

A STUDY ON WATER MANAGEMENT AND CONSERVATION: THINK BLUE ACT GREEN, A DROP SAVED IS A LIFE SAVED

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Abstract: The global increase in demand for water, due to population growth and industrialization, puts heavy pressure on the scant available water resources through overuse and contamination. But how efficient is the world in conserving it?. Saving water is now a collective responsibility. In this age of scientific advancements, using technology to solve environmental problems would contribute in making the Earth a better place for all living beings. Thus, this research examines the frontier innovations poised to rewrite the future of global water security. It explores various methodologies of water conservation. The topics covered in these papers include the employment of IoT technology, PLC (Programming Logic Controllers) based monitoring device, Sensor technology, Transmission cloud and Optoelectronic device.

It emphasizes improvement in water efficiency in petrochemical industry that influence water conservation, a real-time monitoring of water conservation, a conservancy project, a mobile app to regulate water pumps, smart metering, municipal pipe networking, sediment variation, water consumption proportion. The research also investigates the effects of water conservation on the environment and suggests an information architecture. It addresses the importance of water conservation and the methods to evade disasters like flood and also the effective ways to overcome challenges such as water scarcity and water contamination.

Keywords: IoT Technology, Optoelectronic device, Wireless sensor networks, PLC (Programming Logic Controllers), Smart metering.

I. INTRODUCTION

Water resource management has become increasingly vital amid rapid urbanization, industrial expansion, and climate change. This study examines various aspects of water conservation and sustainable utilization, emphasizing both industrial and urban applications. In the Middle Yellow River, changing patterns of water flow and sedimentation reveal the influence of natural conditions and human activities on hydrological systems providing a foundation for improved water resource utilization. The research also highlights the importance of water use efficiency in industries such as optoelectronic device manufacturing and petrochemicals, where the absence of national consumption standards and high water usage underscore the need for optimized processes and recycling measures. To enhance urban water distribution, the study explores the application of pressure-superposed water supply systems that utilize municipal pressure to reduce energy consumption, supported by PLC, inverter, and GPRS technologies. Additionally, intelligent solutions such as IoT-based water monitoring and smart metering systems demonstrate how digital innovation can prevent overflow, reduce losses, and promote efficient water use. Hydrological studies in the Taihu Lake Basin further shows how urbanization alter water level variations, offering insights into improved flood control and water management strategies. Collectively, these investigations provide a scientific basis for advancing sustainable, energy-efficient, and technologically driven water management systems.

II. LITERATURE REVIEW

Sl No.	YEAR	TITLE	DESCRIPTION
1	2023 [1]	An Intelligent Wireless Water Conservation System	The paper describes an automated wireless system to avoid overflow and conserve water through water-level monitoring and control in storage tanks. The ultrasonic sensor, NodeMCU ESP8266 module, and a mobile application form part of the entire automated process that provides switching of the motorized water pump with real-time detection of the water level. It prevents wastage of water, saves time, and makes conservation more efficient. The architecture is IoT-based, which offers remote monitoring, flexibility, and scalability for applications in smart homes, agriculture, and public water management. Experimental results demonstrate the reliability and efficiency of the system in supporting sustainable water use.[1]
2	2022 [2]	A real time online monitoring system for soil and Water conservation based on transmission cloud	Soil erosion has become a serious challenge in regard to ecological stability and human sustainable use of land; therefore, the demand for its efficient monitoring and management is crucial. In this regard, a real-time monitoring system for soil and water conservation is developed based on transmission cloud technology that can collect and analyze environmental data like rainfall, wind, temperature, and soil erosion. There is Real-time Data Collection and Transmission with High Accuracy and Photosensitive Chain Pin which is efficient and Automated Monitoring helps in Remote Access and Data Management of collected data which requires high initial cost and setup it is dependent on Network Connectivity and Power Supply Limitations. Its successful application in the Shanbei-Hubei UHV(Universal Human Values) project shows excellent real-time performance and great practical value, promoting the development of soil and water conservation monitoring.[2]
3	2021 [3]	Distribution and effectiveness of soil and water conservation monitoring about water conservancy project	Soil and Water Conservation Law of China provides a legal framework to prevent soil erosion and manage water resources in a sustainable way. It supports environmental protection, ecological balance, and proper harmony between man and nature, working for both environmental and social welfare. Findings improve environmental protection and reduce the loss of soil and water, supporting sustainable construction. However, challenges include high cost, resource demand, complex coordination, data variability, uncertainty, and challenges in maintenance. The Xinjiang Kurgan Water Conservancy Project enhances soil and water conservation by perfecting the project's design, management, and monitoring to reduce erosion, decrease man-made losses, and protect the ecological environment. It will ensure the sustainable development of the project and environmental restoration by effective supervision and timely measures.[3]
4	2021 [4]	Characteristics of Water Level Changes in Flood Season at Representative Stations in Taihu Lake Basin in the Process of Urbanization	Urbanization has greatly influenced water level variations in the Taihu Lake Basin during the flood season. The rapid industrial and urban growth changed the natural hydrological pattern, increasing the flood risks and adding challenges to water management. Employing a multi-variation point hydrological diagnostic method, the researchers analyzed changes in the highest and average water level of Taihu Lake and eight representative stations. The results reflected an uptrend in all these series, and major variations happened in the 1980s and

