Water Footprint of AI

For Prelims: ChatGPT**,** Artificial Intelligence**,** GPT-4, AI models

For Mains: Balancing technological advancements with resource conservation, Impact of AI on water resources

Why in News?

As AI tools like **OpenAI's ChatGPT** continue to gain popularity for their versatility and automation capabilities, concerns are being raised regarding their environmental impact.

- A recent study has shed light on the water footprint of Artificial Intelligence(AI) models, highlighting the significant amounts of water required to maintain data centers and train these models.

What is the Water Footprint of AI?

- The water footprint of AI is the **amount of water that is used to generate electricity and provide cooling for the data centers** that run AI models.
- The water footprint of AI can be divided into two components: direct water consumption and indirect water consumption.
    - Direct water consumption refers to the **water that is evaporated or discharged as waste during the cooling process** of data center servers.
    - Indirect water consumption refers to the water that is used to produce the **electricity that powers data center servers.**
- The water footprint of AI can vary depending on several factors, such as the type and size of the AI model, the location and efficiency of the data center, and the source and mix of electricity generation.

How Much Water Does AI Consume?

- According to a recent study titled **"Making AI Less 'Thirsty:' Uncovering and Addressing the Secret Water Footprint of AI Models",** training a large AI model such as **GPT-3** can directly consume up to **700,000 liters of clean freshwater,** which is enough to produce **370 BMW cars or 320 Tesla electric vehicles.**
- The same study also estimated that a conversation with an AI chatbot such as **ChatGPT can consume up to 500 ml of water for 20-50 questions and answers,** which may not seem like much until you consider that **ChatGPT has more than 100 million active users** who engage in multiple conversations.
- The **GPT-4**, expected to have a larger model size, is predicted to further amplify these water consumption statistics.
    - However, estimating the water footprint of GPT-4 is challenging due to the lack of publicly available data for calculation.
- Although online activities using AI models occur digitally, the **physical storage and processing**

of data take place in data centers.
    - Data centers **generate considerable heat,** necessitating water-intensive cooling systems, often utilizing evaporative cooling towers.
    - To maintain system integrity, the **water used must be pure freshwater, and data centers also require significant water for power generation.**

What are the Concerns with the Water Footprint of AI?

- **Water Scarcity:**
    - Water scarcity is a global issue, and **AI technologies contribute to the problem.** AI infrastructure requires significant amounts of freshwater for cooling, which strains limited water resources.
- **Environmental Impact:**
    - Extraction of freshwater for AI operations can harm **aquatic biodiversity.**
    - Energy required for water treatment and transport for AI operations contributes to carbon emissions and climate change.
- **Unsustainable Resource Management:**
    - Diverting water for AI operations can hinder access to water for **human consumption, agriculture, and other critical needs.**
- **Equity and Social Implications:**
    - Water scarcity disproportionately affects **vulnerable communities** that rely on limited water supplies for their livelihoods.
    - The water-intensive nature of AI can further exacerbate inequities by diverting water away from communities that need it the most.
- **Long-term Sustainability:**
    - The expanding AI industry could place additional strain on water resources without addressing the water footprint issue.
    - Addressing the water footprint is crucial for the long-term sustainability of both AI development and water availability.

How Can the Water Footprint of AI be Reduced?

- **Use Renewable Energy Sources:**
    - By using renewable energy sources like **wind or** solar power **to generate electricity,** we can significantly reduce the amount of water needed.
- **Implement Water-Efficient Cooling Systems:**
    - Most data centers, which house the servers and other hardware that power AI systems, use water-based cooling systems. Implementing **water-efficient cooling technologies like air cooling or direct-to-chip liquid cooling** can help reduce the amount of water used.
- **Develop Water-Efficient Algorithms:**
    - AI algorithms can be designed to be more water-efficient by **reducing the need for computational power or by optimizing algorithms** to use less water-intensive processes.
- **Increase Hardware Lifespan:**
    - **Extending the lifespan of hardware can reduce the amount of water used** in its production. By designing hardware that lasts longer and is upgradeable, we can reduce the need to replace hardware frequently.
- **Promote Responsible Water Management:**
    - Encouraging responsible **water management practices by data centres** and other AI companies can help reduce the water footprint of AI.
        - This includes measures like recycling wastewater, using rainwater harvesting systems, and implementing water-efficient landscaping practices.
    - Adopting policies and regulations that incentivize or mandate the reduction of the water footprint of AI by setting standards, targets, or taxes.

UPSC Civil Services Examination, Previous Year Question (PYQ)

Prelims

Q1. With the present state of development, Artificial Intelligence can effectively do which of the following? (2020)

1. Bring down electricity consumption in industrial units
2. Create meaningful short stories and songs
3. Disease diagnosis
4. Text-to-Speech Conversion
5. Wireless transmission of electrical energy

Select the correct answer using the code given below:

(a) 1, 2, 3 and 5 only
(b) 1, 3 and 4 only
(c) 2, 4 and 5 only
(d) 1, 2, 3, 4 and 5

Ans: (b)

Source: DTE