Chapter I: Overview for policymakers

Nitrogen opportunities for agriculture, food and environment

Mark A. Sutton, Cláudia M. d. S. Cordovil, Tommy Dalgaard, Clare M. Howard, Barbara Amon, Shabtai Bittman, Tom Misselbrook and Oene Oenema

Goals and context

- Integrated sustainable nitrogen management offers the opportunity to link the multiple benefits of better nitrogen (N) use from environmental, economic and health perspectives, helping to avoid policy trade-offs while maximizing synergies.
- By demonstrating the multiple benefits of taking action on nitrogen, a much stronger mobilization for change is expected, catalysing progress towards many of the United Nations Sustainable Development Goals.
- The present document has been prepared under the lead of the United Nations Economic Commission for Europe (UNECE) Convention on Long-range Transboundary Air Pollution (Air Convention) as part of its work to reduce air pollution impacts, including from acidification, eutrophication, ground-level ozone and particulate matter (PM), as these affect human health, biodiversity and economy.
- There are multiple co-benefits of taking action on nitrogen, especially for climate mitigation, stratospheric ozone and the protection of water resources, including groundwater, rivers, lakes, coastal zones and the wider marine environment.
- The present guidance is simultaneously a contribution from the International Nitrogen Management System (INMS), delivering support to the developing Inter-convention Nitrogen Coordination Mechanism (INCOM) in partnership with the United Nations Environment Programme (UNEP), the Global Environment Facility (GEF) and the International Nitrogen Initiative (INI).

Main points

- Nitrogen is critical as a major nutrient to allow food, fibre and biofuel production. However, the efficiency with which nitrogen is used is very low when considering the full chain from fertilization to human consumption and waste.
- A distinction is made between unreactive atmospheric dinitrogen (N_2) and reactive nitrogen forms (N_r), which represent valuable resources. Around 80 per cent of anthropogenic N_r production is wasted as air and water pollution and through denitrification back to N_2.
- The present guidance document is focused on agriculture in the context of the food system, and includes specific information on the principles and measures that can reduce emissions to the air of ammonia (NH_3), nitrogen oxides (NO_x), nitrous oxide (N_2O) and N_2, plus nitrate (NO_3^-) and other N_r leaching to water and total N loss.
- Informed by 10 keys points that underpin nitrogen cycling, the document reflects on 24 principles of integrated sustainable nitrogen management. The document then identifies 76 specific measures to improve nitrogen management, increase nitrogen use efficiency and reduce polluting losses to the environment.
- The document describes: 5 livestock diet measures; 18 housing measures; 12 manure storage/processing measures; 5 nutrient recovery measures; 20 field-based measures for application of organic and inorganic fertilizers; and 16 land-use and landscape measures.
- The accompanying discussion of basic principles will help strengthen the development of future strategies for pollution and sustainable development, and the establishment of coherent "packages of measures" that maximize the synergies.

A. Background

1. Ever since crops and livestock were first domesticated, the maintenance of civilization has been intrinsically linked to human alteration of the natural nitrogen cycle. The cultivation of crops and rearing of livestock mobilize nitrogen (N) and other nutrients, which are then transported as food, feed and fibre to villages, towns and cities (Lassaletta and others, 2014). Nitrogen-fixing crops and manures have been used for millennia to help increase harvests (for example, Columella, *On Agriculture* 2.13.1, trans. Boyd Ash, 1941), while the last 200 years have seen the mobilization of additional nitrogen, including from mined resources (for example, guano, saltpetre, coal distillation) and, ultimately, in the twentieth century, from the manufacture of inorganic fertilizers directly from atmospheric dinitrogen (N_2) (Sutton and others, 2011). As the scale of human alteration of the nitrogen cycle has increased, so have the consequences. Inorganic nitrogen fertilizers (including manufactured urea) have allowed the production of surplus food and feed in many regions, permitting substantial increases in human and animal populations (Erisman and others, 2008), with consumption of animal products by humans in excess of dietary needs across much of the UNECE region (Westhoek and others, 2014, 2015; Springmann and others, 2018).