			2000s. From the analysis, of urbanization to flood and water-level tendency, provides a detailed hydrological data, which is useful in urban planning and disaster prevention. In addition, an improved diagnostic method enhances the precision of detecting variations and supports sustainable development with better drainage and water management systems. However, the present research is confined to the catchment area of Taihu Lake Basin has less applicability to another region depending on historical data and requires highly technical expertise, increases trend in water level in the Taihu Lake Basin is due to urbanization and water projects adapts flood management for the sustainability of water resources.[4]
5	2013 [5]	Smart Metering Implementation For Enabling Water Conservation And Water Demand Management	This research examines how smart metering technologies might improve water conservation and demand management in municipalities across Gauteng, South Africa. Faced with high non-revenue water levels of 36-40% and increasing demand, the research surveyed municipal engineers and managers on current WC/WDM policies and the adoption of smart metering. Most municipalities have been found to follow the national water policies laid down, yet there is a great limitation in the implementation of smart metering system mechanisms. There was a strong endorsement of smart metering as a way to achieve efficient billing and leak detection to enhance consumer awareness. The study concluded that smart metering adoption is likely to significantly reduce Non-Revenue Water and improve sustainable water use, further recommending standardized metering infrastructure for South African utilities.[5]
6	2013 [6]	Theoretical analysis and experimental study of energy conservation for pressure-superposed water supply in buildings	Technical and economic problems make a traditional system, such as frequency conversion water supply equipment, less successful. The pressure-superposed system pumps directly into the municipal pipelines, adopting existing water pressure to save energy. The research involves theoretical analysis, device development with PLC, inverter, GPRS, and experimental validation. This proves that pressure-superposed water supply significantly improves the energy efficiency and provides a reliable technical basis for sustainable urban water systems. It reuses municipal water pressure with high efficiency and adopts an intelligent monitoring system, realizing remarkable energy saving with high operational stability. Experiments verify theoretical models, reflecting its feasibility in practice. Although some technical problems and cost-related issues still need to be overcome, this system that provides a sustainable solution for optimizing the water supply network and make contributions to the construction of energy-efficient urban infrastructure.[6]
7	2012 [7]	Analysis on Water Consumption and Conservation of Petrochemical Industry in China	Industrial water consumption in China is the second largest water consumer after agriculture, within which the petrochemical industry is a major water consumer and contributor to pollution. Detailed analysis identifies recycled cooling water as the largest consumer and hence offers the most potential for conservation. Optimisation of treatment processes and reutilization should enable industries to achieve sustainable water management. This encourages technological innovation in water treatment and process control, reducing pollution discharge while increasing wastewater quality. Wastewater reutilization will drastically reduce the demand for fresh water. There is complex implementation across diversified industrial infrastructure, which requires huge investment in modern treatment systems and monitoring. In addition, limited awareness and poor adoption of

