



São Paulo School of Advanced Science on
Nitrogen cycling, environmental sustainability and climate change
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Nitrogen in the global and regional policy agenda

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- **Ecosystems / Biodiversity**

- Freshwater systems, forests, estuaries, etc
- Plants, animals, insects, etc

Species distribution and occurrence



- **Processes**

- Photosynthesis,
- Evapotranspiration;
- Cloud condensation nuclei production;
- others

Biosphere-Physical system interactions



- **Service**

- Climate moderation;
- Pollination
- Timber production
- Others.

Equilibrium; moderation



- **Value**

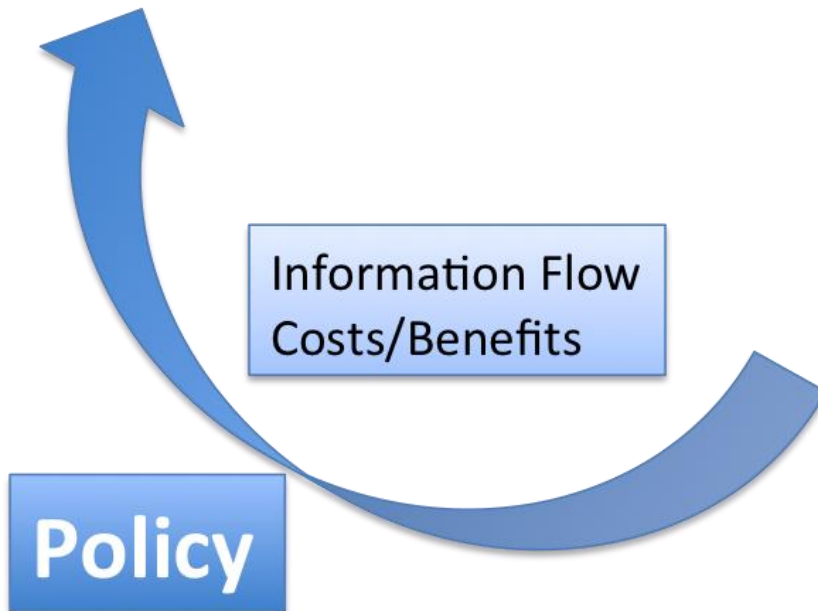
- Conservation;
- Restoration;
- Willingness to allocate financial resources

Institutions; Companies market;



Information Flow
Costs/Benefits

Policy



Some relevant points

- i. Human intervention/interference of the nitrogen cycle => doubled Nr inputs at the global scale over the past century, leading to changes across multiple environmental compartments.
- ii. While the benefits => N increasing crop and livestock production (fertilizer and BNF) have sustained roughly half the world population; The threats => Nr use is causing a combination of freshwater and marine pollution, air pollution, alteration of climate balance, stratospheric ozone loss, loss of biodiversity and soil quality, affecting human health...
- iii. Efforts have began to bring these issues together at the continental scale → with some exception... integration of 'fragmented scientific information';
 - i. “Consistent with the traditional separation of the underlying science, current policy frameworks are equally fragmented, making it difficult to develop policies that consider the multiple impacts of nitrogen” (INI/INMS, Sutton et al. In prep)

When talking about science for the policy process → what is the time-scale are we talking about?

-> Environment time scale -> time need to identify changes in the environment due to N load, processing, etc.

-> Policy-makers time scale -> scale required for the information from the science processes to feed the policy process.

Example: projections, historical risk data; resilience of the systems ... might be relevant to a policy decision → gathering information at the resolution and acceptable uncertainty by the scientific community might require longer periods for analysis.

Challenge → match expectation and producing information that can be promptly accessible to support the policy discussion at the specific level and time.

The Montreal Protocol (1987) → Every member of UN signed. Why can't politicians do the same thing for nitrogen?

- Complex science: The Montreal protocol deals with a 'less complex problem' ... emissions of chlorofluorocarbons (CFCs) create a 'hole' in the stratosphere and scientists could present it in a simple way Climate Change – much 'complex science' that after almost 25 years (since Rio 1992) of discussion built a political and societal perception of the problem led to the Paris (CoP 22) agreement ...
- Would the complexity of the nitrogen treats be on the way of an broader concern in the international policy arena?

=> Carbon world – Climate change ... where the awareness lay on and where the specific actions are

- Mitigation
- Adaptation
- Risk – climate/extreme events
- Resilience, ...