2. This transformation of the global nitrogen cycle, especially over the last century, has led to a web of pollution problems linking the human production and use of nitrogen compounds with multiple environmental threats. Together with nitrogen compounds formed during combustion processes, and those mobilized through wastewater, nitrogen pollution currently affects all environmental media across the whole of planet Earth.

3. Until recently, efforts to address nitrogen pollution had largely been fragmented. This was mainly a consequence of fragmentation in environmental policymaking, management and science between environmental media and issues such as air pollution, water pollution, greenhouse gas (GHG) emissions, stratospheric ozone depletion, biodiversity loss and soil protection. Each of these issues is affected by nitrogen pollution, which thereby acts as a linking driver between many issues related to environment, economy, health and well-being. Traditional fragmentation of policies between these issues has slowed progress in the achievement of policy goals by reducing the coherence of local, national and international actions across the nitrogen cycle, risking trade-offs that can act as barriers to change (Oenema and others, 2011a, 2011b).

4. The emerging recognition of the way that nitrogen links all these issues is now leading to a major policy opportunity to mobilize change. A joined-up approach across the nitrogen cycle can help develop the gravity of common cause between air pollution, water pollution, climate change, stratospheric ozone depletion, biodiversity loss, health and economy (Oenema and others, 2011b; Sutton and others, 2013, 2019; Zhang and others, 2015; Leip and others, 2015; Kanter and others, 2020).

5. UNECE has long been a pioneer in developing such joined-up approaches. These include the Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (Gothenburg Protocol, signed in 1999 and amended in 2012) to the Convention on Long-range Transboundary Air Pollution (Air Convention), which was itself signed in 1979. The amended Protocol came into force on 7 October 2019. The Gothenburg Protocol includes ceilings to limit emissions of sulphur dioxide (SO_2), nitrogen oxides (NO_x) and ammonia (NH_3) up to 2020, together with national commitments to reduce emissions of SO_2, volatile organic compounds (VOCs), particulate matter (PM), NO and NH_3 as from 2020 and onwards, as these contribute to acidification, eutrophication, ground-level ozone and PM. This multi-pollutant, multi-effect approach has encouraged further efforts to understand the many air pollution impacts and interactions of nitrogen. Following the establishment of the Task Force on Reactive Nitrogen (TFRN) in 2007 (ECE/EB.AIR/91/Add.1, decision 2007/1), the *European Nitrogen Assessment: Sources, effects and policy perspectives* (Sutton and others, 2011) extended the approach to consider the full range of nitrogen interactions linking air, water, climate, ecosystems and soils, including identification of abatement options.

6. Concerning agricultural sources of air pollution, most effort under the Gothenburg Protocol has focused on NH_3, which, in the UNECE region, is mainly emitted from animal excreta and nitrogen-containing fertilizers. This led to the establishment of the *Guidance document on preventing and abating ammonia emissions from agricultural sources* (Ammonia Guidance Document) as a comprehensive reference manual, revised in 2012 (ECE/EB.AIR/120) (published as Bittman and others, 2014). This document is complemented by the *UNECE Framework Code for Good Agricultural Practice for Reducing Ammonia Emissions* (ECE/EB.AIR/129), a shorter document describing voluntary approaches, which can also form the starting point for Parties to establish, publish and disseminate their own national ammonia codes, as required under annex IX to the Gothenburg Protocol.

7. With the improved understanding emerging from the European Nitrogen Assessment (Sutton and others, 2011), it was agreed by the Air Convention that there was a need for guidance on mitigating all forms of nitrogen, with the priority in the first instance being to focus on agricultural sources relevant across the UNECE region. This was deemed necessary to support the objectives of the Gothenburg Protocol (twenty-second preambular para. on consideration of the full biogeochemical nitrogen cycle; art. 4 (1) on exchange of information and technology; art. 6 (1) (g) on the implementation of management programmes to reduce emissions; annex IX, para. 2, on reducing nitrogen losses from the whole nitrogen cycle; and the revised Gothenburg Protocol (tenth preambular para. on the influence of the nitrogen cycle and the potential synergies with and trade-offs between air pollution and climate change; art. 7 (3) (d) on the calculation of nitrogen budgets, nitrogen use efficiency and nitrogen surpluses and their improvements; and art. 10 (4) on the need to revise annex IX). As part of the 2016–2017 work plan for the implementation of the Convention agreed by the Executive Body at its thirty-fourth session