			advanced recycling technologies by the petrochemical industries are some of the factors. Management of Recycled Cooling Water: The key to the conservation of this resource in the petrochemical industry depends on the management of reused cooling water. Wastewater recycling, air-cooling systems, and steam condensate recovery have the potential to significantly cut consumption and reduce GHG emissions. While cost and management bottlenecks persist, these technologies provide the necessary backbone for sustainable industrial use of water in China.[7]
8	2011 [8]	Individual China Environmental Awareness and Urban Water Conservation in Kunming,	This paper explores how the residents of Kunming contribute to sustainable water use amidst the growing problem of China's water scarcity. While many people do not have any idea about the sources and price of water, they save water during crises like drought. It shows that personal experiences and knowledge facilitate behavioral change. Industrial water consumption in China is the second largest after agriculture, in which the petrochemical industry is a major consumer of water and pollution contributor. Through detailed analysis, this research identifies the largest consumer as recycled cooling water, hence offering the most potential for conservation. It requires the optimization of treatment processes and reutilization that aims in industries to achieve sustainable water management. This encourages technological innovation in water treatment and process control, reducing pollution discharge while increasing wastewater quality. Wastewater reutilization will drastically reduce the demand for fresh water. Complex implementation through diversified industrial infrastructure requires huge investments in modern treatment systems and monitoring. Moreover, some other contributory factors include limited awareness and poor adoption of advanced recycling technologies by the petrochemical industries.[8]
9	2011 [9]	Analyses on Water Conservation and Water Consumption Quota of Optoelectronic Device Manufacture	Assessment of water utilization efficiency in the optoelectronic device manufacturing industry, for which there are no clear-cut national standards, underscores how undefined water consumption quotas have affected conservation. Researchers carried out field investigations, indicating major water usage processes to include ultra- pure water production and processes for cleaning the devices, for which scientifically calculated quotas were proposed. This helps establish the benchmark for water use in the water-consuming industry and incentivizes technological innovations to reduce waste. This supports national goals on water efficiency in manufacturing. Based on a few case studies from selected enterprises, this may not represent all types of optoelectronic production, and requires continuous updating as technologies evolve. Optimized processes, recycling technologies of water, and improved management systems can achieve sustainability in the utilization of water resources. The proposed quota of 0.34 m ³ per product and 335 m ³ per million Yuan output value serves as a good reference for policy and industrial application.[9]

10	2011 [10]	Prospect of Water and Sediment Variation Trend in the Future in the Middle Yellow River	The paper evaluates the efficiency of water use in the optoelectronic device manufacturing industries for which no clear national standards have yet been stipulated. All this shows that the incompleteness of the water- consuming quota system has restricted conservation efforts. In doing so, major processes involving ultrapure water production and cleaning of devices were outlined, along with scientifically calculated quotas. This sets a water consumption benchmark for an expanding industry and inspires efforts at technological innovations to cut waste. It also helps achieve national aims in terms of water use efficiency in manufacturing. Given the limited nature of case studies from selected enterprises, this may not be entirely representative of all types of optoelectronic production. As technologies continue to evolve, the process should continuously be updated. Optimizing industrial processes, water-reusing technologies, and management systems will help industries achieve sustainable utilization of water resources. A quota of 0.34 m ³ for each product and 335 m ³ per million Yuan output could be a very good reference for both policy and industrial application.[10]
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III. CONCLUSION

Different studies indicate that technological innovation and sustainable management are modern approaches to water conservation. Intelligent systems include pressure- superposed supply networks, cloud-based monitoring, and smart metering, which helps in enhancing efficiency, accuracy, and reutilization of resources. Urban and industrial projects indicate the contribution of better design, automation, and awareness in reducing leakages, regulating floods, and protecting ecosystems. Emphasizing real-time supervision, ecological obligation, as well as flexible policy promotes coordinated development. These developments prove that the integration of technology with ecologically responsible management offers a workable solution for long-term water security and sustainable growth of cities.

IV. SUSTAINABLE DEVELOPMENT GOALS

SDG Goals	Goal Description	Justification
SDG 6:Clean water and Sanitation	Ensure availability and sustainable management of water and sanitation for all	Access to clean water and proper sanitation is essential for human health, dignity, and sustainable living. Ensuring these resources helps prevent disease and supports thriving communities.
SGD 12:Responsible consumption and Production	Ensure sustainable consumption and production patterns	Using resources wisely and reducing waste protects the planet for future generations. Sustainable production fosters balance between human needs and environmental limits.
SDG 13:Climate action	Take urgent action to combat climate change and its impacts	Immediate steps to reduce emissions and adapt to climate change safeguard our planet's future. Protecting the climate means protecting lives, livelihoods, and ecosystems.
SDG 14:Life below Water Conserve and Sustainability	Conserve and sustainably use the oceans, seas, and marine resources for sustainable development	Healthy oceans are vital for food, livelihoods, and global ecosystems. Conserving marine life ensures the balance and beauty of our blue planet endure.

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