



## Nitrogen Pollution

**For Prelims:** Nitrogen pollution, [UNEP](#), [Nitrogen-based fertiliser](#), [Ammonia](#), [Air pollution](#), Methemoglobinemia, [Stratospheric ozone layer](#), [Eutrophication](#)

**For Mains:** Sources of Nitrogen Pollution, Major Impacts of Nitrogen Pollution, Major Compounds of Nitrogen and their effects.

[Source: ET](#)

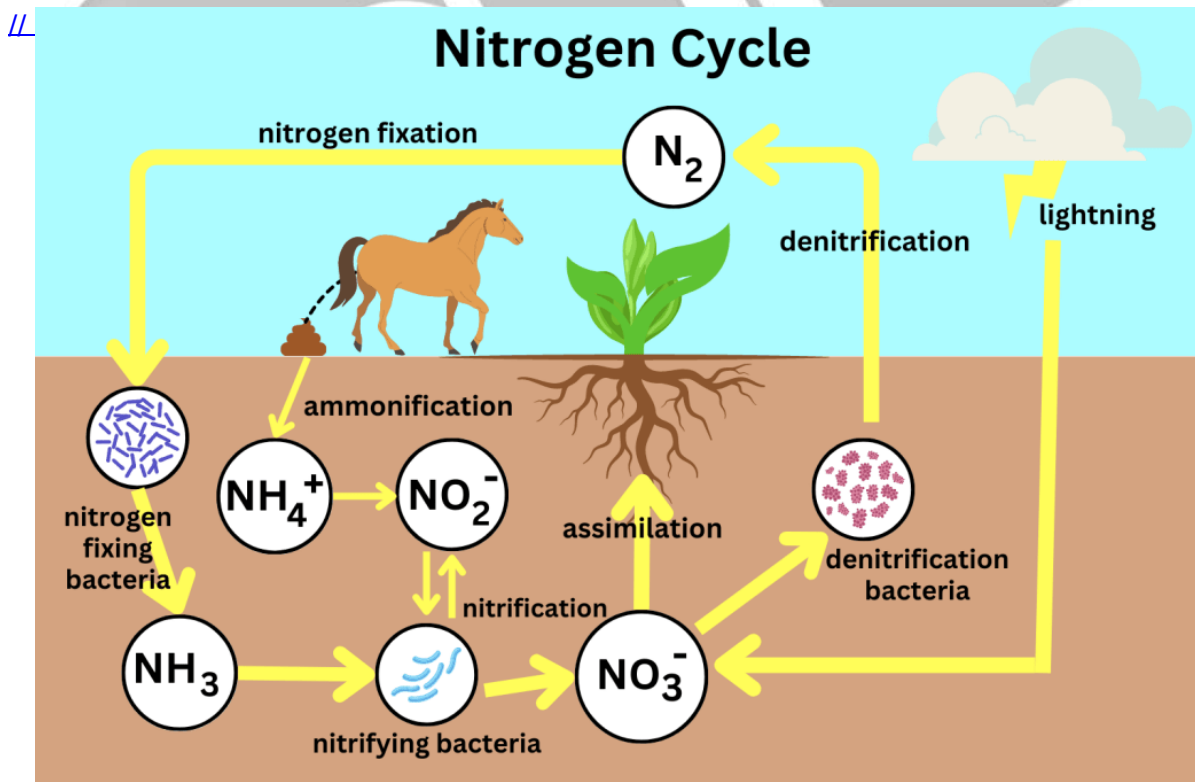
### Why in News?

Recent research has stated that by 2050, one-third of **global river sub-basins** are projected to face severe **scarcity of clean water due to [nitrogen pollution](#)**.

