Environment & Ecology · GS - III

Rapid expansion of data centres is becoming an important component of India's digital infrastructure. Critically examine the environmental trade-offs associated with their development in ecologically sensitive coastal regions. Suggest a framework for sustainable digital infrastructure.

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MARKS	WORD LIMIT
15	~250 words

Answer Hint

Digital infrastructure, water-energy nexus, coastal regulation, environmental impact assessment, ecological carrying capacity, renewable energy, sustainable cooling

Model Answer

Introduction

Data centres form the backbone of cloud computing, artificial intelligence, digital governance and financial services. However, their growing demand for electricity, water and land creates environmental concerns, particularly in coastal cities such as Visakhapatnam.

Environmental Trade-offs

1. **Water stress:** Conventional cooling systems may consume substantial freshwater, competing with domestic, agricultural and industrial requirements.

2. **Energy consumption:** Continuous server operations and cooling create high electricity demand, potentially increasing dependence on fossil-fuel-based power.

3. **Coastal ecosystem degradation:** Poorly planned construction can affect wetlands, mangroves, natural drainage and coastal biodiversity.

4. **Climate vulnerability:** Coastal facilities face risks from cyclones, flooding, storm surges and rising sea levels, potentially disrupting critical digital services.

5. **Waste generation:** Electronic equipment replacement and battery disposal create challenges involving hazardous waste and resource recovery.

Framework for Sustainable Digital Infrastructure

1. **Scientific site selection:** Environmental sensitivity, water availability, flood risks and ecological carrying capacity should guide project locations.

2. **Water-efficient cooling:** Adoption of liquid cooling, recycled wastewater and closed-loop systems can reduce freshwater consumption.

3. **Renewable energy integration:** Solar and wind power procurement, energy-efficient servers and improved cooling systems can lower carbon emissions.

4. **Environmental safeguards:** Applicable environmental clearances, coastal regulation requirements and cumulative impact assessments must be rigorously enforced.

5. **Transparency and accountability:** Developers should disclose water usage, energy consumption, emissions and environmental compliance.

6. **Community participation:** Local residents and ecological experts should be consulted before major infrastructure approvals.

Conclusion

India's digital transformation should not come at the cost of ecological security. Integrating environmental safeguards, resource efficiency and community participation can make data-centre expansion compatible with sustainable development.

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