Bacterial Strain to Reduce Methane Emissions

For Prelims: Bacterial Strain to Reduce Methane Emissions, Greenhouse Gas (GHG)**,** Global Warming**, Aquaculture.**

For Mains: Methane Emissions and Bacterial Strain to Reduce Methane Emissions.

Source: DTE

Why in News?

Recently, a study published in the journal **Proceedings of the National Academy of Sciences** has shown that a strain of bacteria, ***Methylotuvimicrobium buryatense 5GB1C***, can remove methane from **major emission sites such as landfills, paddy fields**, and oil and gas wells.

- This bacterial strain demonstrates the **ability to consume methane, a** Greenhouse Gas (GHG) significantly more potent than carbon dioxide, leading to a substantial reduction in **Global Warming.**

What are the Key Highlights of the Study?

- **Bacterial Strain's Role in Methane Reduction:**
  - The Methylotuvimicrobium buryatense 5GB1C strain of bacteria has been **identified as a methane consumer.**
    - Methane, known for its potency as a greenhouse gas, contributes nearly 30% to total global warming and is over 85 times more potent than carbon dioxide on a 20-year timescale.
  - The bacteria's ability to consume methane at low concentrations, as low as 200 ppm, makes it a **promising candidate for methane removal technology.**
  - While other Methane-eating bacteria (methanotrophs) grow best when the **methane concentration is around 5,000-10,000 parts** per million (ppm).
- **Potential Impact on Global Temperature:**
  - By employing this bacterial strain, **approximately 240 million tonnes of methane emissions** can be prevented from entering the atmosphere by 2050.
    - This reduction in methane emissions **could lead to a global average temperature decrease of 0.21-0.22 degrees Celsius.**
    - This reduction aligns with global efforts to mitigate **climate change and limit temperature rise.**
- **Utilization of Bacterial Biomass:**
  - As the bacteria consume methane, they generate **biomass that can be utilized as feed in** Aquaculture.
  - For every tonne of methane consumed, the bacteria can produce **0.78 tonnes of biomass** with a dry weight.
    - The economic value of this biomass is estimated to be around USD 1,600 per tonne, providing an **additional benefit from the methane reduction process.**

What are the Challenges and Considerations?

- Scaling up this technology presents challenges, such as **controlling temperature for optimal bacterial growth.**
- The bacteria thrive within a temperature range of **25-30 degrees Celsius**, necessitating careful temperature management.
- Economic feasibility and energy efficiency are key **considerations, particularly in different climates, including temperate,** tropical, and arctic regions.
- The researchers emphasize the **need for further field studies to assess the feasibility of deploying** this technology on a larger scale.
- Analyzing the environmental life cycle and techno-economics of the technology is crucial **to ensure both its economic viability and its environmental benefits.**

What are the Initiatives to Tackle Methane Emissions?

- **Indian:**
  - **Harit Dhara (HD)**
  - **India Greenhouse Gas Program**
  - **National Action Plan on Climate Change (NAPCC)**
  - **Bharat Stage-VI Norms.**
- **Global:**
  - **Methane Alert and Response System (MARS)**
  - **Global Methane Pledge**
  - **Global Methane Initiative (GMI)**

UPSC Civil Services Examination, Previous Year Questions (PYQs)

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 atmosphere oxidizes 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)

Exp:

- Methane hydrate is a crystalline solid that consists of a methane molecule surrounded by a cage of interlocking water molecules. It is an "ice" that only occurs naturally in subsurface deposits where temperature and pressure conditions are favourable for its formation.
- Regions with suitable temperature and pressure conditions for the formation and stability of methane hydrate– sediment and sedimentary rock units below the Arctic permafrost, sedimentary deposits along continental margins, deep-water sediments of inland lakes and seas, and, under Antarctic ice. **Hence, statement 2 is correct.**
- Methane hydrates, the sensitive sediments, can rapidly dissociate with an increase in temperature or a decrease in pressure. The dissociation produces free methane and water, which can be triggered by global warming. **Hence, statement 1 is correct.**

- Methane is removed from the atmosphere in about 9 to 12 year period by oxidation reaction where it is converted into Carbon Dioxide. **Hence, statement 3 is correct.**
- **Therefore, option (d) is the correct answer.**