THE IMPACT OF AI IN WATER GOVERNANCE AND SUSTAINABLE DEVELOPMENT.

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Abstract. . Water governance as seen by the economic, social, and administrative systems need managing water resources and service which is fundamental in order to attain sustainable development. Countless academics and scientists have paid particular attention to the plight of water governance and its impact on sustainable development. The Organisation for Economic Co-operation and Development and the United Nations Environment Programme (UNEP) (United Nations, 2020) have addressed the core mission of water governance and its role in sustainable development in light of the UN Agenda 2030, which focuses on the 17 Goals to improve social, economic and environmental sustainability [1]. Taking into account the climate change, the over-growing populations, the increasing demand for freshwater, the efficient managing and environmental conservation are more pressing than ever. Given the lag in good water management and the shortcomings faced in using the innovative solutions proposed by the artificial intelligence, The OECD (2015; 2010) has put in place good governance actions and tools to remedy the world's current water crisis[2] . Moreover, Artificial Intelligence (AI) tools are emerging as transformative technologies that would help enhancing water governance and contribute to the attainment of sustainable development goals (SDGs).

Keywords: Water governance, Sustainable Development, Artificial Intelligence.

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1 Introduction

1.1 The study context

Water governance plays a pivotal role in addressing the growing challenges related to resource scarcity, and climate change. The need for using new technologies tools as means to ensure efficient water management under the continuous pressure of the urbanization of the growing populations, and environmental degradation. The aim of this article is to study the importance of integrating new technologies (AI) which has become an urgent matter to improve the management of the water crisis from which an entire population is suffering.

1.2 Problematic of the study

Through this context, and given the issues revealed above, a fundamental issue concerns us: How Does the Governance of Water Benefit from the new technologies advanced by the AI in order to enhance the Sustainable Development?
To answer this fundamental question, two subsidiary questions call out to us: How can AI be effectively leveraged to address water governance challenges, and what are its implications for sustainable development?

1.3 Research methodology

To carry out this study, we have adopted an interpretativist methodology based on a qualitative approach that combines a review of existing literature of theoretical insights, case studies of AI applications in water management, and analysis of global water governance frameworks.

2 The role of AI in Water Governance

The integration of advanced digital technologies into water governance marks a profound evolution in the management of hydrological systems. This transformation extends beyond the adoption of new tools; it redefines how knowledge, prediction, and decision-making interact within a complex and uncertain environmental context. Artificial intelligence (AI), in particular, offers the ability to process vast and heterogeneous datasets, detect emerging patterns, and forecast hydrological behavior with a level of precision previously unattainable. By combining data analytics, remote sensing, and predictive modeling, AI enables policymakers and water managers to design governance strategies that are both adaptive and evidence-based. A review of recent literature and applied projects reveals several domains in which AI has already demonstrated tangible contributions to water governance and the advancement of sustainable development objectives.

Enhancing Data Collection and Monitoring. AI enables the efficient collection and analysis of a large database from sources such as satellite imagery, IoT devices and sensors embedded in water systems. In the first instance, these technologies enable real-time monitoring of water quality and quantity[3] through machine learning models that can analyze sensor data to detect anomalies such as pollution or sudden changes in

water levels. Secondly, the mapping and monitoring of water resources. Indeed, remote sensing coupled with AI can provide detailed maps of water bodies, groundwater reserves and areas at risk of flooding or drought. Finally, water availability and risk forecasting are based on predictive analysis, using historical and current data to forecast water demand, precipitation patterns and the probability of extreme weather events.

Optimizing Water Resource Management. AI-driven solutions improve the efficiency and sustainability of water resource management in all sectors namely:
- Smart irrigation systems [4]: AI algorithms monitor soil moisture, crop needs and weather conditions to deliver water precisely where and when it's needed, reducing waste and improving agricultural productivity.
- Urban water distribution: Machine learning models can identify leaks in pipes, predict maintenance requirements and optimize distribution networks to ensure equitable access to water [5].
- Hydropower management: AI tools can optimize the use of reservoirs for energy production, while balancing ecological and human needs.

Informing Policy and Decision-Making. AI facilitates evidence-based policymaking by analyzing complex datasets to reveal patterns, correlations, and trends. This enables:

- Scenario modeling: AI-driven simulations can evaluate the long-term impacts of different water management policies, aiding policymakers in choosing the most sustainable options.
- Economic optimization: Tools like AI-powered cost-benefit analyses assess the financial and social impacts of water pricing, subsidies, and conservation initiatives.
- Crisis response planning: Real-time data and predictive models enhance preparedness for water-related disasters such as floods and droughts.

