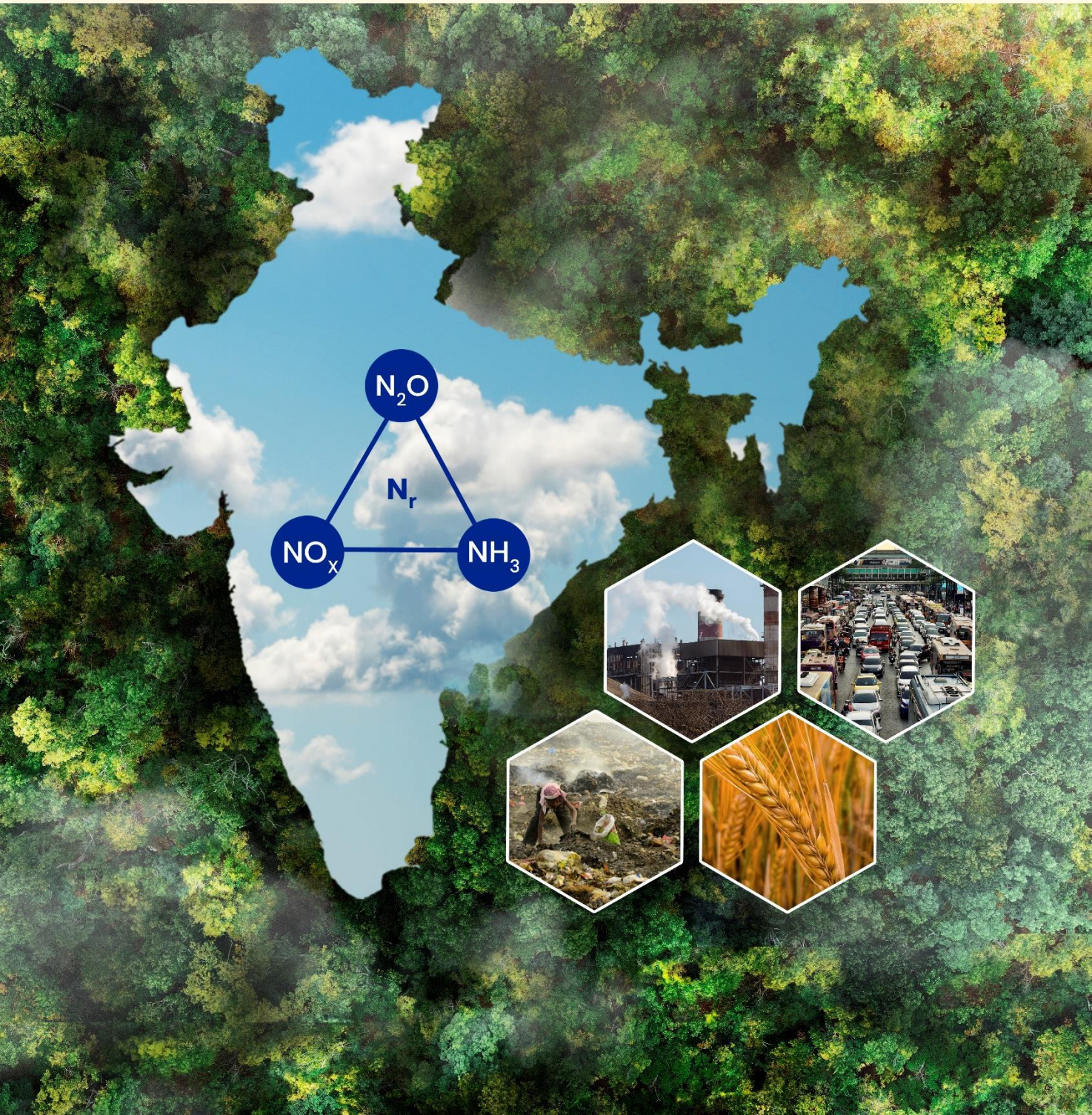
UKRI GCRF South Asian Nitrogen Hub

NATIONAL NITROGEN POLICY REPORT: INDIA



NATIONAL NITROGEN POLICY REPORT: INDIA

2023

SCIENTIFIC EVIDENCE, CURRENT INITIATIVES AND POLICY LANDSCAPE

KALINGA INSTITUTE OF INDUSTRIAL TECHNOLOGY (DEEMED UNIVERSITY), BHUBANESWAR

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Scientific Report 2023

