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Enhancing Water Resource Management Efficiency through Smart Technologies: A Case Study in Kashkadarya Region, Uzbekistan

Meningkatkan Efisiensi Pengelolaan Sumber Daya Air melalui Teknologi Cerdas: Studi Kasus di Wilayah Kashkadarya, Uzbekistan

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Abstract

This article presents a comprehensive study on the implementation of “Smart Water” devices in water management facilities in the Kashkadarya region of Uzbekistan. The goals of this initiative were to achieve efficient water control, real-time monitoring, and rapid water management. Through the installation of smart devices, including “Smart Water” devices and “DIVER” devices, water resources were effectively managed, resulting in online water control and significant water resource savings. The automation of large hydrotechnical facilities, such as the Karshi hydroelectric plant, enabled remote management and reduced technical water losses. Additionally, the pilot project on automation, based on solutions provided by the Australian company “Rubicon Water Pty. Ltd,” showcased the potential for digitalization and automation in water resources management. The project demonstrated successful outcomes, including increased accuracy in land reclamation assessment, reduced water shortage, enhanced water resource utilization, and significant cost savings. The findings highlight the effectiveness and advantages of smart technologies in water management, underscoring the need for their widespread adoption in addressing water scarcity and sustainable water resource management globally.

Highlights:

- Improved Water Control: Implementation of “Smart Water” devices enables real-time monitoring and online water control, enhancing efficient water resource management.

- Cost Savings and Resource Efficiency: Automation and smart technologies lead to significant water savings, reduced technical losses, and improved water utilization, resulting in economic benefits.

- Scalable Solutions for Global Water Management: The successful pilot project by “Rubicon Water Pty. Ltd” demonstrates the potential for widespread adoption of smart technologies in addressing water scarcity and promoting sustainable water resource management globally.

Keywords: water resources, smart water, efficient technologies, water management, automation.
Introduction

In recent years, considerable reforms have been undertaken to optimize the use of land and water resources, advance the water management system, and modernize water facilities. These reforms are in response to the escalating demand for water due to population growth, economic expansion, and the increasing water shortage exacerbated by global climate change. The primary objectives of water management are to ensure a sufficient supply of water of the required quality to all sectors of the national economy and to mitigate any adverse consequences associated with water utilization [1].

Management of water resource conservation and rational use leverages a variety of mechanisms spanning technical, economic, organizational, and social domains. A primary focus in enhancing water resource efficiency is the sustainable administration of water resources and water needs. This involves lowering ineffective water consumption within the sectors of the national economy, which are key participants in the water management complex. A second pivotal aspect is the elimination of significant water losses at all stages of water use [2].

Currently, all constituents of the water management complex are confronted with the issue of water loss. The necessity to manage water resources is dictated by several factors including: the limited and uneven distribution of available water resources [3]; a sharp surge in water demand [3]; fluctuations in the volume of water resources contingent on conditions and sources of formation; increasing contamination of water resources due to natural and anthropogenic influences [4]; and the adverse impacts of water bodies on nature and the national economy [5].

Presently, the prudent utilization of water resources represents a pressing issue in the Central Asian region. It is noteworthy that the surface water resources of the Republic of Uzbekistan are composed of the water resources originating from the regions of Tajikistan and Kyrgyzstan, and the mountainous regions within our Republic [6]. Thus, the strategic management of these resources is paramount for the region's ecological balance and economic stability [7].

Discussion

In the Kashkadarya region, local water resources fulfill merely 21-22% of the total water demand, necessitating reliance on the resources of bird basins to satisfy the bulk of the water requirements. The ever-increasing demand for water underscores the urgency to adopt water-saving technologies [8]. Accordingly, for the year 2023, the region has planned to implement water-saving technologies across 38,586 hectares, encompassing drip irrigation over 22,520 hectares, sprinkler irrigation on 2,166 hectares, and discrete irrigation on 1,500 hectares. Additionally, laser leveling is proposed for an area of 12,400 hectares, with the collective outcome of these measures expected to conserve approximately 265 million cubic meters of water [9].

