NUI Galway
OÉ Gaillimh

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Further reading:

- Ireland's National Water Framework Directive Monitoring Programme, 2019-2021
- The CAP Strategic Plan 2023-2027
- the Agri-Climate Rural Environment Scheme ('ACRES')
- European Union (Drinking Water) Regulations 2014 (S.I. 122 of 2014) (as amended by European Union (Drinking Water) Regulations 2017 (S.I. 464 of 2017[25]
- Nitrates Action Programme
- National Groundwater Monitoring Programme

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Enhanced nature-based solutions to improve water quality in rural Ireland

Background

Ireland is committed to improve its position at the bottom of EU15 listing of the Sustainable Development Goals (SDG) Environment Index and to meet the targets set by the 2030 Agenda for Sustainable Development. One of the top 5 priority SDGs is SDG6: Clean Water and Sanitation, as Ireland ranks 12th on the EU15 list [1]. Water quality in Ireland has been consistently deteriorating the last 20 years and one of the major pressors is agriculture [2, 3] (Table 1).

Intense chemical fertilisation, manure land spreading, and untreated wastewater release contribute majorly to nutrient and microbial pollution. In addition, farmlands, where water pollution is at highest, are commonly separated from the water grid. Drinking water on farmland usually comes from private groundwater wells, 15% of Irish households use private water supplies [4], and the wastewater is treated in septic tanks, which are constructed in proximity to these wells. Indicatively, in 2017 43% of the groundwater monitoring sites were contaminated with faecal bacteria [5]. Regarding nutrient pollution, 47% of surface water and 24% of groundwater have high nitrate concentrations (> 25 mg/l NO_3^-), while 30% of river and lake water present unsatisfactory phosphorus concentrations [3].

Table 1 – Number of at-risk water bodies where agriculture is a significant pressure [adjusted by 5]

Waterbody (WB)	No. of WBs	No. of at-Risk WBs	No. WBs with agriculture as a significant pressure	% of WBs with agriculture as a significant pressure	% of At-Risk WBs with agriculture as a significant pressure
River	3192	1178	629	19.7%	53.4%
Lake	818	132	80	9.8%	60.6%
Transitional	195	56	32	16.4%	57.1%
Coastal	111	13	8	7.2%	61.5%
Groundwater	513	73	31	6.0%	42.5%
All WBs	4829	1452	780	16.2%	53.7%

To battle water quality deterioration, Ireland has introduced several water protection regulations, including the Nitrates Action Programme [3] and the Common Agricultural Policy (CAP) Strategic Plan [5]. In the June 2022 CAP, an Agri-Climate Rural Environment Scheme ('ACRES') was introduced to improve biodiversity and water quality as well as to promote sustainability for farms located in priority environmental areas and water vulnerable areas [6]. To achieve the 2030 goals, efforts to prevent and treat nutrient and microbial pollution in surface and groundwater need to be intensified.

Nature-Based Solutions

Nature-Based Solutions (NBS), such as river restoration, urban forestry, green walls, and constructed wetlands have been shown efficient in treating polluted water passively [7]. Additionally, they improve biodiversity by creating natural habitats and benefit human well-being by promoting socio-educational activities. Yet, constructed wetlands applied in Ireland to treat sewage, farmyard runoff and industrial effluents have presented so far limited capacity in removing nutrients [7].

Combined Nature-Based Solutions and Electrolysis for Grid-Independent Water Treatment

To accelerate and improve the NBS pollutant removal capacity as well as to decrease their surface footprint and enable reuse schemes, the integration of NBS with advanced technologies is essential. Electrolysis can boost the nutrient removal in NBS, by providing the treatment scheme with essential chemicals while requiring just an electricity input. These chemicals include O_2 to boost nitrification, H_2 to boost autotrophic denitrification and metal ions (Fe^{2+}, Al^{2+}) to aid phosphate removal (Figure 1). Furthermore, integration of electrolysis with NBS can aid disinfection and therefore decrease microbial pollution, by production of Cl_2. Thirdly, this integration provides the system with water grid independency, as the raw materials to produce the chemicals required are already provided on site, being just water, compounds contained in the water (Cl^-), or the electrodes themselves (Fe or Al). Lastly, Ireland sits in the fortunate position to be the 2nd largest producer of wind power in the world for 2020 [8], demonstrating the potential of these integrated schemes to be solely powered by renewable energy. The latter not only adds to the sustainability profile of the enhanced NBS solution, but also provides the treatment process with location independency, therefore enabling water treatment off-grid, and decarbonising the whole water treatment process scheme.

