Agostina Dasso Boonman [et al]. "Artificial intelligence expansion and the right to a clean, healthy, and sustainable environment: A comparative regional analysis" (2025) 9 245-265 *Global Campus Human Rights Journal* https://doi.org/10.25330/3220

Artificial intelligence expansion and the right to a clean, healthy, and sustainable environment: A comparative regional analysis

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Abstract: *Artificial intelligence (AI), particularly generative AI, is rapidly transforming global economies and societies while raising significant concerns about its environmental impact on the realisation of the human right to a clean, healthy, and sustainable environment. This article examines the tension between AI's transformative potential and its substantial environmental costs, including energy consumption, water usage, and electronic waste generation. Through legal analysis and desk research, this study maps AI-related environmental harms against the human right to a healthy environment, as recognised by the UN General Assembly in 2022 and elaborated in the work of the UN Special Rapporteurs on the human right to a clean, healthy, and sustainable*

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environment and on the human rights to safe drinking water and sanitation, and surveys regulatory and policy approaches to these harms across four regions, with sustained doctrinal analysis of the European Union's Artificial Intelligence Act. Ultimately, it argues that addressing AI's environmental footprint requires moving beyond voluntary corporate commitments toward binding international standards that recognise environmental protection as integral to responsible AI development. Reconciling AI innovation with environmental rights demands that States, international organisations, and technology companies prioritise human rights obligations, ensuring AI development serves rather than undermines global sustainability for present and future generations.

Keywords: *AI; environmental impact; healthy environment; human rights*

1. Introduction

Artificial intelligence (AI) is a rapidly developing technology that is bringing changes to different sectors such as transportation, communication, healthcare, finance, and many more areas of life. It is transforming economies and societies worldwide with its ability to automate complex tasks, process large amounts of data, and generate novel solutions (McKinsey Global Institute 2017, 2). AI promises various benefits starting from autonomous vehicles to smart cities and optimised supply chains.

Among various types of AI, generative AI (GenAI), capable of creating new content such as text, images, or code, is gaining momentum today. Various GenAI models are being widely used for different purposes: from helping with writing and creative projects, generating realistic images or videos, and automating software coding, to assisting with customer service with personalised interactions and to even helping in drug development (Bubeck et al. 2023).

GenAI usage has surged since mid-2024, with ChatGPT traffic growing by 113 percent to 4.5 billion monthly visits (Liu et al. 2025, 2). AI's potential to innovate and accelerate knowledge creation is well-recognised (Singh et al. 2024; Aldulaijan and Almalky 2025), with AI technology also increasingly being seen as a tool to advance sustainability through optimisation of energy systems by improving resource efficiency and climate monitoring (Rolnick et al. 2022).

At the same time, expansion and deployment of AI carries environmental implications. For example, training OpenAI's GPT-3 emitted around 552,000 kg of CO2 equivalent and required 1,287 megawatt hours of electricity (Patterson et al. 2021). According to the International Energy Agency report (IEA 2025, Executive Summary), electricity demand from data centres that host AI training worldwide is expected to more than double by 2030 to around 945 terawatt-hours, slightly more than the entire electricity consumption of Japan today. Data centres worldwide use substantial water for cooling – training GPT-3 alone consumed around 700,000 litres of fresh water (Li et al. 2025). Additionally, the demand for AI hardware has intensified the extraction of rare earth elements (REEs) needed for production of components such as microchips and high-performance computing devices. The mining and processing of REEs comes with environmental risks and generation of toxic waste, including radioactive byproducts, which can contaminate soil, water, and air (Zapp et al. 2022). The AI expansion also complicates the current e-waste situation: according to the most recent Global E-waste Monitor, the world generated a record 62 billion kg of electronic waste in 2022, of which only 22.3 percent was formally collected and recycled in an environmentally sound manner (Baldé et al. 2024, 12). This data reveals a puzzle: while the development and deployment of AI are advancing at a rapid pace, efforts to address the resulting environmental costs are lagging behind. Despite the fact that tech giants, like Amazon, Microsoft, and OpenAI, started renewable energy sourcing and efficiency improvements such as investments in wind, solar, battery storage, nuclear and hydrogen, these efforts remain voluntary and fragmented (World Economic Forum 2025).

