

A Nitrogen Budget for Scotland

Seminar Report



Nourish Scotland, prepared in cooperation with the Centre for Ecology & Hydrology.

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Background

Nourish Scotland, alongside our partners in Stop Climate Chaos Scotland, are calling on the Scottish Government to commit to developing a nitrogen budget for Scotland in the new Climate Change Bill. On 8th November 2017, we convened a seminar with scientific experts, farming and industry representatives, civil society, and policy-makers from Government and Parliament to consider how a N budget would help Scotland cut its nitrogen pollution.

For more background information, visit www.nourishscotland.org/campaigns/act-for-our-future/ where you will find a briefing prepared by Nourish ahead of the meeting ‘A Nitrogen Budget for Scotland’ as well as the seminar’s video recording of Prof Mark Sutton and Dr Ulli Dragosits from the Centre for Ecology & Hydrology and their visual presentations.

Participants

Andrew Bauer	NFU Scotland
Olga Bloemen	Nourish Scotland
Paul Daly	Scottish Rural Action
Damon Davies	SPICe
Dr Ulli Dragosits	Centre for Ecology & Hydrology
Sarah Govan	ClimateXChange
Mags Hall	Office of Mark Ruskell MSP
Ragne Low	ClimateXChange
Keith McWhinnie	Scottish Government
David Michie	Soil Association
Jack Middleton	Office of Graeme Dey MSP
Andrew Midgley	Scottish Land and Estates
Kevin Mills	Agricultural Industries Confederation
Andrea Moring	University of Edinburgh
Celia Nyssens	Nourish Scotland
Robin Parker	WWF Scotland
Prof Dave Reay	University of Edinburgh (moderator)
Prof Bob Rees	SRUC
Pete Ritchie	Nourish Scotland
Peter Ross	Film-maker
Prof Mark Sutton	Centre for Ecology & Hydrology
Dr Kairsty Topp	SRUC

Key points of discussion

What is a nitrogen budget?

A nitrogen (N) budget is usually represented as a flow diagram that shows the movements of nitrogen across sectors of the economy and the environment, highlighting the inputs and outputs as well as unintended losses of nitrogen. The flows vary in size, based on aggregated Scotland-wide data, or where data is not available based on experts’ best judgement.

The word budget refers to the **accountancy** of what goes in and out, and where it goes: in our food as intended, or lost to the environment in the process. Early questions at the seminar made clear that this terminology could lead to confusion, suggesting that it might be helpful to use a different name.

N budgets can be made at various **scales**; the topic of this seminar was a nitrogen budget *for Scotland*, which would show the in-through-out movements of nitrogen for the whole country, not

at a farm-level. Further discussion may be devoted in future to consider how farm scale nitrogen budgeting could provide decision support for farmers.

How does a N budget serve us to improve nitrogen use efficiency?

Nitrogen budgets in themselves don't reduce nitrogen pollution, they provide a picture of how we use and waste nitrogen. That picture, however, is a critical tool for evidence-based policy-making: as Prof Dave Reay pointed out, "you can't manage what you don't measure".

- A nitrogen budget for Scotland would unpack the complexity of nitrogen flows across ecosystems and sectors of the economy. By doing so, it would show the synergies and trade-offs between different flows of N. The data gathered to develop the budget would also contain useful information about geographical and seasonal differences.
- A national N budget would focus political and societal attention. It shows the scale of the problem and the 'scenarios of achievability'. It should be used to inform a democratic discussion that sets our ambition and builds consensus on the course of action. The N budget also builds confidence that action will deliver the intended goal by showing where the biggest inefficiencies occur in the system, the 'big wins', that a set of targeted measures can address in a highly cost-effective way.
- Developing this tool would mobilise the scientific community so that experts on specific areas would consider the whole system, thereby catalysing interdisciplinary collaboration and connections that will benefit our understanding of the issue and the scientific recommendations for policy-making.
- Further, as Andrew Bauer pointed out, we don't currently know what is happening on farms, so further research would enable us to improve our baseline understanding.
- Finally, as the N budget is developed, the 'knowledge gaps' and priorities for further research would become clear. In successive iterations of the N budget, our knowledge of N flows would improve and progress would be monitored, allowing for greater targeting in policy-making and democratic scrutiny.

Another way to put this is to make the parallel with climate change, as Pete Ritchie explained: "We didn't start acting on climate change until the IPCC reports told us where we're emitting a lot, where emissions are increasing and decreasing, and where the win-win solutions are. The IPCC mobilised action."

How does one make a N budget, why don't we already have one?

