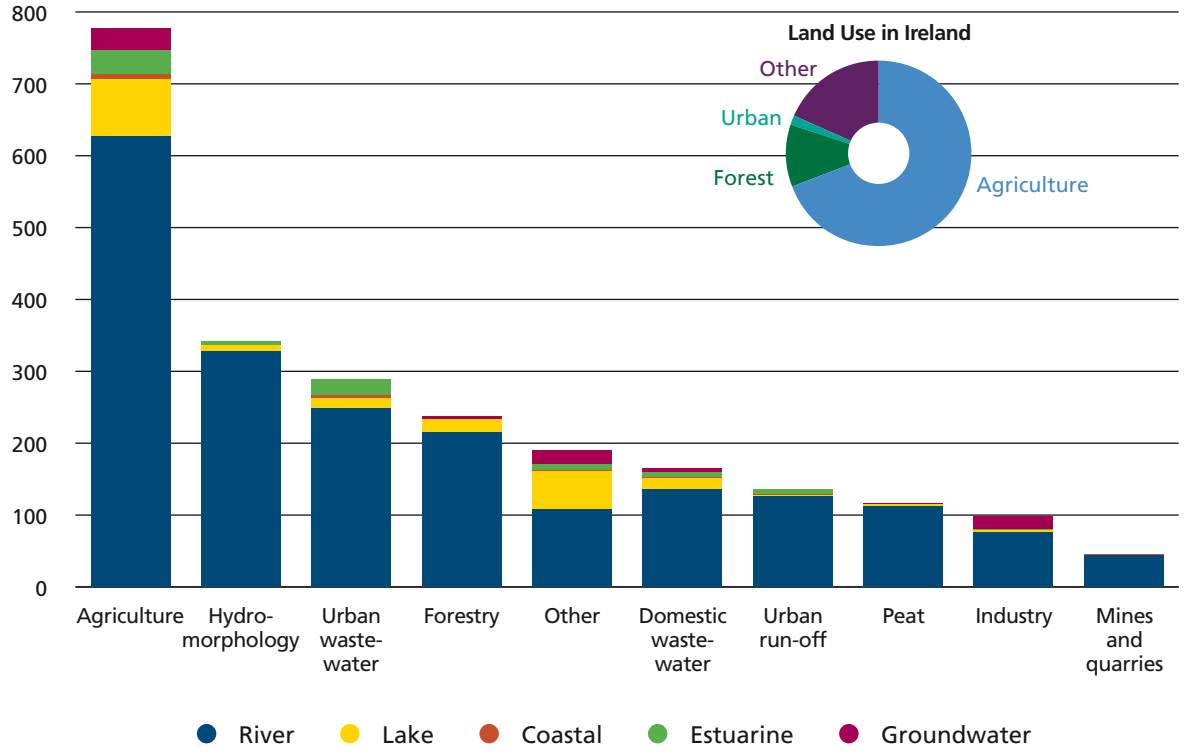
**Figure 13.1** Irish EIP-AGRI operational groups (Source: NUI Galway and National Rural Network)




4 *Natural capital is defined as the stock of natural assets such as geology, soil, air, water and all living things. Humans derive ecosystem services from natural capital, which makes human life possible.*

5 https://www.thebrideproject.ie/

**Figure 13.2** Significant pressures on Ireland's aquatic environment




## Water Quality and Agriculture

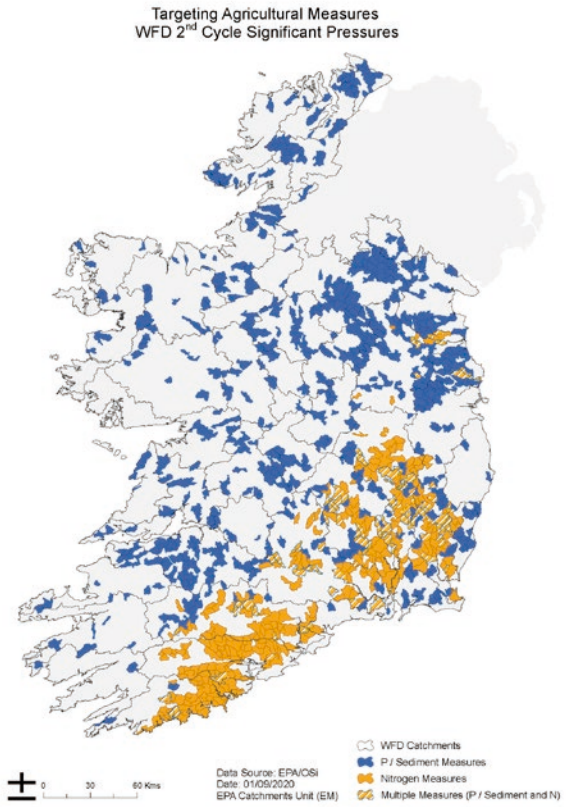
**Nutrient pollution (caused by too much nitrogen and phosphorus in our waters) is the key water quality issue impacting on our rivers, lakes and estuaries.**

Nutrient loss to waters can lead to excess growth of algae and plants, which in turn leads to eutrophication of rivers, lakes and marine waters. Phosphorus is typically the key nutrient associated with eutrophication of rivers and lakes, while excess loss of nitrogen impacts on estuaries and coastal waters (EPA, 2018a). Agriculture, as the most prevalent land use in Ireland, exerts the most pressure on water quality (Figure 13.2), impacting on just over half (780) of the 1452 water bodies that are 'at risk' of not achieving their water quality objectives (EPA, 2019b).

