IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.311 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 12, Issue 12, December 2025

DOI: 10.17148/IARJSET.2025.121250

Sustainable Water Conservation: Challenges and Future Perspectives

Roopa K Murthy[1], D Sohan[2], Rahul Bharadwaj KS[3], Samruddhi[4], Varshini V[5], Varshith HN[6]

Assistant Professor, Computer Science and Design, K. S. Institute of Technology, Bengaluru, India[1]

Students, Computer Science and Design, K. S. Institute of Technology, Bengaluru, India[2-6]

Abstract: Water conservation are important resources to human survival, development and is a daily responsibility which connects straight to human life, health, dignity etc. To protect environment and natural water resources here it uses the water system model that describes on how to preserve water, and to protect layer-1 of Earth which is called Hydrosphere and to meet future human demands. 97% on earth is of salt water in which 3% is suitable for drinking. The system is mainly introduced to protect or manage freshwater and it even reduces the wastage of water to avoid scarcity. In many parts of the world, people walk long distances to accumulate clean water. Factors like climate changes effects the water resources mainly on agriculture irrigation. It is not simply about saving water it is about valuing life, respecting nature, and taking collective steps to protect one of the planet's most irreplaceable resources. As lakes shrivel, rivers dry up, and groundwater levels fall, it becomes clear that water conservation is not an optional practice it is a crucial necessity for human survival and environmental strength. It is also strongly connected to social well-being. This project aims to survey water conservation not only as a subject but also as a human responsibility.

Keywords: Water conservation, rain water harvesting, agriculture irrigation, precipitation, evaporation Ground water.

I. INTRODUCTION

Water is one of the most important natural resources on Earth. Few countries have already adopted this system of water conservation. To save water per day there are many ways. For conserving water, a few key benefits like avoid water loss, avoiding damage to quality of water. Water conservation projects are important. Now a day's online monitoring devices are used for water conservation system in which it collects data of wind direction, rainfall and etc. Some water conservation methods are even used in agriculture field like irrigation, and water used for sprinkling the crops and even rain water harvesting is done in agricultural field which decreases wastage of water. By conserving water, it helps protecting a natural resource which is safeguarding life, health, and certify that the Earth remains alive for those who come after us. Simple actions like fixing leaks, reusing water wisely, harvesting rainwater, and protecting natural water bodies can collectively make a powerful difference. Farmers struggle when rainfall becomes unpredictable. Cities suffer from water shortages during hot summers.

II. IMPOR TANCE OF WATER CONSERVATION

The importance of water conservation is as follows: -

- Protects ecosystem: -
  Water conservation maintains the water bodies like rivers or lakes. When water is conserved its like not only saving resources for us also protecting ecosystem.
- Future Demand: -
  Water conservation system is adopted so that future needs and requirements are fulfilled. By using water wisely now, and decreases the risk of future crises. Conserving water for future demand is an act of responsibility.
- Agriculture: -
  Conserving water in agriculture also protects the environment. Conserving water also helps in agricultural field like it improves irrigation which safe guards the crops. Excessive usage of water can end up in drying water ponds and decreases groundwater levels.
- Cost: -
  At a household saving water directly means lower water bills and reduced electricity costs. For farmers conserving water through rainwater harvesting reduces the cost of irrigation, electricity for pumps. At the community and government level, conserving water helps reduce the high cost of building new dams, pipelines, or treatment plants.

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.311 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 12, Issue 12, December 2025

DOI: 10.17148/IARJSET.2025.121250

III. WAYS TO CONSERVE WATER

There are several ways to conserve water. Some of the ways to conserve water are:

- ✓ Rainwater collecting
- ✓ Less shower time
- ✓ Turning of taps when not required
- ✓ Collecting waste water
- ✓ Leaky taps must be repaired
- ✓ Monitoring water bills
- ✓ Turning of tap while brushing

