ISSN: 0973-4929, Vol. 14, No. (2) 2019, Pg. 182-185

Current World Environment

www.cwejournal.org

Reactive Nitrogen: Alarming Note for New Fossil Fuel and Fertilizer Policies

UMESH KULSHRESTHA
Editor-in-Chief

Article History

Published on 30 August 2019

Dear Readers

The present issue of the Current World Environment is presented before you. I thank the authors, reviewers and the journal secretariat for timely publishing the issue. This issue includes research papers from diversified subareas of environment as given in the table of content. This time we have included `Editorial Contributions' from our Editorial Board members. The theme of the Editorial of this issue is Reactive Nitrogen as detailed below-

The food and energy demand of the global population has resulted in the rapid increase in the levels of reactive nitrogen species (Nr) such as NH_3, NOx, NO_3^- and NH_4^+ etc. in the atmosphere across the globe. These compounds affect air quality, human health, climate, ozone levels, etc. NO_2 at high levels may be responsible for almost 2 million deaths per year due its indoor pollution effect.[1] NO_2 forms smog with excessive O_3 and organic compounds such as aldehydes, ketones and peroxyacyl nitrate (PAN) etc. The excess concentrations of the nitrogenous compounds have adverse impacts on water bodies causing eutrofication problem. Nr species are contributed by both natural as well as anthropogenic activities. Apart from natural sources, anthropogenic sources such as fertilizer production, fertilizer application, fossil fuel combustion and sanitation etc. are the major contributors of the Nr species. A comprehensive Nitrogen Assessment for India has been published by Abrol and co-workers.[2]

Recent research highlights that the anthropogenic N fixation from biological nitrogen fixation (BNF), fertilizers and combustion is estimated as 220 Mt per year against 65 Mt as the natural N fixation from BNF and lightning.[3] This indicates that the extent of human perturbation in N cycle.[4] After north America and Europe, Asian region has the third highest N deposition rates.[5] The global anthropogenic Nr budgets have been

CONTACT Umesh Kulshrestha umeshkulshrestha@gmail.com Director, Trans-Disciplinary Research Cluster
School of Environmental Sciences, Jawaharlal Nehru University, New Delhi 110 067 India.

Doi: http://dx.doi.org/10.12944/CWE.14.2.01

calculated by Dentener et al using a multi-model approach.[6] Indian consumption of nitrogenous fertilizer has touched 15 million tons in 2010-11 against 1 million ton in 1960s.[7] Indo-Gangetic region is considered as a hot spot of Nr abundance.[8-9] In India, among $N\text{-}NH_3$, $N\text{-}NH_4$ and $N\text{-}NO_3$ species, gaseous ammonia contributes highest N in the air.[10] Megacities are huge contributors to the reactive nitrogen. NO_2 levels are seen growing due to their emissions from fossil fuel combustion in thermal power plants, industries and automobiles etc.[11] NO_2 is a significant contributor to the poor air quality of Delhi and other megacities. NO_2 and NO_3^- are also responsible for acid rain.[12] The number of vehicles and population in all the mega cities has risen exponentially. Probably, due to this reason, a remarkable increase in NH_4 and NO_3 fluxes has been reported at Delhi since 1994.[13]

In the agriculture, most of the NH_3 is emitted during fertilizing stage. The urea which is a major fertilizer is the main source of higher NH_3 during fertilizing stage. Urea (NH_2CONH_2) on dissociation results in NH_3 emission. Higher temperature and alkaline dust aerosols adds to the dominance of NH_3 in gaseous phase in contrast with the acidified regions.[14] The ratio of NH_3/NH_4 remains higher in Indian region (alkaline aerosols) as compared to the acidified regions (acidic aerosols). There is a need to carry out studies on NH_3 emissions during different stages of agriculture which can be of help in efficient N management. Similarly, agriculture activity has been considered a major source of N_2O. Paddy cultivation is one among major contributors of N_2O emissions.[15] Livestock is another sector responsible for Nr contributions. N_2O emissions and annual growth rates from different livestock categories have been reported by Aneja *et al.,*[16]. However, the large discrepancies in the Nr budget from livestocks need to be reduced.

