

Innovative Technology and Artificial Intelligence (AI) in Environmental Governance: Enabling Real-time Monitoring, Predictive Modelling and Evidence-based Decision-Making

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Abstract

This paper examines how the ideal of sound environmental governance can be achieved by employing innovative technology and Artificial Intelligence (AI). The paper observes that modern and innovative technologies including AI have emerged as powerful solutions in the global pursuit for sound environmental governance and Sustainable Development. The paper discusses the specific applications of technology and AI in environmental governance. In addition, it also addresses some of the challenges associated with the use of technology and AI in environmental governance. Further, the paper discusses how innovative technology and AI can be effectively utilised to improve environmental governance by enabling real-time monitoring, predictive modelling and evidence-based decision-making.

1.0 Introduction

Environmental governance has been described as a broad concept that encompasses laws, policy, rules and norms that govern human behavior in respect of the environment, while also addressing issues such as who makes environmental decisions, how such decisions are made and carried out, the scientific information needed for environmental decision-making and how the public and major stakeholders can participate in environmental decision-making processes¹. In addition, it has been observed that environmental governance refers to the rules, policies, approaches and institutions that shape how humans interact with the environment². This concept covers a wide range of legal and other tools employed in both the public and private spheres to strengthen environmental protection³. In particular, it has been observed that environmental governance extends beyond government policies, regulations and interventions by involving other stakeholders such as the private sector, non-governmental organizations (NGOs), and the public in environmental decision-making⁴.

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¹ United Nations Environment Programme., 'Environmental Governance' Available at <https://www.unep.org/regions/west-asia/regional-initiatives/environmental-governance> (Accessed on 16/08/2026)

² United Nations Environment Programme., 'Environmental Law and Governance' Available at <https://www.unep.org/topics/environmental-law-and-governance> (Accessed on 16/08/2026)

³ Environmental Law Institute., 'Environmental Governance' Available at <https://www.eli.org/environmental-governance> (Accessed on 16/08/2026)

⁴ Environmental Governance., Available at <https://www.manglai.io/en/glossary/environmental-governance> (Accessed on 16/08/2026)

Sound environmental governance is at the heart of Sustainable Development. For example, the United Nations Environment Programme (UNEP) observes that by building robust and effective environmental governance systems, it is possible to safeguard environmental and human rights and accelerate progress towards the Sustainable Development Goals (SDGs)⁵. In addition, it has been argued that sound environmental governance frameworks ensure inclusive, participatory, just and fair approaches in managing the environment and natural resources for Sustainable Development⁶. By pursuing effective, appropriate and robust environmental governance, it is possible to achieve effective management of the environment and natural resources in a sustainable and transparent manner for Sustainable Development, peace and justice⁷. In addition, it has been observed that by building effective, responsive and inclusive environmental governance frameworks, it is possible to achieve environmental goals including sound biodiversity conservation, pollution control, effective management of natural resources and strong climate action both globally and at regional, national and local levels therefore strengthening Sustainable Development efforts⁸.

Despite its role in fostering Sustainable Development, the global ideal of sound environmental governance is yet to be achieved. For example, challenges such as poor enforcement of environmental laws, policies and regulations, weak environmental institutions, inadequate investments in environmental protection, and lack of diversity and inclusivity in environmental decision-making processes undermine the quest towards sound environmental governance⁹. In addition, it has been observed that environmental governance systems in most countries strained, with marginalized groups including indigenous peoples, local communities, women and the youth often excluded from environmental decision-making processes¹⁰. Failure to design and implement effective, appropriate and robust environmental governance frameworks has adverse impacts on people and planet by fuelling environmental threats including biodiversity loss, environmental degradation, pollution and climate change¹¹. Consequently, there is need to strengthen environmental governance at all levels in order to promote Sustainable Development.

