

Hydro Governance for Equity in Africa: Applying Artificial Intelligence (AI) to Water Availability and Security

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Abstract

This paper examines how Africa can achieve effective and appropriate hydro governance for equity and development. The paper argues that strengthening hydro governance in Africa is a key priority towards Sustainable Development in light of current challenges undermining the realisation of the human right to water and sanitation. In particular, the paper discusses some of the factors affecting water availability and security in Africa. In light of underlying challenges, the paper posits that embracing Artificial Intelligence (AI) is an effective approach towards harnessing the power of technology for effective and appropriate hydro governance in Africa. The paper discusses how AI can be applied to water availability and security towards strengthening hydro governance for equity in Africa.

1.0 Introduction

Water is a fundamental resource for human health and development. The United Nations observes that water is a vital resource that is crucial in unlocking Sustainable Development since it is necessary for socio-economic development, energy and food production, healthy ecosystems and for human survival¹. In addition, the World Health Organization (WHO) correctly notes that safe and readily available water in adequate quantities is important for public health, whether it is used for drinking, domestic use, food production or recreational purposes². Further, it has been argued that water is crucial for Sustainable Development since it offers benefits for climate adaptation, biodiversity, ecosystem services, economic growth and human health³.

Due to its numerous benefits, access to safe water, sanitation and hygiene has been identified as the most basic human need for human health and well-being⁴. Access to adequate, safe and

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¹ United Nations., 'Water' Available at <https://www.un.org/en/global-issues/water#:~:text=The%20UN%20and%20Water,human%2C%20commercial%20and%20agricultural%20needs> (Accessed on 19/08/2026)

² World Health Organization., 'Water' Available at <https://www.afro.who.int/health-topics/water#:~:text=Inadequate%20management%20of%20urban%2C%20industrial,dangerously%20contaminated%20or%20chemically%20polluted> (Accessed on 19/08/2026)

³ Stockholm International Water Institute., 'Why Water is Crucial to Climate Mitigation' Available at <https://siwi.org/latest/why-water-is-crucial-to-climate-mitigation/#:~:text=Protecting%20and%20restoring%20freshwater%20ecosystems,protecting%20us%20from%20disaster%20risks> (Accessed on 19/08/2026)

⁴ United Nations., 'Goal 6: Ensure access to water and sanitation for all' Available at <https://www.un.org/sustainabledevelopment/water-and-sanitation/> (Accessed on 19/08/2026)

readily available water is essential not only to health, but also to poverty reduction, food security, peace and human rights, ecosystems and education⁵. The United Nations *2030 Agenda for Sustainable Development*⁶ recognizes the crucial role of water and sanitation in development. Sustainable Development Goal (SDG) 6 seeks to ensure availability and sustainable management of water and sanitation for all for human health and development⁷.

Despite being a vital resource for human health, well-being and development, challenges relating to water availability and security are undermining the role of water in the Sustainable Development discourse. For example, it has been observed that growing challenges linked to water scarcity, water pollution, degradation of freshwater ecosystems and ineffective cooperation over transboundary water resources are undermining water availability and security with grave impacts on people and planet⁸. The United Nations notes that billions of people globally are still living without access to adequate and safely managed water and sanitation⁹. In particular, it has been observed that the demand for water is rising all over the world due to rapid population growth, urbanization and increasing water needs for agriculture, industry, and energy sectors putting a lot of pressure on available water resources¹⁰.

In light of the foregoing, effective governance of water and water resources is crucial in fostering water availability and security for Sustainable Development. Hydro governance has been identified as a vital tool towards ensuring effective governance of water and water resources for Sustainable Development¹¹.

This paper examines how Africa can achieve effective and appropriate hydro governance for equity and development. The paper argues that strengthening hydro governance in Africa is a key priority towards Sustainable Development in light of current challenges undermining the realisation of the human right to water and sanitation. In particular, the paper discusses some of the factors affecting water availability and security in Africa. In light of underlying challenges, the paper posits that embracing Artificial Intelligence (AI) is an effective approach towards harnessing the power of technology for effective and appropriate hydro governance in Africa.

