Methane Emissions and Global Warming

For Prelims: Methane (CH4) emissions, Paris Agreement, Carbon dioxide, Greenhouse gas, Fossil fuels, Air quality, Ozone, Glasgow climate pact, Global Methane Tracker, Nationally Determined Contributions

For Mains: Initiatives in India to tackle methane emissions, Global Methane Pledge, Significance of methane as a greenhouse gas and its impact on climate change.

Source: DTE

Why in News?

Methane (CH4) emissions are surging, threatening global climate targets set by the **Paris Agreement.** While **carbon dioxide (CO_2)** has been the main focus in climate discussions, **methane, a far more potent greenhouse gas (GHG),** is gaining attention.

- Addressing methane's role in global warming offers significant potential for rapid climate progress.

What is the Climate Impact of Methane Emissions?

- **Climate Impact:** Methane is approximately **80 times more potent than CO_2** as a GHG and has contributed to around **30% of global warming since the industrial revolution.**
    - However, it remains in the atmosphere for **only about 7 to 12 years.** Therefore, **reducing methane emissions or enhancing its sinks** can significantly impact climate change in the **short term,** providing valuable time to tackle the more complex challenge of reducing reliance on **fossil fuels** **and associated CO_2 emissions.**
    - Reducing **methane emissions by 45% by 2030** can help meet the Paris Agreement's goal of **limiting global warming to 1.5°C.**
        - Abating methane emissions and enhancing atmospheric removal can rapidly mitigate warming, turning this climate villain into a crucial ally in keeping **global temperatures within safe limits.**
- **Air Quality Issues:** Controlling methane emissions is crucial for improving **air quality** as methane contributes to the formation of **ground-level (tropospheric) ozone**, a harmful air pollutant that affects respiratory health.
- **Emission Sources:** Key sectors responsible for methane emissions include **energy (especially oil, gas, and coal), agriculture (primarily livestock** and rice cultivation), and waste management **(landfills)**.
    - Global methane emissions are estimated at around **580 million tonnes annually,** with approximately **40% from natural sources** and **60% from human activities** (anthropogenic emissions), their mitigation is seen as a **relatively achievable climate action.**
        - The largest anthropogenic source is **agriculture,** accounting for about **25% of**

emissions, closely followed by the energy sector (coal, oil, natural gas, and biofuels).

What Global Efforts are Underway to Reduce Methane?

- **Global Methane Pledge (GMP)**: It was launched at **CoP26 2021 (Glasgow climate pact),** and aims to reduce methane emissions by **at least 30% below 2020 levels by 2030.**
    - Led by the US and EU, the **GMP** now has 158 country participants representing a little over **50% of global anthropogenic methane emissions.**
    - **India has opted not to sign the Global Methane Pledge.**
- **UN Environment Programme (UNEP)**: **UNEP** leads initiatives like the **International Methane Emissions Observatory (IMEO)** and the **Oil and Gas Methane Partnership** to monitor and reduce methane from energy, agriculture, and waste sectors.
- **International Energy Agency:** The **IEA's Global Methane Tracker** is an indispensable tool in the fight to bring down emissions from across the energy sector.
- **Climate and Clean Air Coalition (CCAC)**: Supports countries in implementing methane reduction measures.
- **Intergovernmental Panel on Climate Change (IPCC) Reports:** The **IPCC** emphasises the importance of reducing methane to meet global climate targets and has provided guidelines for nations to address methane emissions in their climate strategies.

Why Did India Reject the Global Methane Pledge?

- **Impact on Agricultural Livelihoods:** The primary sources of methane emissions in India are **enteric fermentation (**digestive process that occurs in the stomachs of ruminant animals**) from livestock and paddy cultivation.** These practices are vital for **small and marginal farmers**, who form the backbone of India's agricultural sector.
    - The methane emissions resulting from these agricultural activities are considered **"survival" emissions,** as they directly **impact food production** and farmers' livelihoods rather than being associated with luxury consumption.
- **Food Security Concerns:** India is one of the **largest producers and exporters of rice.** A reduction in methane emissions, particularly from rice cultivation, could significantly jeopardize **food security,** affecting both domestic supply and export potential.
    - The potential negative impact on agricultural production could further threaten **farmers' incomes and, by extension, rural economies.**
- **Shifting From CO2:** India contends that CO2, with a lifespan of **100-1000 years,** is the primary contributor to climate change, while the **Pledge shifts focus to methane reduction, which has a shorter lifespan,** thus altering the burden of CO2 reduction.
- **Sovereign Right to Determine Climate Actions:** India's **Nationally Determined Contributions (NDCs)** under the Paris Agreement **do not impose sector-specific emissions reduction targets,** allowing the country to determine its climate actions based on national circumstances and priorities.
    - The Indian government, through assessments, determined that signing the **Pledge would not align with its national interests.**

How is India Reducing Methane Emissions?