(Geneva, 18 December 2015), the Task Force on Reactive Nitrogen undertook to "Initiate the development of an ECE guidance document that describes an integrated approach, addressing multiple compounds and their synergies, with regard to nitrogen management in agriculture and illustrates its co-benefits" (ECE/EB.AIR/133/Add.1, item 2.3.4).

8. Progress in the development of this guidance document was facilitated by assistance from the European Commission Directorate-General for Environment and from the International Nitrogen Management System (INMS). INMS provides global and regional scientific support for international nitrogen policy development, practice and awareness-raising, with financial support through the United Nations Environment Programme (UNEP) and the Global Environment Facility (GEF), while building partnerships, including through the International Nitrogen Initiative and the Global Partnership on Nutrient Management.

9. The present guidance document simultaneously provides a contribution to the developing activity of the Inter-convention Nitrogen Coordination Mechanism (INCOM), currently being established through the Nitrogen Working Group under the auspices of the UNEP Committee of Permanent Representatives. This forms a central part of the Roadmap for Action on Sustainable Nitrogen Management 2020–2022 (UNEP 2019a, 2019b) in implementing United Nations Environment Assembly resolution 4/14 on sustainable nitrogen management (see UNEP/EA.4/Res.14).

10. The financial support from UNEP/GEF and the European Commission, together with the Global Challenges Research Fund South Asian Nitrogen Hub – a regional contribution to INMS – has allowed the work to be developed through two dedicated workshops (Brussels, 11–12 October 2016 and 30 September–1 October 2019), including contributions from Eastern Europe, the Caucasus and Central Asia.

11. The importance of the activities has been emphasized as part of the revised mandate of TFRN (ECE/EB.AIR/142/Add.2, decision 2018/6, annex, para. 3 (g) and (h)), including its functions to:

> 3 (g) Explore the relationships between emission mitigation of ammonia and other nitrogen compounds in the context of nitrogen benefits for food and energy production, considering the opportunities to share experiences on tools for improved nitrogen management and approaches to improve the uptake of the most promising options;
>
> (h) Initiate work on the potential for mitigation strategies that simultaneously reduce ammonia and nitrogen oxide emissions from soils considering the increasing share of NO_x from agriculture and the potential relationships with mitigation of nitrous oxides and dinitrogen.

12. The present Guidance document is a result of this process. It is anticipated that the document will help mobilize efforts to control air pollution from agricultural sources in the context of the wider nitrogen cycle. In particular, the Guidance document aims to foster change by clearly identifying the multiple co-benefits of reducing nitrogen emissions, as relevant for air quality, climate change, water quality, human health, ecosystems and economy. By aiming to harvest the multiple co-benefits of better nitrogen management, a more coherent and effective response may be expected that maximizes synergies, minimizes trade-offs and accelerates progress towards achievement of the United Nations Sustainable Development Goals.

B. Approach of the Guidance document

1. Scope and target groups

13. The present Guidance document on integrated sustainable nitrogen management focuses on the agricultural sector, including both cropping and livestock systems. While humans have implicitly engaged in managing nitrogen over many millennia, this has not always been sustainable or integrated. The use of the word "sustainable" in the title emphasizes the importance of considering the full set of environmental, social and economic consequences of nitrogen use in agriculture. It is consistent with the adoption, in March 2019, of United Nations Environment Assembly resolution 4/14 on sustainable nitrogen management and the follow-up Colombo Declaration on Sustainable Nitrogen Management (UNEP, 2019c), and reflects the fact that sustainable nitrogen management is a prerequisite for achieving most of the Sustainable Development Goals.

