Water Quality in Ireland: Status, Trends, Pressures and Policies

D. Ó hUallacháin, K. Daly, R. Adams
Teagasc, Environment Research Centre, Johnstown Castle, Co. Wexford,
[2]Teagasc Climate Centre

Introduction

Water is a vital natural resource. Healthy aquatic systems deliver multiple ecosystem goods and services, including the provision of drinking water, but also wider ecological and environmental benefits. Abundant, good quality water is thus a fundamental cornerstone of society. In recognition of the importance of healthy aquatic ecosystems, protection and restoration of good water quality is a key goal of sectoral (e.g., Food Vision 2030), national (e.g., Programme for Government), European Union (e.g., Water Framework Directive) and global (e.g., UN Sustainable Development Goals) policies.

The EU Water Framework Directive (WFD) (2000/60/IEC) is the primary piece of legislation aimed at protecting and improving water quality throughout the EU. The WFD stipulates that Member States must achieve at least good status in all waters (both surface water and groundwater) by 2027. Water quality status is determined by a combination of biological (e.g. macro-invertebrates, fish), physio-chemical (e.g. nitrogen, phosphorus) and hydro-morphological (e.g. flow, habitat condition) parameters. Environmental parameters are collected on a temporal resolution ranging from several times annually (e.g. for physio-chemical parameters) to every three years (e.g. biological parameters). Standards and guidelines are set for key nutrients to achieve good water quality status, with a significant focus on phosphorus (<0.035 mg/L of P) and nitrogen (<8 mg/L of NO_3).

Water Quality - Status

Approximately 54% of surface waters in Ireland are achieving satisfactory ecological status (DHLGH, 2024). EPA data (EPA, 2022) highlight that catchments in the west and south of the country have the highest proportion of waterbodies in satisfactory condition. Results at a national scale fall below the objectives of the WFD, which stipulates that all waters must achieve at least good status (i.e. satisfactory condition). At an EU scale, water quality in Ireland compares favourably to our European counterparts, where over half of the surface waters in the EU are of less than satisfactory ecological status (EEA, 2021). Based on data relating to River Basin Management Plan 2 (2010-2015), Ireland lies 7th (of 28 EU countries) when it comes to the proportion of rivers achieving satisfactory ecological status.

With regard to the parameters that contribute to the assessment of ecological status, recent data (EPA, 2024a) indicate that 58% of Irish rivers have satisfactory nitrate concentrations. For comparison with EU counterparts, Ireland is 20th (out of 29 countries) when it comes to the proportion of rivers achieving <2.0mg/L $NO^{3-}N$ (EEA, 2024). Unsatisfactory nitrate concentrations are particularly apparent in the east, south east and south of the country (Figure 1), and are contributing to unsatisfactory concentrations of dissolved inorganic nitrogen in the estuaries and coastal waters of these regions. These trends are persisting, despite a significant reduction (>30% since 2018) in the use of chemical nitrogen.

Seventy-three percent of Irish rivers have satisfactory phosphate concentrations. Rivers in the south east, midlands and east and south display the highest average river phosphate concentrations (Figure 1). Almost all of the assessed estuaries and coastal waters are in satisfactory condition for phosphate (EPA, 2024). For comparison with EU counterparts, Ireland is 6th (out of 25 countries) when it comes to the proportion of rivers achieving <0.05mg/L P[1] (EEA, 2024).

