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Current Condition of Water Resources and Their Saving

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Abstract:
The article presents analytical data on water resources in Uzbekistan and other countries. Based on the system of artificial intelligence, opinions were expressed about the preservation of water resources and the ecosystem in it. Considerations on the wise use of water resources using artificial intelligence, deterministic - stochastic models are presented

Keywords: water, resource, ecosystem, agriculture , smart use, artificial intelligence

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1. Introduction

Water is not only a vital resource for us humans, but also a habitat for various organisms that make up aquatic ecosystems. Aquatic ecosystems are unique and contain a large number of plant and animal species that play an important role in the biodiversity of our planet [1].

Solving the problem of freshwater scarcity is an urgent problem for all mankind. Even for countries that do not currently face shortages [2]. Groundwater is about 24%, and only the rest of the water can be easily extracted, that is, consumed. Cheap water sources, rivers and lakes can be said to account for only 0.01% of the world's supply. But the value of water suitable for consumption is extremely high and the most important resource of our planet, because without water life is impossible [3].

Water has natural circulation cycle. It evaporates from the earth's surface and water reservoirs and enters the atmosphere, then it fills the reserves of water reservoirs and falls in the form of liquid or solid precipitation. Its quantity does not change, its state changes [4,5].

About 80% of precipitation falls directly into the world's oceans, the rest is used by people for their own needs, then enters rivers and lakes, replenishing underground water reserves [6,7,8,9]. It should be said - the deficit is related to the disturbance of the balance between surface and underground water.

Ocean water contains a lot of salts, industrial waste as a result of human activity pollutes all types of water, making it unusable [10]. In Uzbekistan, the agrarian sector has only irrigated land areas, and this agriculture contributes negatively to water pollution, and polluting chemicals are actively used in this sector [11]. From this point of view, the rational use of water resources, its continuous use of information with the help of modern computers and telecommunication tools and the adoption of necessary management decisions are extremely urgent issues.

2. Method

Utilizing a literature review methodology, this study examined the development

and deployment of an AI-based Water Resources Management System (AIWRMS). A systematic search was conducted across academic databases and online platforms using relevant keywords [12]. Inclusion criteria encompassed studies focusing on AI applications in water resource management, while exclusion criteria filtered out non-English publications and studies lacking empirical data. Data extraction and synthesis were performed to identify common themes and trends, while quality assessment ensured the reliability of selected studies. A narrative synthesis approach was then applied to analyze findings, providing insights into current practices, challenges, and future directions in AIWRMS development and implementation. This methodology facilitated a comprehensive understanding of AI's role in optimizing water resource management strategies [13].

3. Results and Discussion

3.1. Importance of monitoring water resources status

Monitoring the status of water resources allows us to monitor the quality of water, the level of pollution, our rational use of it, consumption and other parameters that affect its status. Monitoring of water consumption allows identifying problem areas where water quality may be impaired and taking measures to prevent environmental disasters [14,15,16,17]. For example, according to the monitoring data, it is possible to determine the water level in a certain river, the presence of toxic substances and their level. At the same time, as a result of monitoring, it is possible to control the discharge of waste from production organizations into water bodies, and as a result, this may be a sign of an environmental problem, for example, illegal dumping of industrial waste. Thanks to monitoring, it is possible to identify such problems and take measures to eliminate them.

It is predicted that there will be a shortage of 7 billion cubic meters of water in the Republic of Uzbekistan by 2030. It should be noted that 80% of water resources in Uzbekistan come from other countries, 20% are produced in the country [1].

3.2. AI in monitoring the status of water resources

The distribution and rational use of water resources can be achieved as a result of the information obtained from modern intelligent automated control systems, artificial intelligence systems, and based on them, adequate management. The role of artificial intelligence (AI) in monitoring the status of water resources is extremely important and promising. We can say some positive aspects of using artificial intelligence [2].

First, AI has the ability to process and analyze a large amount of data about water in the shortest possible time. By collecting information about water resources and organisms, AI can quickly analyze this data, identify relationships, and predict potential changes and problems. For example, AI algorithms can analyze data on the concentration of certain substances in water and predict possible pollution in the future. Such an analysis helps to quickly respond to possible problems and take measures to prevent them.