14. The word "integrated" also features in the title of the present guidance document. This reflects recognition by experts and stakeholders of the fact that an integrated approach is needed to link air, water, climate, stratospheric ozone and other issues as a basis for the development of sound strategies. In this way, "integrated'" is here seen as an opportunity and requirement to be aware of synergies and trade-offs in order to mobilize more effective outcomes. The approach is also fully consistent with ongoing developments, coordinated through UNEP and INMS, towards the establishment of an Inter-convention Nitrogen Coordination Mechanism (INCOM) (Sutton and others, 2019). This activity aims to promote synergies through cooperation between the Air Convention and other intergovernmental conventions and programmes, thereby accelerating progress in nitrogen-related challenges in implementing United Nations Environment Assembly resolution 4/14.

15. The present document, prepared under the lead of the Air Convention, can also be seen as providing input to the wider coordination of INCOM, with benefits for many other multilateral environmental agreements. The present guidance document is aimed at policymakers, regulators and agricultural advisors, who will benefit from the overview of principles and measures presented when formulating integrated sustainable nitrogen management strategies and policies. It is anticipated that future materials may be prepared that more specifically target the needs of different farmer groups across the UNECE region and globally.

2. United Nations Economic Commission for Europe categories and magnitude of effect

(a) United Nations Economic Commission for Europe categories

16. The present guidance document adopts the UNECE approach established for the Ammonia Guidance Document (ECE/EB.AIR/120, para. 18), where each abatement/mitigation measure is assigned one of the three following categories according to expert judgement[1]:

(a) Category 1 techniques and strategies: These are well-researched, considered to be practical or potentially practical and there are quantitative data on their abatement efficiency at least on the experimental scale;

(b) Category 2 techniques and strategies: These are promising, but research on them is at present inadequate, or it will always be difficult to generally quantify their abatement efficiency. This does not mean that they cannot be used as part of a nitrogen abatement strategy, depending on local circumstances;

(c) Category 3 techniques and strategies: These have not yet been shown to be effective or are likely to be excluded on practical grounds.

17. Under this UNECE approach, no connection is made to the profitability or otherwise of the measures in assigning these categories, which are purely based on technical criteria. It is therefore quite feasible for a measure to be listed as category 1, while not yet being considered economical from a sector viewpoint in the absence of appropriate support. This approach can be considered distinct from and complementary to definitions of best available techniques (BATs), which typically incorporate criteria about not entailing excessive costs. In this way, it becomes much easier for experts to assign the UNECE categories (with costs of measures specified separately where available), as compared with the technical-political negotiations that are needed to agree what constitutes relevant standards for BATs. In the Technical overview (chapter II) below, each of the measures is assigned a UNECE category for each nitrogen form according to the following colour code: green (category 1); amber (category 2); and red (category 3). It should be emphasized that the red colour code for category 3 does not indicate any adverse effect, but simply signals that the measure has not yet been demonstrated to be effective. This may mean that further research and development is needed. Some measures included in this document are assigned category 3 for all forms of nitrogen pollution. These are included either: (a) because they are frequently discussed and an objective assessment is needed regarding their ineffectiveness; or (b) because further development is needed to demonstrate their potential.

18. The UNECE approach is here extended to allow each measure to be assigned a category according to its suitability for each major nitrogen form: NH_3; NO_x[2]; nitrous oxide (N_2O); nitrate (NO_3^-), including other water-based losses of nitrogen compounds; dinitrogen (N_2); and overall nitrogen loss. The document also includes the term "reactive nitrogen" (N_r), which refers to all nitrogen compounds with the exception of N_2, which is unreactive (see figure I.1).

(b) Magnitude of effect

19. The present guidance document does not replace the UNECE Ammonia Guidance Document (ECE/EB.AIR.120), which provides much more detailed information on quantitative abatement efficiency and the costs of measures for NH_3. By contrast, it is not feasible to provide quantitative details for all the nitrogen components listed for all measures. To address this situation, a qualitative indication is provided in this document for each measure concerning its effectiveness in reducing losses of each nitrogen form. The following system is used:

(a) Downward arrows indicate a reduction in losses: ↓, small to medium effect; ↓↓, medium to large effect;

(b) Upward arrows indicate an increase in losses: ↑, small to medium effect; ↑↑, medium to large effect;

(c) Little or no effect, indicated by ~ ;

(d) Uncertain, indicated by ?.