- **India's Participation in Climate Agreements:** India is a Party to the **United Nations Framework Convention on Climate Change (UNFCCC),** including its **Kyoto Protocol** and the **Paris Agreement ,** which aim to reduce greenhouse gas (GHG) emissions.
- **National Mission on Sustainable Agriculture (NMSA)**: Implemented by the Ministry of Agriculture and Farmers Welfare, **NMSA** promotes climate-resilient practices, including techniques to reduce methane emissions in rice cultivation.
- **National Innovations in Climate Resilient Agriculture (NICRA)**: The **Indian Council of Agricultural Research (ICAR)** has developed multiple technologies to reduce methane emissions in rice production:
    - **System of Rice Intensification (SRI)**: Increases rice yield by 36-49% while using 22-35% less water than conventional methods, reducing methane emissions.

    - **Direct Seeded Rice (DSR)**: The DSR system reduces methane emissions as it does not involve raising nurseries, puddling and transplanting.
    - **Crop Diversification Programme**: Shifts from paddy cultivation to other crops like pulses, oilseeds, maize, and cotton, which reduces methane emissions from rice fields.
- **Capacity Building Programs**: Krishi Vigyan Kendras across India conduct awareness programs for farmers on climate-resilient and methane-reducing agricultural practices.
- **National Livestock Mission**: This mission, under the Department of Animal Husbandry and Dairying (DAHD), promotes:
    - **Breed Improvement and Balanced Rationing**: Feeding livestock with a balanced and superior-quality diet reduces methane emissions.
    - **Green Fodder Production and Silage Making**: Encourages green fodder production, chaff cutting, and total mixed ration practices to reduce emissions from livestock.
- **Gobardhan Scheme (Galvanizing Organic Bio-Agro Resources)**: Incentivizes the utilisation of cattle waste for producing clean energy and organic manure, thus reducing methane emissions from livestock waste in rural areas.
    - The **New National Biogas and Organic Manure Programme** incentivises cattle waste utilisation and clean energy production in villages.

Methane

- Methane is the **simplest hydrocarbon,** consisting of one carbon atom and four hydrogen atoms (CH_4). It is the primary component of **natural gas,** possessing key characteristics: **odourless, colourless, and tasteless gas. Lighter than air.**
    - It burns with a blue flame in complete combustion, yielding carbon dioxide (CO_2) and water (H_2O) in the presence of oxygen.
- Global warming potential (GWP) is a **measure of how much energy the emissions of one tonne of a gas will absorb over a given period**, relative to the emissions of one tonne of **carbon dioxide**.
    - Methane has a GWP of 28, meaning it is 28 times more potent than carbon dioxide.

Table 1: Summary of the GWPs for different greenhouse gases by year.

Greenhouse gas	AR2 GWPs (2008–09 to 2014–15)	AR4 GWPs (2015–16 to 2019–20)	AR5 GWPs (2020–21 onwards)	2020–21 GWPs / 2019–20 GWPs
Carbon dioxide	1	1	1	0%
Methane	21	25	28	12%
Nitrous oxide	310	298	265	–11%
Perfluoromethane (tetrafluoromethane)	6,500	7,390	6,630	–10%
Perfluoroethane (hexafluoroethane)	9,200	12,200	11,100	–9%
Sulphur hexafluoride	23,900	22,800	23,500	3%
Hydrofluorocarbons(HFCs)	dependent on HFC type	dependent on HFC type	dependent on HFC type	dependent on HFC type

Drishti Mains Question:

Discuss the significance of methane emissions in the context of global warming and climate change.

UPSC Civil Services Examination, Previous Year Questions (PYQs)

Prelims:

Q1. Which of the following statements is/are correct about the deposits of 'methane hydrate'? (2019)

1. Global warming might trigger the release of methane gas from these deposits.
2. Large deposits of 'methane hydrate' are found in Arctic Tundra and under the sea floor.
3. Methane in the atmosphere oxidises to carbon dioxide after a decade or two.

Select the correct answer using the code given below.

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

Ans: (d)

Mains:

Q. 'Climate change' is a global problem. How India will be affected by climate change? How Himalayan and coastal states of India will be affected by climate change? **(2017)**

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