=> Where the awareness should be?? Can the awareness get to same level? ... Global Environmental Change

- Food (mitigation (fertilizer use), adaptation (security/diet), risk (security, economical);
- Energy (mitigation, adaptation,), urbanization
- Part of the changes are practical and sectorial ... other is holistic ... claiming for a shift in the society paradigm (e.g, “better governance practices”, changing diet)

If we want to take N to the global agenda The first question that needs to be asked is WHY special attention is needed to the nitrogen cycle....

- i. The key to this is the multiple ways that nitrogen interacts in our world, leading to both many benefits and many and diverse environmental threats
- ii. Figure (next slide) demonstrates the cross-cutting impact of nitrogen (and phosphorus) on global systems

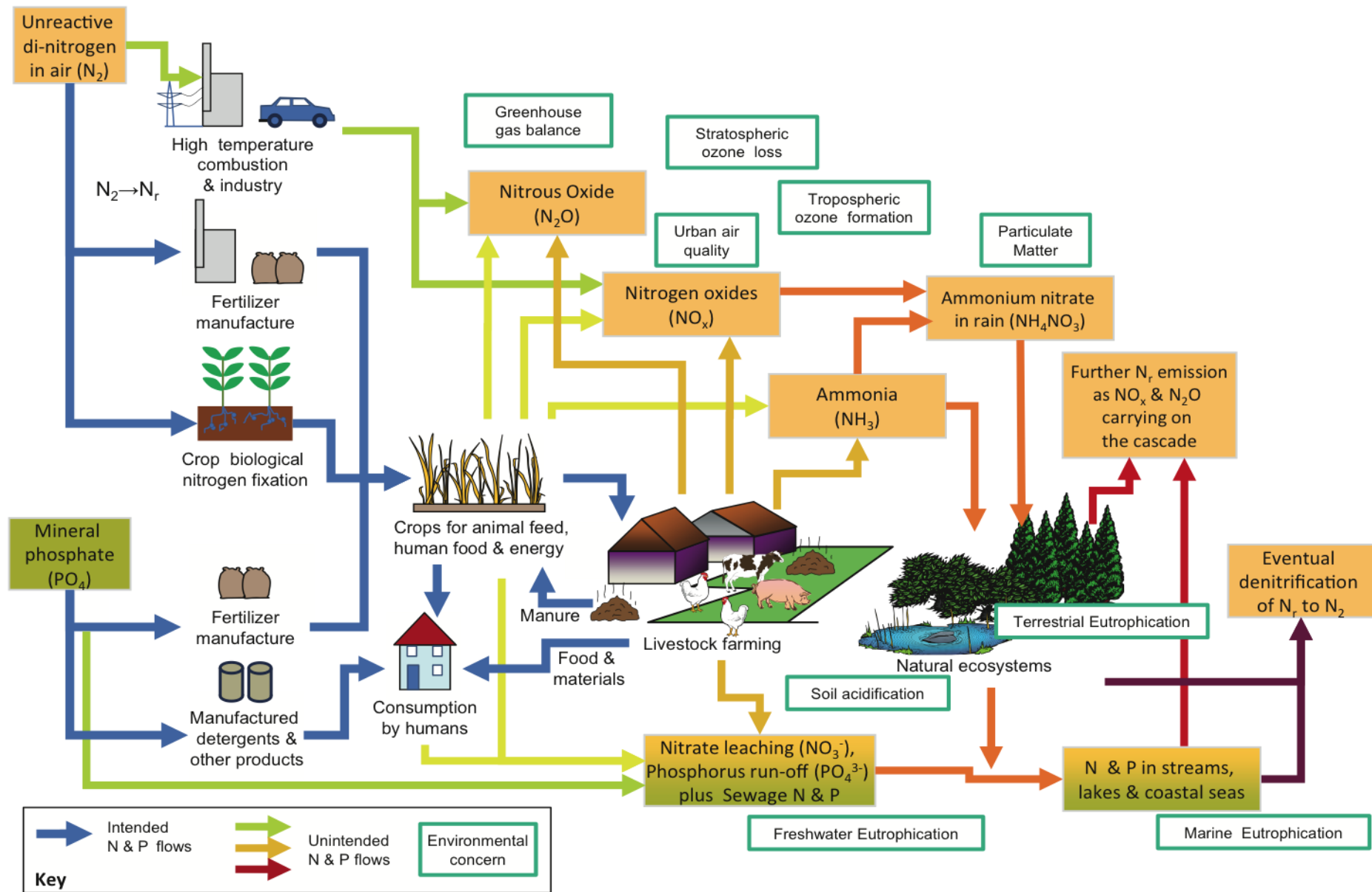


Figure 1.2 Simplified overview of nitrogen (N) and phosphorus (P) flows highlighting major present-day anthropogenic sources, the cascade of reactive nitrogen (N_r) forms and the associated environmental concerns (modified here from Sutton et al., 2011b).

