Nitrogen Deposition and the Nature Directives

Impacts and Responses: Our shared experiences

Department for Environment Food & Rural Affairs

JNCC Joint Nature Conservation Committee

NATURA 2000

Theme 2: Working Group 4: Measures for reducing impacts from agriculture

Zoe Russell, Natural England, UK

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The workshop is being organised by JNCC on behalf of the UK Government, Devolved Administrations and country nature conservation bodies, in collaboration with the Dutch Ministry of Economic Affairs and in co-operation with the Task Force on Reactive Nitrogen.

1. Summary

Nitrogen is essential for feeding the world's steadily growing population, yet it is also a source of air, soil and water pollution.

It is a challenge to sustain or increase food production and at the same time reduce losses of reactive nitrogen to the environment, but there are many potential benefits associated with improving nitrogen use efficiency.

Many techniques/measures are being explored and implemented to reduce nitrogen emissions from agriculture in Europe, based around low emission animal housing, management and feeding strategies, low emission manure/slurry management and storage, and low emission land spreading/soil management techniques. Guidance on identifying ammonia (NH_3) control measures is provided by the UNECE and European Commission, and within national documents.

This working group aims to share knowledge and experience around the implementation of these measures, building on the work of other international groups.

2. Introduction

Agriculture in Europe contributes, on average, about 80 to 90% of the total emissions of ammonia (NH_3) into the atmosphere (Oenema *et al,* 2007). Ammonia dominates atmospheric nitrogen deposition to semi-natural vegetation in agricultural areas, especially in northern Europe. Most of the ammonia originates from animal manure in stables, from manure storage systems and from the application of animal manure to agricultural land. Mineral nitrogen fertilizers also contribute to ammonia emissions.

(Reactive) nitrogen has well documented positive effects in agricultural production systems, human nutrition and food security. Nitrogen, along with other plant nutrients, is essential for plant growth and is needed to achieve optimum crop yields. However, only a fraction (on average 40-50%, (Oenema, 2007)) of the nitrogen input via fertilizers and animal manure to agricultural land is utilized for crop production; the remainder is lost to the environment. Excess nitrogen, in its various forms, plays a major role in a number of environmental issues including: the loss of biodiversity, eutrophication of waters and soils, drinking water pollution, acidification, greenhouse gas emissions, human health risks from exposure to NO_X, ozone and particulates, and destruction of the ozone layer (Sutton *et al*, 2009). The European Nitrogen Assessment (Sutton *et al*, 2011) identified five key societal threats associated with excess reactive nitrogen in the environment: water quality, air quality, greenhouse gas balance, ecosystems and biodiversity, and soil quality.

The UNECE Gothenburg Protocol (Protocol to Abate Acidification, Eutrophication and Ground-level Ozone adopted in 1999, revised in 2012) contains a series of mandatory control measures that the Parties shall employ for the control of ammonia emissions from

agricultural sources. It also requires parties to establish, publish and disseminate an advisory code of good agricultural practice to control ammonia emissions. Furthermore, the National Emission Ceilings Directive 2001/81/EC (NECD), currently under revision, includes a 'ceiling' for ammonia emissions. Emissions from the larger intensive agricultural units/installations are regulated under the EU Directive on Integrated Pollution Prevention and Control (IPPC) (2008/1/EC)[1]. It requires each installation to have a permit containing emission limit values and other conditions based on the application of Best Available Techniques (BAT), as guided by European guidance notes (BREFs), set to minimise emissions of pollutants to air, water or land.

The Nitrates Directive, adopted by the European Union in 1991, is aimed at protecting water quality across Europe by preventing nitrates from agricultural sources polluting ground and surface waters and by promoting the use of good farming practices. The implementation of the Nitrates Directive is expected to contribute to the reduction of ammonia emissions[2] as measures limiting, for example, amounts of fertiliser applied, have in general a positive impact on both nitrate losses towards waters and ammonia emissions into the air. The Common Agricultural Policy (CAP) aids the Nitrates Directive, and drives positive environmental change, through direct support and rural development measures. Reducing nitrates is also an integral part of the EU Water Framework Directive (2000) which establishes a comprehensive approach to water protection, organised around river basin districts (RBDs), with the aim of achieving good status for European bodies of water by 2015. The Water Framework Directive will have implications for farming practices and land management as well as water management.