To accurately inform policy, a Scottish nitrogen budget would require high quality data and a strong methodology. This cannot be achieved without the minimum necessary resources being committed to the task. Scotland has a wealth of scientific expertise in this field: in the world-renowned Centre for Ecology & Hydrology, the SRUC, the James Hutton Institute, and our various universities, but their work is bound to the funding available, and so many of our experts work on international projects backed by EU or UN funding. A commitment from the Scottish Government to fund the research project to develop a Scottish N budget is critical to enable the nitrogen experts to deliver the task together.

Dr Ulli Dragosits explained that while some of the necessary data is already available or can be extrapolated from UK data (fertiliser use, animal numbers, emissions inventories, food and feed statistics), much the information needed to make a reliable N budget is lacking (e.g. movements of N_r through the environment and ecosystems). There is enough information to develop a rough picture of the issue, but to take account of trade-offs and synergies properly, we need more and better data.

Various questions remained open at the seminar, which should be looked at in further discussion between scientists, stakeholders, and policy-makers:

- What level of accuracy and precision in the measurements of N flows do we **need** to inform policy-making? 'How good is good enough?'
- What level of accuracy and precision do we **want**? The more accurate, the better able we would be to design targeted measures, but that would mean a higher cost to develop the budget.
- At what frequency would we want to have successive budgets for progress monitoring: every 2, 5, 10 years?
- The key, overarching question, as Prof Mark Sutton pointed out, is 'how far do we want to get and how quickly, with regard to mitigation for a cleaner environment'. Working toward a political consensus on the level of ambition can then provide the starting point guide the choice of measures and data that need to be considered.

How much would it cost?

The cost of developing the N budget would depend on the level of precision required, and should be examined in further discussion with experts at the CEH and SRUC for example.

Public support will be necessary to help bring technologies to the market for better recycling of N from sewage, combustion, and in farming. Changes in practice, and equipment and infrastructure upgrade in farming will also need to be incentivised and facilitated with public money. However, Prof Sutton stressed that this support should very much be seen as an investment, as it will have positive return, similarly to investments in renewable energy technologies.

Why should we prioritise this issue?

Nitrogen is a valuable nutrient, which we use inefficiently. Nitrogen Use Efficiency (NUE) is the ratio between inputs and outputs, and can be measured at different levels: crop, field, farm, or national full chain (which includes non-food sectors). 100% NUE at the national full chain level would mean that for every 10kg of N entering our food system we would get 10kg in food for human consumption, that nitrogen in manure, animal carcasses, food waste, and sewage would be fully recycled, and that we would capture and recycle nitrogen emitted by burning fossil fuels in transport and energy production. Our current national full chain NUE is only roughly 20-25%. While 100% full chain NUE is not a realistic target, there is considerable scope for improvement.

Our inefficient use of nitrogen is causing considerable damage to our environment and our health, and it is uneconomical for all of us. Tackling N pollution by improving NUE would bring a whole suite of win-wins:

- Improving NUE and reducing air pollution by agriculture and combustion would prevent many lung and cardiovascular diseases, which would benefit our NHS and broader economy.
- Losses of nitrogen to the environment are also harmful to biodiversity: excesses of nitrogen cause eutrophication in rivers, coastal waters, and terrestrial ecosystems which harms fragile ecosystems and affects our fisheries.
- Improving efficiency in farming will contribute to improving profitability. Farmers could save considerable amounts of money by buying in less manufactured fertiliser if we recycle nutrients better and support them to manage nutrients more sparingly.
- Measures to improve animal health lead to both productivity and NUE increases.
- Precision-farming provide a great opportunity to improve N efficiency and vice versa, as Prof Bob Rees pointed out. On this point, Bauer noted that while the Scottish horticulture, vegetable, and cereals sector have embraced precision-farming, uptake in the livestock sector has been slower due to a lack of profitability and more conservative mindsets.
- Improving NUE fits perfectly with Scotland's circular economy ambition, and leadership from Government will lead to innovation and new business opportunities that are tailored to the Scottish context and focused on nutrients recycling and NUE solutions. Prof Sutton

demonstrated this point by highlighting various examples of countries where Government leadership in tackling N pollution led to innovation and job creation.

What is the role of the Scottish Government?

Leadership from the Scottish Government is necessary to stir public and private action and investment. The parallels with climate change are striking: we need the Government to set a clear and ambitious direction of travel, including regulation where needed, to enable farmers and other industry stakeholders to plan and invest for the long-term. While initial financial support from Government will be necessary to help farmers make investments, to develop the necessary infrastructure (e.g. anaerobic digestion hubs), and to bring new technologies to market, in the long term the savings from improved efficiency and the jobs created in new circular economy businesses will pay off any initial cost.