Strong legislation and community concern → found in some developed countries/region

- i. Question of scale – at local scale (farm, county, region, ...)
- ii. Question of scale – trade / market connections
- iii. Global statistics to feed Global Processes ... How is this representative of, or reflect, the local processes?

Policy (action) should not be restrictive policy -> alternative options are needed (e.g.: how to change diet under cultural and availability of food options). Yesterday we heard: Local particularities; sustainable use in the supply and demand sides (broader/global; local); awareness (societal; political; ..)

- *Lack of information* - The impacts of land use and land cover changes, urbanization and climate extremes in the nitrogen cycle, are issues still demanding deeper understanding in Brazil and Latin America .
- In general, only 20% of the domestic wastewater in the region is treated and about 17% of the population has no access to sanitation;
 - Sewage and poor management of watersheds lead to impoverishment of inland water resources at local scale, and leads to degradation of estuaries and coastal zones.
- *Non-sustainable* agricultural practices deplete natural riparian habitats resulting in high sediment and nutrient load in rivers and streams, often causing reduction of flow and eutrophication
 - Few information on N (NO_3 leaching in soils)
- *Too much and too little nitrogen* - Relevant social/economic questions: pollution, agriculture (fertilizer use, food / biomass production), ecosystem services.

LEGISLATION ... (generic and linked to specific chemical specie)

NH₃ ; NO₃

Brazilian National Council legislation (CONAMA - Resolutions 357/2005 and 397/2008) standards for ammonia and nitrate in water and effluents. Standards indicated by resolutions are compared to those from previous Conama Resolution 20/1986 and with North American standards. Ammonia ~5mg/l; Nitrate 10 mg/l

NO_x

There is not a legislation that regulates emission of NO_x but for vehicles (which is based on European general ranges of allowed emissions).

Trans-boundary air pollution (or river water pollution) are not regulate in the region – some debate on water pollution and water transposition among watersheds.

Ecosystem Services → most of the studies relate water quality and riparian zone conservation; biodiversity corridors.

Forest Code → regulate the use and cover at property level.

Our Nutrient World

The challenge to produce more food and energy with less pollution



Prepared by the Global Partnership on Nutrient Management
in collaboration with the International Nitrogen Initiative

Our Nutrient World

The challenge to produce more food and energy
with less pollution

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<http://initrogen.org/sites/default/files/documents/files/ONW.pdf>

<http://initrogen.org/>

The 'Our Nutrient World' report (Sutton et al, 2014, UNEP) examine possible main elements of a future policy approach for nutrients, and the science needs resulting from this. The authors identified the following priorities:

- i. To establish a global assessment process for nitrogen between air, land, water, climate and biodiversity, considering the main driving forces, the interactions with food and energy security, the costs and benefits and the opportunities for the Green Economy,
- ii. To develop consensus on the operational indicators, with benchmarking to record progress on improving nitrogen use efficiency and reducing the adverse environmental impacts,
- iii. To investigate options for improvement of nitrogen use efficiency, demonstrating benefits for health, environment, and the supply of food and energy,

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- iv. To address barriers to change, fostering education, multi-stakeholder discourse and public awareness,
- v. To establish internationally agreed targets for improved N_r management at regional and planetary scales,
- vi. To quantify the multiple benefits of meeting the nitrogen management targets for marine, fresh-water and terrestrial ecosystems, mitigation of greenhouse gases and other climate threats, and improvement of human health,
- vii. To develop and implement an approach for monitoring time-bound achievement of the nitrogen management targets, and for sharing and diffusing new technologies and practices that would help to achieve the targets.

**Towards
INMS**



**Centre for
Ecology & Hydrology**
NATURAL ENVIRONMENT RESEARCH COUNCIL



<http://www.inms.international/>



**Convention on
Biological Diversity**



futureearth

éclair