IV. LITERATURE REVIEW

SL NO	YEAR	PAPER TITLE	DESCRIPTION
1.	2025[1]	IoT-Enabled Water Conservation and Leakage Control System	Internet of Things (IoT) have been advanced in inventing how to manage the water conservation system. This paper discusses on IoT-based water conservation and leakage control system which is designed to detect wastage of water. In this it monitors on the water flow and it even helps in detecting the water leakages. For detecting and monitoring here they use some sensors like microcontrollers and cloud-based platforms. These sensors help in detecting the microcontrollers that help in monitoring the water flow and if some disturbance occurs it will stop the flow slowly and checks if unauthorized usage of water is detected and on other hand the cloud-based platforms give remote access for monitoring. This project aims for practical applications of IoT on water conservation management. [1]
2	2022[2]	A Real-time Online Monitoring System for Soil and Water Conservation Based on Transmission Cloud	This paper explores a real-time online monitoring system for soil and water conservation based on transmission cloud. The system uses photosensitive chain pin method for collecting data. And the method improves the perfection of the data as well as transfers the data quickly to the transmission cloud through 4G. Users can monitor meteoric conditions through monitoring software. The final practical application in the Shanbei Hubei Ultra-High Voltage (UHV) transmission project verifies the real-time and practical application value of this online monitoring system. The software part of this system is very easy to operate. Real time online monitoring system has great consequential value on soil and water conservation monitoring. [2].
3	2022[3]	Unveiling the benefits of condensed water reclaimed for evaporative cooling tower in Part I: Water conservation	This research explores on how water condensed from air-conditioning systems can be reused as a sustainable replacement for fresh water in cooling towers. Because this condensed water is clean, mineral-free, and doesn't need extra energy to collect, it helps reduce the build up of minerals, lowers scaling, and cuts down on the use of chemical cleaning agents. By maintaining a high Cycle of Concentration (CoC) of 19.2, the study managed to save about 44% of the make-up water and 80% of the bleed-off water, which also reduced greenhouse gas emissions by roughly 7,500 kilograms of CO_2 each year. The findings highlight that, unlike grey water, condensed water doesn't require any treatment before use and can safely support cooling tower operations. Overall, the research shows that using reclaimed condensate is a practical, affordable, and environmentally friendly way to conserve water. [3].
4.	2018[4]	Application of UVA in Soil and Water Conservation:	Taiwan is an island-type country which is located in mountains. The environment is special that natural disasters occur frequently to this country. So, it is a mandatory task to build up the soil and

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.311 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 12, Issue 12, December 2025

DOI: 10.17148/IARJSET.2025.121250

		Preparation of Planting Materials for UVA	water conservation to prevent natural disasters. The goal of this study is to develop planting granules, which is worthy for using the UAV vehicle to sprinkle on the bare ground. Polyacrylamide [PAM] is safe and non-polluting polymer. This polymer is used in the industries. The materials which have been used in this project are PAM (different charge density), Grass seeds, Fertilizer. The granules were effectively dispersed and attached to the bare ground. Grass seeds sprouted up and grew in to green grass after half a month. Finally, the artificial and UVA throwing granule tests showed that the planting granules could effectively attached to the ground or slope, and the grass germinated and grew well. [4].
5	2013[5]	Smart metering implementation for enabling Water Conservation and Water Demand Management. An investigation in Gauteng, South Africa	Due to growth demand of water, the supplying of water of good quality and quantity is crucial to utilities in urban areas. Municipalities in South Africa attain water from Vaal River system. A study was supervised and it was mainly focused on Water Conservation and Water Demand Management. The goal of this study was to initiate if there are policies and strategies in place which are being implemented to reduce NRW at the municipalities. The results demonstrate that long-term, integrated water soil conservation can significantly enhance hydrological stability and environmental health in the Yellow River Basin. Smart metering technology general can be used to reduce in commercial losses. The municipalities should embrace this technology. [5].
6.	2012[7]	Discussion on Soil and Water Conservation Activities Hydrological Effects Simulation in the Loess Plateau.	The Loess Plateau, a key water and sediment source of the Yellow River, faces severe soil erosion and water scarcity leading to ecological degradation. Over the past decades, Soil and Water Conservation Activities (SWCA) such as afforestation, terracing, and check dam construction have been widely implemented, significantly altering the hydrological cycle by enhancing infiltration and reducing surface runoff. Quantifying these effects is vital for predicting long-term changes in river flow and sediment yield. Distributed hydrological models provides a promising approach for simulating SWCA impacts due to their physical and spatial accuracy. However, current models often rely only on slope gradients and neglect the flow resistance along with sediment factors, limiting precision. Improving these models will enhance understanding of SWCA hydrological effects and support sustainable water resource management. [6].
7	2011[7]	Individual Environmental Awareness and Urban Water Conservation in Kunming, China.	The study explores on how urban residents' awareness and attitudes affect water conservation behaviour conducted through surveys in Kunming, the research reveals that although most water use in China occurs in rural areas, responsibility for conservation begins in urban centres. The findings indicate that first-hand environmental awareness is far more effective in promoting water-saving behaviour than traditional education. However, public understanding in Kunming remains limited only a small percentage of residents knew the source or cost of their water, and just 59% believed they could personally impact China's water crisis. The paper emphasizes that as China's urban population and living standards rise, water demand will increase unless awareness and behavioural change occur. It concludes that promoting stronger personal responsibility and environmental consciousness in cities is essential for sustainable water use and for preventing future water shortages across China. [7].
8.	2011[8]	Effects of Different Soil and Water Conservation Tillage on Runoff,	This paper discusses about the study of consequence of different tillage on soil and water conservation (SWC). There are 3 tillage measures they are strip intercropping, contour intercropping and clean tillage. Many studies were conducted out to examine water-