⁵ United Nations Environment Programme., 'About environmental rights and governance' Available at <https://www.unep.org/explore-topics/environmental-governance/about-environmental-rights-and-governance> (Accessed on 16/08/2026)

⁶ Bennett. N.J., & Satterfield. T., 'Environmental governance: A practical framework to guide design, evaluation, and analysis' Available at <https://conbio.onlinelibrary.wiley.com/doi/10.1111/conl.12600> (Accessed on 16/08/2026)

⁷ Ibid

⁸ United Nations Environment Programme., 'Environmental Law and Governance' Op Cit

⁹ United Nations Development Programme., 'Environmental Governance: Bolstering inclusive and effective governance systems that champion environmental justice and sustainability' Available at <https://www.undp.org/nature/our-work-areas/environmental-governance> (Accessed on 16/08/2026)

¹⁰ Ibid

¹¹ Ibid

This paper examines how the ideal of sound environmental governance can be achieved by employing innovative technology and Artificial Intelligence (AI). The paper observes that modern and innovative technologies including AI have emerged as powerful solutions in the global pursuit for sound environmental governance and Sustainable Development. The paper discusses the specific applications of technology and AI in environmental governance. In addition, it also addresses some of the challenges associated with the use of technology and AI in environmental governance. Further, the paper discusses how innovative technology and AI can be effectively utilised to improve environmental governance by enabling real-time monitoring, predictive modelling and evidence-based decision-making.

2.0 Role of Technology and Artificial Intelligence (AI) in Environmental Governance

Technology has emerged as a powerful solution in the quest towards sound environmental governance for people and planet. For example, it has been observed that modern technologies allow more accurate tracking of environmental changes and more efficient management techniques thus bolstering environmental governance¹². Technology is being applied in key sectors including environmental data collection, policy enforcement, and monitoring towards sustainable outcomes for people and planet¹³. In addition, modern innovative technologies such as big data analytics, geographic information systems (GIS), and remote sensing are strengthening the tracking and monitoring of environmental changes, enhancing environmental data collection, and improving environmental management techniques¹⁴. Further, it has been observed that new technologies including blockchain technology and digital platforms increase environmental policy accountability and transparency therefore encouraging enhanced public participation and environmental compliance for sound environmental governance¹⁵. Modern technologies such as big data, cloud computing and other internet technologies are also being utilized to dynamically monitor environmental information in real time, and intelligently supervise governance of the environment¹⁶.

Harnessing modern innovative technologies is therefore key towards strengthening environmental governance for Sustainable Development. According to the United Nations Environment Programme (UNEP), technology is the source of many environmental and social problems, but it is also key to addressing environmental threats including environmental degradation, climate change, pollution, food scarcity, waste management and water scarcity

¹² Jha. M.K et al., 'The Role of Technology in Environmental Governance' Available at <https://www.igi-global.com/chapter/the-role-of-technology-in-environmental-governance/363225> (Accessed on 17/08/2026)

¹³ Ibid

¹⁴ Ibid

¹⁵ Ibid

¹⁶ Guo. J., & Shen. X., 'Does Digitalization Facilitate Environmental Governance Performance? An Empirical Analysis Based on the PLS-SEM Model in China' *Sustainability* 2024, 16(7)

among others¹⁷. In particular, it has been correctly observed that eco-friendly technologies have a significant impact on the environment, as well as the economy¹⁸. Such technologies can aid in reducing greenhouse gas emissions, fostering energy efficiency, reducing the amount of waste produced and the amount of money spend¹⁹. Both hard and soft technologies provide solutions that can bolster environmental governance. For example, hard technologies such drones can help detect illegal logging or hunting in protected areas towards effective environmental protection while soft technologies including AI can be used to analyse satellite images and detect changes in land or water quality towards strengthening conservation efforts²⁰.

In particular, AI is a modern and innovative technology that is strengthening environmental governance efforts globally. For example, it has been observed that AI can optimize energy grids towards ensuring energy efficiency, track biodiversity thus enabling effective conservation efforts while also forecasting environmental threats including pollution and greenhouse gas emissions²¹. AI can also aid in the collection and analysis of environmental data, support evidence-based environmental decision- making and policy- making processes while also strengthening the monitoring and enforcement of environmental laws and regulations²². Due to its analysis, predictive and forecasting capacities, AI has emerged as a powerful tool towards combating environmental threats such as climate change, pollution and biodiversity loss for sound environmental governance²³. For example, as the world confronts a mounting climate crisis, AI technologies can aid in minimising waste, conserving energy, fast-tracking the transition to renewable energy, and identifying emission hotspots thus providing a basis for sound climate action²⁴. In addition, AI tools including remote sensing and analysis platforms can operate continuously and across a broad range of ecosystems providing accurate data on threats such as habitat degradation, illegal logging, illegal hunting, human-wildlife conflict, and species migration therefore informing sound biodiversity conservation approaches²⁵. AI is also improving waste management by predicting trends in waste composition, forecasting an