Options for future policy development to manage and mitigate the impacts of nitrogen deposition effects on the Natura 2000 network were discussed at an international workshop (COST 729) in Brussels 2009. The European Nitrogen Assessment (2011) concluded that there is still a large potential for increased nitrogen efficiency (and reduced nitrogen emissions) in European agriculture and of the seven key actions recommended to further develop an integrated approach to nitrogen management, three were related to the agricultural sector: i) improving nitrogen use efficiency[3] in crop production, ii) improving nitrogen use efficiency in animal production, and iii) increasing the fertiliser nitrogen equivalence value[4] of animal manure.

Technologies are available, and are being increasingly employed, to reduce the impact of nitrogen emissions from farming in Europe. These include management strategies, involving nitrogen conserving field practices (e.g. catch crops, reduced soil tillage, better timing of nitrogen inputs etc.), modifications to livestock diets (decreasing nitrogen excretion rates), enhanced manure nitrogen use efficiency through improved environmental technologies (the management, recycling and field application of manures etc.). Many different technologies

[1] In December 2010, the Directive on Industrial Emissions (integrated pollution prevention and control) (Recast) (2010/75/EU) combined the original IPPC Directive with six other Directives.
[2] http://ec.europa.eu/environment/pubs/pdf/factsheets/nitrates.pdf
[3] The ratio of nitrogen input and output of a system. The nitrogen use efficiency (NUE) at farm level indicates how well the imported N on the farm is used to produce crops and animal products (milk, meat and egg).
[4] The fertilizer nitrogen (N) equivalence values for manure (and crop residues) indicate how well manure N (and N from crop residues) are used, relative to the reference fertilizer (ammonium nitrate (NH_4NO_3) based fertilizers), which is set 1 (100%). A high value is indicative for a high N use efficiency, a low value is indicative for a low N use efficiency. The fertilizer N equivalence value depends on the type and origin of manure, crop type, environmental conditions, and management, (i.e. the time and method of application).

to reduce livestock stable/housing and manure/slurry storage emissions have been tested and are increasingly being implemented. These include reducing the fouled surface areas in animal houses, covering manure stores, acidification of slurry to reduce pH, slurry separation, anaerobic digestion, fitting ammonia scrubbers etc. The positive effect of drying poultry manure on lowering emissions has also been demonstrated in pilot studies and on practical farms (Sutton *et al,* 2011). Increasingly, a whole farm/system approach is being considered (i.e. considering the entire nitrogen cycle and the potential for emissions at different stages). Tree buffers, although not necessarily reducing ammonia emissions, have also been shown to capture ammonia and/or reduce dispersion[5].

There are clear economic (ammonia emissions represent a loss of valuable nitrogen), as well as environmental benefits of more efficient nitrogen use in farming. Some of the techniques aimed at reducing nitrogen losses have been shown to have other advantages for farmers such as providing energy, reducing fuel costs or increasing the total fertiliser value of manure. This is in addition to the benefits through protecting water quality etc.

The UNECE provides guidance to the Parties of the Gothenburg Protocol on identifying options and techniques for preventing or reducing releases of ammonia from the agricultural sector (prepared by the Expert Group on Ammonia Abatement), covering dairy, beef, pig and poultry farming. The European Commission also produces a Best Available Techniques reference document (BREF, 2013) for intensive livestock, which must be taken into account when determining 'best available techniques' under the IPPC/Industrial Emissions Directives ('BAT conclusions') and provides information on emerging techniques. The BREF covers feeding strategies, housing systems, storage, on-farm treatment and land spreading of manure and slurry etc., for poultry and pigs. BAT is a dynamic concept and so the review of BREFs is a continuing process. The Task Force on Reactive Nitrogen, the International Nitrogen Initiative and Nitrogen in Europe (Nine) also provide guidance on how to reduce nitrogen pollution and protect human health and the environment.

This 'Nitrogen Deposition and the Nature Directives Workshop', and Working Group 4 on agriculture, provides an exciting opportunity to discuss not only *what* measures and techniques countries are adopting but also *how* they are being implemented, in the context of biodiversity protection.

Farming systems within the Europe Union are diverse, occupying wide ranges of climate, soil type, topography and management practises. Member States have different national legislation and policies, and may face different political and societal pressures. However there are important similarities, and common goals, and this workshop provides a valuable opportunity for sharing knowledge and experience of implementing approaches to manage nitrogen emissions from agricultural sources.

