India’s Rice Fields Among World’s Top Methane Sources – Study Findings

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Rice Fields Latest News

- A new study published in *Nature Food* has found that greenhouse gas emissions from paddy fields worldwide have doubled since the 1960s, with eastern India’s rice fields emerging among the global methane hotspots.

Methane Emissions from Rice Cultivation

- Methane (CH_4) is a potent greenhouse gas, approximately 25 times more effective at trapping heat than carbon dioxide over a 100-year period.
- Agriculture is one of the largest anthropogenic sources of methane, and rice cultivation is the primary agricultural contributor.
- **How Rice Fields Produce Methane**
    - Rice is typically grown in flooded (submerged) fields, which create low-oxygen (anaerobic) conditions in the soil. Under these conditions:

        - Methane-producing microbes (methanogens) thrive.
        - They decompose organic matter in the soil and release methane as a by-product.
        - The gas escapes into the atmosphere through the water column and the rice plants themselves.
        - The longer a field remains flooded, the more methane it produces. Continuous irrigation, a common practice in intensive rice farming, significantly amplifies emissions.
- **Other Contributing Factors**
    - Incorporation of crop residues such as leftover stalks, leaves, and stubble into the soil provides additional organic matter for microbes to decompose.
    - Increased use of nitrogen fertilisers stimulates microbial activity and plant growth, indirectly enhancing methane production.
    - Loss of soil organic carbon reduces the soil's ability to store carbon, turning fields from carbon sinks into carbon sources.

India's Position

- India is the world's top rice producer. The **area under paddy cultivation has increased by approximately 25% since the 1970s and currently covers 55% of India's rainfed harvested area**.
- This expansion, combined with intensive farming practices, has made India's rice fields a major contributor to global agricultural emissions.

News Summary: Key Findings of the Study

- **Global Emissions Have Doubled**
    - 2011-2020: Paddy fields worldwide produced around 1.1 billion tonnes of carbon dioxide-equivalent (CO_2-e) emissions annually.
    - This represents an increase of 90.4% compared to annual emissions in 1961-1980.
- **Loss of Soil Organic Carbon** – Around half the increase in emissions was driven by the loss of soil organic carbon:
    - In 1961-1980, paddy fields removed 289 million tonnes of CO_2-e emissions annually.
    - By the 2010s, over a third of paddy fields worldwide had begun losing carbon rather than storing it.
- **Methane from Eastern India**
    - Paddy fields in eastern India were identified among the global methane hotspots.
    - Irrigated paddy fields in India release approximately 3.9 million tonnes of methane per year, slightly more than the annual methane emissions of Germany.
- **Future Projections** – The study projected that between 2031 and 2050:
    - Annual emissions will increase by a quarter (25%).
    - This rise will be fuelled by global warming, erratic rainfall, and intense use of agricultural inputs.
- **Comprehensiveness of the Study** – The study stood out for its comprehensive approach, integrating:
    - A global meta-analysis of more than 1,200 field experiments.
    - Process-based ecosystem modelling.
    - Artificial intelligence approaches to quantify greenhouse gas emissions from rice cultivation worldwide.

India’s Mitigation Efforts

- While India has not set specific goals to reduce emissions from agriculture, several techniques and incentives are available to farmers.
- **System for Rice Intensification (SRI)** – The National Innovations in Climate Resilient Agriculture (NICRA) project recommends the System for Rice Intensification (SRI) technique:
    - Young seedlings are transplanted precisely.
    - Fields are not continuously flooded during irrigation.
    - This reduces both water use and methane emissions.
- **Other Recommended** Practices – Experts suggest that a combination of the following measures could reduce global rice-related greenhouse gas emissions by approximately 10% by mid-century, even under a warming climate:
    - Improved irrigation practices, including alternate wetting and drying (AWD).
    - Optimised fertiliser use to reduce excess nitrogen application.
    - Residue management to control the decomposition of organic matter.
    - Reduced tillage to preserve soil carbon.

Challenges in Adoption

- Despite the availability of mitigation techniques, farmers remain reluctant due to several barriers:
    - Labour shortages for precision techniques like SRI.
    - Lack of technical knowledge and awareness.
    - Changes in rainfall patterns make alternative methods risky.
    - Regional variation in emission reduction potential, which current methods do not adequately address.

Regional Approaches and Innovations

- **The KERA-AWD Project**
    - The KERA-AWD project, led by the International Rice Research Institute (IRRI), is working to establish processes for cultivating low-emission rice systems in Kerala’s Thrissur kole lands & Palakkad Malampuzha canal regions.
    - The project uses a multi-pronged approach, including:
        - Increasing soil organic carbon.
        - Understanding hydrology and aligned irrigation systems.
        - Managing agricultural inputs and residue.
        - Studying soil microbes and farmer preferences.
    - One innovation involves replacing a portion of lime with phosphogypsum to neutralise acidic soils, which has shown a positive impact on reducing emissions in the subsoil surface.
- **The Case for Crop Diversification**
    - Experts have emphasised that crop diversification is essential for long-term emission reduction:
        - Farmers continue to dedicate large areas to paddy despite India’s agro-climatic diversity.
        - Paddy has the largest area under cultivation, often at the cost of regional indigenous crops.

- An integrated intervention for alternative grains must include:
    - Extension and training services.
    - Involvement of self-help groups.
    - Procurement support for alternative crops.
    - Policies must also prevent further expansion of paddy fields to curb emissions.

Significance for India’s Climate Goals

- **Agricultural Emissions and Climate Commitments**
    - India’s agricultural sector contributes significantly to total greenhouse gas emissions.
    - While India has committed to reducing emission intensity under the Paris Agreement, agriculture remains a challenging sector to address.
    - Rice cultivation alone accounts for a substantial share of agricultural methane emissions.
- **Food Security vs Emission Reduction**
    - India must balance food security concerns with climate commitments.
    - Rice is a staple food for over half of India’s population.
    - Any reduction in paddy cultivation must be accompanied by alternative crop support and procurement guarantees.
- **State-Level Variation**
    - Emission reduction potential varies widely between states due to differences in Topography / Soil type / Irrigation infrastructure / Cropping intensity.
    - A regional approach that considers these factors is crucial for effective mitigation.

Source: TH