A **joined-up approach** is needed to harness the full benefit of measures taken. Ritchie stressed that the approach so far, which mostly focuses on guidance and voluntary action, has not led to a significant decline in excess nitrogen. Measures such as the Beef Efficiency Scheme, and the Nitrate Vulnerable Zones are a good start, but have not achieved significant improvements in NUE because they were developed without taking account of the whole system. A joined-up approach to NUE improvement is critical to avoid negative impacts of individual measures and to consciously mitigate trade-offs.

Concerns were raised by Andrew Midgley and Bauer that this would be another example of 'Government doing stuff to people'. Midgley warned that getting this issue in legislation could mean a purely top-down approach, which would antagonise farmers. They called for a collaborative approach: getting farmers on board through early outreach and moving together towards an agreed goal. We therefore need Government to lead a **democratic consultation process** where all stakeholders are consulted to agree on the right level of ambition and the course of action, informed by the nitrogen budget.

What's the legislative and policy context?

Is climate legislation or policy the right place for tackling nitrogen pollution? "What's unique and uniquely challenging about N is that it links climate change, air pollution, biodiversity, and water pollution" Prof Sutton told us. Climate legislation is thus not the only vehicle for action, but it is a highly relevant one. Indeed, one of the ways in which N escapes into the environment is as nitrous oxide, N₂O, a potent greenhouse gas, which accounted for 7.7% of Scotland's net GHG emissions in 2015. Furthermore, Prof Sutton explained that when a group of experts was asked to look at the best measures to drive down N₂O emissions, their conclusion was that the single best solution was to improve the efficiency of the overall system. Because N flows are so complex, they argued that we cannot reduce N₂O on its own without understanding the trade-offs and synergies.

The Scottish Government published their draft Climate Change Plan (RPP3) in January 2017. Keith McWhinnie brought to our attention that the draft Plan contained various policies and proposals related to NUE (See appendix for the policies and proposals related to N). McWhinnie assured that the Government was not going to remove them from the final Plan. Jim Densham and Ritchie expressed their support for these policies and proposals, but both felt the Climate Change Plan lacked a clear sense of ambition and a joined-up approach. When asked about the commitment to "develop a science-based target for reducing emissions from nitrogen fertiliser" (policy 2 of policy outcome 2), McWhinnie said that developing a national nitrogen budget was being considered as an option.

Densham explained that Stop Climate Chaos Scotland (SCCS) decided to campaign for a N budget to be included in the Climate Change Bill because the approach in the draft Plan regarding agriculture remained mostly voluntary and had limited ambition, compared to most

sectors, which are facing big cuts in GHG emissions and mandatory measures. He called on Government “to set a fair and clear level of ambition for agriculture”. Whether this is most appropriate to be done in the Plan or the Bill was unclear, but Ritchie emphasised that while action on N pollution doesn’t need to start with regulation, it needs to start with ambition and better understanding: “Higher aspirations drive innovation and investment. We want a prosperous, green Scotland”.

Another policy area that is highly relevant to these discussions is agricultural policy, in particular in the context of Brexit. Scotland will have a key chance in the next few years to rethink and reshape the way it supports farmers. David Michie pointed out that the policy landscape change post-Brexit can help focus minds towards improving profitability and efficiency. Bauer said that NUE improvements should be seen as a public-good, so that farmers can receive public support to deliver a better outcome. Ritchie and Densham were supportive, highlighting that reducing excess N in the environment would be hugely beneficial for plant and aquatic life. Ritchie referred everyone to Scottish Environment Link’s position paper ‘Future of Farming and Rural Land Use in Scotland’, which “is a very clear statement that we want to see a profitable and resource use-efficient farming sector in Scotland and absolutely see the need for investment in a transition period to get farmers currently dependent on subsidies up and running post-2020 so they can deliver higher levels public goods.”

How do we move this agenda forward beyond the development of the N budget?

Agriculture accounts for the lion’s share of nitrogen use and losses, but transport, energy, food waste, and waste water treatment will also be important sectors to look in order to improve nitrogen use efficiency across the economy. Kevin Mills pointed out that other nutrients, notably phosphorus (P) and potassium (K) are important too. Prof Sutton agreed, noting that those other nutrients are easier to manage (“P is only a water pollution issue”) and should be addressed by policies to improve resource use efficiency.