The Nr species are deposited through wet and dry deposition processes. The coarser particles are deposited through dustfall which is very common in dusty regions.[17] Wet deposition of Nr species has been reported more extensively as compared to the dry deposition of Nr species.[18] Sensitive ecosystems such as Himalayan region and Western Ghats are highly affected by the deposition of NO_3 and NH_4.[19-20] Deposition of NO_3 and NH_4 contributed by both local as well as transported sources has been reported by Kumar *et al.,*[21]. Emission vs deposition budgets of major Nr species have been given by Kulshrestha.[10]

Recently, carbon cycle imbalance has been the focus of scientific community as well as policy makers. Global warming and climate change issues related research has added tremendous new knowledge about the sources, phases, chemical and physical characteristics of carbonaceous aerosols. Before it becomes second carbon, reactive nitrogen issue needs attention. There is great need to review our fertilizer and fuel policies now. A detailed overview of the south Asian scenario of reactive nitrogen and the suggested actions has been given by Naseem and Kulshrestha.[22] It is worth mentioning here that under the UK Global Challenge Research Fund. the `GCRF South Asian Nitrogen Hub (SANH)' project has been started which has 32 leading research organizations as partners. SANH is a mega project having all eight south Asian countries and the South Asia Co-operative Environment Programme (SACEP). There are several gaps in the nitrogen increase estimates, and its impact assessment but hopefully, this SANH project will be able to provide suitable solutions which can help in an effective global nitrogen management.

References

1. Wolfe, A. H., & Patz, J. A. (2002). Reactive nitrogen and human health: acute and long-term implications. Ambio: *A journal of the human environment*, 31(2), 120-125.
2. Abrol, Y. P., Adhya, T. K., Aneja, V. P., Raghuram, N., Pathak, H., Kulshrestha, U., Sharma C. Singh, B. (Eds.). (2017). The Indian Nitrogen Assessment: Sources of Reactive Nitrogen, Environmental and Climate Effects, Management Options, and Policies. *Elsevier.* ISBN: 978-0-12-811836-8.
3. Sutton M, Drewer J, Moring A., Adhya T K et al. 2017. The Indian nitrogen challenge in a global perspective. In Abrol, Y. P., Adhya, T. K., Aneja, V. P., Raghuram, N., Pathak, H., Kulshrestha, U., Sharma C. Singh, B. (Eds.). (2017). *Elsevier*. ISBN: 978-0-12-811836-8. pp 9-28.