¹⁷ United Nations Environment Programme., 'About Technology' Available at <https://www.unep.org/explore-topics/technology/about-technology> (Accessed on 17/08/2026)

¹⁸ Nichols. M., 'How Can Technology Save the Environment?' Available at <https://born2invest.com/articles/technology-save-environment/> (Accessed on 17/08/2026)

¹⁹ Ibid

²⁰ Technology and the Environment: A Battle between Harm and Benefit., Available at <https://www.telefonica.com/en/communication-room/blog/technology-environment-a-battle-between-harm-benefit/> (Accessed on 17/08/2026)

²¹ Singh. M., & Singh. S., 'Role of Artificial Intelligence for Environmental Protection: An Analysis' Available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=5196899 (Accessed on 17/08/2026)

²² Ibid

²³ Ibid

²⁴ United Nations Climate Change., 'AI and Climate Action: Opportunities, Risks and Challenges for Developing Countries' Available at <https://unfccc.int/news/ai-and-climate-action-opportunities-risks-and-challenges-for-developing-countries> (Accessed on 17/08/2026)

²⁵ United Nations Development Programme., 'People-Centric AI for Conserving Biodiversity' Available at <https://www.undp.org/sites/g/files/zskgke326/files/2025-12/people-centric-ai-for-conserving-biodiversity.pdf> (Accessed on 17/08/2026)

increased demand for certain materials, anticipating equipment problems, pointing out unsafe waste conditions and helping individuals and companies make sustainable decisions towards tackling the problem of pollution and waste²⁶.

Harnessing innovative technologies including AI is therefore key towards bolstering environmental governance for people and planet. However, it has been observed that technology is yet to be fully harnessed and utilised to improve environmental governance especially in the Global South²⁷. For example, inadequate investments, funding, and ineffective government policies are some of the key challenges hindering the application technology in environmental governance in Africa and the Global South²⁸. In addition, barriers to technology development and transfer including capacity constraints and inadequate infrastructure are also hindering effective adoption and application of technology to strengthen environmental governance especially in the Global South²⁹. Despite its role in strengthening environmental governance, it has been observed that AI can also have negative environmental impacts³⁰. For example, it has been observed that AI data centres rely on vast amounts of energy and water for cooling while also generating large quantities of electronic waste thus creating environmental concerns³¹.

In light of the foregoing, there is need to ensure that modern and innovative technologies including AI are appropriately harnessed in order to improve environmental governance for people and planet.

3.0 Harnessing Technology and AI for Sound Environmental Governance

Modern innovative technologies including AI provide valuable solutions that can strengthen environmental governance for Sustainable Development. Consequently, countries have been urged to harness technology in an appropriate manner including through the formulation of laws, policies, frameworks and programmes that encourage its use in environmental governance³². In addition, it has been observed that countries can boost their capacity to utilise

²⁶ How AI Is Revolutionizing the Recycling Industry., Available at <https://news.climate.columbia.edu/2025/06/18/how-ai-is-revolutionizing-the-recycling-industry/#:~:text=In%20addition%2C%20the%20data%20AI,people%20how%20to%20recycle%20properly>. (Accessed on 17/08/2026)

²⁷ United Nations., 'Science, Technology and Innovation for Sustainable Development in the Global Partnership for Development Beyond 2015.' Available at https://www.un.org/en/development/desa/policy/untaskteam_undf/thinkpieces/28_thinkpiece_science.pdf (Accessed on 17/08/2026)

²⁸ Ibid

²⁹ Johnson. D., & Kristina. M. L., 'Challenges to Technology Transfer: A Literature Review of the Constraints on Environmental Technology Dissemination.' *Colorado College Working Paper* No. 2009-07

³⁰ United Nations Environment Programme., 'AI has an environmental problem. Here's what the world can do about that' Available at <https://www.unep.org/news-and-stories/story/ai-has-environmental-problem-heres-what-world-can-do-about> (Accessed on 17/08/2026)

³¹ Ibid

³² United Nations Environment Programme., 'About Technology' Op Cit

technology in environmental governance through education, training, funding, research, and innovation³³. International cooperation is also a vital solution towards integrating technology in environmental governance since it can support capacity building, technology development and transfer especially for developing countries³⁴. In the context of AI, it has been observed that there is need to reduce the environmental footprint of data centres including through fostering energy efficiency and reducing the demand for water in order promote environmental sustainability³⁵. In addition, harnessing AI systems and models that are trained on environmental data sets specific to Africa and the Global South, with emphasis on indigenous and traditional ecological knowledge is necessary towards improving environmental governance for posterity³⁶.

