

Conjunctive Use of Surface Water and Groundwater for Sustainable Water Management

C. P. Kumar, Former Scientist 'G', National Institute of Hydrology, Roorkee - 247667, India

Abstract

The conjunctive use of surface water and groundwater is a water management strategy that can help in ensuring a reliable and sustainable water supply. This approach involves the coordinated use of both surface water and groundwater resources to meet water demands. This article explores the best practices for implementing conjunctive use and the challenges associated with it. We also examine case studies from India, Australia, and the United States that demonstrate the benefits of conjunctive use, such as increased water availability, improved water quality, and improved agricultural productivity. To ensure the successful implementation of conjunctive use, an integrated and coordinated approach to water resources management is required, involving all stakeholders. The use of innovative technologies, such as remote sensing, geographic information systems (GIS), and artificial intelligence (AI), can also help in the effective management of conjunctive use. By adopting these best practices, countries can ensure the sustainability of conjunctive use and the effective management of water resources in the long run.

Introduction

Water is the most important natural resource for sustaining life on earth. Water is a scarce resource, and its availability and distribution are not uniform across different regions. The availability of water depends on various factors like rainfall, geography, and climatic conditions. Surface water and groundwater are the two main sources of water that are used for various purposes like drinking, irrigation, industrial use, and many more. In this article, we will discuss the conjunctive use of surface water and groundwater, its benefits, and challenges.

What is Conjunctive Use of Surface Water and Groundwater?

Conjunctive use of surface water and groundwater refers to the use of both surface water and groundwater resources in a coordinated and integrated manner to meet the water demand. It involves the simultaneous use of both sources of water to maximize the benefits and minimize the limitations of each source. Conjunctive use is a management strategy that aims to optimize the use of water resources by integrating surface water and groundwater management.

Benefits of Conjunctive Use of Surface Water and Groundwater

Increased Water Availability: Conjunctive use of surface water and groundwater increases the overall availability of water for various uses. It helps in ensuring a reliable and sustainable water supply by utilizing both sources of water.

Improved Water Quality: Surface water and groundwater have different qualities and characteristics. By using both sources of water, the overall quality of water can be improved. For example, the use of groundwater can dilute the high salinity levels in surface water, thereby improving the water quality.

Increased Agricultural Productivity: Conjunctive use of surface water and groundwater can significantly increase agricultural productivity. Surface water can be used for irrigation during the wet season, while groundwater can be used during the dry season when surface water is scarce. This can help in ensuring a steady water supply for crops and increasing their yield.

Reduced Dependence on a Single Source: By using both surface water and groundwater, the dependence on a single source of water is reduced. This helps in reducing the risks associated with water scarcity or quality issues in a particular source.

Improved Groundwater Recharge: The use of surface water can help in recharging the groundwater aquifers. During the wet season, excess surface water can be allowed to percolate into the ground, thereby recharging the groundwater aquifers. This can help in replenishing the depleted groundwater resources.

Challenges of Conjunctive Use of Surface Water and Groundwater

Lack of Coordination: Conjunctive use of surface water and groundwater requires a high level of coordination and integration between different water management agencies. In many cases, there is a lack of coordination between different agencies, which can hinder the effective implementation of conjunctive use.

Regulatory Challenges: The regulatory framework for conjunctive use is often complex and fragmented. There may be conflicting regulations and policies at the state and federal levels, which can make it difficult to implement conjunctive use.

Technical Challenges: Conjunctive use of surface water and groundwater requires a high level of technical expertise. There are technical challenges associated with the management and operation of conjunctive use systems, such as the optimization of pumping rates, monitoring of groundwater levels, and management of water quality.

Environmental Concerns: Conjunctive use can have environmental impacts, such as the depletion of surface water resources and the overexploitation of groundwater resources. There may also be concerns about the impact of pumping on surface water ecosystems and the quality of water resources.

Cost: Conjunctive use of surface water and groundwater can be expensive. The cost of infrastructure, such as pumps, pipelines, and monitoring equipment, can be significant. There may also be operational costs associated with the management and maintenance of the conjunctive use system.

To overcome the challenges associated with the conjunctive use of surface water and groundwater, several best practices have been developed. These best practices can help in the effective implementation of conjunctive use and ensure the sustainable use of water resources.

Integrated Water Resources Management (IWRM): IWRM is a management approach that aims to coordinate and integrate the management of water resources across different sectors and stakeholders. IWRM can help in the effective implementation of conjunctive use by ensuring the coordination between different water management agencies and stakeholders.

Stakeholder Participation: Stakeholder participation is crucial for the successful implementation of conjunctive use. The participation of local communities, water user associations, and other stakeholders can help in ensuring the sustainability of conjunctive use and the effective management of water resources.

Monitoring and Evaluation: Monitoring and evaluation are essential for the effective management of conjunctive use. Regular monitoring of groundwater levels, surface water flows, and water quality can help in identifying the challenges and opportunities associated with conjunctive use. Evaluation can help in determining the effectiveness of conjunctive use and identifying areas for improvement.

Adaptation to Climate Change: Climate change can significantly impact the availability and distribution of water resources. The conjunctive use of surface water and groundwater can help in adapting to climate change by ensuring a reliable and sustainable water supply. Adaptation strategies, such as the use of climate-resilient crops and water-efficient irrigation techniques, can also help in the effective implementation of conjunctive use.

Innovative Technologies: Innovative technologies, such as remote sensing, geographic information systems (GIS), and artificial intelligence (AI), can help in the effective management of conjunctive use. These technologies can help in monitoring and predicting water availability, identifying areas for conjunctive use, and optimizing the management of water resources.

Case Studies

Several countries have implemented the conjunctive use of surface water and groundwater. The following are some case studies that demonstrate the benefits and challenges associated with conjunctive use.

India: India has implemented conjunctive use of surface water and groundwater in several regions to ensure a reliable and sustainable water supply. For example, in the state of Gujarat, the Sujalam Sufalam Water Conservation Project aims to recharge the groundwater aquifers by using excess surface water during the wet season. The project has helped in improving the availability and quality of water for irrigation and domestic use.

Australia: In Australia, conjunctive use of surface water and groundwater has been implemented in several regions to ensure a sustainable water supply. For example, the Murray-Darling Basin Plan aims to manage the surface water and groundwater resources in the Murray-Darling Basin in an integrated and coordinated manner. The plan has helped in improving the efficiency of water use and reducing the risks associated with water scarcity and quality issues.

United States: In the United States, conjunctive use of surface water and groundwater has been implemented in several regions to ensure a reliable and sustainable water supply. For

example, the Central Valley Project in California uses both surface water and groundwater to meet the water demand for agriculture, urban, and industrial uses. The project has helped in improving the availability and quality of water and reducing the risks associated with water scarcity and quality issues.

Conclusion

The conjunctive use of surface water and groundwater is a management strategy that can help in ensuring a reliable and sustainable water supply. Conjunctive use can increase water availability, improve water quality, increase agricultural productivity, reduce dependence on a single source, and improve groundwater recharge. However, there are several challenges associated with conjunctive use, such as the lack of coordination, regulatory challenges, technical challenges, environmental concerns, and cost. To overcome these challenges, several best practices have been developed, such as integrated and coordinated approach to water resources management, stakeholder participation, and the use of innovative technologies. By adopting these best practices, countries can ensure the sustainability of conjunctive use and the effective management of water resources in the long run.