This raises concerns about the impact of AI on the realisation of the human right to a clean, healthy, and sustainable environment, recognised by the United Nations (UN) as a universal human right in 2022. The existing literature on the topic of AI and human rights focus on ethical and social implications of AI including matters like privacy issues, bias, and misinformation (see Romero Moreno 2024). The studies on the topic of AI and sustainability focus on, e.g. AI's impact on realisation of the UN Sustainable Development Goals (Goralski and Tan 2020; Vinuesa et al. 2020). A third, more directly relevant strand has only recently begun to connect digital technologies specifically to environmental law and to business-and-human-rights obligations. A recent scoping review of environmental law and digital technology scholarship finds this literature to be markedly siloed, with little sustained cross-citation between environmental lawyers and technology scholars (Holley et al. 2025), a gap this article's analysis is intended to help narrow for the specific case of GenAI. Within that emerging strand, recent commentary has also begun to frame the environmental risks of data-centre infrastructure, water and energy demand, and mineral extraction in explicitly business and human rights and environmental criminal law terms, arguing that such risks properly fall within corporations' human rights due diligence obligations under the UN Guiding Principles on Business and Human Rights (UN 2011) rather than being treated purely as a sustainability concern (Di Donato 2026). While the number of research on the topic grows, relatively few studies examine how AI's environmental implications threaten the human right to a clean, healthy, and sustainable environment or how these impacts are managed or neglected across different regions of the world. Therefore, this article seeks to explore the following research questions:

(1) What are the direct and indirect environmental impacts of AI development and deployment? How do these environmental impacts threaten the enjoyment of the human right to a healthy, clean, and sustainable environment?

(2) Are there regional differences in the regulation or mitigation of AI-related environmental harms?

(3) How do businesses, Governments, and international organisations address – or fail to address – the environmental implications of AI within the scope of human rights obligations? What lessons can be drawn globally to reconcile AI development with the protection of environmental rights?

To answer these questions, this study combines desk research with doctrinal legal analysis. Desk research was used to compile empirical evidence on AI's environmental footprint, spanning energy, water, and material use, from technical, scientific, and policy sources; legal analysis proper was then applied to identify the relevant State and corporate obligations under the substantive and procedural framework set out in section 2.1 and to assess how far existing regulatory instruments in each region give effect to them.

The four regions examined, the European Union (EU), Asia, Africa, and Latin America, were selected on three grounds. First, taken together they capture the principal current poles of AI infrastructure investment, so that regulatory responses in these regions bear most directly on where the underlying environmental harms actually occur. Second, they offer a genuinely comparative spread of regulatory posture, from the EU's binding, instrument-based model to the predominantly principle-based or human-rights-derived approaches found in Asia, Africa, and Latin America, allowing the analysis to test whether binding regulation produces materially different outcomes from softer governance. Third, each region furnishes at least one primary legal or quasi-legal instrument, whether legislative (the EU Artificial Intelligence Act (AI Act)), continental strategy (the African Union's Continental AI Strategy) or jurisprudential (the Inter-American Court of Human Rights Advisory Opinion 32), against which the obligations identified in section 2.1 can be tested directly, rather than relying on regulatory intention alone.

Priority was given throughout to primary legal instruments, statutes, regulations, treaty-body jurisprudence, and Special Rapporteurs' reports, where these were available. Secondary and grey literature, policy commentary, law-firm client alerts, and journalistic sources were used to establish factual and technical context and to fill evidentiary gaps where primary sources on AI-specific environmental regulation do not yet exist, reflecting the nascent state of this field of law; such sources are treated as illustrative rather than authoritative. This limitation is most acute for Asia, Africa, and Latin America, where the analysis is necessarily closer to a policy survey than to the sustained doctrinal treatment afforded to the EU, an asymmetry that reflects the current state of AI-specific environmental regulation across these regions rather than an analytical choice, and against which the article's regional findings should be read. The paper is structured as follows: the following section introduces the right to a clean, healthy, and sustainable environment, and clarifies what is meant by AI, particularly GenAI. The next section explores the direct and indirect environmental impacts of AI, from energy use to e-waste, and examines how these impacts can compromise human rights. After that, the regional analysis considers how AI-related environmental harms can manifest differently across regions and what lessons can be drawn from diverse regulatory and policy approaches. The following section examines how various actors – AI companies, States, and international organisations – are addressing or neglecting these challenges and evaluates possible governance mechanisms or technological innovations. The conclusion reflects on the broader implications of AI's environmental footprint for human rights and sustainability and suggests ways to align AI development with global environmental and human rights obligations.