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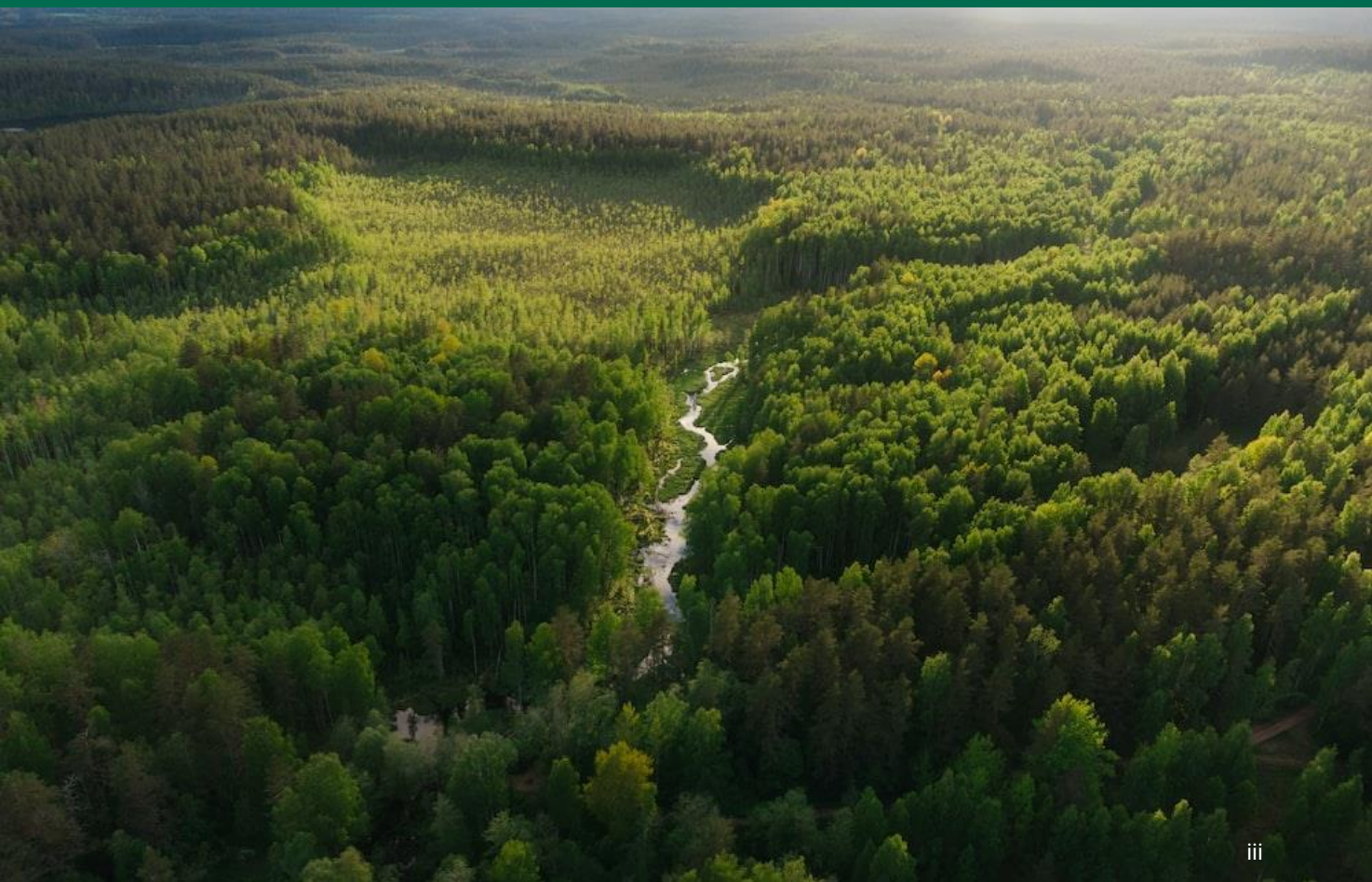


Executive Summary

This report, the first of its kind, provides a necessary step to understand the current nitrogen policy landscape for India within the broader South Asian context. It highlights the issues and challenges around nitrogen pollution and management, with recommendations for action.