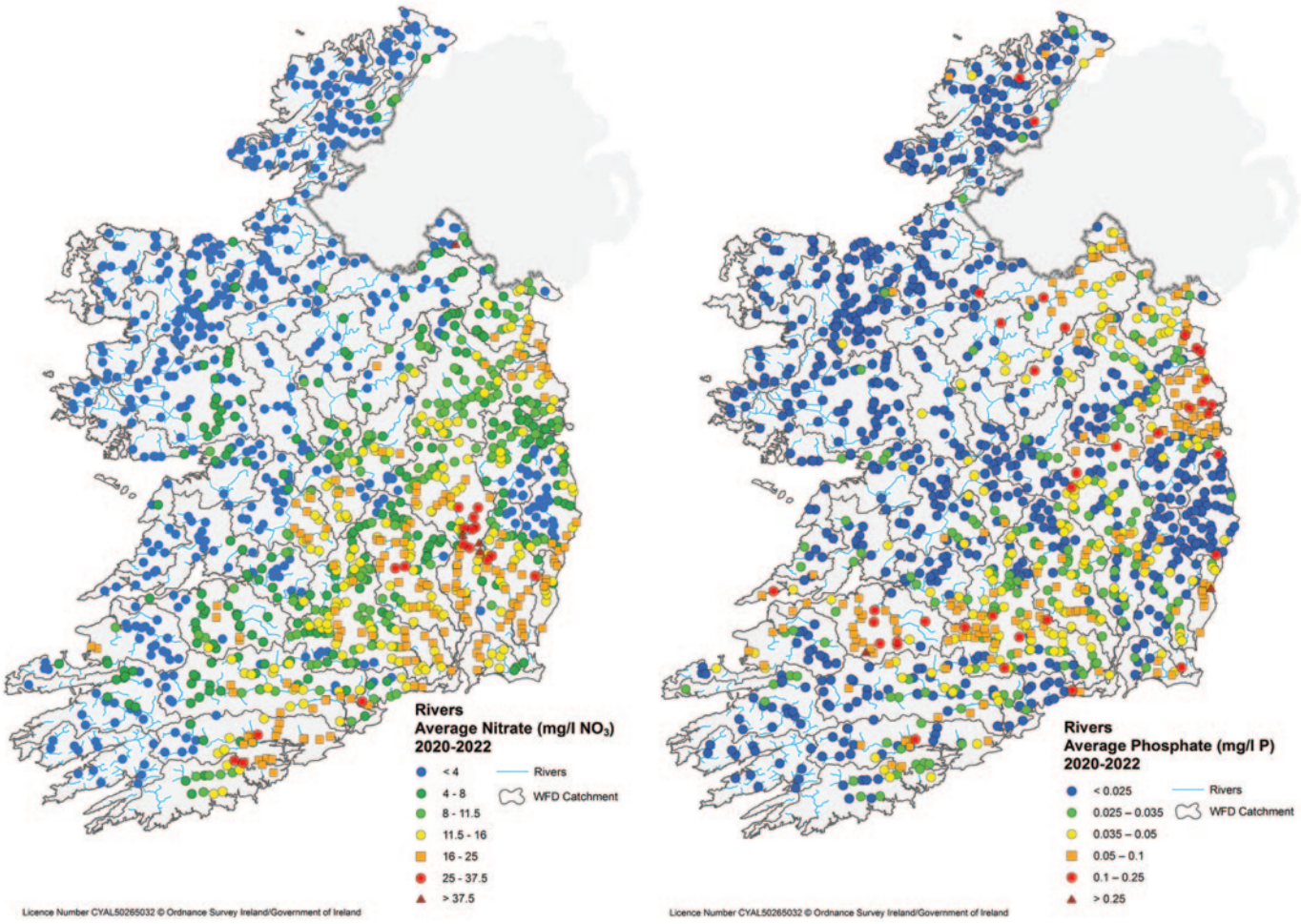

Figure 1 Maps showing water quality status in Ireland giving mean nitrate (left) and phosphate concentrations (right).

[1] This figure is above the thresholds set, but has been used to facilitate inter country comparisons.

Water Quality – Trends

Water quality has declined globally over the last number of decades (IPBES, 2019). In Ireland there has been a modest decline in water quality, from 61% of rivers achieving satisfactory status in 1987-1990, to 55% of rivers achieving satisfactory status in 2020-2023 (EPA, 2024). Of noted concern is the fact that rivers achieving high status have declined from 27% to 16%, with pristine water (i.e. Q5) experiencing the most significant declines. Encouragingly, rivers with poor or bad status have also declined (from 25% to 18%).

Water Quality – Pressures

Agriculture is the dominant land use in Ireland, accounting for almost 70% of the land area. The loss of nutrients (e.g. nitrogen and phosphorus) and sediment from agricultural systems to water has been highlighted as one of the main threats to water quality in Ireland (EPA, 2024) and throughout the EU. Excessive nitrogen and phosphorus can contribute to the eutrophication of surface waters, impacting aquatic species through excessive plant growth and associated fluctuations in oxygen concentrations in water. Sediment can impact the physical quality of aquatic habitats, for example clogging gravels for spawning trout and salmon.

