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Need to Focus on Nitrogen Pollution Control

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According to recent reports, levels of atmospheric reactive nitrogen species (RNS) are increasing worldwide due to rise in fossil fuel combustion for energy and agricultural yields. The use of fossil fuel is changing air composition by adding NH_3 and NOx and their related compounds. The other RNS include HNO_3, HONO, NO_3, $N2O_5$, NO_3- Peroxy acetyl nitrate (PAN), NH_4+ etc. The RNS are also disrupting life in general on land and underwater. Some of the RNS are key contributors to climate change. High levels of RNS in water and air affect human health. Also, nitrogen waste management is a great challenge for the economy. According to UNEP report, nitrogen is very significant for economy. It costs between US$340 billion and US$3.4 trillion to global economy after taking into account its effect on human health and ecosystems.[1] Food waste also has unnecessary consequences for nitrogen cycle alterations.

Nitrogen dioxide (NO_2) is one of the major RNS and is a criteria air pollutant under National Ambient Air Quality Standards (NAAQS). It is mainly emitted from fossil fuel combustion and biomass burning. It is a precursor to tropospheric ozone. It is oxidized to HNO_3 which is responsible for acid rain. NO_2 is harmful to human health. High levels of NO_2 are linked with acute human respiratory diseases including lung cancer.[2] Global NO_2 trend is reported increasing from 2005-2018. However, there are regional differences in the trends.[3] Eastern USA, Western Europe, Japan and for parts of China show some negative NO_2 trends while some parts of China, India and Middle-east show strong positive NO_2 trends.

NH_3 is another criteria air pollutant listed under National Ambient Air Quality Standards (NAAQS). NH_3 is mostly contributed by fertilizers. 81% of global ammonia emissions are from agricultural sources.[4-5] Livestock, manure, and synthetic fertilizer application are the major agricultural sources contributing to large fraction of atmospheric NH_3[6-7] However, a fraction of NH_3 is also contributed by transport sector in urban areas.

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Ammonia contributes almost 50% of $PM_{2.5}$ air pollution in EU and 30% is USA. Ammonium rich $PM_{2.5}$ causes chronic respiratory illnesses and can lead to premature mortality.

From Green Revolution to present, the urea consumption in India is increased from 1 million ton to around 33.5 million tons. Higher rates of fertilizer production have caused an increase in RNS. Major fertilizer is urea which is manufactured through Haber-Bosch process during which inert nitrogen (N_2) is transformed into urea. In the urea production process, each molecule of NH_3 production contributes one molecule of CO_2. Apart from this, transport sector also co-emits NOx and CO_2. Thus, the reactive nitrogen issue is also linked with global warming and climate change. Also, the application of fertilizer in soil is a source of greenhouse gas (N_2O) responsible for climate change.

Considering the importance of nitrogen pollution, governments adopted a resolution on sustainable nitrogen management at the United Nations Environment Assembly held in 2021. It includes both an ambition to "significantly reduce nitrogen waste globally" as well as a timeline "by 2030 and beyond.[8] Our recent studies have revealed that the reactive nitrogen levels in ambient air are increased significantly.[9] Such pattens need serious attention of scientists and policy makers to monitor selected RNS levels and related impacts, and frame necessary policies on fertilizers and fuels.

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