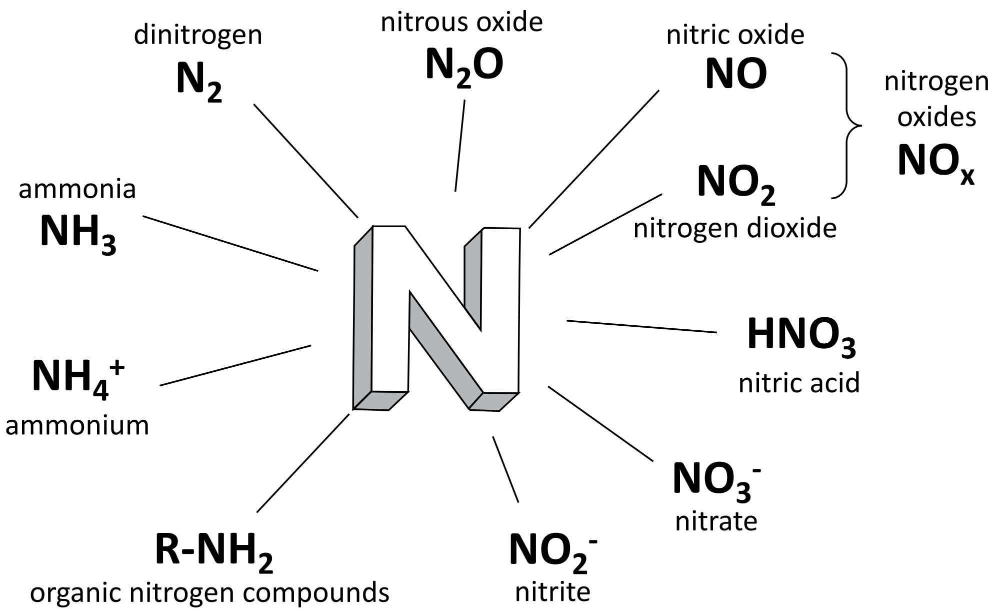
20. The magnitude of effect can be considered as an indication of "effectiveness" of the measure as distinct from the extent to which the measure is "applicable" in different contexts. Arrows indicate outcomes at the scale of the measure described (for example, animal housing, fertilizer application), but wider system consequences also need to be considered. Where a measure is considered to increase losses of a specific nitrogen form, it is, by definition, assigned to category 3 for that nitrogen form. Where clarification is necessary, magnitude of effect of a measure is described in comparison to a specified reference system.

21. Some measures targeted to benefit one form of nitrogen pollution can increase the risk of losses in other nitrogen forms. Such trade-offs (or "pollution swapping") are not inevitable and may often be avoided by appropriate actions that are not easy to summarize in tabular form. For this reason, the text describing each measure will typically mention main interactions, while chapter III is dedicated to the principles of good nitrogen management, helping to minimize trade-offs and maximize synergies. This highlights the opportunity to develop coherent "packages of measures". For example, while many of the measures are applicable to both conventional and organic systems (as well as to other agroecological farming systems), overall packages of measures would be expected to differ according to climate

1 The UNECE categories and system for representing magnitude of effect described here in chapter I, paras. 16–20, of the present document apply throughout the present document.

2 Nitrogen oxides (NO_x) represent a mix of nitric oxide (NO) and nitrogen dioxide (NO_2). Emissions of NO_x from agricultural soils occur mainly in the form of NO, although emissions as NO_2 may also be possible. Reactions of NO with ozone (O_3) within the air space of plant canopies can mean that a substantial fraction of emission occurs as NO_2 at the canopy scale. Although the research community has mainly referred in the past to NO emissions from soils, for these reasons, and in the interests of consistency with the Convention on Long-range Transboundary Air Pollution (Air Convention) nomenclature, this document refers primarily to NO_x emissions from soils.