### What is Nitrogen Pollution?

- **About:** Nitrogen pollution refers to the **excessive presence of nitrogen compounds in the environment**, primarily in water bodies like rivers and lakes.
  - According to the [United Nations Environment Programme \(UNEP\)](#), each year, 200 million tonnes of reactive nitrogen, 80% of the total, is lost to the environment.
  - One of the main drivers of nitrogen pollution has been the rising consumption of **nitrogen-based fertiliser**, which doubled between **1978 and 2014 globally**.
    - The amount of reactive **nitrogen produced by humans is now greater than the amount created through natural processes**.
- **Sources of Nitrogen Pollution:**
  - **Agricultural Activities:** One of the main drivers of nitrogen pollution has been the rising consumption of [nitrogen-based fertilizer](#), which can leach into groundwater or runoff into surface water bodies.
  - **Industrial Processes:** Manufacturing processes, particularly those involved in the **production of nitrogen-based chemicals** and fertilisers, release nitrogen compounds into the environment.
    - [Combustion of fossil fuels in industries](#) also emits nitrogen oxides (NO<sub>x</sub>) into the atmosphere.
  - **Livestock Farming:** Livestock waste, primarily from **manure and urine**, contains nitrogen compounds such as [ammonia](#).
    - Improper storage and management of livestock waste can lead to nitrogen runoff, contaminating water bodies and contributing to eutrophication.
    - The livestock sector currently emits **65 teragrams (Tg) of nitrogen per year**, equivalent to one-third of current human-induced nitrogen emissions.
  - **Biomass Burning:** Wildfires and burning of **cow dung cake as a fuel** release nitrogen oxides (NO<sub>x</sub>) and nitrous oxide (N<sub>2</sub>O) into the atmosphere.
    - These emissions contribute to [air pollution](#) and can have regional and global impacts on atmospheric chemistry and **climate**.
- **Major Impacts of Nitrogen Pollution:**

- **Eutrophication:** Excess nitrogen acts as a **nutrient fertiliser for aquatic plants**, leading to excessive growth of **algae** and other aquatic vegetation. This phenomenon is known as **eutrophication** and leads to algal blooming.
  - This **creates oxygen-depleted zones (dead zones)**, where aquatic life suffocates and dies.
- **Human Health Impacts:** Nitrogen pollution can have direct and indirect effects on human health.
  - High levels of nitrogen dioxide (NO<sub>2</sub>) in the air can exacerbate respiratory conditions such as **asthma and increase the risk of respiratory infections**.
    - An estimated 77% of people breathe annual average concentrations of nitrogen dioxide beyond safe levels.
  - Nitrate contamination of drinking water can also pose health risks, particularly to infants, by causing **methemoglobinemia or "blue baby syndrome."**
- **Ozone Depletion:** Nitrous oxide (N<sub>2</sub>O) released into the atmosphere can lead to the depletion of the **stratospheric ozone layer**, which protects the Earth from harmful ultraviolet (UV) radiation.
  - Depletion of the ozone layer can increase the **risk of skin cancer, cataracts, and other health problems in humans**, as well as harm marine ecosystems and agricultural crops.
  - It also leads to the **creation of tropospheric ozone** which creates respiratory illnesses.
- **Related Government Initiatives:**
  - **Bharat Stage (BS VI) Emission Standards:** Stricter emission standards for vehicles and industries aim **to curb the release of nitrogen oxides and particulate matter**, which are precursors to air and water pollution.
  - **Nutrient-Based Subsidy (NBS):** This policy incentivizes the use of **controlled-release fertilisers**, encouraging more efficient nutrient management.
  - **Soil Health Cards:** Issued to farmers, these cards provide soil nutrient status and customised fertiliser recommendations, **promoting balanced nutrient application**.
  - **Nano Urea:** It is a fertiliser patented and sold by the **Indian Farmers Fertiliser Cooperative Limited (IFFCO)**, and has been approved by the government for commercial use.
    - **Nano urea reduces the unbalanced and indiscriminate use of conventional urea** and increases crop productivity.



## Note

In March 2019, the [United Nations Environment Assembly](#) adopted a resolution calling for sustainable nitrogen management.

