



Mains Practice Question

Q. As AI holds immense potential for transformation but comes with a substantial environmental cost. Discuss its environmental challenges and suggest measures to reduce its impact. **(150 words)**

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Approach

- Briefly introduce AI's transformative role and its environmental costs.
- Discuss AI's environmental impact across different stages, including energy consumption, carbon emissions, and e-waste.
- Suggest sustainable solutions for reducing AI's environmental footprint.
- Conclude by balancing AI-driven innovation with ecological responsibility.

Introduction

Artificial Intelligence (AI) is revolutionizing industries and economies, but its **growing environmental footprint** is a critical concern. From **high energy consumption in data centers** to **e-waste from AI hardware**, unchecked AI expansion can contribute to **ecological degradation**. Balancing **technological progress with sustainability** is essential for AI's long-term viability.

Body

Environmental Challenges of AI:

- **High Energy Consumption:** AI data centers require enormous electricity, increasing pressure on power grids and raising greenhouse gas emissions.
 - According to the **International Energy Agency (IEA)**, energy demand from data centers is expected to double by 2026.
- **Carbon Emissions from Model Training:** Training advanced AI models requires intensive computational power, leading to high CO₂ emissions.
 - For instance, training **GPT-3** emits 552 tonnes of CO₂, equivalent to the annual emissions of dozens of cars.
- **Growing E-Waste:** Frequent hardware upgrades, driven by AI's computational demands, contribute to electronic waste.
 - The rapid expansion of **AI infrastructure** increases obsolete computing equipment, exacerbating the global e-waste crisis.
- **Water Consumption for Cooling:** AI data centers require significant water resources to cool high-performance computing systems.
 - Major **AI hubs, like Google's data centers**, consume millions of liters of water annually for cooling operations.
- **Material Extraction for Hardware:** AI chip manufacturing relies on rare earth metals, leading to environmental degradation from mining.
 - The extraction of minerals like **lithium and cobalt** for GPUs and semiconductors harms ecosystems and depletes natural resources.

- **Inefficiency in Model Training:** Large, general AI models use excessive computational resources compared to smaller, specialized models.
 - Generative **AI models such as ChatGPT** require 10–100 times more computing power than earlier AI versions, worsening the environmental footprint.
- **Lack of Environmental Regulations:** Most AI governance frameworks focus on ethics and security but overlook sustainability.

Conclusion

AI drives **innovation and economic growth**, but its environmental impact must be addressed. **Sustainable AI** requires clean energy, optimized models, and responsible **e-waste management**. Aligning AI progress with ecological preservation is an ethical imperative.

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