Promoting Stakeholder Engagement and Transparency. Participatory water governance benefits from AI's ability to process and present information in an accessible way, such as:

- Analysis of community feedback through natural language processing tools that analyze surveys, social media and public forums to assess community concerns and priorities.
- Transparent reporting using AI platforms that can provide stakeholders with real-time updates on water availability and quality, as well as governance actions, fostering trust and collaboration [6].
- AI-driven visualization and simulation educational tools inform stakeholders about water management strategies and their potential outcomes.

Addressing Environmental and Climate Challenges. Climate change exacerbates water-related issues, such as scarcity, pollution, and extreme weather events. AI tools play a vital role in resilience-building by:

• Climate prediction for the water system: Machine learning prototypes study various climate-related data to initially predict long-term changes in water withdrawals, river flow, and groundwater recharge.

• Adaptive infrastructure development: AI tools enable the design of infrastructure such as drought-resistant crops, flood defense mechanisms, and wastewater treatment systems.

• Ecosystem observation: AI offers ways to monitor the evolving trends of aquatic ecosystems for the design of development policies.

To Address the complexity water governance and to ensure effective and efficient management of resources moving forward sustainable development, AI contributes greatly through its diverse tools and prototypes.

3 Study findings

The findings of this article highlight the great potential of artificial intelligence in achieving sustainable development goals by improving water governance. These findings can be categorized as follows:

Resource optimization and decision-making. New AI-powered models and prototypes contribute to optimal water resource management while providing authorities with real-time information and effective data forecasting. This includes, for example, predicting water needs, identifying canal leaks, and improving irrigation methods, which will further reduce drinking water waste to ensure the effective and efficient sustainable use of this increasingly scarce resource.

Ethics and Innovation. It is important to integrate ethics into the implementation of AI, to take into consideration concerns of confidentiality and access to sensitive data in order to maintain good water governance based on a fair and inclusive AI system.

Promoting inclusion. Integrating input from strategic stakeholders will enable AI to simplify participatory governance while ensuring transparency in decision-making processes. Water system management will benefit from tools such as natural language processing to promote social inclusion.

Strengthening collaboration and cooperation. AI requires significant investments to anchor capabilities and strengthen the establishment of solid regulatory frameworks. Stakeholders such as NGOs, the private sector, and government, as well as university scientific research laboratories, must cooperate to create and develop the technical expertise and infrastructure that will serve as the basis for AI deployment.

Supporting resilience to climate change. Leveraging the potential of AI, it can anticipate and mitigate the impacts of various weather events, such as severe droughts and flooding. Predictive models will enable better planning of emergency strategies by taking into account the resilience of water governance systems.

4 The Moroccan Case: A Path Toward Smarter and Fairer Water Management

In Morocco, the issue of water governance has become one of the country's most pressing national priorities. Repeated droughts, growing cities, and the expansion of irrigated agriculture have all placed immense stress on limited water reserves. To respond to this situation, the government adopted Law 36-15 on Water.

This law promotes a decentralized and integrated approach to managing water resources. This law assigns clear roles to national and local institutions: the Ministry of Equipment and Water provides overall direction, River Basin Agencies coordinate actions at the regional level, municipalities handle distribution and sanitation, while the National Office for Electricity and Drinking Water (ONEE) manages infrastructure and treatment.

Despite this strong legal framework, several obstacles remain—particularly fragmented data systems, limited forecasting tools, and weak communication between institutions. Here, artificial intelligence could play a decisive role. By introducing predictive models and real-time monitoring tools, Morocco could anticipate droughts, detect leaks in urban networks, and optimize irrigation systems in agricultural areas. Some national strategies, such as "Green Generation 2020–2030" and the Digital Agriculture Program, already show how technology can help improve resource management. Yet, the challenge goes beyond technical innovation: it lies in building local expertise, ensuring transparent access to environmental data, and involving citizens in water decision-making.

Morocco's approach demonstrates that digital transformation and environmental stewardship can move forward together. If successfully implemented, AI could help the country not only preserve its water resources but also become a regional leader in sustainable and inclusive water governance.

Conclusion:

Artificial intelligence is transforming the water sector and will play a pivotal role in the future, particularly in terms of sustainability, efficiency, and proactive resource

management. Its scope of application ranges from leak detection to flood prevention while optimizing water treatment systems. In this same directive, the success of this technological innovation will depend on the quality of the data and the ability of humans to refine these models.

The great potential of artificial intelligence offers numerous advantages for improving and strengthening water governance. AI is working to achieve sustainable development goals by leveraging its tools. However, stakeholders must adopt a collaborative approach that combines this technological innovation with capacity building to ensure sustainable water resource management for future generations.

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