Why nitrogen?

“Nitrogen is not just another problem. Rather it must be part of the solution if we are to make progress with so many of the problems we already know.”
**Nitrogen or Nutrients?**

- **Unreactive di-nitrogen in air (N₂)**
- **High temperature combustion & industry**
  - Fertilizer manufacture
  - Crop biological nitrogen fixation
- **Fertilizer manufacture**
  - Manufactured detergents & other products
  - Mineral phosphate (PO₄³⁻)
- **Crop biological nitrogen fixation**
  - Crops for animal feed, human food & energy
- **Fertilizer manufacture**
  - Crop biological nitrogen fixation
  - Crops for animal feed, human food & energy
- **Consumption by humans**
  - Manufactured detergents & other products
  - Food & materials
  - Manure
- **Livestock farming**
  - Natural ecosystems
    - Greenhouse gas balance
    - Stratospheric ozone loss
    - Tropospheric ozone formation
    - Urban air quality
    - Particulate Matter
    - Nitrous Oxide (N₂O)
    - Nitrogen oxides (NOₓ)
    - Ammonium nitrate in rain (NH₄NO₃)
    - Ammonia (NH₃)
    - Nitrate leaching (NO₃⁻), Phosphorus run-off (PO₄³⁻) plus Sewage N & P
    - Freshwater Eutrophication
    - Marine Eutrophication
    - Terrestrial Eutrophication
    - N & P in streams, lakes & coastal seas
    - Soil acidification
    - Eventual denitrification of N₂ to N₂

**Key**
- Intended N & P flows
- Unintended N & P flows
- Environmental concern
The five key threats of Nitrogen

The WAGES of imbalanced nitrogen

Water quality
Air quality
Greenhouse balance
Ecosystems
Soil quality

European Nitrogen Assessment; Our Nutrient World
How much does eutrophication prevent recovery after coral bleaching?

Maldives: Thoddoo

@MarkNitrogen

1 September 2019
- Health (Lung, Heart, COVID-19?)
- Visibility, Climate, Ecosystems, Economy etc.
Nitrogen threat to vulnerable ecosystems

See article “The Trouble with Ammonia” and YouTube: “The CAFRE Ammonia Challenge”
#StikstofCrisis

See: “A Tale of Two Tractors” (Nourish Scotland)
INMS Approach

Data need & concepts

C1: Tools and methods for understanding the N cycle

Informing modelling requirements

C2: Global & regional quantification of N use, flows, impacts & benefits of improved practices

Improved management practices, Mitigation, Adaptation

Options & Scenarios, including Cost-Benefit-Analysis

C3: Regional demonstration & verification

Opportunities, Local/region priorities, Policy context, Local data, Barriers-to-change

C4: Awareness raising & knowledge sharing

Policy homes, Public awareness, Consensus building,

Better basis for transformational change

INMS Approach
Towards a Nitrogen Circular Economy

Fourth Nitrogen Revolution

1. Agricultural use of biological N fixation (-2000?)
2. Mining N in the ground (+500)
3. Mining N in the atmosphere (+1900)
4. Embracing the circular N economy (+2020…)

Major $N_r$ & $N_2$ emissions to air: air quality, climate, stratosphere

Major $N_r$ & $N_2$ emissions to air: air quality, climate, stratosphere

Reduced $N_r$ losses to water: groundwater, rivers, lakes, coastal zone
Huge progress at the nitrogen science-policy interface

• International Nitrogen Management System established (2016)
• GCRF South Asian Nitrogen Hub established (March 2019) - Regional championship for global transformation
• Resolution 4/14 on Sustainable Nitrogen Management adopted at 4th UN Environment Assembly (March 2019)
• Launch of UN Nitrogen Campaign ‘Nitrogen for Life’ under lead of President of Sri Lanka (October 2019)
  – Colombo Declaration agrees to work on national roadmaps with “ambition to halve nitrogen waste by 2030”, preparing for UNEA-5
  – First Nitro-Innovation Exhibition
  – Premiere of the Nitrogen Song with Grammy® Award winner Ricky Kej
• First meeting of the Inter-convention Nitrogen Coordination Mechanism – INCOM (June 2020)
Nitrogen Champions
Pathways from South Asia to the World