4. Galloway, J.N., Townsend, A.R., Erisman, J.W., Bekunda, M, Cai ZC, Freney JR, Martinelli, L.A., Seitzinger SP, Sutton, M.A., 2008. Transformation of thenitrogen cycle: recent trends, questions, and potential solutions. *Science* 320, 889–892.
5. Galloway, J.N., Cowling, E.B.,2002. Reactive nitrogen and the world: 200 years of change. *Ambio* 31, 64–71 .
6. Dentener, F.; Drevet, J.; Lamarque, J. F.; Bey, I.; Eickhout, B.; Fiore, A. M.; Hauglustaine, D.; Horowitz, L. W.; Krol, M.; Kulshrestha, U. C.; Lawrence, M.; Galy-Lacaux, C.; Rast, S.; Shindell, D.; Stevenson, D.; Van Noije, T.; Atherton, C.; Bell, N.; Bergman, D.; Butler, T.; Cofala, J.; Collins, B.; Doherty, R.; Ellingsen, K.; Galloway, J.; Gauss, M.; Montanaro, V.; Müller, J. F.; Pitari, G.; Rodriguez, J.; Sanderson, M.; Solmon, F.; Strahan, S.; Schultz, M.; Sudo, K.; Szopa, S.; Wild, O (2006). Nitrogen and sulfur deposition on regional and global scales: A multimodel evaluation. *Global Biogeochem. Cycles*, Vol. 20, No. 4, GB4003, 10.1029/2005GB002672.
7. FAOSATAT: Food and Agriculture Organization o the United Nations. 2015. Food and Agriculture Database (Food, Agriculture Organ, UN, Rome).
8. Singh S. and Kulshrestha U.C. 2014. Rural versus urban gaseous inorganic reactive nitrogen in the Indo-Gangetic Plains (IGP) of India. 2014.*Environmental Research Letters*, 9, DOI: doi:10.1088/1748-9326/9/12/125004
9. Tiwari R. and Kulshrestha U. 2019. Wintertime distribution and atmospheric interactions of reactive nitrogen species along the urban transect of Delhi – NCR. *Atmospheric Environment*, DOI: 10.1016/j.atmosenv.2019.04.00.
10. Kulshrestha U. (2017). Assessment of Atmospheric Emission and Deposition of Major Nr Species in Indian Region. In Abrol, Y. P., Adhya, T. K., Aneja, V. P., Raghuram, N., Pathak, H., Kulshrestha, U., & Singh, B. (Eds.). (2017). The Indian Nitrogen Assessment: Sources of Reactive Nitrogen, Environmental and Climate Effects, Management Options, and Policies. *Elsevier*.
11. Sharma, S K, M Saxena, T Saud, S Korpole, TK Mandal. 2012. Measurement of NH3, NO, NO2 and related particulates at urban sites of Indo Gangetic Plain (IGP) of India. *J Scientific & Industrial Research*, 71, 360-362.
12. Kulshrestha, U. C., Kulshrestha, M. J., Satyanarayana, J., Reddy, L. A. K.,2014. Atmospheric Deposition of Reactive Nitrogen in India, (April). Nitrogen Deposition, *Critical Loads and Biodiversity* (Eds: M Sutton *et al.,*), pp 75–82 (Springer).
13. Singh S., Kumar B., Gupta G.P., Kulshrestha U.C. 2014. Signatures of Increasing Energy Demand of Past Two Decades as Captured in Rain Water Composition and Airmass Trajectory Analysis at Delhi (India). *Journal of Energy, Environment & Carbon Credits*, 2014, 4(3), 43-61.
14. Singh S, Kulshrestha UC (2012) Abundance and distribution of gaseous ammonia and particulate ammonium at Delhi, India. *Biogeosciences* 9:5023-5029.
15. Adhya T K, Pathak H and Chhabra A. 2007. N fertilizers and gaseous N emissions from rice based cropping system. In Agricultural Nitrogen Use and Its Environmental Implications (Eds:Y. P. Abrol, Nandula Raghuram M S Sachdev), I K International Pvt. Ltd. New Delhi, pp 459-476.
16. Aneja V P, William H. Schlesinger, Jan Willem Erisman, Sailesh N. Behera, Mukesh Sharma, William Battye. 2012. Reactive nitrogen emissions from crop and livestock farming in India. *Atmospheric Environment.* 47 (2012) 92-103.
17. Mishra M. and Kulshrestha U. 2016. Chemical Characteristics and Deposition Fluxes of Dust-Carbon Mixed Coarse Aerosols at Three Sites of Delhi, NCR. *J Atmospheric Chemistry*, http://link.springer.com/article/10.1007/s10874-016-9349-1.
18. Kulshrestha, U. C., Granat, L., Engardt, M., Rodhe, H., 2005. Review of precipitation monitoring studies in India — a search for regional patterns. *Atmospheric Environment*, 39, 7403–7419. http://doi.org/10.1016/j.atmosenv.2005.08.035
19. Kulshrestha U. 2018. Threats to Himalayan Ecosystem due to Long Range Transport of Air Pollutants and Land Use Changes. *Current World Environment*, DOI: http://dx.doi.org/10.12944/CWE.14.1.01.
20. Satyanarayana, J. Reddy, L.A.K., Kulshrestha, M.J. Rao, R.N. and Kulshrestha, U.C. (2010). Chemical

composition of rain water and influence of airmass trajectories at a rural site in an ecological sensitive area of Western Ghats (India). *J. Atmos. Chem.,* 66, 101-116.

21. Kumar, B, Singh, S., Gupta, G. P., Lone, F. A., Kulshrestha, U. C., 2016. Long range transport and wet deposition fluxes of major chemical species in snow at Gulmarg in north western Himalayas (India). *Aerosol and air quality research,* 16: 606–617.
22. Naseem M and Kulshrestha U. 2019. An Overview of Atmospheric Reactive Nitrogen Research: South Asian Perspective. *Current World Environment*, 14, 10-26.