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.311 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 12, Issue 12, December 2025

DOI: 10.17148/IARJSET.2025.121250

		Sediment and Soil Carbon	storing and soil-retaining effects of different agriculture measures. Park of soil, and water conservation was selected for conducting experiments on that field. During 5 years, the interest of these farming measures to soil and water conservation stands ranked in the successor order of contour intercropping, strip intercropping and clean tillage. [8].
9	2011[9]	Effect of Comprehensive Harnessing on Water and Soil Conservation in SanChuanhe River Basin	The study investigates the effect of comprehensive harnessing on water and soil conservation in the SanChuanhe River Basin, located in the coarse sediment-producing area of the middle reaches of the Yellow River. Using the Hydrological Method, the research quantifies the impact of conservation measures implemented between 1997 and 2006. Results show that these measures reduced 34.77 million m^3 of floodwater and 1.482 million tons of sediment, corresponding to reduction rates of 62.7% and 83.6%, respectively. Compared with the 1970s and 1980s, these rates have more than doubled, indicating the growing effectiveness of watershed management practices. The analysis further reveals that while rainfall influences sediment and runoff variability, management measures now play a dominant role in achieving hydrological stability. Long-term implementation of soil and water conservation has significantly mitigated erosion, improved ecological balance, and reduced flood intensity. The findings confirm that comprehensive conservation practices are vital for sustainable watershed management and environmental protection, ensuring continued ecological and hydrological benefits for the SanChuanhe River Basin even under changing climatic conditions. [9].
10.	2010[10]	Research on Water & Soil Conservation and Eco-restoration Management in West-East Natural Gas Pipeline of China.	This study evaluates the ecological impacts of the West–East Natural Gas Pipeline Project in Ningxia, Northwest China, where construction has intensified soil erosion and desertification. Combining engineering techniques with bio-vegetation restoration, the research demonstrates that excavation and land disturbance threaten ecological balance and pipeline safety. Implemented strategies—such as slope protection, drainage control, and mixed shrub–grass planting—reduced over 85% of soil loss and improved vegetation recovery. The study highlights the importance of integrating environmental protection into infrastructure development. Sustainable construction, supported by continuous monitoring and adaptive management, ensures long-term ecosystem stability and pipeline safety, providing a practical model for eco-friendly large-scale engineering. [10].

V. CONCLUSION

Water conservation is essential for sustaining life, supporting ecosystems, and ensuring future water security. With growing population, urbanization, and climate change, the demand for freshwater continues to rise while natural resources are depleting. Effective water conservation practices such as rainwater harvesting, efficient irrigation methods, wastewater recycling, and public awareness play a vital role in minimizing wastage and maintaining the natural water cycle. Conserving water not only protects aquatic habitats and reduces energy use in water treatment but also enhances agricultural productivity and ensures equitable water distribution. Sustainable management of this finite resource requires collective responsibility from individuals, communities, industries, and governments. Ultimately, water conservation is not just an environmental necessity but a shared duty to secure a healthy and sustainable future for all living beings.

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.311 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 12, Issue 12, December 2025