Committee of Permanent Representatives

Lead & Supporting Countries

Proposed Nitrogen Resolution

SACEP
Governing Council

UN
Environment
Assembly

Environment Ministers & Officials

Ambassadors & Officials

Nitrogen Working Group & INCOM

Mar. 2019

Oct. 2018

Mar. 2018

Sep. 2017

2020

Director General & Secretariat

Environment Ministers & Officials

Preparatory Actions 2013-2017

Draft Resolution SACEP / INMS Malé Workshop

2018-2020
Resolution
UNEP/EA.4/L.16 agreed
UNEP/EA.4/Res.14 final

United Nations Environment Assembly of the United Nations Environment Programme

Fourth session
Nairobi, 11–15 March 2019

Sustainable nitrogen management*

The United Nations Environment Assembly,

Recognizing the multiple pollution threats resulting from anthropogenic reactive nitrogen, with adverse effects on the terrestrial, freshwater and marine environments, contributing to air pollution and greenhouse gas emissions, while acknowledging the benefits of nitrogen use for food and energy production,

Recognizing also that global crop production in the world and the world’s food security is dependent on nutrients, including nitrogen and phosphorus resource use,

Calls on the Executive Director of the United Nations Environment Programme to:

(a) Consider the options to facilitate better coordination of policies across the global nitrogen cycle at the national, regional and global levels, including consideration of the case to establish an intergovernmental coordination mechanism on nitrogen policies, based primarily on existing networks and platforms and consider the case for developing an integrated nitrogen policy, which could enhance the gravity of common cause between multiple policy domains.
“Every year, an estimated US$200 billion worth of reactive nitrogen is now lost into the environment, where it degrades our soils, pollutes our air and triggers the spread of “dead zones” in our waterways.”
Ten key actions for nitrogen management

Agriculture
1. Improving nitrogen use efficiency in crop production
2. Improving nitrogen use efficiency in animal production
3. Increasing the fertilizer N equivalence value of animal manure

Transport and Industry
4. Low-emission combustion and energy-efficient systems
5. \( \text{NO}_x \) capture and utilization technology

Waste water treatment
6. Improving food supply efficiency & reducing food waste
7. Recycling nitrogen (& phosphorus) from waste water systems

Societal consumption patterns
8. Energy and transport saving
9. Lowering the human consumption of animal protein

Spatial optimization
10. Spatial optimization and integration
Is Biological Nitrogen Fixation the answer?

- BNF – a natural form of slow release fertilizer = expect smaller % N loss than with fertilizer
- Can BNF deliver enough N?
- Hot-moments of nitrate & other N losses from ploughed-in legumes?
- Brave new world: Nitrogen fixing GM wheat & rice?
- Most harvest goes to feed livestock, so still need better urine & dung management

Farmer with his nursery for Azolla: a N-fixing floating fern
INI commits to support a global goal to halve nitrogen waste. Bali, Oct 2018

Multiple benefits of working to Halve Nitrogen Waste from all sources globally

1. NO POVERTY
   - Supporting livelihoods by reducing nitrogen resource loss
   - Nitrogen fertilizer efficiency & BNF to sustain global food production

2. ZERO HUNGER
   - Improved health through better nitrogen air & water quality
   - Education & training in Sustainable Nitrogen Management

3. GOOD HEALTH AND WELL-BEING
   - Valuing nutrients in manure helps to address gender inequalities
   - Decreased nitrate (NO₃⁻) contamination of drinking water & rivers

4. QUALITY EDUCATION
   - Decreased nitrogen oxides (NOₓ) & PM₂.₅ improves urban air quality
   - Less nitrogen water pollution helps protect reefs & avoid coastal dead zones

5. GENDER EQUALITY
   - Nitrogen & healthy food: demitarian, vegetarian & vegan lifestyles
   - Less nitrous oxide (N₂O) as a long-lived greenhouse gas

6. WATER AND SANITATION
   - Decreased ammonia (NH₃) & NO emissions help protect terrestrial biodiversity
   - Less nitrogen oxides (NOₓ) & PM₂.₅ improves urban air quality

7. INDUSTRY INNOVATION
   - Widening access to cost-effective nitrogen resources
   - Nitro-Innovation for resource recovery in air & water

8. CLIMATE ACTION
   - Nitro-Finance to mobilize growth in the Circular Economy
   - Nitro-Finance for resource recovery in air & water