The EPA's most recent report on water quality in Ireland (EPA, 2019b) found that water quality has declined. Two of the main issues driving this deterioration are the excessive levels of nutrients and sediment entering our water courses. Land management practices, including agriculture, forestry and peat extraction, all contribute to this problem. In particular, increased agricultural activity in recent years, through increased cattle numbers and fertiliser use, has led to increased nutrient loadings, which in turn impact negatively on water quality (Figure 13.3).

Significant improvements in controlling nutrient losses from agricultural point sources have been made over the last decade, with investments being made in increased storage capacity and improved farm infrastructure. However, significant challenges remain with regard to the control of diffuse losses of nutrients from land, arising from chemical and organic fertiliser use. Diffuse phosphorus losses occur most often from overland flow on poorly draining (heavy) soils. These types of heavy soils are common in parts of Cavan, Monaghan, Wexford, Limerick and Meath. Only a very small amount of phosphorus needs to be lost relative to the amount used on the land to cause water quality problems. The best solutions are therefore measures that break the pathway connecting the nutrient source to the watercourse. Examples of these measures include buffer zones, hedges, farm ponds and management of ditches. On the other hand, diffuse losses of nitrogen occur in freely draining soils where nitrogen easily infiltrates through the soil into groundwater before being discharged into river systems and onwards to estuaries and coastal waters. This is a concern for Cork, parts of Tipperary, Kilkenny, Carlow and parts of Wexford. In these areas the solutions centre on using less nitrogen fertiliser and using it more efficiently.

**Figure 13.3** Targeting agricultural measures (Source: EPA)




Siltation caused by poor practice in the drainage of rivers and land drainage has been identified as having widespread environmental impacts. Agricultural sources of silt include land drainage, river bank collapse from cattle accessing watercourses, lack of buffer/riparian zones or catch crops on tillage land, farm roadways, poaching of wet soil by animals and exposed soils during reseeding. Measures aimed at reducing siltation are similar to those proposed for reducing phosphorus loss as they need to break the pathway between the source of the silt and watercourses. Good practice examples include well-designed and targeted buffer zone, farm ponds and managed ditches.

Reducing the impact of agriculture on water quality requires urgent, coordinated and evidence-based intervention. Under the national River Basin Management Plan 2018-2021 (DHPLG, 2018), action is now being targeted in 190 Areas for Action. Where water quality is being impacted by agricultural activities in these areas, 30 new farm sustainability advisors (twenty from Teagasc and ten from the dairy industry), under the Agricultural Sustainability Support and Advice Programme (ASSAP), are working with farmers to identify the problems and implement the right measures in the right places. This is a free and confidential advisory service funded and involving collaboration between the DAFM, the Department of Housing, Planning and Local Government, Local Authority Waters Programme and Dairy Sustainability Ireland.

## Drinking Water and Agriculture

### Protecting drinking water sources from the pesticide MCPA and slurry spreading are important public health issues in Ireland.

The quality of drinking water sources can be affected by many factors such as soil type, geology, agricultural practices, industrial, municipal and domestic discharges and heavy rainfall events. As a result, the treatment of water for use as a potable supply is complex in nature. There are two sources of drinking water in Ireland, namely public water supplies and private water supplies (which includes group water schemes and private wells). Agricultural activities pose a significant risk to drinking water sources through the storage and use of pesticides and through microbial contamination. While the quality of drinking water in public supplies remains high, with over 99 per cent microbiological and chemical compliance after treatment, persistent pesticide failures in some supplies remain (EPA, 2020c).

Pesticides, mainly MCPA (2-methyl-4-chlorophenoxyacetic acid), are used to control rushes, ragwort and thistles. They are also used in parks, on sports grounds and on golf courses, as well as in private gardens. MCPA is the most common pesticide found in drinking water (63% of all cases in 2019). At the end of 2019, the EPA was investigating 31 supplies serving just under 294,300 people because of failures to meet the necessary pesticide standard. This was a decrease from 42 supplies affecting 283,500 people at the end of 2018. It is important to note that pesticides may have been sprayed on land that is far from drinking water sources (lakes, groundwater or rivers) and that a considerable period of time may elapse between spraying and when contamination is found in water samples as part of routine monitoring. A perverse incentive exists whereby rush-dominated swards may be controlled through the use of products such as MCPA so that lands remain or become eligible for payments under the Common Agricultural Policy (CAP). This means that drinking water sources are being put at risk because of the eligibility rules for payments under the CAP. Efforts are needed to encourage the responsible use of pesticides and, where possible and feasible, the use of non-chemical methods for weed control should be considered. Further information on the protection of drinking water from pesticides can be found on the EPA website.[6]