The N budget should be used to inform policy, which can include a mix of regulation, financial support, market-based measures, and information campaigns through advice and extension services.

Prof Sutton stressed that it is important to find the right balance between a mandatory and voluntary approach. An exclusive focus on one or the other may lead to problems (e.g. a fully mandatory approach may allow ambitious progress but can polarize opinion, leading to resistance; a fully voluntary approach may appear appealing, but lead to little progress or higher transaction costs to monitor progress). This advice resonated with other attendees, and there was strong consensus on the need to accompany regulation with the right support, and to build a common sense of direction amongst all stakeholders:

- Bauer: “We need to switch people on to this agenda, help them see the value of it so that they take ownership and invest their own money into solutions. Farmers can get behind measures such as soil testing and developing better understanding of the baseline on farms, with the right advisory support”
- Midgley: “Developing a budget won’t necessarily drive a regulatory burden, it could lead to other measures, eg. better financial support and behaviour change in farmers through advice. It’s a culture issue, it’s about developing a common goal and using the different levers to achieve it collaboratively.”
- Michie: “Extension and advice services are crucial: advice is a very good way to bring people along with you, to identify win-wins. It is also key to give land managers ownership of the solutions”

The technological solutions put forward by Prof Sutton, such as low emissions land spreading and better slurry storage, were met by caution with Bauer: “compulsory slurry storage or high

tech spreading techniques would meet fierce opposition from farmers.” Celia Nyssens pointed out that these changes in farm infrastructure and equipment should be considered in the context of a long-term transition, as with the example of phasing out fossil fuel cars, a clear indication of the direction of travel from Government would be key to catalyse investment and the development of appropriate technology for the Scottish context, with the objective to achieve change in the next 15 years for example.

Moving forward, it will be key to reach out to the farming community and gather support for action on nitrogen. On this, AB warned against using language and examples that would switch farmers off, recommending to use international examples that Scottish farmers could relate to. He also indicated that the word ‘budget’ might not be appropriate.

Appendix: Excerpt from the Scottish Government’s Climate Change

Plan (the full document can be downloaded from: www.gov.scot/Publications/2017/01/2768)

Policy outcome 2: Emissions from nitrogen fertiliser will have fallen through a combination of improved understanding, reduced application and better soil. (page 137)

Policies which contribute to the delivery of policy outcome 2

- 1) Communicate and demonstrate the benefits of precision farming and nitrogen use efficiency in order to achieve a reduction in nitrous oxide emissions.
- 2) Work with industry to develop a science-based target for reducing emissions from nitrogen fertiliser, by establishing the amount of nitrogen fertiliser Scottish soils need to produce an economically optimal crop, taking account of good practice in soil management.
- 3) From 2018 we will expect farmers to test the soil in all improved land every 5/6 years, and will work with them to establish how best to achieve this. This will be for pH, and we will consult on including testing for potassium and phosphorus.

Proposals which contribute to the delivery of policy outcome 2

- 1) Minimum leguminous crops in rotation.
- 2) Plant varieties with improved Nitrogen-use efficiency.

Policy outcome 3: Work with Quality Meat Scotland and others to reduce emissions from red meat and dairy through improved emissions intensity. (page 138)

Policies which contribute to the delivery of policy outcome 3

- 1) In 2017, publish emissions intensity figures for beef, lamb and milk.
- 1) By working with Quality Meat Scotland and livestock producers, we will encourage improved emissions intensity through genotyping, improving fertility, reducing animal mortality and improving farm management practices.

Policy development milestones which contribute to the delivery of policy outcome 3

- 1) Establish target for reduction in the intensity of emissions for beef, sheep and dairy sectors.
- 2) Consult in 2017 to determine the nature of livestock health measures that the sector will adopt from 2018.

Proposal which contributes to the delivery of policy outcome 3

- 1) Livestock feed additives to reduce methane.

Policy outcome 4: Emissions from the use and storage of manure and slurry will have been reduced.

Policy development milestones which contribute to the delivery of policy outcome 4

- 1) Determine the potential feasibility of self-financing large-scale anaerobic digesters.
- 2) Engaging with farmers to explore their support requirements, establish how they can improve the use and storage of manure and slurry, including the potential for cooperatively owned and managed anaerobic digesters.

Proposals which contribute to the delivery of policy outcome 4

- 1) Inclusion of livestock grazing in rotation on current arable land.
- 2) Conduct a feasibility study for the establishment of manure/slurry exchange.
- 3) Determine how to consistently minimise emissions from slurry storage.