2. Mapping the field

2.1. The right to a clean, healthy, and sustainable environment – what does it entail?

The right to a safe, clean, healthy, and sustainable environment (or more simply: the right to a healthy environment) has been slowly incorporated in the framework of international human rights framework as well as domestic legislations. In 2021, the UN Human Rights Council adopted a resolution, recognising the right and committing the UN General Assembly to do the same (UN Human Rights Council 2021), which happened a year later (UN General Assembly 2022). This right has been granted legal protections in more than 100 countries and is recognised in regional conventions, case law, or legislation in more than 150 States (UN Special Rapporteur on the human right to a clean, healthy and sustainable environment 2022, para. 24; Knox 2019). These recent recognitions, while very significant, do not mean that the right has been only recently "discovered." Human rights law has been applied to environmental issues for years preceding these official statements, especially in the context of the right to life and health (UN Special Rapporteur on the human right to a clean, healthy and sustainable environment 2018a, para. 12; African Commission on Human and Peoples' Rights 2001, para. 52; Inter-American Court of Human Rights 2017). Broadly speaking, the right to a healthy environment includes clean air, safe and sufficient water, healthy and sustainably produced food, a safe climate, healthy ecosystems and biodiversity, and toxic-free environments where people can live, work, study, and play (UN

Special Rapporteur on the human right to a clean, healthy and sustainable environment 2018b). It could be conceptualised as having a bundle of rights, with different components, which include substantive and procedural elements (Preston 2024). Stakeholders are obliged to protect people against environmental harm that interferes with the enjoyment of human rights overall. As environmental harm may threaten a variety of rights, substantive obligations will depend on the content of their duties with respect to the rights threatened by the harm (UN Independent Expert on the issue of human rights obligations relating to the enjoyment of a safe, clean, healthy, and sustainable environment 2013, para. 44). With regard to that, the Independent Expert has identified several categories of obligations : the issue of human rights obligations relating to the enjoyment of a safe, clean, healthy and sustainable environment 2013), including the obligation to adopt and implement legal framework that protect against, and respond to, environmental harm that may or does interfere with the enjoyment of human rights; obligations to protect against environmental harm from private actors (see United Nations 2011); and obligations relating to transboundary environmental harm as well as obligations with respect to groups particularly vulnerable to environmental harm. As for the procedural component, this includes duties to assess environmental impacts and make information public, to facilitate public participation in environmental decision-making (by protecting freedom of expression and freedom of association), and to provide access to remedies for harm (UN Independent Expert on the issue of human rights obligations relating to the enjoyment of a safe, clean, healthy and sustainable environment 2013; UN Special Rapporteur on human rights and the environment 2018b).

2.2. *Artificial intelligence*

While AI technology has become an ever-present aspect of our societies, there is no consensus on its definition, with various degrees of preciseness applied in different definitions. The UN Special Rapporteur on the right to privacy has referred to the taxonomy introduced by Russel and Norvig (UN Special Rapporteur on the right to privacy 2023, para. 7), where they identified constituent elements of AI systems: systems that think like humans, systems that act like human beings, systems that think rationally, and systems that act rationally (Russell and Norvig 2009). Further, existing legal frameworks potentially draw from the definition introduced by the OECD (adopted in 2019 and revised in 2023), which defines an AI system as "a machine-based system that, for explicit or implicit objectives, infers, from the input it receives, how to generate outputs such as predictions, content, recommendations, or decisions that can influence physical or virtual environments," and notes that "different AI systems vary in their levels of autonomy and adaptiveness after deployment" (OECD 2024, 4).

While the development of rudimentary AI has been observed for decades, it was the recent development of general-purpose AI, specifically

GenAI, that brought heightened attention to this technology, including its impact on human rights (see Peñalvo and Ingelmo 2023). This development was notably facilitated by the advances in computing power and the growth and significance of data, crucial for training AI. Broadly speaking, general-purpose AI systems have the capability to competently perform a wide range of distinct tasks, such as content generation, calculation, and programming. Large GenAI models are among the most recognised examples of general-purpose AI. They may produce new, previously unseen information dependent on the data on which they were trained (Peñalvo and Ingelmo 2023, 7). In principle, the AI research community reserves the term "generative" for complex models that can create high-quality, human-like material (Peñalvo and Ingelmo 2023, 8). The development of generative adversarial networks marked an important milestone in GenAI – a type of machine-learning algorithm using competing neural networks (Chakraborty et al. 2024). Later, large language models (LLMs) emerged as another form of GenAI capable of performing language processing tasks through Natural Language Processing. LLMs can generate content such as text, translations, and code, with some advanced multimodal models also capable of processing images or converting text to speech.