6 http://www.epa.ie/water/dw/protectingdrinkingwatersupplies/

Microbial contamination of drinking water supplies (by *Escherichia coli*, *enterococci* or *Cryptosporidium*, for example) can arise from human or animal faeces or from water treatment plants that aren't operating to the standards needed to clean and disinfect water. Poor farm management practices or land spreading of manure close to drinking water abstraction points and private wells can also lead to contamination. The risk to supplies may also be increased as a result of poorly constructed abstraction points and private wells. Additionally, in the case of private wells serving individual houses, disinfection practices may not be in place, which could increase the risk even further.

It is well known that the drinking water quality in private water supplies is consistently poorer than that in public water supplies (EPA, 2020d). Private supplies mostly serve rural areas, with the source for most supplies being a spring or a well. While contamination can come from a number of sources, slurry spreading close to the source and animals being allowed to roam too close to the source increase the risk of contamination. This is also a potential source of verocytotoxigenic *E. coli* (VTEC) contamination – this issue is dealt with in more detail in Chapter 14.

## Soil Fertility

**There have been significant improvements in soil pH status in recent years, reversing past trends. Continued emphasis on lime application is required to improve nutrient use efficiency.**

Efficient production of livestock and crops is a critical first step in ensuring sustainability from both an environmental and an economic standpoint. One important aspect that underpins efficient production is soil fertility. Soil pH plays a key role in soil fertility and maintaining soil pH at the optimum level increases nutrient availability and the microbiological activity of the soil, resulting in better nutrient utilisation. For a number of years there were increasing concerns that soil pH levels were not being kept at their optimum through the regular targeted application of lime. Between 2014 and 2016 only 34 per cent of soil samples were at the optimum pH (Teagasc, 2019b), and between 2017 and 2019 57 per cent of soil samples were at the optimum pH (Teagasc, pers. comm.). National statistics on lime use show that its use declined from 1.7 million tonnes per annum in the 1980s to under 0.9 million tonnes per annum in 2014. However, there has been a growth in the quantities of lime applied to soils in recent years, with 1.04 million tonnes applied in 2018. The quantity of lime applied in 2019 however reduced to approximately 800,000 tonnes.

Soil phosphorus and potassium levels also showed a decline in the period between 2007 and 2016 (Teagasc, 2019c), with only 38 per cent of soil samples sufficient in phosphorus and 45 per cent sufficient in potassium for optimal grass and crop production in 2016. Overall, only 10 per cent of soils were at optimum fertility in terms of pH, soil phosphorus and soil potassium. As with pH control, there are some indications that the situation is

improving, with 43 per cent of soil samples sufficient in phosphorus and 50 per cent sufficient in potassium in 2017-2019 (Teagasc, pers. comm.). The Smart Farming initiative has found that maintaining soil fertility at optimum levels represents the largest cost saving on participating farms.

It is crucial that soil fertility and soil pH are addressed on farms in a coordinated manner as one of the most important responses to reduce agricultural emissions to air, soil and water.

# 4. What's Being Done

## Common Agricultural Policy and Common Agricultural Policy Reform

**Post 2020, the Common Agricultural Policy (CAP) is expected to set ambitious new requirements with respect to environmental protection and climate change that will be based on results and performance.**

The CAP is a system of subsidies and support programmes for agriculture operated by the EU. Originally launched in 1962 it was developed as a partnership between agriculture and society, and between Europe and its Member State farmers. The main aims of the policy are to secure a decent standard of living for farmers and a stable, secure and varied food supply for European citizens. A key facet of the current iteration of the CAP is the application of 'greening' rules, which was supported by the 2014-2020 Rural Development Programme for Ireland (DAFM, 2015b).[7] The CAP is currently undergoing significant reform and is likely to set ambitious new requirements with respect to environmental protection and climate change. These requirements are likely to include the preservation of carbon-rich soils through the protection of wetlands and peatlands; the use of nutrient management tools to improve water quality and reduce nitrous oxide and ammonia emissions; and the use of crop rotation instead of crop diversification. The European Commission has also proposed a more flexible system of administration to shift the emphasis from rules and compliance to results and performance-based indicators. This will allow Member States to tailor policies to local and national needs.

The new greening architecture of the CAP offers significant opportunities to raise the overall environmental performance of the agricultural sector. It is essential that measures introduced under the new CAP can show quantifiable and verifiable environmental gains and attract intensive farmers. However, the new CAP alone will not provide all of the solutions to the growing pressures from agriculture on water, climate, air pollution and biodiversity.

