

PROSPECTS OF ECONOMIC EFFICIENCY OF WATER-SAVING TECHNOLOGIES

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Abstract.

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Received:22.07.2025

Revised: 23.07.2025

Accepted:24.07.2025

Key words:

growing populations,
economic efficiency,
biological treatment,
ultraviolet disinfection,
reverse osmosis, water
resources.

Water, the lifeblood of our planet, is facing an unprecedented crisis. Growing populations, changing climate patterns, and inefficient water management practices are leading to escalating water scarcity, threatening agricultural production, economic development, and human well-being. The need for water-saving technologies has never been more urgent, and the economic efficiency of these technologies holds the key to unlocking sustainable solutions. This article delves into the promising prospects of water-saving technologies, exploring their economic benefits, challenges, and the crucial role they play in shaping a water-secure future.

Introduction. Some of the technologies and innovations that make water treatment and recycling more feasible and cost-effective include membrane filtration, biological treatment, ultraviolet disinfection, and reverse osmosis. Water treatment and recycling is a key part of water circularity. Water efficiency means “doing more and better with less” by obtaining more value with given resources, reducing resource consumption, and minimizing the pollution and environmental impact of water use for producing goods and services. The focus on economic efficiency as the primary objective in the development and allocation of water resources is because of its importance as a social objective; efficiency values having viable meaning in resolving conflicts and assessing the opportunity costs of pursuing alternative uses.

The world is facing a water crisis of unprecedented proportions. Key factors driving this crisis include:

Population Growth: The global population is projected to reach 9.7 billion by 2050, placing immense pressure on water resources.

Climate Change: Shifting precipitation patterns, increased droughts, and more frequent extreme weather events are exacerbating water scarcity.

Inefficient Water Management: Outdated irrigation systems, leaks in infrastructure, and wasteful consumption practices contribute to water losses.

Pollution: Industrial and agricultural activities contaminate water sources, reducing the availability of clean water.

The Economic Impact of Water Scarcity

Water scarcity has profound economic consequences, impacting:

Agriculture: Reduced agricultural yields, leading to food shortages and price increases.

Industry: Disruptions in industrial production due to water shortages and increased costs for water treatment and desalination.

Tourism: Reduced tourism revenue due to water-related issues like drought and water pollution.

Human Health: Increased risk of waterborne diseases and health problems related to water scarcity.

Social unrest: Competition for scarce water resources can lead to conflicts and social unrest.

Water-Saving Technologies: A Beacon of Hope

Water-saving technologies offer a compelling solution to address the water crisis, optimizing water usage, reducing waste, and enhancing water security. These technologies encompass a wide range of innovations, from efficient irrigation systems to water-saving appliances. Efficient water use can have major environmental, public health, and economic benefits by helping to improve water quality, maintain aquatic ecosystems, and protect drinking water resources. Bench scale coagulation tests can be used to determine which coagulant to use for a specific raw water. As a result, to remove color and turbidity, coagulation and flocculation are considered the most effective treatment techniques. Due to various natural calamities (e.g., seasonal storms, hailstorms, cyclonic storms, heavy rainfall and floods), dry season is the main and safe cropping season in the EGP, which has an annually renewable groundwater system [1,2]. Here irrigation is predominantly done with groundwater; 79% of total irrigation in Bangladesh and more than 90% of irrigation in North-West India uses groundwater. An individual farmer considers the

combined outflow of water by evapotranspiration, seepage and percolation as water usage by his/her rice field and hence actual water loss in the field. However, when considering a large spatial scale, achieving water-saving by one user may be a loss to another since the seepage and percolation from one's field enter the underlying aquifer or nearby surface water sources, from where others can reuse the water [3].