⁵ Ibid

⁶ United Nations General Assembly., 'Transforming Our World: the 2030 Agenda for Sustainable Development.' 21 October 2015, A/RES/70/1., Available at <https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf> (Accessed on 19/08/2026)

⁷ Ibid

⁸ United Nations., 'Goal 6: Ensure access to water and sanitation for all' Op Cit

⁹ United Nations., 'Human Rights to Water and Sanitation' Available at <https://www.unwater.org/water-facts/human-rights-water-and-sanitation> (Accessed on 19/08/2026)

¹⁰ United Nations., 'Goal 6: Ensure access to water and sanitation for all' Op Cit

¹¹ Ganoulis. J., & Fried. J., 'Understanding Hydro-Governance' Available at https://link.springer.com/chapter/10.1007/978-3-319-78625-4_4 (Accessed on 19/08/2026)

The paper discusses how AI can be applied to water availability and security towards strengthening hydro governance for equity in Africa.

2.0 The Need for Effective Hydro Governance in Africa

Hydro governance has been defined as a multi-disciplinary and multi-scale socio-economic process that focuses on effective governance of all kinds of water including surface, groundwater and coastal waters¹². Hydro governance covers the political, social, economic, and administrative systems that influence the use and management of water at different levels¹³. Hydro governance can also be described as the rules, policies, practices, and processes through which decisions for the management of water, water resources and water services are designed and implemented, and decision-makers are held accountable¹⁴. This concept covers both formal and informal institutions, policies and power structures that determine how water is allocated, managed and contested¹⁵. It has been observed that hydro governance aims to foster effective, efficient and inclusive water governance at all levels including at the global, regional, national and local levels¹⁶.

Effective and appropriate hydro governance is vital in the pursuit of Sustainable Development. For example, it has been observed that better governance of water resources, can boost countries' economic growth and bolster efforts towards poverty reduction¹⁷. Sound hydro governance ensures effectiveness of laws and policies on water at levels, efficiency towards ensuring sustainable water management and welfare at the least cost to society, and engagement of all stakeholders in decision-making processes related to water for democracy, justice and fairness¹⁸.

Sound hydro governance is especially important for Africa due to challenges relating to water availability and water security. For example, despite being endowed with numerous water resources including ground water and major freshwater rivers and lakes, millions of people all over Africa are affected by water scarcity¹⁹. It is estimated that water scarcity affects one out of

¹² Ganoulis, J., & Fried, J., 'Understanding Hydro-Governance' Op Cit

¹³ What is Water Governance? What is Water Management?., Available at <https://www.hidropolitikakademi.org/en/article/30221/what-is-water-governance--what-is-water-management-> (Accessed on 19/08/2026)

¹⁴ Ibid

¹⁵ Hydrosocial Dynamics and Water Governance., Available at <https://www.nature.com/nature-index/topics/14/hydrosocial-dynamics-and-water-governance> (Accessed on 19/08/2026)

¹⁶ Organisation for Economic Co-operation and Development., 'Water Governance' Available at <https://www.oecd.org/en/topics/water-governance.html> (Accessed on 19/08/2026)

¹⁷ World Health Organization., 'Water' Op Cit

¹⁸ Organisation for Economic Co-operation and Development., 'OECD Principles on Water Governance' Available at <https://www.oecd.org/content/dam/oecd/en/topics/policy-sub-issues/water-governance/oecd-principles-on-water-governance-en.pdf> (Accessed on 19/08/2026)