Harnessing the specific applications of technology and AI is also crucial towards strengthening environmental governance. For instance, through real-time monitoring, AI innovative technologies including AI can enable sound environmental governance. In particular, it has been observed that AI tools and systems can be used to monitor large and often inaccessible areas, tracking changes in habitats and land use thus being able to detect challenges such as deforestation, habitat fragmentation, and other environmental changes in real-time³⁷. Through this, technology and AI can strengthen biodiversity conservation efforts towards Sustainable Development. Predictive modelling is another specific application of innovative technology and AI that can boost environmental governance³⁸. For example, it has been observed that machine learning technologies can be used to forecast environmental threats and changes thus informing sound decision-making processes for effective environmental governance³⁹. Through predictive modelling, AI can be used to improve climate governance, biodiversity monitoring and conservation, air and water quality management, waste management and disaster risk reduction⁴⁰. Innovative technology and AI can also enable evidence-based decision-making towards sound environmental governance. It has been correctly observed that addressing global environmental threats and vulnerabilities including climate change, biodiversity loss, pollution

³³ The African Manifesto for Science, Technology and Innovation., Available at https://atpsnet.org/wp-content/uploads/2017/05/the_african_manifesto_for_sti.pdf (Accessed on 17/08/2026)

³⁴ United Nations Economic Commission for Africa., 'Advancing Technology Transfer for Sustainable Development in Africa' Available at https://www.uneca.org/sites/default/files/TCND/STIF2023/Advancing_Technology_Transfer.pdf (Accessed on 17/08/2026)

³⁵ United Nations Environment Programme., 'AI has an environmental problem. Here's what the world can do about that' Op Cit

³⁶ United Nations Development Programme., 'People-Centric AI for Conserving Biodiversity' Op Cit

³⁷ Mbeti. S., 'New technologies for monitoring and conserving biodiversity' Available at <https://africasustainabilitymatters.com/new-technologies-for-monitoring-and-conserving-biodiversity/> (Accessed on 17/08/2026)

³⁸ Pioneering Data-Driven Environmental Governance Through Artificial Intelligence., Available at https://www.researchgate.net/publication/389853571_Pioneering_Data-Driven_Environmental_Governance_Through_Artificial_Intelligence (Accessed on 17/08/2026)

³⁹ Ibid

⁴⁰ Ibid

and waste, and environmental degradation requires evidence-based responses by decision-makers⁴¹. Consequently, modern and innovative technologies including AI can strengthen environmental governance by providing the evidence needed to justify environmental laws and guiding decision-making processes⁴². Due to their monitoring, predictive and analytical capabilities, AI and other innovative technologies can translate vast and complex environmental data into actionable insights thus ensuring that environmental decision-making processes are supported by facts and evidence⁴³. Enabling real-time monitoring, predictive modelling and evidence-based decision-making is therefore necessary towards appropriately harnessing innovative technology and AI for sound environmental governance.

4.0 Conclusion

Strengthening environmental governance is a key global agenda in the quest towards Sustainable Development. In particular, leveraging innovative technology and AI is a useful and practical approach towards bolstering environmental governance for sustainability. This dream can be achieved by enabling real-time monitoring, predictive modelling and evidence-based decision-making.

⁴¹ Global Council for Science and the Environment., 'The Imperative Role Science Plays in Global Environmental Governance Today' Available at <https://www.gcseglobal.org/gcse-essays/imperative-role-science-plays-global-environmental-governance-today> (Accessed on 17/08/2026)

⁴² Bridging Science & Advocacy: How Environmental Scientists Influence Public Policy., Available at <https://www.nrep.org/blog/how-environmental-science-influences-policy> (Accessed on 17/08/2026)

⁴³ Ibid

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