Agricultural sources of nitrogen and phosphorus include animal waste and fertiliser, whilst eroding stream banks, farm tracks and field topsoil are key sources of sediment.

Multiple environmental, climatic and anthropogenic factors can impact the loss of nutrients and sediment for agricultural land. For example, the Agricultural Catchments Programme (ACP) (Mellander *et al.*, 2022) has monitored two intensively-farmed grassland dominated catchments in the south-east and south-west of Ireland since 2009. The Ballycanew catchment in Co. Wexford is poorly-drained and vulnerable to high losses of P during storm events (i.e. P-risky). In contrast, the Timoleague catchment in Co. Cork is well-drained and vulnerable to leaching nitrate (i.e. N-risky). Table 1 clearly indicate that losses vary from year to year and nitrate losses in Timoleague were more than three times greater than losses from Ballycanew. Loss of P were greater in Ballycanew. However, in the 2021 water year the losses of TP from Timoleague were almost as high as from Ballycanew. These observations indicate that N-risky catchments are still vulnerable to generating high P losses particularly if their soils become saturated and generate overland flow and/or fast subsurface flow in the wetter months.

Table 1 Losses of N and P from two grassland-dominated ACP Catchments.

Catchment (Year)	TRP Loss (kg P/ha/year)	TP Loss (kg P/ha/year)	NO3 Loss (kg N/ha/year)
Ballycanew (2020)	0.93	1.72	13.7
Ballycanew (2021)	0.68	1.53	12.2
Timoleague (2020)	0.47	0.76	38.2
Timoleague (2021)	0.82	1.30	50.1

The 3rd River Basin Management Plan has highlighted agriculture as the most common pressure on "at risk" waterbodies, impacting 62% of these waterbodies (DHLGH, 2024). This is an increase on the 53% that was reported in the 2nd River Basin Management Plan. These findings, coupled with the fact that agriculture is the dominant land use in Ireland, highlights the critical role agriculture can play in improving water quality in Ireland.

Improving Water Quality

Protecting the quality of water is the cornerstone of a sustainable farming system. In recognition of this, management prescriptions to protect and improve the water quality in surface and ground-waters have featured prominently in national and international policies for decades. The focus is frequently on the source-pathway-receptor concept. Prescriptions typically aim to either reduce the source of pressure, or break the pathway between source and watercourse. Such measures broadly fall within compulsory (e.g. Good Agricultural and Environmental Condition, Pillar I of the Common Agricultural Policy) and optional (agri-environment measures, Pillar II of the CAP) mitigation measures. The Nitrates Directive (91/676/EEC), aims to protect surface water from pollution by agricultural sources and to promote good farming practice.

Running concurrently with developments in agri-environmental policy, there have been significant advancements in: a) understanding the hydrological and biogeochemical processes that govern the transport of pollutants (e.g. nutrients, sediments, pesticides) to water, b) developing tools to support the targeting of mitigation approaches, and c) implementing multi-actor knowledge transfer programmes.

The Agricultural Catchments Programme: The Agricultural Catchments Programme (ACP) came about in 2008 in order to assess the effectiveness of the implementation of the Nitrates Directive (see above) across six catchments with different soil types, farming practices and climate. A key aspect of each catchment is the collection of high-frequency (sub hourly) monitoring data comprising metrological data, streamflow data and stream chemistry data. This novel approach has enabled the underlying processes that generate and transport nutrients to water to be investigated for over more than a decade. A key finding has been the identification of the influence of climate change on water quality over this period (Mellander and Jordan, 2021). Crucial to the success of the programme has been the active engagement with farmers through an advisory service with an emphasis on knowledge transfer through fostering strong farmer to advisor relationships and dissemination events.

Pollution Impact Potential (PIP) maps: Coupled with enhancing our understanding of hydrological and biogeochemical processes there have been significant developments in mapping approaches to help identify the critical source areas and delivery pathways (throughout the landscape) in relation to pressures on our waterbodies (Thomas *et al.*, 2021). The EPA Pollution Impact Potential (PIP) maps (for Nitrogen (N) and Phosphorus (P)) are a key example of these developments which came about from the findings of the Pathways Project and other research into diffuse pollution.

Agricultural Sustainability Support and Advisory Programme: Coordinated activity at field to catchment scale can result in sustained improvements in water quality, ultimately contributing to national (River Basin) scale objectives. Ensuring active engagement with farmers, industry, community, and government stakeholders throughout this process is crucial to addressing the challenges of water quality.