¹⁹ African Development Bank Group., 'World Water Day 2025: Preserving Africa's Water Resources' Available at <https://www.afdb.org/en/news-and-events/world-water-day-2025-preserving-africas-water-resources-81976> (Accessed on 19/08/2026)

three people in Africa with this situation expected to get worse due to rapid population growth, urbanization and increased water demand for agriculture and industrialization²⁰. A huge portion of Africa is categorized as arid or semi-arid despite the continent holding nearly 9 percent of the planet's freshwater resources²¹. This has largely been attributed to uneven distribution of freshwater resources in Africa²². For example, it is estimated that the six most water-rich countries in Central and Western Africa hold fifty four per cent of the continent's total resources while twenty seven most water-poor countries hold only seven per cent²³. Therefore, most of Africa's freshwater resources are held by a few countries with most countries in the continent facing severe levels of water scarcity and poverty²⁴. In addition, it has been observed that rapid growth in population, inappropriate water governance and institutional arrangements, depletion of water resources through pollution, environmental degradation, deforestation, and low and unsustainable financing of investments in water supply and sanitation are some of the main challenges undermining effective hydro governance in Africa with negative implications on the human right to clean, safe and adequate water²⁵.

Failure to ensure water availability and security in Africa has grave impacts on human rights especially for vulnerable populations. For example, it has been observed that in rural areas where agriculture sustains many livelihoods, water scarcity can impact food production fuelling food insecurity and poverty²⁶. Further, human health and well-being are severely impacted with waterborne diseases causing millions of deaths each year²⁷. In addition, it has been observed that since the responsibility to collect water in many rural households in Africa falls on women and girls, when water becomes scarce or unavailable, they are forced to spend more time and energy in search of water reducing educational opportunities for girls, and the chance for women to pursue other income generating activities fuelling gender injustices²⁸. Further, ineffective

²⁰ World Health Organization., 'Water' Available at <https://www.afro.who.int/health-topics/water> (Accessed on 19/08/2026)

²¹ Water woes: 13 undeniable facts about Africa's water scarcity., Available at <https://www.greenpeace.org/africa/en/blog/55086/water-woes-13-undeniable-facts-about-africas-water-scarcity/> (Accessed on 19/08/2026)

²² Ibid

²³ Valuing Water a Challenge in Africa, Says UN Report' Available at <https://www.downtoearth.org.in/news/water/valuing-water-a-challenge-in-africa-says-un-report-76092> (Accessed on 19/08/2026)

²⁴ Water woes: 13 undeniable facts about Africa's water scarcity., Op Cit

²⁵ Valuing Water a Challenge in Africa, Says UN Report' Op Cit

²⁶ African Development Bank Group., 'World Water Day 2023: Accelerating Change in solving Africa's Water and Sanitation Crises' Available at <https://www.afdb.org/en/news-and-events/world-water-day-2023-accelerating-change-solving-africas-water-and-sanitation-crises-59935#:~:text=22%2DMar%2D2023,associations%2C%20and%20global%20development%20partners.> (Accessed on 19/08/2026)

²⁷ Ibid

²⁸ Water woes: 13 undeniable facts about Africa's water scarcity., Op Cit

governance of transboundary water resources in Africa has been a source of violent conflicts for many decades undermining peace, security and development²⁹.

In light of the foregoing challenges, strengthening hydro governance is necessary for justice, equity and fairness in Africa.

3.0 Utilising Artificial Intelligence (AI) for Effective Hydro Governance in Africa

In light of current challenges undermining water availability and water security, it is imperative to strengthen hydro governance in Africa for equity, sustainability and development. In particular, technology provides effective solutions towards promoting sound hydro governance for people and planet. For example, it has been observed that technology can improve governance of water and water resources by providing accurate data to inform sound decision-making processes, tracking and monitoring water resources to detect threats thus informing sound conservation policies, and ensuring efficient distribution of water towards water security³⁰. Modern technologies can ensure evidence-based management of water resources while also promoting equitable access to water and more transparent governance processes³¹.

In particular, AI is a modern technology that is revolutionizing hydro governance. It has been observed that AI is improving water governance by enabling more efficient and sustainable use of this critical resource. For example, AI systems can analyze vast amounts of water data from various sources, such as weather forecasts, gauging stations, satellite imagery, and sensors, towards optimizing access, distribution and usage of water³². In particular, in order to ensure water availability, AI can predict the precise water needs of users thus enabling decision-makers to allocate water more equitably³³. In addition, in order to ensure water security, it has been observed that AI tools can aid in detecting challenges such as leaks in urban water systems by analyzing pressure and flow data in real time, thus enabling faster repairs and reducing water loss³⁴.