A whole-of-sector approach is required in which the whole industry (from livestock and land management to the food industry, agricultural education and government) is closely involved in establishing effective and accountable programmes and initiatives that will deliver on environmental targets and sustainability but also underpin on-farm efficiencies and market access. This challenge cannot be underestimated and will need collaboration right across the industry.

## EU Biodiversity Strategy for 2030

**Biodiversity loss and climate change are interlinked. Maintaining our soils, our forests and our wetlands will help to mitigate and adapt to climate change.**

The recently published EU Biodiversity Strategy for 2030 (EC, 2020a) aims to establish protected areas for at least 30 per cent of the land in Europe and restore degraded ecosystems on land through an increase in organic farming and biodiversity-rich landscape features; halting and reversing the decline in pollinators; reducing the use of pesticides by 50 per cent by 2030; and planting 3 billion trees by 2030. The strategy requires every European Member State to play a role, based on objective ecological criteria, recognising that each country has a different quantity and quality of biodiversity.

As custodians of our land, farmers are pivotal. When biodiversity is lost on agricultural land farmers are the first to see the consequences, and when it is restored they are the first to see the benefits. To support the sustainability of both nature and farming the EU Biodiversity Strategy is aligned with developments in the new CAP and the EU's Farm to Fork Strategy (EC, 2020b).

7 *Payment for a compulsory set of 'greening measures' was implemented to enable the CAP to be more effective in delivering its environmental and climate objectives.*

## Farm to Fork Strategy

**The Farm to Fork Strategy is an opportunity to improve the environment that agriculture depends on.**

The Farm to Fork Strategy (see Figure 13.4) aims to make food systems fair, healthy and environmentally friendly (EC, 2020b). It identified the need for an accelerated transition to more sustainable food systems, which among other objectives should have a neutral or positive environmental impact, help to mitigate climate change and adapt to its impacts and reverse the loss of biodiversity. A legislative framework will be proposed to support the implementation of the strategy and the development of sustainable food policy.

Significantly, under the strategy the European Commission will take action on two major fronts. First, a target to reduce nutrient losses by at least 50 per cent, while ensuring no deterioration in soil fertility, will aim to reduce synthetic fertiliser use by at least 20 per cent by 2030. Second, targets will be implemented to reduce the overall use of chemical pesticides by 50 per cent and the use of more hazardous pesticides by 50 per cent by 2030.

**Figure 13.4** Farm to Fork (European Commission, 2020b)


## Nitrates Action Programme and Derogation Review

**Intensively stocked livestock farms with Nitrates Directive derogations will be required to further improve efficiencies and reduce their environmental footprint across a range of issues.**

The Nitrates Directive (91/676/EEC)[8] aims to protect water quality by reducing pollution from agricultural sources and promoting the use of good agricultural practice. It forms an integral part of the Water Framework Directive (2000/60/EC) and is one of the key instruments in the protection of waters against pollution from agricultural practices. All EU Member States are required to prepare Nitrates Action Programmes that outline the rules for the management of livestock manures and fertilisers and their application to soil. Ireland's Fourth Nitrates Action Programme runs from 2018 to 2021; this will be reviewed and will form the basis for its Fifth Nitrates Action Programme. Ireland has taken an approach whereby the whole national territory is defined as a nutrient-sensitive area under the Nitrates Directive. Furthermore, Ireland also uses the national implementation of the Directive to control phosphorus as well as nitrogen. Phosphorus is a key driver of freshwater eutrophication. Under the programme there is a closed period when land spreading of manure and fertiliser is prohibited, and minimum manure storage requirements are set for different geographical zones nationally and legal limits are established for nutrient use.

The Department of Housing, Local Government and Heritage is the lead authority for the European Union (Good Agricultural Practice for Protection of Waters) Regulations (S.I. No. 605 of 2017). The DAFM implements and operates the nitrates derogation (S.I. No. 65 of 2018), including inspections of participant farms and imposition of penalties for non-compliance. Ireland's nitrates derogation allows farmers to farm at higher stocking rates, above 170 kg of livestock manure nitrogen/hectare, subject to additional conditions designed to protect the environment. The derogation is seen as an important facility for more intensive farmers and almost 7000 intensively stocked farms availed of the derogation in 2018. It is estimated that these 7000 farms represent 11 per cent of the farmed area and 20 per cent of bovine livestock. A further 5000 farms representing 13 per cent of bovine livestock exceed the 170 kg of livestock manure nitrogen/hectare limit but these farms either export manure or take other actions to comply with the limit. It is recognised that compliance of a higher standard is required from these farmers to ensure that a greater level of environmental efficiency is achieved.

8 https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:31991L0676&from=EN

A national interim review of Ireland's nitrates derogation was undertaken in 2019 (DAFM, 2019b). This review examined further opportunities for derogation farms to improve efficiencies and continue to reduce their environmental footprint, particularly in relation to water, climate and air quality. Several recommendations were made including the adoption of nutrient management planning, training programmes on best practice in nutrient efficiency, specific rules and requirements in relation to the spreading of slurry using low-emission spreading techniques, grass sward measurement and implementation of a minimum clover content in swards.