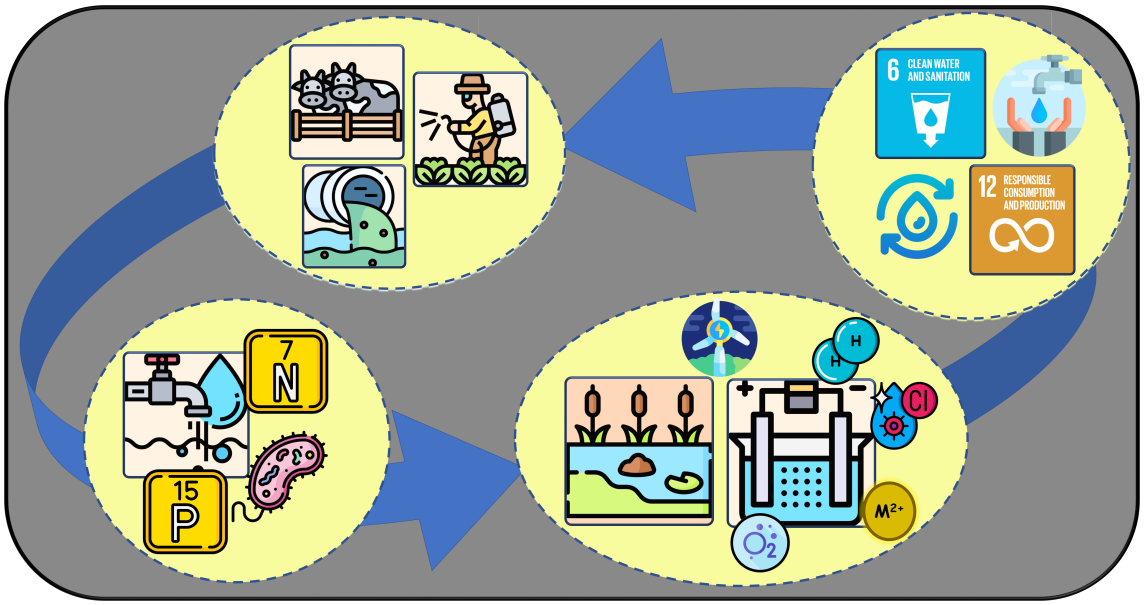

Figure 1 – Circular water treatment combining Nature-Based Solutions (NBS) with electrolysis for performance enhancement or effluent polishing, by incorporating small scale, renewable energy

Recommendations for governmental actions

- Encourage water quality awareness and education on interconnectedness of agriculture and water quality
- Engage with local farmers during the decision making process on the future of sustainable agriculture and water quality
- Expand and intensify monitoring of private septic tanks and map all sources of untreated wastewater release
- Include financial support for private well groundwater quality monitoring in current agricultural policy plans
- Initiate and enhance public funding on innovative, off-grid water treatment

The data reference links can be found below:

1. Charles M.A. Clark and Catherine Kavanagh "Measuring Progress: The Sustainable Progress Index 2020," *Soc. Justice Irel.*, p. 80, 2020.
2. Department of the Environment Climate and Communications, "Ireland's Second National Implementation Plan for the Sustainable Development Goals 2022-2024," 2022.
3. Government of Ireland, "An Overview of Ireland's Fifth Nitrates Action Programme," 2022.
4. EPA, Household Wells, https://www.epa.ie/environment-and-you/drinking-water/household-wells/)
5. "Strategic Environmental Assessment Environmental Report of the Common Agricultural Policy Strategic Plan 2023-2027," 2022.
6. "Overview Of Agri-Climate Rural Environment Scheme 'ACRES,'" 2022.
7. Heneghan et al., Biology and Environment: Proceedings of the Royal Irish Academy, 2021, Vol. 121B, No. 3 (2021), pp. 147-162
8. https://www.seai.ie/technologies/wind-energy/