DOI: 10.17148/IARJSET.2025.121250

VI. SUSTAINABLE DEVELOPMENT GOALS

Sustainable Development Goal (SDG)	Goal Description	Justification
SDG 6: Clean Water and Sanitation	Ensure availability and sustainable management of water and sanitation for all.	The entire document focuses on **water conservation**, reducing wastage, maintaining water quality, and improving accessibility. It highlights issues like scarcity, groundwater depletion, and the need for rainwater harvesting and IoT-based monitoring systems
SDG 2: Zero Hunger	End hunger, achieve food security, improve nutrition, and promote sustainable agriculture.	The report discusses how **irrigation systems, agricultural water use, and efficient farming methods** directly rely on water conservation. Conserving water ensures better crop yields and food security, especially during unpredictable rainfall
SDG 11: Sustainable Cities and Communities	Make cities inclusive, safe, resilient, and sustainable.	The study emphasizes **urban water management**, leaky taps, water wastage, rainwater harvesting in cities, and "smart metering" to reduce losses. These improvements directly support sustainable urban infrastructure
SDG 12: Responsible Consumption and Production	Ensure sustainable consumption and production patterns.	The document encourages **responsible household water use**, monitoring water bills, fixing leaks, reducing wastage, and adopting technologies that ensure efficient resource use
SDG 13: Climate Action	Take urgent action to combat climate change and its impacts.	Climate change impacts water availability, rainfall patterns, and agricultural production. The document mentions how **changing climate affects irrigation and leads to scarcity**, making water conservation essential in climate resilience
SDG 14: Life Below Water	Conserve and sustainably use oceans, seas, and marine resources.	Protecting freshwater reduces pollution, prevents contamination, and supports the natural hydrosphere. Proper water management helps maintain aquatic ecosystems and prevents degradation of rivers and lakes
SDG 15: Life on Land	Protect, restore and promote sustainable use of terrestrial ecosystems.	Several studies in the document discuss **soil and water conservation**, erosion control, afforestation, tillage methods, and ecological restoration—key to protecting land ecosystems.
SDG 9: Industry, Innovation, and Infrastructure	Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation.	The literature review highlights **IoT-enabled systems, cloud monitoring, smart metres, and UAV-based conservation**, showing how innovation supports sustainable water management

REFERENCES

[1]. C. Preethi, S. S. Hammed, K. Haripriya, S. Pavalarajan, H. S. P and S. B, "IoT-Enabled Water Conservation and Leakage Control System," 2025 7th International Conference on Inventive Material Science and Applications (ICIMA), Namakkal, India, 2025, pp. 993-997, doi: 10.1109/ICIMA64861.2025.11073938.

[2]. L. Lei et al., "A Real-time Online Monitoring System for Soil and Water Conservation Based on Transmission Cloud," 2022 9th International Forum on Electrical Engineering and Automation (IFEEA), Zhuhai, China, 2022, pp. 614-618, doi: 10.1109/ IFEEA57288.2022.10037809.

DOI: 10.17148/IARJSET.2025.121250

[3]. Y. K. Leung and K. W. E. Cheng, "Unveiling the Benefits of Condensed Water Reclaimed for Evaporative Cooling Tower in Part I: Water Conservation," 2022 IEEE 9th International Conference on Power Electronics Systems and Applications (PESA), Hong Kong, Hong Kong, 2022, pp. 1-8, doi: 10.1109/PESA55501.2022.10038364.

[4]. S. -Y. Fan, M. -F. Tsai, L. -H. Chou, Y. -T. Lai and M. -T. Lee, "Application of UVA in Soil and Water Conservation: Preparation of Planting Materials for UVA," 2018 IEEE International Conference on Advanced Manufacturing (ICAM), Yunlin, Taiwan, 2018, pp. 163-165, doi: 10.1109/AMCON.2018.8615083.

[5]. O. A. Masia and L. D. Erasmus, "Smart metering implementation for enabling Water Conservation and water demand management: An investigation in Gauteng, South Africa," 2013 Africans, Pointe aux Piments, Mauritius, 2013, pp. 1-5, doi: 10.1109/ AFRCON.2013.6757631.

[6]. Z. Shengtang, C. Peng and L. Miaomiao, "Discussion on Soil and Water Conservation Activities Hydrological Effects Simulation in the Loess Plateau," 2012 International Conference on Computer Distributed Control and Intelligent Environmental Monitoring, Zhangjiajie, China, 2012, pp. 241-244, doi: 10.1109/CDCIEM.2012.63

[7]. L. Krusac, "Individual environmental awareness and urban water conservation in Kunming, China," 2011 International Symposium on Water Resource and Environmental Protection, Xi'an, China, 2011, pp. 2757-2760, doi: 10.1109/ISWREP.2011.5893450.

[8]. Haijin Zheng, Hongjiang Zhang, Shaowen Fang, Jie Yang, Songhua Xie and Xiaoan Chen, "Effects of different soil and water conservation tillage on runoff, sediment and soil carbon," 2011 International Conference on Remote Sensing, Environment and Transportation Engineering, Nanjing, 2011, pp. 268-271, doi: 10.1109/ RSETE.2011.5964266.

[9]. P. Zhang and W. -y. Sun, "Effect of comprehensive harnessing on water and soil conservation in SanChuanhe river basin," 2011 International Symposium on Water Resource and Environmental Protection, Xi'an, China, 2011, pp. 2475-2477, doi: 10.1109/ ISWREP.2011.5893377.

[10]. W. Wang, J. Xie, Z. Li and J. Zhu, "Research on Water & Soil Conservation and Eco-restoration Management in West-East Natural Gas Pipeline Project of China," 2010 International Conference on EBusiness and E-Government, Guangzhou, China, 2010, pp. 808-811, doi: 10.1109/ICEE.2010.210.

