

Nitrous oxide (N₂O) – responsibility and action

J. R. Bhatt

Research and Information System for Developing Countries, New Delhi 110 003 and Vivekananda International Foundation, New Delhi 110 021, India; Formerly at the Ministry of Environment, Forest and Climate Change, Government of India.

India's nitrous oxide emissions in 2019 were pegged at 161.84 million tons CO₂e, which amounts to only 5.17% of the total annual greenhouse gas emissions of India. The two predominant sources of nitrous oxide emissions in India are agricultural soils and manure management. The country's annual per capita N₂O emissions are ~116.63 kg CO₂e, ranking it 147th in the world. However, India ranks 15th if we consider the historical cumulative emissions of the livestock sector. The USA, European Union, China, Russia, and Brazil are the top five nitrous oxide emitters in absolute terms. India ranks sixth, and the nitrous oxide emissions gap between the USA and India is substantial, India's emissions being 86% less than the USA's. Despite its low N₂O emissions on an annual, cumulative and per capita basis, India is making all efforts to reduce its nitrous oxide emissions from fertiliser use by coating all agriculture-grade urea with neem oil and also subsidising it, leading to annual N₂O savings of 7.529 MtCO₂e. With India's emphasis on equity, its national circumstances, and its refusal to allow the conflation of mitigation with adaptation in the agriculture sector, India has not signed any international pledge to reduce N₂O. For a better understanding of the historical responsibility for and future reductions of N₂O emissions by various countries, the article argues for the development of global N₂O budgets on the pattern of global carbon budgets as refined recently by the Intergovernmental Panel on Climate Change in its Sixth Assessment Report.

Keywords: Climate change, fertiliser use, India's ranking, Nitrous oxide, N₂O pledges.

and some of the chlorofluorocarbons (as an ozone layer-depleting substance). The long persistence of N₂O in the atmosphere means that most of the N₂O emitted by humans over the last century is still in the atmosphere and that its effect on climate change and ozone layer depletion will persist even if emissions were to stop immediately.

Atmospheric observations are consistent with agriculture being the largest contributor to human-influenced emissions of N₂O as it is a by-product of the use of nitrogen-based fertilisers, which are commonly applied to farm fields². Anthropogenic sources are mainly agricultural production processes, industrial production, and livestock emissions. From 1998 to 2016, Thompson, *et al.*³, found that the rise in global emissions was almost twice as large as previous estimates. Agriculture currently accounts for 56-81% of gross anthropogenic N₂O emissions⁴. A study⁵ found that the global concentration levels of N₂O have increased from 270 parts per billion (ppb) in 1750 to 331 ppb in 2018, a jump of 20%. The growth has been the quickest in the past five decades because of human emissions. A major proportion of the N₂O emissions in the last four decades came from the agricultural sector, mainly because of nitrogen-based fertilisers.

Nitrous oxide emission, like its other GHG counterparts, is quantified in terms of an equivalent amount of CO₂, together with the period over which this equivalence is to be considered. Thus, 1 tonne of N₂O equals 298 tonnes of CO₂ over 100 years. This equivalence is referred to as global warming potential (GWP₁₀₀). Knowledge about GWP has been evolving, following advances in scientific understanding that have led to its updating over several years. The value of GWP₁₀₀ for N₂O from the latest IPCC assessment report is 273 (ref. 6). The estimation of GWP₁₀₀ for N₂O has been reduced from 310 to 273 from the IPCC's second assessment report of 1995 to the latest report in 2022.