The Teagasc Agricultural Catchments Programme was established with funding from the DAFM. It aims to evaluate the environmental and economic effects of the Nitrates Action Programme measures. The Agricultural Catchments Programme works with over 300 farmers across six water catchments, with a multidisciplinary team evaluating both the environmental and the economic effects of the Nitrates Directive and Ireland's water quality challenges. It is currently in its fourth phase, covering the period to 2023.

## Sustainability Programmes

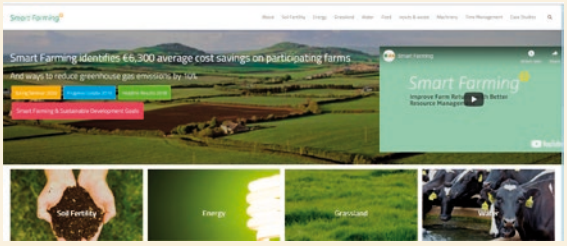
### Voluntary programmes operated by the sector aim to improve sustainability and reduce wastage of resources.

Sustainability programmes include Agricultural Catchments, Origin Green and Smart Farming (Topic Box 13.3).

Origin Green, launched in 2012, is a voluntary sustainability programme led by Bord Bia that brings together the food industry, from farmers to food producers, retailers and food service operators. According to Bord Bia the programme enables Ireland's food industry to set and achieve measurable sustainability targets that respect the environment and serve local communities, with progress independently assessed and verified. To this end, on-farm assessments are a key component of the programme, with over 100 auditors undertaking approximately 800 audits per week. The audit criteria cover greenhouse gases, biodiversity, water measures, energy efficiency, soil management and socio-economic factors, in addition to quality assurance. To date, over 50,000 farmers are in the Sustainable Beef and Lamb Assurance Scheme and the Sustainable Dairy Assurance Scheme. The Sustainable Egg Quality Assurance Scheme covers 97 per cent of Irish egg production and similar schemes are being developed for other types of poultry production and pig production. Following each audit, farmers receive a feedback report detailing their performance, which is then reassessed every 18 months. In addition, over 300 companies, representing 90 per cent of Irish food and drink exports, have implemented independently verified and annually monitored sustainability plans.

**Topic Box 13.3 Smart Farming**

Smart Farming is an initiative led by the Irish Farmers' Association in partnership with the EPA that brings together the knowledge of Teagasc, the Fertilizer Association of Ireland, the EPA, University College Dublin and others[9]. This voluntary initiative focuses on ways to reduce costs inside the farm gate and at the same time protect the environment through better resource management in eight key areas: feed, grassland, water, inputs, time management, soil fertility, machinery management and energy use. In 2018, the average cost saving on participation farms was €7,170, with an associated average greenhouse gas emission reduction of 9 per cent (IFA, 2019). The largest cost savings were seen on dairy farms.




## EPA and LAWPRO Focus Action to Improve Water Quality

### Water bodies that need improvement and protection have been prioritised as Areas for Action under the River Basin Management Plan.

A large number of our water bodies require further action because of water quality issues. The EPA and the Local Authority Waters Programme (LAWPRO) led a detailed programme of collaboration with local authority personnel and public bodies to determine, at a regional level, which water bodies should be prioritised as Areas for Action in the national River Basin Management Plan 2018-2021 (Chapter 7). The process was based on national water protection priorities, scientific evidence, local expertise, data and knowledge of public body staff, and local priorities such as amenity value. In total, 190 Areas for Action were identified for priority action, including 726 water bodies. Public engagement sessions on the Areas for Action are being carried out on a phased basis by the Local Authority Water and Communities Office (LAWCO). Information on where these areas are, and the reasons for their selection and when they will be addressed, is available at https://www.catchments.ie/areas-for-action/.

9 www.smartfarming.ie

## Local Water Catchment Assessments to Locate Problem Areas

### Water catchment walks and assessments are being carried out to evaluate water quality problems at the field scale level.

In 2018, the LAWPRO Catchment Assessment Team was established to carry out Local Catchment Assessments within the 190 Areas for Action. The purpose of the Local Catchment Assessments is to carry out catchment, stream, street and shore walks to evaluate water quality problems at the field scale, the options for addressing them and how to implement agreed actions at water body level to improve water quality. Thirty-five scientists are undertaking the work as part of LAWPRO. The Catchment Assessment Teams are also working closely with other bodies (Topic Box 13.4) that have local knowledge and expertise and can contribute to the implementation of actions. Further information is provided in Chapter 7.