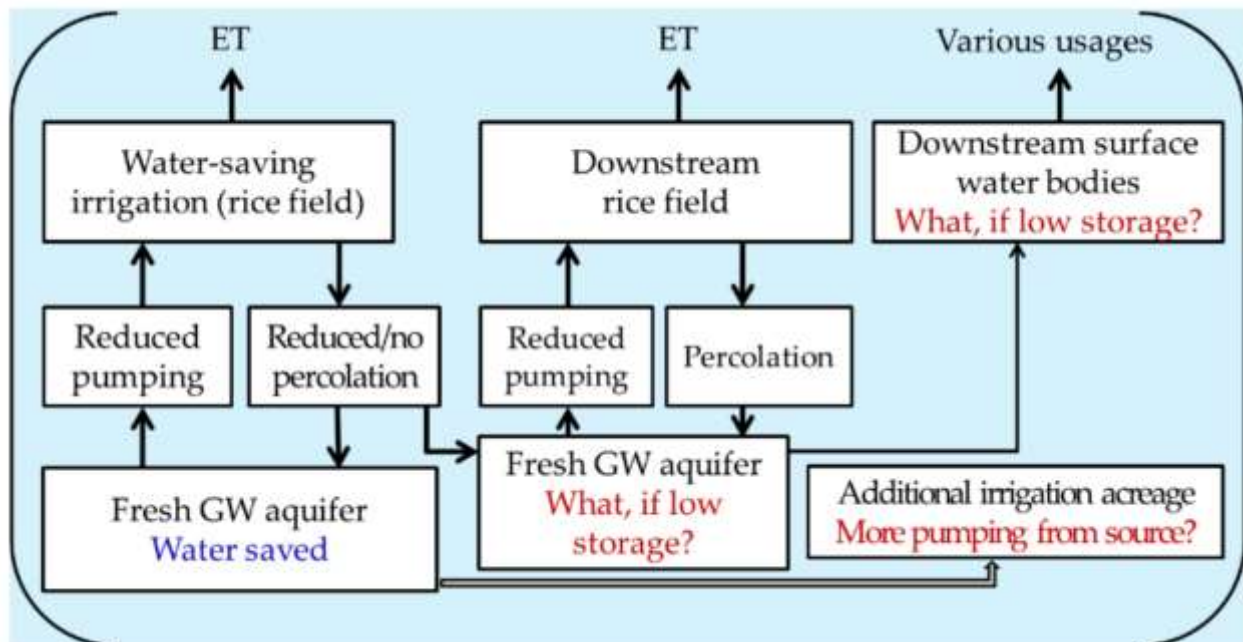


Figure 1. Water-saving agricultural technologies

Economic Benefits of Water-Saving Technologies

Cost Savings: Reducing water consumption leads to lower costs for water extraction, treatment, and distribution, benefiting both individuals and businesses.

Increased Efficiency: Optimizing water use improves the productivity of agricultural and industrial activities, boosting economic output.

Enhanced Resource Management: Water-saving technologies contribute to better resource management, maximizing the utilization of existing water resources.

Environmental Sustainability: Reduced water consumption minimizes environmental impacts, such as depletion of groundwater resources and pollution.

Investment Opportunities: Development and implementation of water-saving technologies create new economic opportunities, fostering innovation and job creation [4].

Key Water-Saving Technologies and Their Economic Prospects

Efficient Irrigation Systems:

- Drip Irrigation: Delivers water directly to plant roots, minimizing evaporation and runoff.
- Sprinkler Irrigation: Efficiently applies water over a larger area, reducing losses through evaporation.
- Subsurface Irrigation: Delivers water below the soil surface, minimizing evaporation and improving water infiltration.

Water-Saving Appliances:

- Low-Flow Showerheads and Toilets: Reduce water consumption in residential and commercial settings.
- Water-Efficient Washing Machines and Dishwashers: Conserve water during domestic cleaning tasks.

Water Treatment and Reuse:

- Greywater Recycling: Reusing treated wastewater from sinks and showers for non-potable purposes like irrigation.
- Industrial Wastewater Treatment: Reusing treated industrial wastewater for various purposes, reducing water demands.
- Desalination: Converting saltwater into freshwater, a vital option in water-scarce regions with access to seawater.

Water Harvesting and Storage:

- Rainwater Harvesting: Collecting and storing rainwater for various uses, reducing reliance on freshwater sources.
- Groundwater Recharge: Artificial replenishment of groundwater aquifers, ensuring sustainable water availability [5].

Challenges and Considerations in Adopting Water-Saving Technologies

Initial Investment: Water-saving technologies often require a significant upfront investment, which can be a barrier for individuals and businesses, particularly in developing countries.

Technological Expertise: Implementing and maintaining some water-saving technologies require specialized technical knowledge and expertise.

Policy Support: Government policies and incentives are crucial to encourage the adoption of water-saving technologies and create a supportive environment.

Social Acceptance: Changing long-standing water use practices and habits can face resistance from certain communities.

Sustainability of Technologies: Ensuring the long-term sustainability of water-saving technologies requires proper maintenance, repair, and adaptation to changing conditions.

The Role of Governments and International Organizations

Governments and international organizations have a pivotal role to play in promoting the adoption of water-saving technologies:

Policy Incentives: Implementing policies that provide financial incentives, tax breaks, and subsidies for adopting water-saving technologies.

Education and Awareness: Raising public awareness about the importance of water conservation and promoting the benefits of water-saving technologies.

Research and Development: Investing in research and development to create new and more efficient water-saving technologies.

Infrastructure Investment: Investing in water infrastructure to improve efficiency and reduce water losses through leakage and evaporation.

International Collaboration: Facilitating international cooperation and sharing best practices in water management and the deployment of water-saving technologies.

Economic Efficiency: A Key to Success

The economic efficiency of water-saving technologies is paramount to their widespread adoption and success. By demonstrating the financial benefits of these technologies, governments, businesses, and individuals are more likely to invest in their implementation [6,7].

Conclusion. The prospects for water-saving technologies in addressing global water scarcity are bright. By leveraging their economic benefits, overcoming existing challenges, and fostering collaboration among stakeholders, we can pave the way for a water-secure future. Investing in research, development, and deployment of these technologies is not just a matter of environmental sustainability; it is an investment in the economic well-being, social equity, and the very survival of our planet.

Cost-Benefit Analysis: Conduct comprehensive cost-benefit analyses of various water-saving technologies to quantify their economic returns.

Policy Evaluation: Evaluate the effectiveness of existing policies and incentives in promoting the adoption of water-saving technologies.

Technological Advancement: Continue investing in research and development to create innovative water-saving technologies with improved efficiency and affordability.

Social Impact Assessment: Assess the social impact of water-saving technologies, considering issues such as equity, access, and community engagement.

International Cooperation: Strengthen international cooperation to share knowledge, best practices, and resources for promoting water-saving technologies.

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