INTRODUCTION

- **Nitrogen is essential for life, but nitrogen in its reactive form (N_r) in excess can cause severe harm to people and the environment.** Excess reactive nitrogen (N_r) is a significant issue globally and for South Asia.
- Multiple sectors including agriculture, transportation, industry, and energy sectors have increased their share of nitrogen pollution and related greenhouse gas (GHG) emissions due to growing anthropogenic demands.
- **Five principal threats of nitrogen pollution** are to water quality, air quality, greenhouse-gas balance, soil quality, ecosystem and biodiversity.
- Addressing climate change by reducing greenhouse gas (GHG) emissions is a key priority in international politics. **Managing nitrogen is essential for international climate change mitigation: nitrous oxide (N_2O) has ~310 times[1] more warming potential than CO_2.**
- **South Asia is a global hotspot for N_r emissions** for the main nitrogen compounds: nitrogen oxide, nitrous oxide and ammonia, with emission levels above global averages.
- **Nitrogen pollution can be managed directly or indirectly** by legislation, financial or regulatory measures taken by governments.
- Government and non-government measures can support and encourage efficient nitrogen management, and hence, minimize the negative impacts.
- The **management of nitrogen is a major issue of international policy, yet information about nitrogen policies at national levels is scarce.** There is a limited understanding of the policies, the issues addressed, and the types of instruments used, and how existing policies might impact nitrogen pollution.

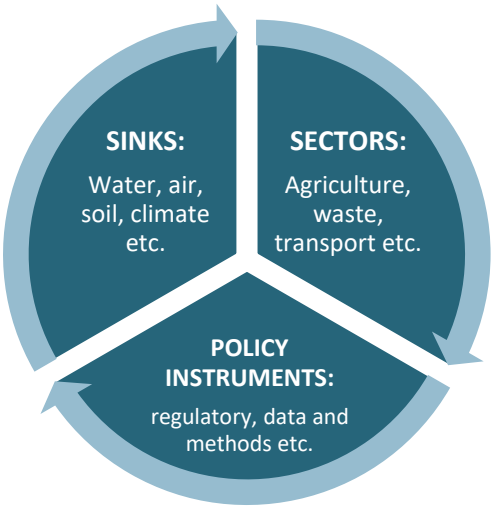
UKRI GCRF SOUTH ASIA NITROGEN HUB (SANH)

- **SANH aims to tackle the nitrogen challenge by bringing together experts from leading research organizations from across South Asia and the UK.** The hub focuses on four main areas: i) building the nitrogen policy arena for South Asia; ii) finding nitrogen solutions; iii) improving understanding and awareness of key nitrogen threats; iv) integrating data on regional nitrogen flows and impacts in south Asia.
- The South Asia Co-operative Environment Programme (SACEP) and SANH undertook an initial **South Asian regional assessment of nitrogen emissions and policy and created a database of 966 nitrogen-relevant policies from South Asia.**
- **The SANH India team conducted a second round of policy search in 2021 with a State and Union Territory level focus collecting an additional 114 policies.** This led to a collection of 306 nitrogen-relevant policies for India, contributing to 28% of the total policy collection for South Asia.
- **Drawing on that database, this SANH national report outlines the implications of these findings for India**. The country report is the first of its kind to provide a national overview on the extent of nitrogen-related policies for India.

[1] In a 100-year time period (IPCC, 2021)

NITROGEN-RELATED POLICY ANALYSIS FOR INDIA

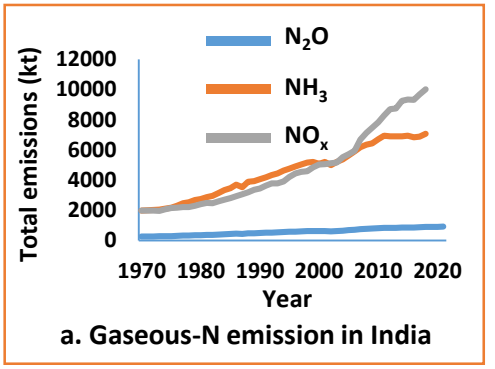
- **All nitrogen-related policies collected were classified** based on certain characteristics. Classifications include: environmental sink; sector; sub-sector; policy type; pollution source type; impact direction; relevance; and impact scope.
- **The policy type classification indicates the type of policy instruments that are incorporated within a particular policy**. A single policy may have multiple policy type characteristics, which indicate a more comprehensive approach. **For India, there were 531 classifications from the 306 policies, 172 policies (56%) of which had more than one policy type identification**.



