Discrepancies in Satellite Data on Farm Fires

For Prelims: Air quality, Commission for Air Quality Management, National Aeronautics and Space Administration, Indian Space Research Organisation, INSAT-3DR, INSAT-3DS, Particulate matter

For Mains: Satellite Technology in Environmental Monitoring, Government Initiatives to Tackle Air Pollution, Graded Response Action Plan (GRAP) and its Effectiveness

Source: IE

Why in News?

Recently, the **Supreme Court (SC) of India** highlighted discrepancies in **farm fire data collected** **by satellites,** which is provided by the **Commission for Air Quality Management (CAQM).** This data is crucial for monitoring **air quality**, especially in regions like Delhi, Punjab and Haryana.

- In response, the **Indian Space Research Organisation (ISRO)** acknowledged gaps in the existing satellite data and committed to developing in-house algorithms to analyze data on Farm Fires more accurately.

What are the Issues with Current Satellite Data on Farm Fires?

- **Accuracy of Data**: The data from **National Aeronautics and Space Administration(NASA) polar-orbiting satellites,** is insufficient for accurately counting farm fires.
  - This is mainly due to their **limited observation window period** over the regions of Haryana and Punjab.
  - The current satellites, including **India's INSAT-3DR** provide low-resolution images that are inadequate for accurately counting farm fires.
    - This issue is compounded by the **lack of calibration and validation** of these data sets specifically over India.
  - Climatic conditions, particularly **cloud cover and water vapor,** can obstruct satellite sensors, hindering accurate readings and data acquisition.
    - Additionally, **seasonal changes and time-of-day discrepancies** affect the effectiveness of fire detection thresholds, creating **hurdles for consistent monitoring.**
- **Evasion by Farmers**: Farmers are **reportedly timing their stubble burning activities to avoid satellite detection.** They often conduct burns **after the satellites have passed the region,** knowing the observation windows.
  - This results in an **undercount of farm fires in the official data.** This raises concerns about the accuracy of the data used by government agencies for monitoring farm fires.
- **Inconsistent Reporting**: Despite concerns raised by the SC, the **CAQM** has not yet made necessary data adjustments public, leading to questions about transparency and the real scope of the **stubble-burning issue.**

What is the Need for Accurate Farm Fire Data in India?

- **Impact on Air Quality**: Farm fires, particularly in states like Punjab and Haryana, **contribute to severe air pollution in the National Capital Region (NCR)** and adjoining areas, especially during the winter months.
- **Better Policy Planning**: Accurate data on farm fires can help government agencies take timely actions to **mitigate pollution, regulate farming practices, and implement crop residue management strategies.**
    - Accurate farm fire data can assist in identifying regions with high instances of crop burning, which could prompt interventions such as **promoting alternatives to stubble burning** or providing **incentives for sustainable farming practices.**
- **Health Risks:** The fine **particulate matter (PM2.5)** released by farm fires is a major health hazard. People in areas affected by high pollution levels experience respiratory problems, cardiovascular diseases, and other health issues.
    - Reliable data helps health officials predict and mitigate these risks by coordinating actions across regions.
- **ISRO's Efforts to Improve Satellite Monitoring**: The **ISRO** has acknowledged that current data processing algorithms are not suited for accurate fire detection in the Punjab and Haryana regions.
    - They are working on developing in-house algorithms to analyze foreign satellite data more effectively.
    - ISRO aims to upgrade its satellite, **INSAT-3DS,** by February 2025 to improve its ability to detect farm fires with greater accuracy.
    - ISRO is working on improving satellite capabilities with the upcoming **GISAT-1,** but issues with the satellite launch have delayed progress.
        - The use of satellites like **RESOURCESAT-2A,** with higher resolution imaging, could provide better monitoring of farm fires and their impact on air quality.

What are Farm fires?

- **About:** Farm fires usually refer to **deliberate fires set on agricultural fields, primarily after the harvest season to clear crop residue,** particularly in regions practicing **stubble burning.**
    - These fires often involve **burning leftover straw, stubble, or crop residues** to prepare fields for the next planting season quickly.
    - However, farm fires can also occur accidentally due to machinery malfunctions or other unintended causes.
- **Concerns Regarding Farm Fires:** Farm fires can be a cost-effective and time-saving method for farmers, it contributes significantly to **air pollution, emitting large amounts of smoke, particulate matter, and greenhouse gases** into the atmosphere.
    - Burning crop residues leads to the loss of essential nutrients such as nitrogen, phosphorus, potassium, and sulfur, which are vital for **soil fertility.**
- **Crop Residue Management(CRM):** CRM Options can be classified as **in-situ and ex-situ management options.**

