Sustainable Nitrogen Alliance

Briefing: Sustainable Nitrogen Management

From Pollution to Solutions: Unlocking Benefits for People, Nature, and Climate

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"We're always scavenging for nitrogen, and we can't afford to lose any of it into the environment. Developing a system where you really want to look after your nitrogen and where you see it as gold dust – your manures as a valuable resource rather than something that has to be disposed of – actually instils a completely different mindset. It is in your farming interest too to get this right for the environment." **Helen Browning, organic livestock and arable farmer in Wiltshire, England, and Chief Executive of the Soil Association**

INTRODUCTION

Super pollutant or essential to life?

The UK is one of the most nature-depleted places in the world. Our soils are increasingly degraded, our rivers polluted, and public and environmental health impacted by noxious gases and particulates. The way we use, and waste, nitrogen is one of the key drivers of this harm. On the other hand, nitrogen is essential to life. Nitrogen gas forms 78% of the air we breathe, and the reactive compounds it forms are fundamental to producing the food we eat and are a constituent of the proteins in our diet.

However, reactive nitrogen becomes a serious environmental pollutant when fossil fuels are burned for transport and energy, fertilisers or manure are over-applied due to poor soil or nutrient management, and where wastewater treatment plants are not equipped or required to remove nitrate from their effluent. This is also related to protein consumption in the UK being around 1.5 times our dietary need with nitrogen-rich waste flowing into sewage systems and wastewater treatment plants.

From harm to harmony

Nitrogen flows through the environment in complex, interconnected ways, and tackling one source without considering others can lead to 'pollution swapping' – solving one problem while worsening another. **We urgently need a more integrated perspective** on how nitrogen pollution affects human health and air quality; nature and biodiversity - especially river health and water quality - its climate and atmospheric impacts; and the role it plays in soil and land degradation.

So far, government **efforts to address the damage caused by excessive nitrogen pollution have been siloed and imbalanced**. Nitrogen oxides (NOx) emissions have declined sharply since 2005, due to air quality and climate mitigation strategies. In recent years, attention in the UK has sharpened around the frequent and alarming discharge of untreated sewage into rivers and coastal waters, while pollution from agricultural sources – such as nitrate runoff and ammonia emissions – has remained largely under the radar. **Policy responses have followed a similarly disjointed approach, overlooking the broader, systemic nature of nitrogen pollution**.

A joined-up approach is essential – not only to **meet legal obligations and commitments** including under the Environment Act 2021, Climate Change Act 2008 and the Global Biodiversity Framework, but to **unlock co-benefits for food security, public health, and nature recovery.** This has been reiterated by the Lords Environment and Climate Change Committee's new report which recommends a holistic nitrogen strategy as well as a circular economy approach to nitrogen.

As recommended by the Committee's report, **an economy-wide nitrogen strategy is needed to integrate all policy, regulatory and legislative levers into one coherent framework.** This is projected to bring a multitude of benefits for people, nature and climate, while **a new UK Nitrogen Balance Sheet should underpin this work, quantifying nitrogen inputs and outputs** across sectors and tracking progress towards statutory targets and international commitments over time.

Achieving these targets would save money for farmers and the taxpayer, cut emissions and deliver benefits for nature and human health.

KEY POINTS

Nitrogen pollution and its impacts

- There is no pathway to reach net zero and reverse biodiversity loss that does not involve addressing nitrogen pollution. Our use of nitrogen is currently well above safe planetary limits and levels compatible with limiting global warming to 1.5°C.
- In the UK, nitrogen pollution is a driver of six of the eight priority environmental pressures identified by the Office for Environmental Protection in need of immediate government action.
- One third of UK nitrogen losses are from agricultural sources to water systems. The most widespread source of failing river health is caused by the runoff of fertilisers and manure into our rivers, which can lead to dense algae blooms that choke rivers and suffocate wildlife.
- Agriculture is also responsible for three-quarters of UK nitrous oxide emissions. Nitrous oxide (N_2O) is a potent and long-lived greenhouse gas (GHG) with a Global Warming Potential of about 273 times that of carbon dioxide over a 100-year period.
- The UN Global Nitrous Oxide Assessment warns that N_2O is now the most significant ozone-depleting substance being emitted, and that without urgent action, millions of people are at risk of being exposed to harmful UV radiation.
- Ammonia from agriculture and nitrogen oxides (NOx) from the energy, industry and transport sectors together account for 92% of the nitrogen in air pollution. Nitrogen compounds, especially nitrogen dioxide (NO_2), play a significant role in the UK's estimated 30,000 premature deaths per year linked to air pollution. In England, 99% of sensitive habitats are overloaded with nitrogen, causing biodiversity loss and species shifts, which drives a decline in the health of Sites of Special Scientific Interest (SSSI).