A crucial component of these initiatives is the establishment of four service groups comprising 300 employees who are part of the water management system organizations [10]. These groups are tasked with providing hands-on assistance to agricultural producers in the execution of construction and installation of water-saving technologies. However, the allocation of subsidies from the state budget to agricultural producers who have implemented water-saving technologies in the prescribed manner presents a challenge. Of the planned 22,520 hectares for drip irrigation, contracts amounting to 259.7 billion soums have been signed with 374 applicants for 10,422 hectares. So far, one applicant has been financed with 4.7 million soums for 189 hectares, and construction and assembly work is in progress over an area of 3,130 hectares [11].

This year also sees the plan to install 846 ‘smart water’ devices for real-time water management in irrigation networks [12]. Funds amounting to 5.97 billion soums have been received from the Finance Department for 477 such devices. A parallel initiative is to install 276 ‘DIVER’ devices to monitor the level and mineralization of seepage water in reclamation wells.

A program for the repair and restoration of reclamation facilities is concurrently being implemented. In addition, the Karshi hydroelectric plant, a major hydrotechnical facility, is slated for automation, with a financial allocation of 413 million soums from the regional Finance Department set aside for this purpose [13]. Efforts are ongoing to secure funding for the remaining 369 units of smart water devices from the regional Finance Department. The introduction of ‘smart water’ devices in water management facilities promises significant advantages, allowing for online water control and account book maintenance [14].

This rapid water management strategy is expected to result in considerable water resource savings. Additionally, online monitoring of groundwater levels and their mineralization indicators in reclamation monitoring wells is set to enhance the accuracy of land reclamation condition assessment by 20%. Furthermore, the automation of management processes for large water management facilities enables remote management, reducing technical water loss by up to 10%. It also curtails the involvement of human factors in these processes.

Alongside these initiatives, a pilot project on the automation of water resources management processes is being implemented in the Kashkadarya region, reflecting the broad-based efforts toward digitalization of water use in Uzbekistan. A noteworthy reference in this context is the Decision of the President of the Republic of Uzbekistan.
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No. PQ-5055, titled "On measures to further improve the activities of the Ministry of Water Management of the Republic of Uzbekistan".

In compliance with this Decision, the Ministry of Water Management of the Republic of Uzbekistan has enlisted the Australian company, "Rubicon Water Pty. Ltd," to initiate a pilot project on the automation of water resources management processes. "Rubicon Water," a leading provider of solutions for automation of open irrigation channel management, remote control, and monitoring of hydrotechnical structures, accurate calculation of water in the channel, and digitization of irrigation farm management, has installed over 30,000 devices for automating water resources management processes across 15 countries worldwide.In order to execute the tasks outlined in the aforementioned decision, the Ministry of Agriculture, in collaboration with the Ministry of Water Management, has chosen the Kamshi-Mirishkor canal of the Kashkadarya region as the pilot site for automation [15].

The issue of water scarcity associated with this canal is a pressing problem in the Kashkadarya region, making it an ideal location to demonstrate the efficacy and advantages of Rubicon Water's solutions. The canal also employs other mechanisms such as pumping stations, further underscoring the wide-ranging applicability of Rubicon Water's devices and comprehensive software solutions. As part of the project, hydrometers are planned to be installed at 25 facilities along the 13.2-kilometer stretch of the canal, as well as at three pumping stations, thereby covering more than 7,000 hectares of irrigated land [16].

The project aims to achieve full automation of channel management, water consumption calculation, remote control of the channel, and prevention of water loss within the canal. The successful implementation of the project is projected to reduce the general indicator of water resource use in the canal to 70%, increase the efficiency of water use for irrigation from 37% to 90%, and result in savings of 3.8 billion soums due to the rational use of water. As the project proceeds, automated gates and other hydrotechnical means of the canal have been installed and commissioned [17].

The complex automated system of water resources management in the Qamashi-Mirishkor canal is currently operating in test mode, marking the initiation of the project's trial approval. These ambitious initiatives, all aimed at enhancing the effectiveness and efficiency of water resource management in the Kashkadarya region, embody a comprehensive approach to addressing the urgent issue of water scarcity. The successes of these programs may serve as a blueprint for similar efforts across Uzbekistan and in other regions grappling with similar challenges.

Conclusion

Due to global climate change, the growth of the population and economic sectors, their demand for water is increasing year by year, the shortage of water resources is increasing year by year. The main tasks of water management are to provide them with the required quantity and quality of water based on the requirements of all branches and sectors of the national economy, as well as the prevention of negative consequences related to water. Management of the rational use of water resources and their protection is carried out with the help of various mechanisms, including technical, economic, organizational and social mechanisms.

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