**Topic Box 13.4 Agricultural Sustainability Support and Advice Service engaging with farmers**

An integral part of the work being undertaken to improve water bodies involves close collaboration with farmers. This work is being carried out by the Agricultural Sustainability Support and Advice Service (ASSAP)[10]. The ASSAP advisory programme has 20 Teagasc advisors, funded by the DAFM and Department of Housing, Local Government and Heritage and ten specialist dairy advisors, funded by Dairy Sustainability Ireland. ASSAP is focusing on knowledge exchange and collaboration with farmers to co-design the best solutions that are specific to each farm. It is encouraging behavioural change, best practice and more environmentally sustainable farming practices. The 30 expert advisors are working directly with farmers and their existing advisors on voluntary farm-level action plans – looking at yards, lands and nutrient management planning. Up to 5000 farmers are to receive support and advice. This support will focus on issues within the 190 prioritised catchment Areas for Action. In addition, 18,000 dairy farmers will receive advice on sustainable farming practices under the Dairy Sustainability Initiative.[11]

All of these schemes and advisory initiatives have the potential to make a significant contribution to improving farm practices nationally, with the overall objective of reducing the environmental impacts of agricultural activities. This will be achieved only through a coordinated programme of activities based on mutual cooperation and respect among all stakeholders. Monitoring, verification and reporting are important components of implementation, providing the necessary evidence to gauge performance at both farm and catchment levels. Dialogue and consensus are essential, as is ongoing knowledge exchange based on the evidence.

10 https://www.teagasc.ie/media/website/publications/2019/Agricultural-Sustainability-Support-and-Advisory-Programme-(ASSAP).pdf

11 http://eda2018.eu/dairy-sustainability-ireland/

## Climate Action Plan and Greenhouse Gas Emissions Marginal Abatement Cost Curve for Irish Agriculture

Climate abatement measures require widespread on-farm adoption and verification.

In 2012, Teagasc published its first greenhouse gas emissions marginal abatement cost curve for Irish agriculture (Teagasc, 2012). This was followed by a second iteration (Teagasc, 2018), which was undertaken in the context of Food Wise 2025. This second iteration investigated 16 separate measures aimed at reducing emissions from livestock, manure management, fertiliser use and land use. The report suggested that mitigation of methane and nitrous oxide emissions could yield a reduction in emissions of 1.85 Mt $CO_2$ eq per annum. Furthermore, the report suggested that there is the potential for sequestration of 2.7 Mt $CO_2$ eq associated with land use measures. An emissions target of 17.5-19 Mt $CO_2$ eq by 2030 under the government's Climate Action Plan (DCCAE, 2019) has been agreed for the agriculture sector. The measures identified to achieve this target, however, exist on paper only and require widespread on-farm adoption. On-the-ground verification of their use for inclusion in national emissions inventory and projection estimates is also required.

In 2019 the DAFM launched a public consultation on Ag-Climatise: A Draft National Climate and Air Roadmap for the Agriculture Sector to 2030 and Beyond. This document set out the unique climate and air challenges facing Irish agriculture, the opportunities that may arise from meeting emission targets and ambitions. At the time of writing of this report (October 2020), the final plan has not as yet been published. This plan will also form the basis of required activities in the agriculture sector under the National Air Pollution Control Programme.

## National Air Pollution Control Programme

Implementation of the adopted Code of Good Agricultural Practice for reducing ammonia emissions will be central to reducing emissions, but other measures could be needed.

Reporting of air pollutants is an obligation for all European Member States (Chapter 3) and annual emissions of air pollutants are regulated under the National Emission Ceilings Directive. Article 10(1) of this Directive requires a National Air Pollution Control Programme to be developed. A draft programme for Ireland was submitted to the European Commission in 2019, with an updated final version to be submitted in autumn 2020. The agricultural sector is a significant contributor to nitrogen oxide, NMVOC and particulate matter emissions in Ireland; however, it is almost solely responsible (> 99%) for national ammonia emissions and as such the sector will have to play a significant role in reducing these emissions. A Code of Good Agricultural Practice for reducing ammonia emissions was published in late 2019 (DAFM, 2019c). The measures outlined in the Code are voluntary but will play an important role when adopted at farm level in decreasing ammonia emissions and moving Ireland onto a pathway towards compliance.

Additionally Teagasc (2015, 2019a, 2020b) has produced marginal abatement cost curves of the abatement of ammonia from Irish agriculture. This type of analysis represents an economic and technical assessment of the best available abatement techniques, based on scientific, peer-reviewed research conducted by Teagasc and associated national and international partners.

## Industrial Emissions Licences for Pig and Poultry Installations

Ammonia emissions and organic fertiliser (slurry and manure) from the intensive pig and poultry sectors must be properly managed to prevent environmental pollution.

Intensive pig and poultry-rearing installations are required to hold an Industrial Emissions Licence from the EPA. These installations have the potential to impact on the environment; for example, ammonia emissions can negatively impact on sensitive habitats, such as mosses (bryophytes), and organic fertiliser (slurry and manure) can impact on water quality if not managed properly.