Sustainable nitrogen management and farmers' livelihoods

- Nitrogen pollution is not just an environmental problem, but an economic issue for farmers too. Around £420 million worth of synthetic nitrogen fertiliser is lost unintentionally each year in the UK, leaking into the environment, much of which could be saved through improved practices.
- Better use of nitrogen can be at the heart of a just and resilient agricultural transition.
- Many farmers and growers are already taking action to drive nitrogen use down and efficiency up, but we know much more can be achieved if the financial and technological support is made available.
- Proper enforcement of regulations should be rolled out alongside a comprehensive package of supportive measures, including training, targeted advice and support for peer-to-peer learning and a knowledge exchange network. This would demonstrate to farmers the benefits of working towards a balanced system which focuses on profit and Nutrient Use Efficiency (NUE) rather than maximum yield.
- The 50% uplift in the Environment Agency's targets for farm inspections in July 2025 is welcome, but there will still be 50-60% of holdings that will not be inspected this decade, even if the new target to inspect 6,000 farms annually is met. We urge the Government to simultaneously drive change across all farms through such a package of support and enforcement.
- The number of large intensive livestock 'megafarms' is continuing to grow, despite the unsustainable pollution impacts of these units, and recommendations of the Environmental Audit Committee that there should be a presumption against expansion in polluted catchments. Highly capitalised farm business models, like 'megafarms', also present attendant risks to individual farmers currently being encouraged down this route by the demand for economies of scale regardless of environmental impact. The recent Nitrogen Inquiry report supports the Corry review and the Cunliffe review recommendations for a review and gap analysis of existing regulation on agricultural water pollution and recommended that the permitting of intensive livestock farms is extended to intensive beef and dairy units.

SOLUTIONS

A system-wide approach to tackling nitrogen pollution

- The solutions to nitrogen pollution and waste as identified here would help progress each of the Department for Environment, Food and Rural Affairs' five priorities – clean rivers, lakes and seas; nature recovery; protecting communities from flooding; supporting farmers; and achieving a zero-waste economy. There are also clear links to the Government missions, most notably to 'clean energy', 'building an NHS fit for the future' (linked to public health impacts of nitrogen pollution) and 'kickstarting economic growth'.
- The House of Lords Environment and Climate Change committee has recognised the importance of efficient nitrogen management by launching an inquiry into nitrogen.
- The report, 'Nitrogen: time to reduce, recycle, reuse', published on 24 July 2025, "is a response to a widely perceived failure of successive Governments to effectively manage nitrogen pollution". The select committee calls for a holistic nitrogen strategy having found that a piecemeal approach to nitrogen management and regulation has led to an ineffective regulatory framework, with poor enforcement. The report also recommends a circular economy approach to nitrogen management.
- There is a need for a cross-economic strategy to reduce nitrogen pollution to meet relevant air quality, water quality, biodiversity and climate targets, while incentivising a more sustainable and nature-friendly agricultural system that also delivers higher animal welfare.
- A Nitrogen Balance Sheet (see below) implemented using a similar methodology to the Scottish Nitrogen Balance Sheet, which has been enshrined in law, would calculate the stocks and flows of nitrogen across the environment and the economy. The Sustainable Nitrogen Alliance has commissioned a provisional UK Nitrogen Balance Sheet, which enables the prioritisation of policy actions that provide the greatest reductions in nitrogen loss to the environment. Nitrogen balance sheets and nitrogen budgets can also help identify synergies and trade-offs and inform the development of more integrated policies and abatement strategies.
- A cross-economy plan to halve nitrogen waste, backed by new nitrogen budgets at various scales that operate in a similar way to carbon budgets, would save money for farmers and the taxpayer, cut emissions and deliver benefits for nature and human health.