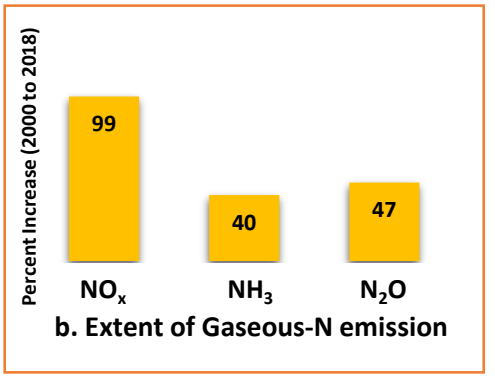
- **In terms of sectors, the most common classification of policies was for 'agriculture' (21%)**. Agriculture is one of the main contributors to GDP of India and also a core contributor to national N-emissions.
- **Another common classification for sectors was for 'multiple sectors' (20%)**. Having multiple sectors within a policy is an advantageous characteristic indicating an understanding that multiple sectors have roles to play in N_r management.
- **For environmental sinks, the most common classification was where 'no sink' had been included in the policy text (40%), and the policy was therefore purely sector oriented**. This could be regarded as an unfavourable policy characteristic, indicating that N_r environmental impacts have been overlooked.
- **Policies classified as having low relevance and/or low impact scope (36%) should, however, not be considered 'irrelevant'**, as such policies still hold potential to have an impact and via amendments, they can mitigate any N_r waste and pollution, if they do not pose a potential risk.
- **Over half the policies (70%) were identified as having a potentially positive impact on N_r management,** as there are mostly environmentally orientated policies. Policies classified as mixed/neutral (20%), indicate to varying degrees' dual goals for economic development and the environment. **Policies with a potentially negative impact direction (2%) include those that risk promoting N_r waste.**
- **To deal with N_r pollution better, it is necessary to have policies that consider multiple sectors and sinks and policy instruments.** Currently 11 policies meet this criterion to some degree. Policy examples include the 'Policy Statement for abatement of Pollution, 1991' and the 'State Action Plan on Climate Change (Haryana)'. Although, not all policies would need to be integrated in this manner, a policy gap is visible.

DRIVERS OF REACTIVE NITROGEN EMISSIONS

- **Emissions of all three nitrogen compounds, ammonia, (NH_3), nitrogen oxides (NO_x), and nitrous oxide (N_2O), have been increasing over time in south Asia and India**[2]. These results highlight that current policy efforts so far have not yet been able to stabilise or reduce N_r emissions.
- **N_r emission levels will continue to increase unless they are arrested further via tight policy actions taken at international, national, and local levels**.
- **Nitrogen oxides (NO_x) in India are the fastest rising N_r compound, particularly** since the year 2000 increasing by 99% from 2000 and 2018.
- **For ammonia (NH_3) the emission levels in India have been increasing steadily,** and at a somewhat similar pace since the 1970's. NH_3 emission grew by 40% in the period 2000 to 2018.
- There was a 47% increase in nitrous oxide (N_2O) emissions. **N_2O emissions are the lowest (in total amount) compared to the other N_r compounds**. The emissions for N_2O, NH_3 and NO_x were about 894, 7074 and 10025 Gg/year in 2018, respectively.
- **Agriculture is the largest source for ammonia (NH_3) and N_2O emission.**



a. Gaseous-N emission in India



b. Extent of Gaseous-N emission

- **Industrial combustion (others) and road transportation accounts for other major sources of nitrogen oxides (NO_x)** and their contribution increased to 1211% and 457% respectively from 2000 to 2015.
- **Power, industry and other industrial combustion also contributed to NH_3 emissions**, with the emission increasing by 507% and 361% respectively between 2000 and 2015.