Chapter 10 provides further details of the licensing process for these and other installations. Each licence includes conditions that control the operation of the activities and requires licensees to prevent, reduce and eliminate as far as possible emissions into air, water and land arising from such activities.

The licence conditions are in addition to the requirements of other environmental regulations, including the European Union (Good Agricultural Practice for Protection of Waters) Regulations and the Animal By-products regulations.

## Research Responses

### A range of research projects is examining the broad environmental challenges facing the agri-food sector.

The EPA continues to invest significant resources into environmental research both through its own research calls and through co-funding of projects with other bodies. Since 2016, the EPA has funded 78 new research projects relevant to the Environment and Agriculture area; an investment of €15 million. These projects were funded across the three Pillars of the EPA Research Programme 2014-2020. The most recent awards in relation to agriculture are largely focused on reducing nutrient loss to water, evaluating land use and land use management in the context of soil carbon, quantifying carbon and other emissions to the atmosphere from upland burning, and identifying scenarios for carbon neutrality for the agriculture sector. In terms of water, the focus of the research is on the achievement of Water Framework Directive goals. Projects funded include identification of the pressures associated with farm roadways acting as a conduit for nutrient transport, the effect of forest management on inland waters, the exclusion of livestock from watercourses, and management of riparian buffer zones. Further information on currently funded projects and end-of-project reports are available on the EPA website.[12]

Several research projects are currently examining soil carbon stocks, one with a view to creating a more robust system of reporting for national greenhouse gas emission and removal inventories for grassland and cropland; another study is examining the peatland properties influencing greenhouse gas emissions and removals. Furthermore, the National Policy Position on Climate Acton and Low Carbon Development includes a key action to develop 'an approach to carbon neutrality in the agriculture and land-use sector, including forestry, which does not compromise capacity for sustainable food production'. In response, the EPA has recently funded a project aimed at developing scenarios in which this key action may be met. The recently published AgriBenchmark report explored the possibilities of benchmarking nutrient performance on Irish farms using data from the National Farm Survey (Murphy *et al.*, 2019). The results of this study suggest that there is scope to increase nutrient use efficiency. Furthermore, the study suggests that effective knowledge transfer is central to achieving potential improvements in nutrient management.

Through the Stimulus and CoFoRD (Programme of Competitive Forestry Research for Development) programmes, and through various joint initiatives with other state bodies and European agencies, the DAFM has strongly supported climate change research relevant to the Irish agri-food sector, committing €19 million to 25 projects that include climate change elements in 2013-2017 alone. A number of research proposals have recently been funded in response to the DAFM Research Call 2019 under the 'Environment & Climate Smart Approaches to Agri-Food Systems' topic. One of these projects aims to identify mechanisms whereby the greenhouse gas and ammonia footprints of pasture-based production systems can be lowered, while another is specifically aimed at furthering our understanding of ammonia abatement techniques in an Irish context. Two further projects are investigating novel technologies for the reduction of methane emissions and developing farm sustainability tools for efficient nutrient management.

In addition, the DAFM has used other transnational call processes to make awards from its funding programmes in the agri-environmental area. These include collaborative transnational partnerships in European Research Area Networks (ERA-Nets) and EU Joint Programming Initiatives. Further details are available on the DAFM website.[13] The DAFM is on the governing board of the Joint Programming Initiative on Agriculture, Food Security and Climate Change (FACCE-JPI) and the Global Research Alliance initiative. The Global Research Alliance initiative has 56 member countries and aims to find ways in which food production can be produced without increasing greenhouse gas emissions.

12 http://www.epa.ie/researchandeducation/research/

13 https://www.agriculture.gov.ie/research/

# 5. Conclusions

## Environmental Pressures and Sustainability

It is clear from this integrated environmental review of agriculture that change is now required in the sector to ensure its environmental sustainability. Ireland has a reputation for natural food production and critical to this reputation is the appeal that food produced in Ireland has a low environmental footprint. However, this reputation is at risk of being irreversibly damaged because of current growth trends in air pollutant emissions (most importantly ammonia) and greenhouse gas emissions, and the decline in water quality and biodiversity. Business as usual will not reverse these trends; systemic change is required across the food system to address the challenges.The sector is responsible for approximately a third of national greenhouse gas emissions and over 99 per cent of national ammonia emissions and has been identified as the largest significant pressure on our water resources.

## Food Wise 2025

A core principle of the Food Wise 2025 strategy was that 'environmental protection and economic competitiveness are equal and complementary: one cannot be achieved at the expense of the other'. The strategy also stated that 'future food production systems must be as focused on managing and sustaining our natural resources as they are on increasing production'. However, the evidence shows that these two objectives have not been met and that the economic growth of the sector in recent years has occurred at the expense of the environment, as witnessed by the negative trends in water quality, greenhouse gas emissions, ammonia emissions and biodiversity. It is also clear from the evidence that agricultural and other land management practices are key drivers of these negative trends. Further work is now urgently required to address this imbalance, most importantly in the context of the new strategy for the sector to 2030 that is currently being developed. The agri-food and land management sectors in both the public and the private arenas also need to become, and be seen to be, strong advocates for a clean and well-protected environment, as they have been for intensification and efficiency. This re-balancing of focus needs to be a top priority for the sectors; otherwise, commitments to sustainability and environmental protection risk being seen to be of lesser importance than commitments to expansion, intensification, competitiveness and efficiency.