Figure I.1: Major forms of nitrogen occurring in the environment



Source: The figure was created for the present document.
Note: The sum of all forms except N_2 is often termed fixed or reactive nitrogen (N_r).

and farming system.

22. Some forms of nitrogen loss tend to be much larger than others in terms of the overall mass of nitrogen involved. The largest losses often occur as NH_3 emission, nitrate and other nitrogen leaching/run-off, and as denitrification to N_2. By contrast, emissions of nitrous oxide (N_2O) and NO_x tend to represent a small fraction of nitrogen flows (often ~1 per cent of inputs). Although N_2O and NO_x losses from agricultural systems therefore only make a minor contribution to total nitrogen loss, they are relevant because of their specific impacts on air quality, climate and stratospheric ozone depletion. Conversely, although dinitrogen (N_2) emissions through denitrification are environmentally benign, they represent a potentially large fraction of available nitrogen resources. This means that abatement of N_2 emissions is important because it can help improve overall system efficiency, decreasing the need for fresh production of nitrogen compounds and therefore helping to reduce all nitrogen loss pathways and impacts. The philosophy of the present guidance document is to promote transformation towards a "circular economy" for nitrogen, as illustrated in figure I.2.

C. Main messages of the Guidance document

23. The core of the present Guidance document consists of a set of principles for sustainable nitrogen management followed by detailed consideration measures to reduce N losses from major parts of the agrifood system.

24. The description of sustainable nitrogen management is underpinned by ten key points of nitrogen cycling, as summarized in figure I.3. The fundamental reflections of biogeochemistry must be recognized if human management of the nitrogen cycle is to move from a system emphasizing new production of N compounds and wasteful losses to a more circular system, which maximizes the recovery and reuse of available N resources.

25. Twenty-four principles of integrated sustainable nitrogen management are identified and summarized in the Technical overview (chapter II). The first listed principle encapsulates the overall philosophy of the approach:

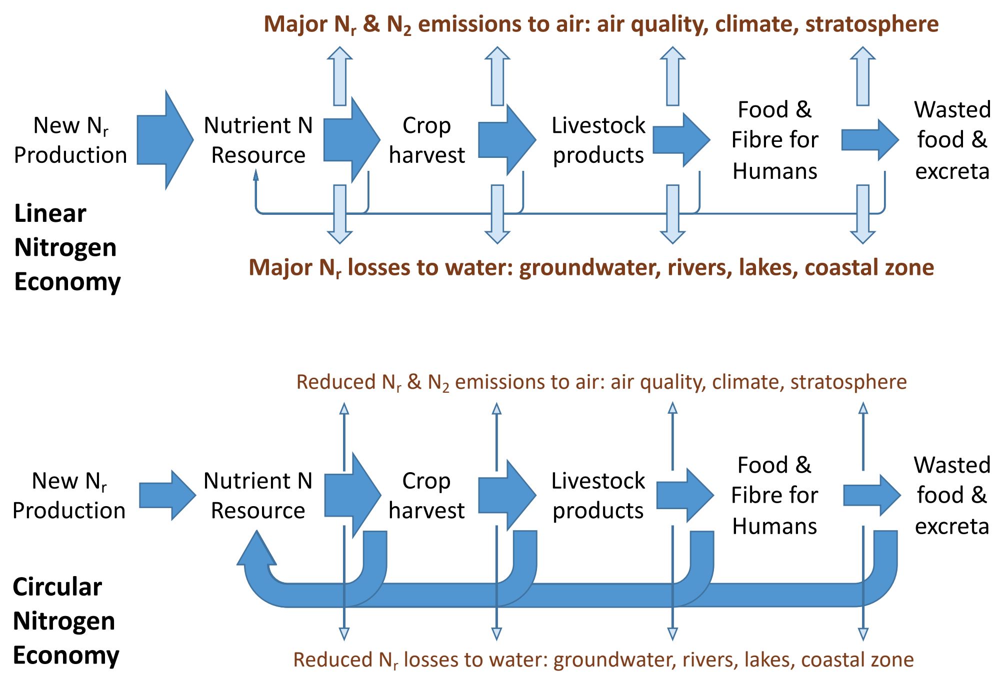
> Principle 1: The purpose of integrated sustainable nitrogen management in agriculture is to decrease nitrogen losses to the environment to protect human health, climate and ecosystems, while ensuring sufficient food production and nitrogen use efficiency, including through appropriately balanced nitrogen inputs.