The targeting of actions at a local level, coupled with the multi-actor approach has been pursued successfully by the Agricultural Sustainability Support and Advisory Programme (ASSAP). The ASSAP is an innovative government-industry collaborative initiative (with support from Ireland's farming organisations) that provides agricultural advice regarding water quality.

Scientists from the Local Authority Water Programme (LAWPRO) assess rivers and streams and engage with ASSAP advisors. ASSAP advisors then work closely with farmers to identify potential issues and recommend mitigation approaches. Over 6,500 farms have been visited to date, with

an average of 5.5 issues identified per farm. Key actions implemented by farmers vary depending on the pollutant type. For phosphorus and sediment, management of critical source areas, installation of riparian buffers and fencing of watercourse to exclude cattle have been critical. For nitrogen, actions relating to implementation of a nutrient management plan, and ensuring appropriate application of organic manures, have been widely implemented. Note: Lessons learned from the ASSAP have helped inform the design of the Teagasc Better Farming For Water: 8-Actions for Change campaign (see below).

The latest River Basin Management Plan (DHLGH, 2024) highlighted that where local actions were targeted through the ASSAP, there was a greater net improvement in status of water bodies compared to the national trend.

Building on the success of the ASSAP, a new Farming For Water EIP was launched in 2024. The EIP is a collaboration between Teagasc, LAWPRO and Dairy Industry Ireland. Over the next 3-4 years the Farming For Water EIP will provide €50 million to approximately 15,000 farmers to implement a range of measures designed to help improve water quality.

Better Farming for Water: 8-actions for change: Building on the developments with understanding hydrological and biogeochemical processes; the identification of critical source areas and delivery pathways; and the lessons learned from ASSAP and similar multi-actor approaches (e.g. Duhallow Farming for Blue Dot Catchments EIP). Teagasc has developed the *"Better Farming for Water: 8-Actions for change"* water quality campaign in 2024. The objective of the campaign is to support all farmers to reduce the loads of nitrogen, phosphorous, sediment and pesticides entering the river network from agricultural sources. The 8-Actions for Change focus on nutrient management, farmyard management, and land management, and provide a structured, relatable approach for farmers to effectively engage with improving water quality.

For grassland farmers, priority actions include ensuring that there is sufficient slurry and soiled water storage capacity. Sufficient storage capacity will in turn support activities to ensure that fertiliser and organic manure are applied at appropriate times and under favourable conditions. A key action for livestock farmers is to exclude bovines from all watercourses. This action will reduce phosphorus, sediment and E. coli contributions to water. All farmers can implement mitigation actions such as riparian buffer zones. Riparian buffers help reduce nutrient and sediment inputs, whilst supporting wider ecosystem services (e.g. biodiversity and carbon storage).

Better Farming for Water is a 7-year campaign. The extended duration of the campaign aims to take into account the lag-time that occurs between the implementation of actions, and a response in water quality. Multiple environmental, climatic and anthropogenic factors can influence the lag-time response.

We have never been in a better position to address water quality. Science has enhanced our understanding of the processes that govern the generation and transport of pollutants, and identify potential mitigation actions. Tools have been developed to identify pressures and support the targeting of actions. Multi-actor approaches have demonstrated the steps needed to achieve sustained practice change. Coupled with this there is a heightened awareness and desire amongst all stakeholders, across the wider agri-food industry, to tackle water quality challenges.

References

DHLGH (2024). *Water Action Plan 2024: A River Basin Management Plan for Ireland*. Department of Housing, Local Government and Heritage.
EEA (2021). *Drivers of and pressures arising from selected key water management challenges: A European overview*. European Environment Agency.
EPA (2024a). *Ireland's State of the Environment Report 2024*. EPA 2024.
EPA (2024b). *Water Quality in 2023: An Indicators Report*, EPA 2024. 3.
Mellander, P. E., & Jordan, P. (2021). *Science of the Total Environment*, 787, 147576.
Mellander, P. E., *et al.* (2022). Irish Journal of Agricultural and Food Research, 61(1), 201-217.
Thomas, I., *et al.* (2021). EPA Research Report 396, EPA, Dublin.
IPBES (2019). *Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services*.

Page 25