As indicated, AI, specifically GenAI and LLMs, is able to operate as effectively as it does nowadays thanks to the huge amount of data that it is trained on. Processing these datasets requires thousands of specialised processors running continuously for weeks or months, consuming energy equivalent to hundreds of households annually. This training cycle, repeated each time models are updated or improved, creates a substantial environmental footprint.

3. Environmental impacts of GenAI technology

When we talk about the emergence of AI, in the field of promises we are told about positive impacts such as decarbonisation, the revolution in connectivity and inclusion, and the way society interacts, learns, and perceives reality. The potential implications of increased demand for critical minerals, REEs, and water resources to meet new data centre needs require careful consideration (UNEP and International Science Council 2024, 31).

Before examining these environmental costs, it is important to acknowledge the technology's potential contributions to environmental sustainability. AI can detect patterns in data and use historical information to help predict future outcomes, potentially supporting climate change mitigation and adaptation efforts. The technology can also be used to tackle climate change through tracking air emissions and promoting environmental monitoring and management procedures. Measurements for air emissions, supply chains, and waste management can be collected and analysed through innovative AI solutions, with AI system governance ensured through frameworks such as ISO 42001 (ISO 2023). In this regard, for example, the UN Environment Programme (UNEP) uses AI to detect when oil and gas facilities vent methane (a greenhouse gas that drives climate change) (UNEP and International Science Council 2024, 31). Other mitigation opportunities include AI applications in sustainable agriculture, which adopt AI tools as part of environmental solutions and present potential mechanisms by which AI can contribute to sustainable farming activities. For instance, AI-powered smart irrigation systems provide optimised water supply and fertiliser distribution, replacing traditional or seasonal use of agricultural water resources in response to climate change challenges.

While AI can address environmental emergencies, the physical infrastructure required for AI systems also carries significant environmental costs (UNEP 2025). Research is carried out on the effects of AI on the environment, however there is little concrete and disaggregated information available on the subject. In the words of Golestan (Sally) Radwan, director of digital transformation at the UNEP, "We have a reasonable idea of what the environmental impacts might be ... However, it is impossible to predict how AI-based applications will affect the planet" (UNEP 2025). Behind the major productions of GenAI language models lie vast physical infrastructures that support their operation and have a significant impact on the environment. The infrastructure involved can lead to various problems. On the one hand, data centres, facilities that house the infrastructure needed to deploy and deliver AI applications and services, host large-scale AI deployments including those operated by cloud service providers. These centres require large, non-overcrowded infrastructure to operate. Unlike traditional data centres, those dedicated to AI require high-performance graphics processing units (GPUs), as well as advanced storage, networking, power, and cooling capabilities, and a larger footprint. The production of GPU chips and other electronic components, with their brief useful life of under five years, depends heavily on minerals extracted from Africa. The continent's reserves of cobalt, tantalum, and gold make African mining operations essential to AI system manufacturing. These kinds of practices in the region have frequently led to resource exploitation without sustainable benefits for local communities, ecological devastation, and have adversely affected the quality of life for local communities (AUDA-NEPAD 2024). Furthermore, the "cloud," contrary to what its name suggests, refers to a vast network of interconnected internet servers used to store, distribute, and manage data. These server networks are located in giant data centres or warehouses distributed around the world and connected by approximately 450 submarine internet cables, as well as thousands of giant terrestrial structures hosted in various countries.

In addition, data centres generate significant environmental challenges through electrical and electronic waste (e-waste), water consumption, and energy usage. E-waste from data centres often contains hazardous substances such as mercury and lead, and includes discarded or broken electronic devices like computers, smartphones, chargers, cables, and server systems (Schwaller 2024). Relatedly, GenAI intensifies this problem, since it depends on rapid improvements in hardware infrastructure and chip technology that generate more electronic waste as hardware is upgraded or replaced (Schwaller 2024). Recently, experts estimated that e-waste could reach 1.2 and 5.0 million metric tons by 2030, which is about 1,000 times more e-waste than the amount produced in 2023 (Schwaller 2024). This projection is consistent with the UN's fourth Global E-Waste Monitor, which found that in 2022, a record of 62 billion kg of e-waste was generated globally and only 22.3 percent of this e-waste mass was documented as formally collected and recycled in an environmentally sound manner (Baldé et al. 2024, 12).