In-Situ Crop Residue Managemen (residues are handled directly in the field)	**Ex-Situ Crop Residue Management** (removing the residues from the field and using them for other purposes)
▪ **Mulching:** Leaves crop residue on the soil surface, protecting it from erosion and retaining moisture. ◦ Suppresses weeds and enriches the soil with nutrients.	▪ **Biomass Power Generation:** Burning crop residues to produce electricity or heat, reducing dependency on traditional fuels.
▪ **No-Till Farming:** Seeds are planted directly into the soil without disturbing the crop residue. ◦ It helps conserve moisture and reduces soil erosion.	▪ **Animal Feed:** Residues, especially from cereal crops, can be baled and used as animal fodder.
▪ **Strip-Till Farming:** Involves tilling	▪ **Composting:** Crop residues are mixed

narrow strips where seeds are planted, leaving crop residue on the soil surface. ◦ Reduces soil disturbance and promotes a healthy environment for seed germination.	with other organic materials to create nutrient-rich compost that improves soil health.
▪ **Crop Rotation:** Alternating crops each season to reduce soil depletion and improve soil health.	▪ **Industrial Uses:** Crop residues can be converted into products like paper, textiles, and building materials.

What is the Commission for Air Quality Management?

- **About:** The CAQM in the National Capital Region (NCR) and adjoining areas was established through an ordinance in 2020, later replaced by the **The Commission for Air Quality Management in NCR & Adjoining Areas Act, 2021.**
  - Its main objective is to address air pollution through better coordination, research, and resolution of pollution-related problems, particularly in Delhi and surrounding states.
  - The CAQM replaced the **EPCA (Environmental Pollution (Prevention and Control) Authority),** which was formed in 1998 by the Supreme Court.
- **Powers of the CAQM:** Issue directions and take necessary measures to improve air quality. Investigate complaints related to air quality and pollution control.
  - Take action against non-compliance by authorities under the provisions of the CAQM Act. Investigate complaints related to air quality and pollution control.
  - It formulates action plans for controlling key pollution sources like **vehicular emissions, industrial activities, and agricultural stubble burning.**
    - One of its key initiatives is the **Graded Response Action Plan (GRAP),** which implements restrictions based on pollution severity.
- **Graded Response Action Plan:** It is a proactive strategy to tackle air pollution in Delhi-NCR. It includes staged actions based on air quality levels, ensuring timely interventions to reduce health risks and environmental damage during high pollution periods.
  - **Stage I (AQI 201-300):** "Poor" air quality, with actions such as stricter enforcement of vehicle regulations.
  - **Stage II (AQI 301-400):** "Very Poor" air quality, focusing on hotspot actions and limiting the use of diesel generators.
  - **Stage III (AQI 401-450):** "Severe" air quality, involving vehicle restrictions and potential school closures.
  - **Stage IV (AQI > 450):** "Severe+" air quality, with stringent entry restrictions for vehicles and possible shutdowns of non-essential businesses and educational institutions.

India’s Crop-Residue Management Initiatives

- **Baler Machine**
- **Bio-Decomposer**
- **National Policy for Management of Crop Residue (NPMCR):** In 2014, the Ministry of Agriculture introduced the NPMCR to curb residue burning. Key objectives include:
  - Promoting technologies for **optimal use and in-situ management of crop residues**. Supporting appropriate machinery for farming.
  - Using satellite-based technologies for monitoring and providing financial support through a multidisciplinary approach for innovative projects.

Way Forward

- **Educating farmers** about alternatives to stubble burning and **providing incentives for sustainable practices** will play a key role in reducing farm fires.
  - **Promoting in-situ and ex-situ crop residue management techniques** can greatly reduce the need for stubble burning.

- The reliance on outdated satellite technology and fire-counting methods must be revisited. Collecting data from **GEO Imaging Satellites** and incorporating more advanced techniques, such as **high-resolution satellite imagery**, and **machine learning algorithms** to track the extent of burned areas, will provide a more accurate measure of farm fires.
- **A pan-regional policy** addressing stubble burning across all affected states, with consistent guidelines and coordinated enforcement, is essential for ensuring better compliance.

Drishti Mains Question:

Discuss the challenges in accurately monitoring farm fires and the implications of these challenges on air quality management?

UPSC Civil Services Examination, Previous Year Question (PYQ)

Mains

Q. Mumbai, Delhi and Kolkata are the three mega cities of the country but the air pollution is much more serious problem in Delhi as compared to the other two. Why is this so? **(2015)**