SUSTAINABLE INDIA TRUST

ANNUAL REPORT

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WHY FOCUS ON NITROGEN POLLUTION?

Utilising nitrogen, in its reactive form (Nr), has been essential for human development. Non-reactive elemental nitrogen predominant in the air we breathe, has been altered to reactive form (Nr) to produce chemicals, fertilisers, and other useful products. Agriculture depends heavily on Nr , with fertilisers, largely synthetic, making it possible to fulfil global food demands (FAO, 2021), but most of them are leaked as Nr into the air and water. Likewise, energy, transport and wider industry depends heavily on fossil fuels but emitting Nr as a by-product. It has been estimated that "global reactive nitrogen production has more than doubled during the last century as a result of human activity" (Galloway et al., 2008; Sutton et al., 2009).

Nitrogen pollution is the result of environmental accumulation of Nr compounds from human activities involving fossil fuels, fertilizers, and others beyond nature's capacity for restoration. They disrupt the natural nitrogen cycle, causing environmental damage. Nr compounds occur as gaseous air pollutants and include ammonia (NH3), nitrogen oxides (NOx), and nitrous oxide (N2O), a potent greenhouse gas with up to 310 times higher global warming potential than carbon dioxide over 100- year period (IPCC/TEAP, 2005; Forster et al., 2007). Nr further causes water pollution in the form of nitrites (NO2 -), nitrates (NO3 -), and ammonium (NH4 +).

The growing demands of sectors such as agriculture, transport, industry, and energy have given rise to sharp increases in the levels of nitrogen pollution and related greenhouse gas (GHG) emission (Sutton et al., 2019). Five principal threats of nitrogen pollution are to water quality, air quality, greenhouse-gas balance, ecosystems and biodiversity (see Figure 1). The growing intergovernmental concern about these threats led to the first ever UN resolution on 'sustainable nitrogen management' from South Asia, initially led by India (UNEP, 2019) and followed up by Sri Lanka (UNEP, 2022).

WHY FOCUS ON NITROGEN POLLUTION?

Reductions in greenhouse gas (GHG) emissions are key to combating climate change, and a key area in international collaboration in the United Nations Framework Convention on Climate Change (UNFCCC). The Paris agreement, in 2015, is a legally binding international commitment to limit global warming to well below 2, preferably to 1.5 degrees Celsius, compared to pre-industrial levels (UNFCCC, 2015). These concerns were reiterated in COP 26 with 'net zero' emission commitments by different countries. Nitrogen management is essential for international climate change mitigation actions. It is scientifically well-known but less recognized in policy matters that nitrous oxide (N2O) produced by industry and combustion, is the third most important GHG after carbon dioxide and methane in terms of global warming potential.

Excerpt from Adhya, T.K., Panda, A.N., Kaushik, H., Bansal, S., Raghuram, N., Ramachandran, R., Das, S., Tyagi, N., Yang, A. and Jeffery, R. (2023). India National Nitrogen Policy Report: Scientific Evidence, Current Initiatives and Policy Landscape. UKRI-GCRF South Asia Nitrogen Hub (SANH) Policy Paper 2, pp100.

ACTIVITIES

1. Profs. N. Raghuram and Tapan Adhya participated in online meetings with SANH-SACEP partners on the South Asian Roadmap for Sustainable Nitrogen Management on 03 Apr., and 10 May 2023. These meetings were held to develop a document to promote regional scientific and intergovernmental cooperation for a coordinated South Asian approach towards nitrogen management.

2. Prof. Raghuram attended virtual meetings of the UNEP GPNM Steering Committee as its member. Among other things, these important meetings sought to improve the coordination between UNEP Working Group on Nitrogen and the GPNM/GWWI, in which India is playing increasingly important roles, including SIT's joint projects of both these partnerships on nutrient recovery/recycling from wastewater.

3. Prof. Raghuram chaired a session and delivered a Keynote lecture titled 'Towards Nitrogen Use Efficiency (NUE) Improvement for Sustainable Nitrogen Management in Rice' at the XXI International Conference on Biodiversity, Food Security, Sustainability and Climate Change, 24-28 Apr., 2023, held at Assam Agricultural University, Jorhat, Assam.

4. Prof. Raghuram was consulted several times through the year as an expert and stakeholder with the SANH partners at The Energy and Resources Institute and later Xavier Institute of Management, New Delhi, as a part of their stakeholder analysis on various aspects of sustainable nitrogen management in South Asia, especially from the main sectors outside agriculture, such as energy/power and transport sectors.