[5] http://www.pik-potsdam.de/avec/peyresq2005/talks/0926/sutton/literature/trees_for_nh3.pdf; http://www.nitrogen2011.org/_poster_presentations/S12_Famulari.pdf

3. Objectives of the working group

The aim of this working group is to share knowledge and experience from implementing measures and programmes to reduce atmospheric ammonia emissions (and the associated nitrogen deposition) from agricultural sources. It is to build upon work already undertaken by expert groups under the UNECE and EU and to share experience of how Member States are taking this work forward.

The objectives include:

i) to explore what range of measures have been implemented to reduce nitrogen emissions/deposition from agriculture, whether these have been delivered through regulatory, voluntary or incentive and grant schemes, and how effective they have been at driving down emissions/deposition at the national and local levels;

ii) to examine how the need for sustainable agricultural practices can be delivered alongside the need for agricultural growth and increased production, and other challenges around the uptake and implementation of measures to reduce ammonia emissions;

iii) to share information and thinking on any innovative techniques and approaches being explored or piloted in this area;

Scope: It is acknowledged that crop/livestock type and species, crop nitrogen response, farm type and management, soil type, climate etc. vary significantly between field, farms, regions and countries. We will therefore need to consider a range of different farm types and situations. In discussing the implementation of measures to reduce ammonia emissions, we will consider crop management, soil management, animal management and housing systems, manure/slurry management, and landscape options (e.g. tree buffers) around farms or Natura 2000 sites. We will also cover the range of environmental instruments including regulatory, economic and communicative/voluntary aspects. We will not look at habitat management, as this is covered by another Working Group (Working Group 7).

4. Discussion points

Members of this working group are asked to discuss:

i) experience around the implementation of programmes and measures to reduce ammonia emissions from agriculture, and the level of success achieved. This is with a view to identifying key ingredients for successful uptake and implementation;

ii) the most effective 'levers' and delivery mechanisms, and the relative success of improving farm management through a) legislation and regulation ('the polluter pays principle', b) incentive and grant schemes and c) voluntary schemes offering advice and guidance to farmers. Furthermore, whether any specific 'targeting' is required in terms of delivery and support, in the context of seeking cost effective benefits for biodiversity;

iii) how much farmer education, advice, training and skills development is required to support any implementation programme, and whether any such advice can be generic or has to be bespoke to the farm/area;

iv) how to measure outcomes, e.g. how well we can record the effectiveness of the action taken (especially through advice and voluntary approaches);

v) innovative approaches or new/novel measures with potential for future use;

vi) the challenge of delivering sustainable agriculture alongside agricultural growth, and what is being down at the national and European level to support this.

5. How the group will operate

Members of the group are invited to provide a short (5-10 minute) presentation on experiences from within their country of reducing nitrogen emissions/deposition specifically from agriculture. Members are asked to bring examples/case studies to illustrate their approaches, including information on:

i) the key farm types and farming systems in their country (an overview) and how spatially these relate to Natura 2000 sites/areas. Information on the current 'status' of the farming industry may also provide useful context (e.g. are certain sectors expanding or in decline?);

ii) examples of any national or local implementation programmes to directly or indirectly reduce ammonia emissions from farming, the range of measures they include (and don't include) and the farming sectors they apply to;

iii) levers for implementation (regulation/incentives/advice), any funding provision, and whether there is any specific targeting of measures. Whether the Habitats Directive has been used to drive this action;

iv) evidence of effectiveness in terms of a) farmer uptake and b) reducing ammonia emissions/N deposition at the local or national level. Evidence of any significant co-benefits or trade-offs;

v) any barriers to the uptake of measures or other implementation challenges, and how they have or are being overcome;

vi) the effect on and engagement with the farming industry; any associated farm advice programmes and tools.

A digital projector and power point will be provided. Presenters are encouraged to bring printed handouts of their presentation, so these can be circulated amongst the group. However, delegates may wish to make a more informal presentation for example, a short report, without the use of slides.

Following the presentations, we will discuss any similarities and differences in our approaches and experiences around the implementation of ammonia reduction measures, and any elements that may be transferable to other countries, and work through the discussion points listed above.

Towards the end of the session, we will agree on a selection of key messages and recommendations to present to the rest of the workshop participants, and collect references for case studies/pilots, innovation programme reports etc. to include in the published workshop report.

6. References

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