NEEDED ACTIONS

- **Despite the number of policies in India (306) that have relevance for N_r management, and the high number of policies with a potentially positive impact direction, all major N_r compound emissions (ammonia, nitrous oxide and nitrogen oxides) are on the rise.**
- **India is a major contributor to all three N_r compounds in South Asia.** The South Asia region has been identified as a global nitrogen emission hotspot (SACEP-SANH, 2022). This indicates that more has to be done at the international, national and state level to tackle N_r waste.
- **As well as addressing nitrogen management systematically, policies with higher relevance should also be accompanied by direct actions, such as 'core' policies, that contain regulatory and economic policy instruments**. Setting quantifiable and enforceable constraints on N production and consumption in nitrogen-related policy is recommended.
- **Existing policies can also be adapted to deal more directly/effectively with nitrogen management by referring explicitly to nitrogen pollution itself, and ideally to specific relevant N_r compounds**. In order to address nitrogen pollution issues, amendments – ranging from minor to major ones – could be applied to these policies.

[2] The image 'a' shows Ammonia, (NH_3), Nitrogen oxides (NO_x), and Nitrous oxide (N_2O) emissions for India, 1970 – 2018/2021. Image 'b' shows the extent of percent change in the emission of gaseous reactive-N emission. Source: Crippa et al. (2021) derived from EDGAR v7.0. and EDGAR v6.1 air pollutants, https://edgar.jrc.ec.europa.eu/dataset_ap61

- **For policies with high nitrogen management relevance, amendments to specify pollution source type and the risk of nitrogen waste would be advantageous**. Only a small number (27%) of directly nitrogen-relevant policies (from a total of 197) determined if pollution sources were 'point source' locations or 'non-point source' or both. Such policies indicate potentially useful examples for N_r management as there are different challenges involved according to the different pollution source types.
- **Sector-based policies would benefit from ensuring that they directly, or via other connected policies, consider the potential risks, or options to mitigate negative N_r impacts referring to one or more environmental sink.** A large proportion (40%) of India's nitrogen relevant sector-based policies have not referenced any sinks.
- **To deal with N_r pollution better, it is necessary to have policies that consider multiple sectors and sinks and policy instruments.** Currently, 11 policies meet this criterion to some degree. Although not all policies would need to be integrated in this manner, a policy gap is visible.
- **Agriculture is one of the main contributors to national N_r emissions**. Fertilizers play a vital role but much of the inputs are wasted. Sustainable alternatives are available. Such methods, that would increase crop-N use efficiency (NUE) and simultaneously reduce N waste, have the potential to save considerable revenue, maintain soil and human health.
- **Action is needed in emerging sectors, considering relative changes in N_r emissions.** Different sectors contribute to the emission of N_r compounds in various ways and are growing at different rates. Currently, NO_x is one of the fastest rising and most abundant N_r compound in India, sourced mostly by the energy, transport and other forms of industrial combustion sector activities. The overlap in contributing sectors to different compounds, such as NOx, indicates areas where integrated policies are necessary to avoid pollution swapping and promote coordinated actions.
- **The development of National Action Plans is advised in the United Nations Environment Assembly (UNEA-5) new resolution on sustainable nitrogen management**. India has the ability to strengthen regional/international commitments such as support of UNEA-5.2 and preparing for UNEA-6 to manage nitrogen sustainably.
- **Further in-depth research on these N_r relevant policies is necessary, to assess, amongst other aspects, their impact**. SANH will continue to analyse N-relevant policy, increase the evidence base, and engage with SACEP member states to broker a better understanding.
- **Science-based decision-making is crucial to move towards N_r sustainability and SANH is supporting this journey to create the scientific evidence of the sources and causes of emissions, and ways to mitigate their impact**. SANH will improve the scientific and technical base and help strengthen India's contributions to address N_r both nationally, regionally and beyond.

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UK Research and Innovation

GCRF Global Challenges Research Fund

The South Asian Nitrogen Hub (SANH) is a UKRI GCRF funded research partnership that brings together 32 leading research organisations and project engagement partners from South Asia and the UK. SANH is working towards enabling South Asia to 'adopt and champion a strategic approach to nitrogen management as a key step towards the Sustainable Development Goals'. SANH aims to provide relevant scientific insights identify barriers to change and demonstrate the economic benefits of tackling nitrogen.

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