Second, AI can provide predictions of water status and quality based on more accurate and better data. AI algorithms are capable of analyzing and accounting for many factors, including climate conditions, hydrological data, water consumption data, and more. This will help to make more accurate predictions about the distribution and availability of water in the Central Asian regions. For example, with the help of artificial intelligence, it is possible to estimate the water level in rivers and lakes, which is especially useful for Uzbekistan in planning water resources and preventing excessive water consumption.

3.3. Advantages of AI-based monitoring and analysis of water resources

Automated monitoring and analysis of water resources with the help of artificial

intelligence provides a number of important advantages.

1) Accuracy and reliability: AI is able to process and analyze large amounts of data with high accuracy. It can detect and correct errors automatically, making it a reliable tool for monitoring water resources. This will improve the quality of data and provide a more accurate picture of the state of water systems.
2) Speed and efficiency: the use of AI allows to automate the processes of monitoring and analysis of water resources, which significantly speeds up the work. Unlike manual methods, SI can analyze large amounts of data in a short period of time. This reduces the time to quickly study information on changes in water resources and make adequate decisions based on it.
3) Detection of hidden patterns: AI algorithms are able to detect various "hidden" information that may not be noticed by humans. This allows for a deeper understanding of the processes taking place in water systems and to determine the factors affecting their condition. For example, artificial intelligence can identify the relationship between water pollution and the health of fish populations, helping to develop more effective strategies to protect and restore aquatic ecosystems.
4) Forecasting and prediction: AI can be used to predict the future dynamics of water resources based on information about past trends and current conditions. This allows to take measures to prevent potential problems and develop more effective strategies for managing water systems.
5) Optimization of resource management: the use of artificial intelligence in the monitoring of water resources allows to optimize the management of these resources. Automation of monitoring and analysis processes and, as a result, allows obtaining more accurate and up-to-date information, which helps to make informed decisions about water system management. This includes optimizing the allocation of water resources, developing effective pollution control strategies, controlling introduced species, and other measures.

3.4. Problems in water management

In general, the use of artificial intelligence in monitoring the state of water resources and analyzing data about aquatic organisms offers unparalleled opportunities for more accurate and efficient management of water systems, not only the average values of the desired properties, but also the ranges of their possible changes in solving large-scale practical problems related to the assessment and forecasting of wastewater flow, the arrival of dissolved compounds in water bodies, as well as the formation of loads to water bodies.

One of the possible ways to solve such problems is the use of deterministic-stochastic (DS) models, including a long input block of meteorological elements as input to subsequent deterministic blocks of the model describing water flow and impurities in catchment areas [3,8,9]. Orientation to meteorological observation data as a basis for DS modeling, as a rule, the series of measured values of meteorological parameters is explained by the series of measured values of water discharge significantly longer than water flow and even more. Creating a complex of such models fully meets the main task of applied ecology, which is determined by "developing the principles of rational use of natural resources based on general forms of life organization" [18,19,20].

The initial input to the DS modeling system is a series of observations of meteorological elements. Calculation results are presented in the form of average monthly and average annual flow layer distribution parameters, annual biogenic load in the reservoir, annual solid flow, as well as an assessment of the intensity of siltation of the reservoir with river sediments in different hydrometeorological situations. DS modeling methods were created by some Russian and foreign scientists.

4. Conclusion

The comprehensive review of literature on AI-based Water Resources Management Systems (AIWRMS) reveals a burgeoning field with significant potential for revolutionizing water management practices. Through the synthesis of empirical evidence and analysis of emerging trends, it is evident that AI technologies offer promising solutions for enhancing the efficiency, resilience, and sustainability of water resource management systems.

Key findings highlight the diverse applications of AI in predictive modeling, decision support systems, optimization algorithms, and real-time monitoring, enabling more accurate forecasting, improved resource allocation, and informed decision-making. However, challenges such as data quality, model interpretability, and scalability remain significant barriers to widespread adoption.

Moving forward, future research should focus on addressing these challenges through interdisciplinary collaboration, innovative methodological approaches, and the integration of advanced data analytics techniques. Additionally, there is a pressing need for practical implementation strategies and policy frameworks to facilitate the deployment of AIWRMS in real-world settings.

By harnessing the power of AI technologies, stakeholders can unlock new opportunities for optimizing water resource management, mitigating the impacts of climate change, and ensuring the availability of clean water for present and future generations. This research underscores the importance of continued investment in AI-driven solutions and the imperative of fostering a collaborative ecosystem to accelerate innovation and drive positive change in water resources management practices.

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