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The Ecological and Ethical Cost of Scaling AI

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1. The Material Demands of AI

Artificial intelligence has been presented to the world as a technology driving economic and social transformation, being efficient and minimal environmental impact. Yet the reality of high energy and natural resource consumption, to keep its data centers operational, often remains invisible in mainstream narrative. This continuous energy and freshwater demand positions AI as a material actor within the planet's ecosystem with considerable ecological costs, marking a major shift in Anthropocene, where human technologies shape planetary systems (Creutzig, et al., 2022; Wu, et al., 2022). Although the CO2 emissions from data centers have gained much attention, the water consumption remains opaque due to significant lack of independent third-party auditing and assessments (US Department of Energy, 2024). The only information source available comes from the tech giants owning these data centers. With accelerated adoptability rate of AI, expansion and scaling of Hyperscale and Edge data centers requires massive quantities of fresh, potable water – both directly and indirectly – draining the local sources, that local communities rely on, for their livelihoods. Data centers, though used for diverse digital services, are increasingly being scaled to host AI workloads. The lack of transparency and clear policies in design choices, selecting geographical locations and inequities in stakeholder inclusion emerges as a critical issue.

The increased deployment of AI-based systems results in increased demand of its infrastructure, raising urgent concerns about planetary boundaries. Water, a core utility, is a finite and unevenly distributed natural resource and already under stress in many regions (UNESCO, 2021). AI, with its environmental cost, cannot be treated an immaterial. Overlooking AI's water consumption in sustainability assessments is no longer an option. There is a pressing need of transparency in sourcing, usage and reporting frameworks across the AI value chain.

Data centers rely heavily on fresh water with each query costing a measurable amount of water, as mentioned recently by Sam Altman, CEO of Open AI. Fresh water is used directly for 'cooling' and maintaining optimal operational costs (McKinsey & Company, 2024). A single hyperscale datacenter, for example, can use up to 550,000 gallons of water per day, totaling to 200 million gallons (760 million liters) annually. This is enough quantity for approx. 8,000 households (5 person) for their basic needs, based on WHO's per capita daily water requirement (WHO, 2020).

The situation gets further complicated due to water-energy nexus. The demands of vast AI computational resources need electricity. Globally, most of electricity is produced via thermal or nuclear power plants which places additional strain on freshwater reserves. Analyzing the nexus reveals that the indirect water consumption, needed for electricity generation, can match or even exceed the amount of water needed for cooling, compounding the overall water footprint of AI. Despite this scale, companies do not share the Water Usage Effectiveness (WUE) report consistently and transparently (IEA, 2024). The claims of replenishment of water consumption such as 'water-positive' pledges remain vague, often lacking critical information about when, where and how freshwater is drawn and what is actual ecological benefit gained (Microsoft, 2025). Such data is vital in understanding the offset occurring outside the watershed, where extraction happens and therefore fail to provide meaningful accountability.

2. Water-Stressed Geographies and Data Center Boom

The freshwater scarcity has affected billions of people in recent years. Yet the growing mismatch between data center geographical placement and water availability reflects a negligence towards this escalating crisis. A closer look at spatial convergence of water risk locations and number of data centers they are hosting, reveals the overlooked construction of digital futures on fragile water foundations (World Resources Institute, 2023; Data Center Map, 2024). Countries like Belgium, Spain, Chile and India are hosting large number of data centers despite high or extremely-high baseline (2023) and projected (2030) water stress level, as reported by Aqueduct Water Risk Atlas. India, for instance, hosts 265 datacenters while facing extreme water stress while major tech firms like Google, plan to set additional hyperscale data centers in the country. Spain hosts 161 data centers with presence of Microsoft, Google, Meta and Amazon Web Services and Belgium has 48 data centers supporting operations of significant and long-standing hyperscale data centers such as Google.

Between depletion of water resources and economic benefits, countries show a paradox between digital infrastructure growth and water scarcity. The local ecosystems and communities increasingly compete for resource availability, without any mechanism to govern or mitigate this competition (Lehuedé, 2024; Vinuesa, et al., 2020). Meanwhile the developing countries position themselves in AI revolution by actively welcoming foreign investment brought by data centers as part of their digital transformation goals. Nations like South Africa, Egypt, Angola, and Pakistan, with ongoing water scarcity challenges, seek investments in data centers by offering land and rebates. They seemingly ignore any consideration of ecological trade-off that comes along with economic prosperity. Egypt, for example, faces extremely-high projected water-stress and when combined with its rising number of AI data centers, it may have a short-term economic uplift but also deepen long-term water scarcity.

3. AI Growth and Ecological Fragility

With scaling of global AI models and increase in localization, demand for data centers will intensify. This expansions risks triggering a rebound effect (Hertwich, 2005). The efficiency gains in AI models will lead to increase in overall resource consumption and a need for more data centers. With AI capabilities getting more distributed and embedded in daily systems, the consumption of energy and water will be accelerating too. So, despite any improvements in AI model efficiency or cooling innovations, the need of accountability and transparency in its environmental impact cannot be denied. To keep up with the demand, the data center operators pursue locations with low operational cost and greater water accessibility. Such sites are often situated in resource-constrained regions. Meanwhile developing countries are ready to avail this opportunity for digital transformation and foreign investment. However, any international standard, guiding the integration of water risk in AI infrastructure policy is still missing, leaving the discussions to fragmented national strategy or at public private discretion.

The absence of regulatory safeguards, along with its environmental impacts, may intensify conflicts between data center operators, agricultural users, diverse industrial consumers and local populations who share freshwater sources. Such conflict may lead to disrupted food systems, local protests and inequitable water allocations, and in some cases, the corporate interests overriding public welfare. Such politicization may further destabilize already vulnerable communities.

The expansion of AI calls for accountability of its environmental footprint in sustainability and governance debates requiring independent audits, inclusive planning and enforceable global standards. In Anthropocene, responsible AI must align with planetary limits and social equity or otherwise risk heavy ecological strain and systematic injustice.

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