## What are the Key Points Related to Nitrogen?

- **About:** Nitrogen is the **most prevalent element in living organisms**. It is a constituent of amino acids, proteins, hormones, chlorophylls, and many vitamins.
  - There is an inexhaustible supply of nitrogen (N<sub>2</sub>) in the atmosphere, but most living organisms cannot use the elemental form directly.
  - Nitrogen must be 'fixed' (**converted to ammonia, nitrites, or nitrates**) **before plants can take it up**.
- **Nitrogen Fixation:** Nitrogen fixation on earth is accomplished in three different ways:
  - By **N-fixing microbes** (bacteria and [blue-green algae](#))
  - By **industrial processes** (fertilizer factories)
  - To a **limited extent by atmospheric lightning**.
- **Major Compounds of Nitrogen:**

Compound	Source	Benefits	Effects
<b>Nitrous Oxide (N<sub>2</sub>O)</b>	Agriculture, industry, combustion	Used in rocket propellants. Used in medical procedures as laughing gas.	As a <a href="#">Greenhouse gas</a> , 300 times more potent than carbon dioxide - Causes depletion of the stratospheric ozone layer, which shields humanity from harmful ultraviolet radiation
<b>Di-Nitrogen (N<sub>2</sub>)</b>	Makes up 78% of the air we breathe	Maintains a stable atmosphere for life on Earth	Harmless and chemically unreactive
<b>Ammonia (NH<sub>3</sub>)</b>	Manure, urine, fertilisers, biomass burning	Foundation for amino acids, proteins, and enzymes- Commonly used as fertiliser	Causes eutrophication and affects biodiversity, Forms particulate matter in the air, affecting health by causing shortness of breath, affecting lung function, and exacerbating respiratory diseases such as asthma
<b>Nitrate (NO<sub>3</sub>)</b>	Wastewater, agriculture, oxidation of NO <sub>x</sub>	Widely used in fertilisers and explosives	Forms particulate matter in the air and affects health when ending up in groundwater, causing what's known as blue baby syndrome, Leads to eutrophication in water bodies
<b>Nitric Oxide and Nitrogen Dioxide</b>	Combustion from transport, industry, energy sector	Essential in human physiology (NO)	Major air pollutant, contributing to heart disease and respiratory illness

## Way Forward

- **Sustainable Agricultural Practices:** Implementing techniques like **precision agriculture (applying the right amount of fertiliser in the right place)** and cover cropping (planting vegetation during off-seasons to prevent soil erosion and nutrient runoff) can help minimize fertiliser use and reduce pollution.
- **Improved Wastewater Treatment:** Upgrading and expanding wastewater treatment infrastructure ensures proper treatment and disposal of industrial and urban sewage, **preventing nitrogen-rich compounds from entering water bodies**.
- **Incentivizing Green Infrastructure:** Offering incentives and subsidies for the implementation of

green infrastructure projects, such as **green roofs, rain gardens, and permeable pavements**, which help mitigate nitrogen runoff by absorbing and filtering stormwater.

- **Enhancing Public Awareness:** Raising awareness about responsible water and nitrogen management practices amongst farmers, industrial operators, and the general public is crucial to promoting sustainable practices and reduce pollution.

### **UPSC Civil Services Examination, Previous Year Question:**

**Q. Which of the following add/adds nitrogen to the soil? (2013)**

1. Excretion of urea by animals
2. Burning of coal by man
3. Death of vegetation

**Select the correct answer using the codes given below:**

- (a) 1 only
- (b) 2 and 3 only
- (c) 1 and 3 only
- (d) 1, 2 and 3

**Ans: (c)**

**Q. Which one of the following sets of elements was primarily responsible for the origin of life on the Earth? (2012)**

- (a) Hydrogen, Oxygen, Sodium
- (b) Carbon, Hydrogen, Nitrogen
- (c) Oxygen, Calcium, Phosphorus
- (d) Carbon, Hydrogen, Potassium

**Ans: (b)**

**Q. Which feature of some species of blue-green algae helps promote them as bio-fertilizers? (2010)**

- (a) They convert atmospheric methane into ammonia which the crop plants can absorb readily
- (b) They induce the crop plants to produce the enzymes which help convert atmospheric nitrogen to nitrates
- (c) They have the mechanism to convert atmospheric nitrogen into a form that the crop plants can absorb readily
- (d) They induce the roots of the crop plants to absorb the soil nitrates in larger quantities

**Ans: (c)**

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### **Mains:**

**Q. Sikkim is the first 'Organic State' in India. What are the ecological and economical benefits of Organic State? (2018)**