## Climate Change

As a society we will all face the consequences of climate change and we must adapt to the changes in our climate that are foreseen. The agriculture sector will also have to adapt to these changes, as well as addressing the challenge of reducing its greenhouse gas emissions. Ireland will experience extended periods of drought-like conditions leading to potential water shortages, increased run-off volumes during intense rainfall events and the emergence of plant and animal diseases that have previously not been prevalent in Ireland. These challenges must be faced in conjunction with addressing environmental pressures, placing further emphasis on the development of holistic responses that are wide-ranging and designed to deliver multiple environmental, social and economic benefits.

The establishment of the Teagasc Carbon Navigator, marginal abatement cost curves, Smart Farming initiative and ASSAP are examples of good practice. However, much wider uptake and implementation of measures at the farm level is needed.

## Nutrients and Soil Fertility

Issues surrounding soil fertility need to be addressed to enhance nutrient use efficiency particularly on our more intensive farms. Soils at optimum fertility and soil pH status recycle nutrients more efficiently, leading to a reduction in the inputs needed to maintain or increase levels of grass and crop production, while also reducing nutrient loss. This has wide-ranging positive outcomes for all of the environmental pressures identified and is a win-win solution from both an economic and an environmental standpoint. Policy decisions are now required to address and implement mitigation options; however, given the complex nature of the interface between soil, environmental and meteorological conditions a one-size-fits-all approach is unlikely to be successful across Ireland. Nutrients behave differently in the landscape depending on the soil type and the setting, for example, and actions to address nutrient loss must take this into account. In many areas the existing pressures have already exceeded the capacity of soil and water bodies to accept nutrients and sediment without causing significant harm. This provides the rationale for the adoption of region-specific integrated programmes of measures.

## Biodiversity Protection

The decline and/or loss of biodiversity, including certain species of farmland birds and bees, butterflies and other insects, must be addressed as a matter of urgency. Current EU LIFE and EIP projects funded under the Rural Development Programme should serve as a significant stepping stone for the national roll-out of measures in which the maintenance and/or re-introduction of specific habitats are a prerequisite for sustainable food production. EPA-funded research has estimated that the annual value of animal pollination to home-produced crops in Ireland is €20-59 million per year, while the contribution of global pollination services to Ireland's balance of trade is >€150 million per year.


## Farm and Catchment-level Approaches

A more holistic farm-and-catchment-level approach encompassing all environmental pressures will be fundamental for making progress towards more environmentally sustainable and low-carbon food production. The implementation of mitigation measures will also require monitoring and verification to gain recognition as part of both EU and international reporting mechanisms, for example being able to prove that land is a net sink for carbon. A network of integrated catchment/land use management plans informed by farm and nutrient management plans, catchment assessments and associated Areas for Action could form the basis of a more joined-up collaborative and cooperative approach to environmental management of our farms. This could provide the mechanism to reduce the cumulative environmental footprint of agricultural systems in Ireland, in an integrated way, covering areas such as biodiversity, greenhouse gases, climate change, air quality and water quality. Such an integrated approach could also identify and highlight the assimilative capacity of agricultural/catchment landscapes to process nutrient loads associated with intensification. It would also contribute significantly to the branding and marketing of Irish agricultural produce at home and abroad.

## Chapter Highlights for Environment and Agriculture

Agricultural practices are identified in EPA reports as being one of the main pressures responsible for the decline in water quality nationally. Moreover, the agriculture sector is responsible for approximately one-third of national greenhouse gas emissions and over 99 per cent of national ammonia emissions. Biodiversity is also under pressure from land use changes and intensive farming. Ireland's reputation as a food producer with a low environmental footprint is at risk of being irreversibly damaged. Outcome-focused and activity metrics are required to allow for tracking of the sector's performance and accountability in improving sustainability and protecting the environment.

Economic growth in the agri-food sector in recent years is happening at the expense of the environment, as evidenced by trends in water quality, emissions and biodiversity all going in the wrong direction. Business-as-usual scenarios will not reverse these trends. New measures must go beyond improving efficiencies and focus on reducing total emissions by breaking the link between animal numbers, fertiliser use and deteriorating water quality. Measures are also needed to address new EU strategies including the Farm to Fork Strategy, which sets ambitious but sustainable targets to 'transform the EU's food system'.

The adoption of a more holistic farm and catchment-level approach, encompassing all environmental pressures, will be fundamental to progress towards more environmentally sustainable and carbon-neutral food production.

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