Furthermore, data centres consume water both during construction and during operation, where it is used to cool electrical components and prevent overheating. The scale of this water consumption, illustrated above by the GPT-3 training example, is staggering when extrapolated across the industry as a whole. According to UNEP, global AI infrastructure could consume six times more water than a country of six million people like Denmark, in a context where a quarter of the world's population currently lacks access to clean water and sanitation (UNEP 2025). Other sources (e.g. Water Usage Effectiveness) point out that water use by data centres could double by 2030 (Pais Circular 2025). This could lead to local droughts. According to one of the recent reports of the Special Rapporteur on the human rights to safe drinking water and sanitation, the proliferation, often in the name of economic progress, of data centres happened in opaque circumstances, with a lack of transparency, participation, access to information and accountability, and that lack of transparency causes difficulties to access up-to-date information and to assess the sector's water consumption at the national or regional level (UN Special Rapporteur on the human rights to safe drinking water and sanitation 2025, paras. 45 and 47). Moreover, the Special Rapporteur on the human rights to safe drinking water and sanitation points out that "water demands are being proposed as demands to be satisfied as a priority, in opaque agreements with large corporations. Such a priority undoubtedly entails serious risks for other uses, such as irrigation or even drinking water supplies, during periods of drought" (UN Special Rapporteur on the human rights to safe drinking water and sanitation 2025, para. 47).

The final point to consider is energy usage, which depends largely on the policies of both the companies operating data centres and the States where they are located. In most cases, the vast majority of required energy still comes from burning fossil fuels such as gas and coal, ultimately contributing to the greenhouse effect. Relatedly, the UN Special Rapporteur on the human rights to safe drinking water and sanitation observed that:

"exponential growth in energy demand generates intense pressure to revive the construction of large hydroelectric dams – which would have a corresponding impact on riverine communities and freshwater ecosystems – and thermal and nuclear power plants, even at the cost of accelerating climate change and increasing the risks of water pollution. In fact, corporations, such as Amazon, Google, Meta and Microsoft, are developing strategic alliances with the hydrocarbon industry and even plan to build nuclear power plants to meet their explosive energy demands." (UN Special Rapporteur on the human rights to safe drinking water and sanitation 2025, para. 49)

The Special Rapporteur adds that water and energy equity are endangered not only by these dynamics but also because the priority given to large technology companies, and the preferential energy rates from which they benefit produce unfair asymmetries with respect to other, more labour-intensive sectors of the economy (UN Special Rapporteur on the human rights to safe drinking water and sanitation 2025, para. 55).

The geographic distribution of AI infrastructure also reveals certain disparities. The data centres of various leading companies that pursue the development of GenAI are spread across several countries, primarily concentrated in the United States, the EU, and China (New York Times 2025). This not only suggests a gap in digital sovereignty and the ability to leverage the benefits of AI compared to regions such as Latin America and Africa but also provides an indication of the underlying environmental impacts. Nevertheless, data centres that power the development of AI are also noticeable in other parts of the world, often generating local environmental concerns. Recent examples include Malaysia, where environmental groups have called for stricter regulations requiring new AI data centres to operate solely on renewable energy (Hicks 2025). Furthermore, the uneven distribution of AI's environmental impacts remains an issue (Ren and Wierman 2024). The adverse effects may particularly be a burden to already vulnerable regions and communities. Notably, water-consumption of data centres will be disproportionately higher in drought-stricken areas, precisely where water is scarcest. For this reason, AI's environmental inequity has been raised as an important matter (Li et al. 2024). Li et al. (2024) found that geographical load balancing algorithms, which route computing workloads to data centres across different regions, create environmental inequity by disproportionately burdening certain locations with higher carbon and water footprints, even while minimising total environmental costs.

Read against the substantive and procedural obligations mapped in section 2.1, these harms are not merely descriptive data points but indicators of specific State and corporate duties left unmet. The obligation to protect against environmental harm from private actors is engaged directly by the opaque, unregulated water-allocation agreements between data-centre operators and host States documented by the Special

Rapporteur on the human rights to safe drinking water and sanitation; the procedural duties to assess environmental impact and to make information public are precisely what such opacity denies to affected communities, from Querétaro to rural Malaysia. The obligation relating to transboundary environmental harm is engaged by the geographically concentrated extraction of REEs and cobalt in Africa to supply AI hardware consumed predominantly elsewhere, while the obligation to protect groups particularly vulnerable to environmental harm is engaged by the disproportionate siting of water-intensive infrastructure in already drought-prone regions, as the geographical load-balancing evidence above illustrates. Framed this way, the environmental footprint of GenAI is not simply an efficiency problem to be optimised away, but a pattern of largely unaddressed human rights obligations.