ACTIVITIES

5. Prof. Raghuram attended a high level brainstorming session on 17 May 2023 at the Indian Council for Research on International Economic Relations, New Delhi and made a presentation on Nitrogen Pollution and its impact on Environment. This meeting was also attended by presenters from IFFCO and Coromandel fertilizers, who presented their work on nano-fertilizers.

6. Prof. Raghuram and Dr Sangeeta have developed and implemented another UNEP SSFA project as a follow up of the successful earlier project on Nutrient management of wastewater to prevent eutrophication in Delhi. The current project is titled Management of nutrients and microplastics from wastewater to prevent eutrophication and plastic pollution in Delhi, India. It expanded the number of sewage treatment plants and areas/water bodies of Delhi. It also expanded the parameters of study, including nutrients and microplastics in wastewater apart from sludge analysis over two seasons to provide more robust conclusions on the extent of nutrient and plastic pollution in the wastewaters of Delhi and their potential for removal and recycling the usable nutrients.

7. Prof. Raghuram signed a MoU on behalf of SIT and GGSIPU on 6th June 2023 with the Hyderabad Municipal Water Supply and Sewerage Board, Indian Institute of Rice Research and Prof. Jayashankar Telangana State Agriculture University, Hyderabad. This was done in the presence of the Telangana Minister for Municipalities and IT, Shri K.T. Rama Rao and the MD of HMWSSB, Shri Dana Kishore, at a function held the at the Academic Staff College, Hyderabad and received the attention of local media. This MoU was followed by the development and submission of a project proposal involving these partners on ‘Sustainable management of waste water for nutrient recycling and prevention of eutrophication in the water bodies of Hyderabad Metropolitan area’.

ACTIVITIES

8. As a part of SIT's continued engagement with various stakeholders on the role of sustainable nitrogen/nutrient management, Prof. Raghuram delivered a virtual presentation on 23 Jun 2023 at a webinar on 'The Nitrogen Questions: What, Why & How of Sustainable Nitrogen Management' organized by the Centre for Sustainable Agriculture, Hyderabad, and Krishna Sudha Academy of Agroecology. He ended by emphasizing the role of civil society in bringing the fruits of scientific research to inform policies and stakeholder practices governance to help the society in its transition towards agroecology for sustainable development. He also gave similar presentations and scientific inputs to S&T advocacy groups and farmers' organizations concerned with climate change and agroecology on different occasions during the year.

9. The SIT component of the GEF-UNEP-INI-CEH project 'Towards INMS' ended in June 2023, with SIT fulfilling most of its commitments despite the challenges of COVID-19. As a part of our commitment towards the project outputs, Prof. Raghuram attended multiple editorial meetings online with INMS partners throughout the year as one of the editors of the forthcoming book on International Nitrogen Assessment. and as a champion of regional assessments since 2012 that led to their inclusion under the global INMS project. This book to be published in 2024-25 by the Cambridge University Press contains an entire section on regional demonstrations of assessing nitrogen, including a comprehensive chapter on South Asian Nitrogen Assessment, coauthored by Prof. Adhya, Prof. Raghuram and Dr. Sangeeta Bansal from SIT, among other partners from South Asia and elsewhere.

ACTIVITIES

10. SIT also completed its work commitments under the UKRI-GCRF-SANH Project during this year. SIT members attended dozens of project partner meetings online in this regard, including meetings of the Ethics committee and the South Asian nitrogen policy Programme, of which Prof. Raghuram was a co-Chair. He was also the member of the Executive Group that oversaw the project along with Prof. Adhya, who was also the overall Science Director and Advisory Board member. This prestigious project involved 8 South Asian countries plus UK and SIT is proud to have contributed significantly to the national and regional policy documents and also a draft nitrogen roadmap for South Asia. As a part of this effort, Prof. Adhya organized a stakeholder workshop in KIIT, Bhubaneswar during 25-26 Aug 2023 involving farmers, civil society organisations, scientists, social scientists, Management professionals, research scholars, school and university students, among others. The Summary version of the Indian National Nitrogen Policy Report approved by the Interministerial National Nitrogen Steering Committee was released in the inaugural function, in which Prof. Raghuram made a presentation, on the role of SANH project in 'Spearheading Global Sustainable Nitrogen Management'. It was also attended by Dr. Abha Misra (UNDP), Dr. Asutosh Sharma (President, INSA), while UK partners of SANH joined online. The stakeholder workshop produced insights into the levels of interest and influence on various aspects of sustainable nitrogen management among various stakeholders. On the 2nd day (26 Aug 2023), Prof. Raghuram made a presentation on the 'Environmental impacts of Reactive N in South Asia'. SIT trustees and Dr. Sangeeta Bansal also attended the last annual meeting of this project held in the University of Perediniya, Kandy, Sri Lanka (2-6 Oct 2023), in which the final version of the Indian Nitrogen Policy Report was released. They have also shared the results of their various studies under their project components and contributed to discussions on various aspects of the project.