9. LIFE ON LAND
   - Strengthened partnerships through the Nitrogen Coordination Mechanism
   - Decreased ammonia (NH₃) & NO emissions help protect terrestrial biodiversity

10. LIFE BELOWWATER
     - Less nitrogen water pollution helps protect reefs & avoid coastal dead zones
     - Less nitrous oxide (N₂O) as a long-lived greenhouse gas

11. PEACE, JUSTICE AND STRONG INSTITUTIONS
     - Nitrogen cooperation as a contribution to Environmental Diplomacy

12. PEACE, JUSTICE AND STRONG INSTITUTIONS
     - Decreased nitrate (NO₃⁻) contamination of drinking water & rivers

13. CLIMATE ACTION
     - Nitro-Finance for resource recovery in air & water
     - Nitro-Innovation for resource recovery in air & water

14. LIFE BELOWWATER
     - Decreased ammonia (NH₃) & NO emissions help protect terrestrial biodiversity

15. LIFE ON LAND
     - Nitrogen & healthy food: demitarian, vegetarian & vegan lifestyles

16. PEACE, JUSTICE AND STRONG INSTITUTIONS
     - Supporting livelihoods by reducing nitrogen resource loss
     - Nitrogen fertilizer efficiency & BNF to sustain global food production

17. PARTNERSHIPS FOR THE GOALS
     - Improved health through better nitrogen air & water quality
     - Education & training in Sustainable Nitrogen Management

INI commits to support a global goal to halve nitrogen waste. Bali, Oct 2018

Everywhere & Invisible across the SDGs
UN Campaign on Sustainable Nitrogen Management

23-24 October 2019

Nitrogen for Life

Global implication: halve nitrogen waste from all sources by 2030 to save $100 billion annually.

Colombo Declaration on Sustainable Nitrogen Management

1. Endorse the proposed Roadmap for Action on Sustainable Nitrogen Management 2020-2022, including its activities as one of the instruments to establish an Inter-convention Nitrogen Coordination Mechanism and secretariat to better facilitate communication and coherence across nitrogen policies, consistent with mandates of existing conventions and MEAs.

2. Call upon UN agencies and other international organizations, development partners, philanthropic agencies, academic and civil society organizations, to support the implementation of this Declaration, through the establishment of mechanisms of cooperation to mobilize human, financial and technical resources, including capacity building and transfer of know-how and technology, for this purpose;

3. Agree that countries should consider, in line with their national circumstances and where relevant, to:

   3.1 Develop and implement comprehensive policies on Sustainable Nitrogen Management;

   3.2 Develop national roadmaps for sustainable nitrogen management, with an ambition to halve nitrogen waste by 2030;

   3.3 Conduct comprehensive assessments on quantitative and qualitative nitrogen cycling processes, emphasizing the

Inter-convention Nitrogen Coordination Mechanism and secretariat to better facilitate communication and coherence across nitrogen policies, consistent with mandates of existing conventions and MEAs.
Nitrogen Working Group

• Nitrogen WG to develop Terms of Reference for the Interconvention Nitrogen Coordination Mechanism (INCOM)

• First e-meeting 8-9 June (register through INMS)
  – Views from intergovernmental conventions & programmes
  – Views from UN Member States (National Focal Points)
  – Presentation of INMS & International Nitrogen Assessment for advice from Member States
  – Forwardlook on emerging initiatives
Next Steps to “Halve Nitrogen Waste”

• Pin-ball multiplier: UN Decade of Ecosystem Restoration “Halve nutrient pollution by 2040….”

• Equitable approach: more waste means more action needed

• Massive economic & environmental benefits for climate, air, water, health biodiversity etc.

• Business opportunities for circular economy (30% of fertilizer made from recycled sources by 2030…?)

• Action for UNEA-5… UNGA…
The Nitrogen Bottom Line

• N affects water pollution, climate, air quality, biodiversity & ozone, relevant for multiple SDGs

• Past fragmentation has limited progress: A joined-up perspective offers multiple win-wins

• Measures require better use of fertilizers, urine, dung, with business opportunities from efficiency savings

• Colombo Declaration (Oct 2019): ambition to halve nitrogen waste by 2030 and save $100 billion annually.

• Interconvention Nitrogen Co-Ordination Mechanism: INCOM to boost INCOME – vital in a post-COVID world