4. Regional nuances

The growth of AI has contributed to an exponential increase in data centres globally, from 500,000 in 2012 to over eight million today (Correia et al. 2025). The previous section has laid down the global scope of the environmental burden of data centres necessary for the development of GenAI, however, it must be acknowledged that environmental impacts vary across continents, shaped by distinct geographical, climatic, and infrastructural conditions. While data centres globally consume substantial energy and water resources, the volume of e.g. water usage is highly dependent on location, with mechanical cooling required in hot climates and data centres located in areas already experiencing water scarcity. Against this backdrop, the following section examines how different regions have developed regulatory frameworks to address these impacts and protect the right to a healthy, clean, and sustainable environment.

In the EU, AI technology is increasingly regulated through a combination of legislative and policy measures that integrate energy efficiency, transparency, and sustainability into AI governance. According to the International Energy Agency, by 2026 the AI sector's energy demand could increase tenfold compared to 2023, with EU data centres alone expected to consume 30 percent more electricity (Hickman et al. 2025). To mitigate these harms, the EU has adopted the AI Act (Regulation (EU) 2024/1689) on 13 June 2024 (European Union 2024). The regulation integrates environmental protection into its broader governance framework for AI, recognising sustainability as an essential component of trustworthy technology. From the outset, Article 1(1) establishes environmental protection alongside health, safety, and fundamental rights as one of the Regulation's overarching objectives. This foundational principle is reinforced by Recital 4, which explicitly acknowledges AI's potential to advance resource and energy efficiency, environmental monitoring, and climate change mitigation and adaptation. Together, these provisions elevate environmental stewardship to a guiding regulatory value rather than a peripheral policy concern.

On the operational level, the EU AI Act introduces targeted transparency and accountability measures to mitigate AI's ecological footprint. Article 53, in conjunction with Annex XI, obliges providers of general-purpose AI models to document and disclose the energy consumption associated with model training and use – either through direct measurement or credible estimation. This represents a landmark step toward quantifying the environmental cost of large-scale AI models, ensuring that sustainability becomes part of compliance documentation. Likewise, Article 51 and Annex XIII(2)(c) link high energy consumption during training to the classification of a model as having systemic risk, thereby embedding environmental performance into risk assessment and oversight mechanisms. These obligations encourage developers to prioritise energy-efficient architectures and transparent reporting, aligning AI innovation with the EU's Green Deal objectives (European Commission, 2019). Further, Recital 130 introduces an emergency exemption mechanism allowing national authorities to authorise AI systems for environmental protection or a climate crisis response even before full conformity assessment – demonstrating that environmental imperatives can justify accelerated regulatory flexibility when necessary for urgent ecological action.

Nevertheless, while these articles represent significant progress, the Act stops short of imposing substantive sustainability standards or quantitative emission limits. Environmental accountability remains primarily procedural – focused on transparency, documentation, and classification rather than enforceable environmental performance thresholds. The absence of a mandatory environmental impact assessment for AI systems or a requirement to use renewable energy sources during training highlights a regulatory gap. Thus, although the AI Act symbolically aligns AI governance with Europe's environmental commitments, its provisions remain cautious and technocratic, leaving much of the environmental burden to be addressed through subsequent delegated acts or complementary green policies.

In Asia, while there is no overarching regulation akin to the EU's AI Act specifically addressing the environmental impact of AI, several countries and regional initiatives are beginning to incorporate environmental considerations into AI governance.

For example, in the Asia Pacific at least 16 jurisdictions are either exploring or implementing frameworks to regulate AI (Correia et al. 2025). These approaches can be broadly categorised into four types. China follows a mandatory, State-driven model, implementing binding, technology-specific measures to steer AI toward developmental goals. In contrast, South Korea and Japan rely on market-oriented policies aimed at supporting local innovation. Malaysia and Singapore have adopted non-binding principles and codes of conduct, while Vietnam and Thailand apply risk-based regulations, varying in strictness depending on the context and type of AI application.

Despite this regulatory activity, few countries have taken decisive steps to address the environmental impacts of AI or to embed climate considerations into mandatory AI regulations. For instance, AI's resource intensity is only lightly referenced in the ASEAN Guide on AI Governance and Ethics (ASEAN 2024). A notable exception is the Philippines, where the Philippine Development Plan 2023–2028 and the National Innovation Agenda and Strategy Document 2023–2032 position AI as a tool for sustainable development. Sector-specific initiatives incorporate AI into crop mapping, disaster resilience, and water and grid efficiency, supported by a regulatory environment that promotes AI-driven upskilling, green technology, sustainable mobility, and environment, social, and governance compliance.