UKRI GCRF South Asian Nitrogen Hub

ACTIVITIES

11. Prof. Adhya and Prof. Raghuram attended the 3rd and 4th meetings of the interministerial National Nitrogen Steering Committee set up by the Indian govt to advise on the implementation of the India-led UN resolution (UNEA 4/14) on sustainable nitrogen management. Due to their efforts, India also now co-chairs the UNEP Working Group on nitrogen for the global implementation of the UN resolutions on nitrogen.

12. As a part of SIT's wider engagement with civil society organisations dealing with issues of sustainable agriculture and livelihoods, Prof. Raghuram attended a National Consultative Meeting on Agroecology, during 26-27 Oct, 2023 at the USO house, New Delhi. He also gave a presentation on Nutrient Management for Sustainable Food System in India, where he emphasized the importance of legume-based crop rotations for sustainable nitrogen management as well as nutritional security.

13. During 06-09 November, Prof. Raghuram attended the Fifth International Symposium on the Nitrogen Nutrition of Plants, Univ. of Sydney, Sydney, Australia, where he delivered a lead lecture on 'Convergence in divergence: Functional genomic identification and shortlisting of genes for NUE in rice', highlighting the latest findings from the UKRI-GCRF-SANH project, in which SIT was also an important partner.

14. As a part of the international efforts to highlight the emerging technologies for nutrient recovery from wastewater, Prof. Raghuram (2023) presented its scientific background remotely at the Swedish Pavilion side event during Climate COP28, organized by Par Larshans on 9th December 2023 at Dubai. The presentation was on Reactive nitrogen management for sustainable development.

ACTIVITIES

15. Similarly, he also made an invited lead presentation remotely at the International Symposium on Plateau Ecological Environment Protection and High-quality Development of the Yellow River Basin, 13 Dec., 2023, held at the Northwest A&F University, Yangling, Shaanxi, China, on the topic ‘Resource utilisation for farm nitrogen use efficiency and sustainable nutrient management is critical for agroecological transition’.

16. SIT was also represented by Prof. Raghuram in several online discussions among UNEP-accredited major S&T civil society groups under the open-ended working group on the development of a Science-Policy Panel on chemicals, waste and pollution prevention. He was initially a member of the Adhoc-panel and continues to be on Science Alliance Contact Group.

17. SIT continues to be represented by Prof. N. Raghuram in the Steering Committee of the International Nitrogen Initiative as its Chair Emeritus, and had participated in several of its meetings during this year.

ACTIVITIES

18. The most important highlight of SIT's activities in this year was the successful organisation of the 8th International Nitrogen Conference during 6-8 Feb 2024, in association with the International Nitrogen Initiative and Guru Gobind Singh Indraprastha University. This triennial event attracted about 300 participants from 31 countries over 4 days and included 35 sessions spanning scientific and policy sessions. Prof. Raghuram, Prof. Adhya, Dr. Sangeeta Bansal, Dr. Sarita Bansal and Dr. Prabhat Tanwar actively participated and presented their work from SIT in the conference. In all, there were 07 Keynote lectures, 19 Lead Talks, 108 Oral Presentations, 36 Oral Flash Presentations, 35 Poster Presentations apart from panel discussions on research/policy agenda and international cooperation. The lead lecture by Prof. Raghuram was titled 'Systemwide Nitrogen use efficiency for Climate-smart and Sustainable Food System in India'. SIT is grateful to INI and GGSIPU for their excellent organisational support, and to SANH, MoEFCC, ICAR and IFFCO for their financial support, as well as to Springer nature for its best presenter certificates for the N2024 conference. SIT also thanks the members of the international, national and local committees of the conference apart from the young scientists of the University School of Biotechnology and its Centre for Sustainable Nitrogen and Nutrient Management for their consistent help and support throughout the conference. Our former trustee Prof. Himanshu Pathak was the Chief Guest as DG-ICAR and Prof. Raghuram presided over as the Conference Chair. Apart from the scientific sessions, the conference adopted a Delhi Declaration on balancing global change and sustainability with nitrogen management.

8th GLOBAL NITROGEN CONFERENCE

ACTIVITIES

19. SIT functionaries virtually attended some of the UNEP events such as the OECPR and UNEA6 and GPNM webinars in order to keep abreast with the international developments and contributed to their deliberations.