AI is therefore an innovative technology that can improve hydro governance in Africa. AI combines data analytics, remote sensing and predictive modeling therefore enabling decision-makers to design hydro governance strategies that are both adaptive, context-specific and

²⁹ Unraveling the spatial patterns of water conflicts in Africa through a multi-scale lens., Available at <https://www.cgiar.org/research/publication/unraveling-spatial-patterns-water-conflicts-africa-multi-scale-lens/> (Accessed on 19/08/2026)

³⁰ Water in Africa. Technology and alliances to cooperate., Available at <https://www.wearewater.org/en/insights/water-in-africa-technology-and-alliances-to-cooperate/> (Accessed on 20/08/2026)

³¹ Ibid

³² United Nations Educational, Scientific and Cultural Organization., 'Applications of AI for water management' Available at <https://unesdoc.unesco.org/ark:/48223/pf0000393243> (Accessed on 20/08/2026)

³³ Ibid

³⁴ Ibid

evidence-based³⁵. For example, AI enables real-time monitoring of water quality and quantity through machine learning tools that can detect threats such as pollution or changes in water levels³⁶. AI can also improve governance of water resources by providing detailed information on water bodies, groundwater reserves and areas at risk of flooding or drought³⁷. In addition, it has been observed that AI can optimize water availability through smart irrigation systems, efficient urban water distribution, and sustainable hydro power management³⁸.

Due to its immense benefits, it is imperative for African countries to integrate AI into hydro governance for sustainable and equitable outcomes. It has been correctly observed that integrating AI into water governance systems, it is possible to achieve a more sustainable and resilient approach to managing this vital and scarce resource³⁹. For Africa, AI can improve hydro governance by predicting demand and storage needs, and ensuring sustainable water usage⁴⁰. In addition, in a continent where agriculture is the main economic activity supporting millions of livelihoods, it has been observed that AI-driven platform can monitor irrigation systems in real-time, thus enabling small scale farmers to improve water use efficiency and enhance their crop yields⁴¹. In general, AI can bolster hydro governance in Africa through data-driven insights that can enable better policy development, and transparency and accountability in water governance⁴².

Applying AI to water availability and security is therefore crucial towards bolstering hydro governance in Africa by tackling water scarcity, improving efficiency, minimizing waste, and preserving the health of the continent's water systems⁴³. Consequently, it is imperative for Africa to leverage on AI to improve hydro governance by investing in the necessary digital infrastructure, strengthening human and institutional capacities on AI, and encouraging collaboration between governments, the private sector and the public for inclusive governance processes⁴⁴. In addition, it has been observed that by developing AI models that are specifically designed to tackle Africa's unique water challenges including through training AI systems on

³⁵ Amine. E., 'The Impact of AI in Water Governance and Sustainable Development' Available at https://www.researchgate.net/publication/398876858_The_Impact_of_AI_in_Water_Governance_and_Sustainable_Development (Accessed on 20/08/2026)

³⁶ Ibid

³⁷ Ibid

³⁸ Ibid

³⁹ United Nations Educational, Scientific and Cultural Organization., 'Applications of AI for water management' Op Cit

⁴⁰ International Water Management Institute., 'How AI can revolutionize water research and management in Africa' Available at <https://www.iwmi.org/blogs/how-ai-can-revolutionize-water-research-and-management-in-africa/> (Accessed on 20/08/2026)

⁴¹ Ibid

⁴² Ibid

⁴³ Ibid

⁴⁴ International Water Management Institute., 'How AI can revolutionize water research and management in Africa' Op Cit

local water contexts, data and indigenous water management techniques, it is possible to improve hydro governance for equity, justice and sustainability in Africa⁴⁵.

4.0 Conclusion

With Africa struggling to promote the human right to clean, safe and adequate water, improving hydro governance in Africa is necessary for equity, justice, fairness and development. In particular, there is need for African countries to apply technology and AI to water availability and security in order to achieve sound and effective hydro governance for people and planet towards Sustainable Development.

⁴⁵ Ibid

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