Given the rapid pace of AI development and the pressing environmental challenges in the Asia Pacific, a more ambitious, coordinated, and targeted approach is required to fully align digital innovation with sustainability goals. The African continent currently has no single, comprehensive and legally binding law dedicated to mitigating the environmental impact of AI across the continent. Instead, environmental mitigation is currently addressed through some of the existing fundamental human rights law and regional policy frameworks that mandate environmental protection. For instance, the primary legal basis for environmental protection against any technology, including AI, comes from the African Charter on Human and Peoples' Rights (the African Charter 1981) which guarantees the right to a clean environment in Article 24, establishing a legally enforceable right that any AI activity in a Member State must respect. In case of any AI projects that cause environmental harm, such harm can be challenged as a violation of this right. In addition, the African Union's Continental AI Strategy of 2024 embeds environmental protection as fundamental both in its guiding philosophy and its concrete action plans. The principle of peace and prosperity calls for the creation of a prosperous Africa where the natural environment is actively preserved and protected (African Union 2024), setting environmental stewardship as a non-negotiable condition for AI development. This is complemented by the local first or people-centred principle, which directs AI development to tackle Africa's unique environmental challenges, such as managing water resources and building resilience against climate-induced disasters like droughts and floods (African Union 2024). These ideas are then translated into specific, actionable policies. Under the strategic focus of minimising AI risks, the strategy identifies the need to mitigate threats to a sustainable environment, acknowledging that AI itself must be developed responsibly to avoid causing ecological harm (African Union 2024, 51).

As for Latin America, some sources consider the existence of a "data centre boom in Latin America" which implies an accelerating infrastructure investment in some countries (Menski et al. 2024). The data centre sector in Latin America is growing fast, and so are investments. In this sense, the countries that stand out are Brazil, México, and Chile with Colombia, Peru, Costa Rica, and Panama as emerging centres for investments (Menski et al. 2024). Recently, OpenAI and Sur Energy announced the signing of a Letter of Intent to develop a large-scale data centre in Argentina's Patagonia (OpenAI 2024). These projects are attractive to Latin American Governments because they position countries as exporters of computational capacity, enabling them to provide processing services to companies and nations lacking the necessary infrastructure.

According to experts from the Inter-American Development Bank, data centres in Latin America generate environmental impacts that extend beyond aggregate measures to affect local communities directly. In Querétaro, Mexico, for example, the water demand for data centres competes with the needs of local farmers, creating conflicts in a region already facing water scarcity. Farmers depend on this water for their crops and livelihoods, making the competition for resources particularly acute (Aguirre et al. 2025). Despite this, Latin American countries have an embryonic domestic regulation on AI, and they do not have an environmental regulation on a regional level in light of AI development. Nevertheless, international human rights law is still binding for countries in the region. The environmental human right law principally emanates from the Inter-American Human Rights System, with Inter-American Court of Human Rights (IACtHR) consolidated jurisprudence on environmental protection which is binding for State Parties. The recent IACtHR's Advisory Opinion 32 of 2025 recognises the current situation as a climate emergency and acknowledges States' obligations to face it (Inter-American Court of Human Rights 2025). The IACtHR has stated that nature is a human right subject; the obligation to not cause irreversible damages to nature is a peremptory norm of general international law; and States must mitigate greenhouse gas emissions, regulate the activities of businesses, assess the climate impact of them, and actively protect ecosystems.

Separately, under the XLII Meeting of High-Level Authorities on Human Rights, MERCOSUR[1] has issued a statement of principles, where they recognise that AI implementation has environmental effects and the AI development must promote its protection (Reunión de Altas Autoridades sobre Derechos Humanos del MERCOSUR 2023).

Despite the above-mentioned legal progress, most of the specific regulations concerning GenAI and the environment remain non-binding or

1 MERCOSUR is a regional integration process whose States Parties are Argentina, Brazil, Paraguay and Uruguay; Bolivia and Venezuela (currently suspended) joined later (see MERCOSUR 2025).

are limited to regional frameworks that do not fully address environmental human rights considerations. In this context, it becomes crucial to question the role of AI development amid the climate emergency – especially given the lack of precise data on its overall environmental impact, and in regions like Latin America, which contribute less than 10–15 percent of global emissions yet possess some of the highest levels of biodiversity on the planet (UNEP 2018).

5. AI's environmental footprint: existing measures and the case for binding standards

Addressing AI's environmental impacts requires a multi-faceted approach encompassing technological innovation, strategic infrastructure planning, and corporate sustainability commitments. UNEP's foresight report acknowledges that while AI and digital transformation can bring benefits, there are significant environmental implications, which need addressing (UNEP and International Science Council 2024). Some of the current solutions range from optimising existing operations to reimagining the geographical distribution of AI computing infrastructure. Ultimately, there is a lot more to be done, both with regard to viable options to reconcile AI development with the protection of the right to a healthy, clean, and sustainable environment, and with regard to binding regulations in this context.