PUBLICATIONS

1. Jaiswal D. and Raghuram, N. (2024). Molecular Interventions for Improving Crop Nitrogen Use Efficiency: Trends, Opportunities and Challenges in Rice. In Improving nitrogen use efficiency in crop production, Ladha J.K. (Ed), Burleigh Dodds Science Publishing, Cambridge, UK, ISBN:13: 9781801464703. Pp: 57-112

2. Yang, A., Carnell, E., Begho, T., Jain, N., Nayak, D., Panda, A. N., Bansal, S., Sandiliya, D., Pearson, C., Anik, A. R., Adhya, T. K., Raghuram, N., Skiba, U., Jeffery, R., Sutton, M. A., & Dragosits, U. (2024). Synthetic Nitrogen Fertiliser in South Asia: Production, Import, Export, and Use for Crops, South Asia Nitrogen Hub (SANH) Policy Brief. https://sanh.inms.international/policy/FertiliserPolicySupplement

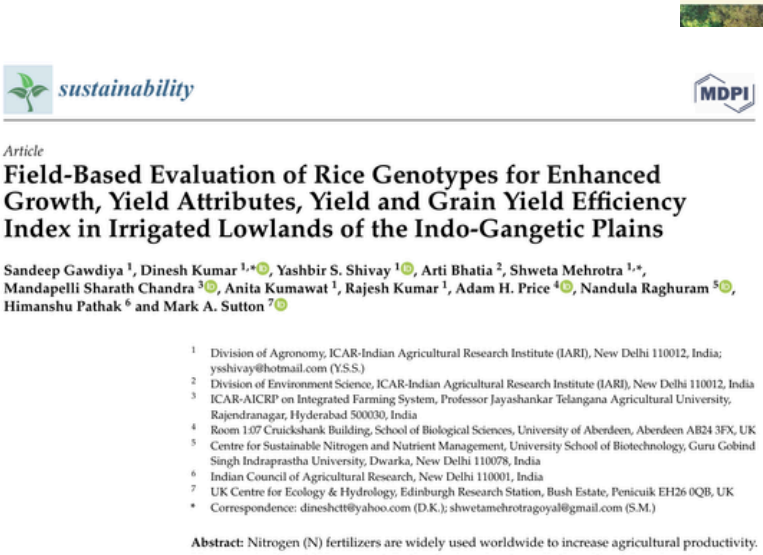
3. Gawdiya, S., Kumar, D., Shivay, Y.S., Bhatia, A., Mehrotra, S., Chandra, M.S., Kumawat, A., Kumar, R., Price, A., Raghuram, N., Pathak, H. and Sutton, M.A. (2023). Field-Based Evaluation of Rice Genotypes for Enhanced Growth, Yield Attributes, Yield and Grain Yield Efficiency Index in Irrigated Lowlands of the Indo-Gangetic Plains. Sustainability 15 (11), 8793; https://doi.org/10.3390/su15118793.

4. Adhya, T.K., Panda, A.N., Kaushik, H., Bansal, S., Raghuram, N., Ramachandran, R., Das, S., Tyagi, N., Yang, A. and Jeffery, R. (2023). India National Nitrogen Policy Report: Scientific Evidence, Current Initiatives and Policy Landscape. UKRI-GCRF South Asia Nitrogen Hub (SANH) Policy Paper 2, pp100. https://sanh.inms.international/sites/default/files/2023-11/nitrogen_policy_report.pdf

5. SACEP & SANH (2022) South Asian Regional Cooperation on Sustainable Nitrogen Management, Nitrogen Pollution in South Asia: Scientific Evidence, Current Initiatives and Policy Landscape, SANH Policy Paper PP1. https://sanh.inms.international/sites/default/files/2022-12/sacep_sanh_south_asia_regional_nitrogen_pollution_and_policy_report_2022.pdf

PUBLICATIONS

6. Yang A.L, Adhya, T.K., Anik, A.R., Bansal, S., Carnell, E., Chowdhury, S., Das, S., Hassan R., Jayaweera, A., Jeffery R., Joshi, R., Kaushik, H., Khaleel, Z., Nayak, D., Nissanka, S., Panda, A., Pokhrel, A., Porter, S., Raghuram, N., Safi, Z., Sharmin, S., Sharna, S.C., Shazly, A., Sutton, M.A, Tomlinson, S., Tshering, D., & Watto, M.A. (2022). Nitrogen Pollution and Policy Responses In South Asia, SANH policy briefing. https://sanh.inms.international/sites/default/files/2022-06/sacep_sanh_policy_briefing_june_2022_0.pdf



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