A circular economy approach to nitrogen

- There is growing recognition that reactive nitrogen is also a valuable resource – which is currently being wasted at a vast scale.
- The agricultural sector demonstrates an average nitrogen use efficiency (NUE) of around 55% for crop production, and only 6-37% for animal products. When considering a full-lifecycle approach, from the creation of reactive nitrogen to its intended use for crops, this decreases to 11% with the remaining 89% lost to the environment in varying forms. In addition to an environmental and social cost, this represents the loss of a valuable resource for farmers.
- The overuse and waste of nitrogen across the UK agri-food chain would be worth approximately £2.3 billion each year to buy as fertiliser, equivalent to around half of all annual agricultural profits and the equivalent of the Government's current farming budget.
- The inclusion of enabling nutrient circularity (including nitrogen) in the Government's Circular Economy Strategy is welcome, signalling a clear recognition of the need and opportunity to recover and recycle nitrogen in agriculture more effectively, viewing it as a resource rather than a waste product.
- It remains vital that the 'waste hierarchy' is applied to this work, with reduction being given top priority. That also means applying recycled sources of nitrogen such as animal manure to land to reduce reliance on manufactured fertiliser and using food waste to replace imported protein feed used in animal farming, thereby improving nitrogen use efficiency. Applying animal manure directly, provided environmental regulations are followed, can also improve soil health and carbon storage.
- Technologies like anaerobic digestion (AD) and making fertiliser pellets from animal waste have been proposed as a route to manage manures, including enabling transportation of nutrients to other areas. However, AD plants require that crops are grown specifically for 'feeding' the plant, in combination with manure. Typically, maize is used, which is classified as a 'high risk crop' for erosion and nitrogen pollution and can displace crops grown directly for human consumption on the same land.
- There is a particular concern around energy recovery from manure incineration and its potential for 'pollution swapping' - burning a useful nutrient rich resource for energy recovery would mean not cycling those nutrients in agriculture, generating air pollution from nitrogen (and CO_2

emissions), and creating phosphorous rich ash that would have to be disposed of some other way.
- To realise the full potential of nitrogen within a circular economy, policies must be designed to prevent unintended consequences and avoid pollution swapping – ensuring that solutions in one sector do not drive environmental harm in another, as highlighted above.
- A holistic nitrogen strategy across sectors to halve nitrogen waste would support this and could also be well-aligned with the Government's circular economy roadmap for the agri-food sector, which is proposing an intervention to enable nutrient circularity.

TARGETS AND COMMITMENTS

- Through the Environment Act 2021, England has a legally binding target to directly address nutrient pollution in the water environment by reducing nitrogen, phosphorous and sediment pollution from agriculture by at least 40% (against a 2018 baseline).
    - January 2028 interim targets require England to reduce nitrogen pollution from agriculture into the water environment by 10%, compared to a 2018 baseline.
    - In catchments containing protected sites (like SSSIs) that are in unfavourable condition due to nutrient pollution, the target is 15% reduction by the same date.
- Under the National Emission Ceilings Regulations 2018, the UK is legally committed to reduce nitrogen oxides (NO_x) emissions by 73% by 2030, compared to 2005 levels and ammonia emissions by 16% by 2030. England does not currently have a specific numerical target for reducing nitrogen dioxide (NO_2) emissions but is pursuing reductions through a combination of statutory air quality standards, locally enforced action plans, and national strategies for clean transport and air.
    - The Environment Act 2021 also sets targets for reducing $PM_{2.5}$ annual mean concentration and population exposure reduction by 2040. As ammonia can contribute significantly to the formation of $PM_{2.5}$, reducing ammonia emissions is essential to achieving these targets.
    - Under Target 7 of the Global Biodiversity Framework (GBF), the UK has committed to reducing pollution to levels that are not harmful to biodiversity and ecosystem functions by 2030 with a specific focus on nutrient pollution, including nitrogen. The commitment also entails halving excess nutrients lost to the environment by 2030.
    - The Climate Change Committee's Seventh Carbon budget 'balanced pathway' involves almost halving nitrous oxide (N_2O) emissions from 2025 to 2050.
    - Currently, the UK is off-track in meeting several of its nitrogen pollution targets.

FURTHER INFORMATION

The Sustainable Nitrogen Alliance (SNA) is a group of environmental, public health and climate-focused organisations offering solutions to excessive nitrogen use and pollution in the UK. Members include WWF-UK, the Soil Association, Plantlife, ClientEarth, the Woodland Trust, RSPB, Sustain, The Wildlife Trusts, the Chartered Institute for Environmental Health, the Sustainable Food Trust, Wildlife and Countryside Link, the Environmental Investigation Agency and Compassion in World Farming. Professor Kevin Hicks, Senior Research Fellow at the Stockholm Environment Institute at York, University of York, and an author on the forthcoming International Nitrogen Assessment, acts as the group's scientific advisor.

To receive further information or if you're interested in opportunities to raise awareness of nitrogen pollution, please contact Ellie Roxburgh, eroxburgh@soilassociation.org