Technological optimization and the strategic deployment of AI systems represent key approaches to mitigating environmental impacts. For instance, Google partnered with DeepMind, that developed a framework which led to the reduction of energy used for data centre cooling by 40 percent (Evans and Gao 2016). Complimenting efficiency gains like this, major technology businesses may also integrate renewable energy solutions in the existing infrastructures of their data centres. Collectively, Amazon, Microsoft, Google, and Meta represent the largest corporate purchasers of renewable energy globally, each having procured multiple gigawatts through long-term power purchase agreements (de Hoop Scheffer 2025). These initiatives can, however, face criticism for potentially diverting renewable energy from other users and delaying broader clean energy transitions.

Furthermore, a considerable solution with regard to mitigating the impacts of AI data centres could be locating them in cold-climate regions, where natural cooling could reduce energy and water consumption while enabling waste heat reuse for nearby communities. However, this can involve significant trade-offs – for instance, higher infrastructure costs in remote areas or connectivity and latency challenges.

Beyond location decisions, equity-aware geographical load balancing proposes dynamically distributing AI computing across dispersed data centres to minimise environmental impacts on disadvantaged regions by routing workloads based on regional carbon and water footprints (Li et al. 2024). This can address the environmental justice concerns by preventing the concentration of AI's burdens in already environmentally vulnerable areas.

These solutions represent important progress, yet remain insufficient without binding regulatory frameworks that extend beyond voluntary commitments to ensure AI development respects the right to a healthy, clean, and sustainable environment globally.

Concretely, three elements would give this call for binding standards operational content. First, the mandatory energy and water disclosure obligations that the EU AI Act currently applies only to general-purpose models (Article 53 and Annex XI) could be extended, through a dedicated protocol or amendment, into binding quantitative thresholds tied to environmental permitting, rather than disclosure alone, along the lines already used for industrial installations under EU environmental law. Second, the transparency and public-participation duties identified by the Special Rapporteur on the human rights to safe drinking water and sanitation, and mapped onto AI-related water use in section 3 above, could be codified into a standing requirement that data-centre operators publish the terms of water- and energy-allocation agreements with host States, enforceable through national environmental-impact-assessment regimes. Third, given the absence of a single global forum with a mandate over AI's environmental footprint, the UN Human Rights Council could extend the mandate of the Special Rapporteur on the human right to a clean, healthy and sustainable environment to include a dedicated reporting stream on digital infrastructure, building on the mapping exercise already conducted by the Special Rapporteur on the human rights to safe drinking water and sanitation, with a view to negotiating a framework instrument akin to the Guiding Principles on Business and Human Rights but tailored to the AI sector. None of these steps requires a new treaty; each builds on existing institutional mandates and could plausibly be pursued within the next reporting cycle.

6. Conclusions

This article has examined the complex relationship between AI expansion, particularly GenAI, and the realisation of the human right to a clean, healthy, and sustainable environment. The analysis reveals a significant tension: while AI promises transformative benefits across sectors and potential contributions to climate solutions, its physical infrastructure demands, including energy consumption, water usage or electronic waste generation, pose threats to environmental sustainability and human rights.

The environmental impacts of AI are neither uniform nor equitable. Training a single LLM like GPT-3 consumes 700,000 litres of fresh water and emits around 552,000 kg of CO2 equivalent, while projections suggest AI-related e-waste could reach up to five million metric tons by 2030. These burdens fall disproportionately on already vulnerable regions, particularly those experiencing water scarcity or dependent on fossil fuel-based energy grids.

Regulatory responses vary dramatically across regions. The EU's AI Act represents the most comprehensive attempt to integrate environmental considerations into AI governance through transparency requirements and energy consumption disclosure, though it stops short of imposing mandatory sustainability standards. In contrast, Africa, Latin America, and parts of Asia rely primarily on existing human rights frameworks and non-binding principles, leaving significant regulatory gaps.

Addressing AI's environmental footprint requires moving beyond voluntary corporate commitments toward binding international standards that recognise environmental protection as integral to responsible AI development. Ultimately, reconciling AI innovation with environmental rights demands that States, international organisations, and technology companies prioritise human rights obligations over unchecked technological expansion, ensuring that AI development serves rather than undermines global sustainability and the right to a healthy environment for present and future generations.

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