26. All of the principles are important, with the wide diversity of principles reflecting the diversity of N forms, issues, and impacts. By considering these principles, a sound foundation is provided to inform the selection of suitable measures.

27. At the heart of nitrogen management is the idea that taking a nitrogen cycle perspective allows synergies to be identified and trade-offs minimized. This can be illustrated by the comparison of principles 4, 5 and 6 of sustainable nitrogen management:

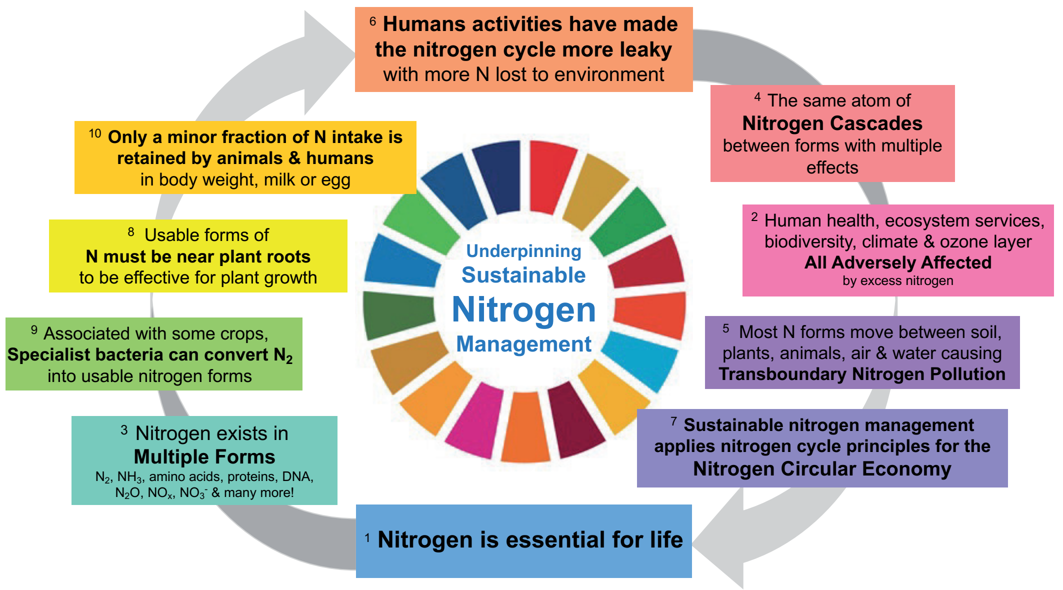
(a) Principle 4: Possible trade-offs in the effects of N loss

Figure I.2: Simplified comparison of linear and circular economies for nitrogen in the agrifood system



Source: The figure was created for the present document.

Figure I.3: Ten key points of nitrogen cycling



Source: The figure was created for the present document.

Note: These key points underpin the principles of integrated sustainable nitrogen management. The numbers reflect the ordering as described in chapter III of the present document. Humans introduce huge amounts of additional reactive nitrogen into the nitrogen cycle, meaning that the system is now out of balance.

abatement/mitigation measures may require priorities to be set, for example, which adverse effects should be addressed first;

(b) Principle 5: Nitrogen input control measures influence all N loss pathways;

(c) Principle 6: A measure to reduce one form of pollution leaves more N available in the farming system, so that more is available to meet crop and animal needs.

