



ATMOSPHERIC RESEARCH TESTBED (ART) - GS III MAINS

Q. Enumerate the key objectives of the Atmospheric Research Testbed (ART) in India along with its needs and significance in the present context. (10 marks, 150 words)

News: *Govt: Lab to monitor sea water quality and testbed to track monsoon systems inaugurated*

What's in the news?

- Recently, the first phase of India's Atmospheric Research Testbed in Central India (ART-CI) was inaugurated at Silkheda in Sehore district, Madhya Pradesh.

Key takeaways:

- Funded by the Ministry of Earth Sciences (MoES), the facility will house 25 high-end meteorological instruments for studying vital cloud processes associated with the monsoons over central India's Monsoon Core Zone (MCZ).

Atmospheric Research Testbed (ART):

- The ART is an **open-field, focused observational and analytical research programme.**
- It will also be used for calibrating and validating various satellite-based observations, part of weather predictions and forecasting.

Functions:

- **Observe weather conditions on the ground**, such as temperature and wind speeds, and
- Study weather systems like low-pressure areas and depressions that develop in the Bay of Bengal during the southwest monsoon season from June to September.
- Studying these systems and their associated cloud parameters will be used to generate high volumes of data over a long period.
- It can then be compared with the existing weather models so that improvements can be made to obtain accurate rainfall predictions.

Institutions Involved:

- It has been developed by the **Ministry of Earth Sciences** for Rs 125 crore.
- The Indian Institute of Tropical Meteorology (**IITM**), **Pune**, is in charge of the operations.

Different Phases:

- Under the first phase, remote sensing-based and in-situ measurements using 25 meteorological instruments have commenced.



- In the second phase, ART will deploy instruments such as a radar wind profiler and balloon-bound radiosonde, and soil moisture and temperature measuring equipment.

Location at Madhya Pradesh:

- This location falls directly in line with the path of major rain-bearing synoptic systems. This will facilitate direct monitoring and tracking.
- Synoptic systems are weather systems that span a few hundred to several thousand kilometers.
- These systems are characterized by features such as low-pressure areas, high-pressure areas, fronts (boundary between air masses), and associated weather phenomena like precipitation and winds.
- Besides, the locality is pristine and free of anthropogenic and other pollutants, making it the best site in central India for setting up sensitive, high-end meteorological instruments and observatories for recording data.

Objectives of ART:

1. Understand Monsoon Dynamics:

- To better understand processes governing monsoon convection and land atmospheric interactions over the monsoon core region.

2. Measure Parameters:

- To measure relevant meteorological parameters using state-of-the-art observational systems.

3. Observational Campaigns:

- To organize intense observational campaigns along with weather prediction model runs for testing hypotheses and to improve physical parameterizations in the models related to convection and land surface processes.

4. Address Research Needs:

- There is an urgent need to understand more on monsoon convection, its diurnal variation and land-atmospheric interactions.

5. Outreach and Training:

- The testbed will be made into an international facility for intense observational campaigns and testing physical parameterization schemes including sensitivity runs.

6. Improve Weather Predictions:

- To use ART-CI data to test, validate, and constrain numerical models for improving predictions of intense convective storms and high-impact mesoscale weather events observed predominantly over the Central India region.



7. Data Dissemination:

- The data collected at this facility will be shared for research to the national and international scientific community within the data policy of the Ministry of Earth Sciences.

Significance of ART:

1. Agricultural Dependence:

- About 45% of India's labour force is employed in agriculture, which relies heavily on rain, especially in the Monsoon Core Zone (MCZ) spanning central India².

2. Monsoon Significance:

- The southwest monsoon brings 70% of India's annual rainfall, critical for Kharif crops cultivated during July and August.

3. Study Rainfall Patterns:

- It helps study the synoptic systems like low pressures or depressions originating in the Bay of Bengal, which significantly influence the monsoon rainfall in the MCZ.

4. Weather Forecasting:

- The long term data from ART will improve weather models, leading to more accurate rainfall predictions, benefiting the agricultural sector.

5. Rainfall Correlation:

- The rainfall in central India is closely linked to the overall monsoon performance across the country, making it a key area for study.

6. Climate Change:

- With changing climate patterns, understanding monsoon behaviour in this region helps in adapting to erratic rainfall strengthened low pressure systems.

7. Research Advancements:

- The Atmospheric Research Testbed (ART) enables scientists to gather long-term data, improving weather models and rainfall predictions.

Challenges in ART:

1. Location and Infrastructure:

- The testbed is close to a region with a monsoon climate that is greatly influenced by seasonal and interannual oscillations.
- Performing an effective and good arrangement of the up-to-date utilities in such an environment is a difficult mission.



2. Instrumentation and Maintenance:

- Installing and sustaining the observation site with high-tech instruments and their operation and maintenance is a work to be done and, particularly in spite of harsh weather conditions, such a task needs special attention.

3. Data Management:

- This huge amount of data is accumulated by the different devices. It necessitates an archiving system of high level and an analysis application.

4. Research and Development:

- It is required to conduct continuous R&D work in order to enhance the predictive models accuracy and become able to foresee not only the single process but also on the ecosystem complexities.

5. Collaboration and Funding:

- Stable interaction with many national and international study centres as well as guaranteeing permanent funding are vital for the endurance of cellular automata-based intelligence development.

The Atmospheric Research Testbed in Central India (ART-CI) is a pivotal project for **understanding the monsoon and atmospheric processes**. Despite its advanced technology and significant potential for meteorological research, it faces challenges such as maintaining sophisticated equipment, managing extensive data, and securing ongoing funding and collaborations. Overcoming these challenges is crucial for the testbed to realise its full potential in **improving weather predictions and aiding in climate-related policy-making**. The success of ART-CI can provide valuable insights not only for regional weather phenomena but also for **global atmospheric science**.