28. Principle 7 highlights that "The nitrogen input-output balance encapsulates the principle that what goes in must come out". This can be translated to ensure that inputs match crop and livestock needs, allowing opportunities to reduce all N losses simultaneously (principle 8), as well to reflect spatial variations between vulnerability of agricultural and semi-natural land (principles 9 and 10). The focus on land-use and landscape management is reflected in the principle whereby unfertilized agricultural land and woodlands are recognized as being able to provide buffers that can strengthen landscape resilience to decrease adverse effects in the local environment (principle 11), so long as this does not contravene any specific habitat conservation objectives for the identified buffer ecosystems themselves.

29. It is recognized that nitrogen management must be seen in relation to other limiting factors, which need to be optimized to have the largest possible reduction in nitrogen pollution, both for crop and livestock systems (principles 12 and 13). This is extended by principles that recognize the need to consider nitrogen management in relation to wider management of all nutrients and biogeochemical cycles (including carbon (C), phosphorus (P), sulphur (S), silicon (Si), micronutrients, etc.) and water resources (principles 19, 20 and 21).

"Manure once it is spread, should be ploughed in immediately and covered over, that it may not lose its strength from the heat of the sun".
Columella, circa 50 AD

30. Principles 14, 15, 16 and 17 reflect the physicochemical basis for reducing emissions, including slowing urea hydrolysis, avoiding exposure of ammonium-rich resources to air and the heat of the sun and slowing nitrification and denitrification, which simultaneously maximize the potential to usefully manage nitrogen resources.

31. It is recognized that nitrogen management in agriculture is intimately linked to the entire food system. This means that both dietary measures in livestock and human dietary choices, as well as waste management, will be essential if ambitious sustainability goals are to be achieved (principle 18). At the same time, ruminant dietary strategies need to consider the possible impact on methane emissions (principle 22), where certain measures will be contraindicated for sustainable nitrogen and methane management.

32. Further principles recognize the social and economic dimension, including local aspects among the various actors in agriculture and the food chain, where these actors have a shared responsibility in N management (principle 2), including food supply, food processing, retail and consumers. As a part of these principles, it is acknowledged that "the whole farm-level is often a main integration level for emission-abatement/mitigation decisions" (principle 24), in addition to the wider actions of citizens and other actors in the food system. In the case of farmers, principle 23 recognizes that the cost and effectiveness of measures to reduce N losses need to take account of the regional opportunities and constraints of farmers, including effects of farm size, farm structure and economic context. Altogether, the principles show that integrated sustainable nitrogen management is an opportunity for different actors in the agrifood system to work together, where efficiency, waste reduction, environmental stewardship and investment for profitable food production all go hand-in-hand.

33. The Technical overview (chapter II) and chapters IV–VI provide a detailed listing of the measures identified, indicating the opportunity for abatement and mitigation of different nitrogen forms relevant for air pollution, water pollution, climate change, biodiversity, human health, stratospheric ozone, etc. Lastly, chapter VII reflects briefly on how the different measures may fit together, giving examples of possible "packages of measures" that can provide a coherent approach to sustainable nitrogen management according to the levels of ambition needed to meet different local, national and international goals.

34. The present document takes a significant step forward in supporting international policy development by applying understanding of the nitrogen cycle to catalyse sustainable development across multiple challenges. In this way, the document breaks new ground by providing guidance on reducing losses of all main nitrogen forms: NH_3, N_2O, NO_x, NO_3^- and N_2. While the integration is new and draws on the latest research, it also depends on long-established experience. This point was made by a Roman farmer writing nearly 2,000 years ago:

> *"Manure once it is spread, should be ploughed in immediately and covered over, that it may not lose its strength from the heat of the sun and that the soil, being mixed with it, may grow fat on the aforesaid nourishment. And so, when piles of manure are distributed in a field, the number of those so scattered should not exceed what the ploughmen can dig in on the same day."*
>
> Columella, *On Agriculture* 2.5.2 (trans. Boyd Ash, 1941)

35. This measure and its principles, as explained by Columella, are still relevant today and represented in the present guidance document. The example shows how measures to reduce nutrient losses have been recognized for centuries. The challenge is to put them into practice.

D. References

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