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Research Article

Sustainable Water Resource Management and Conservation

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ABSTRACT

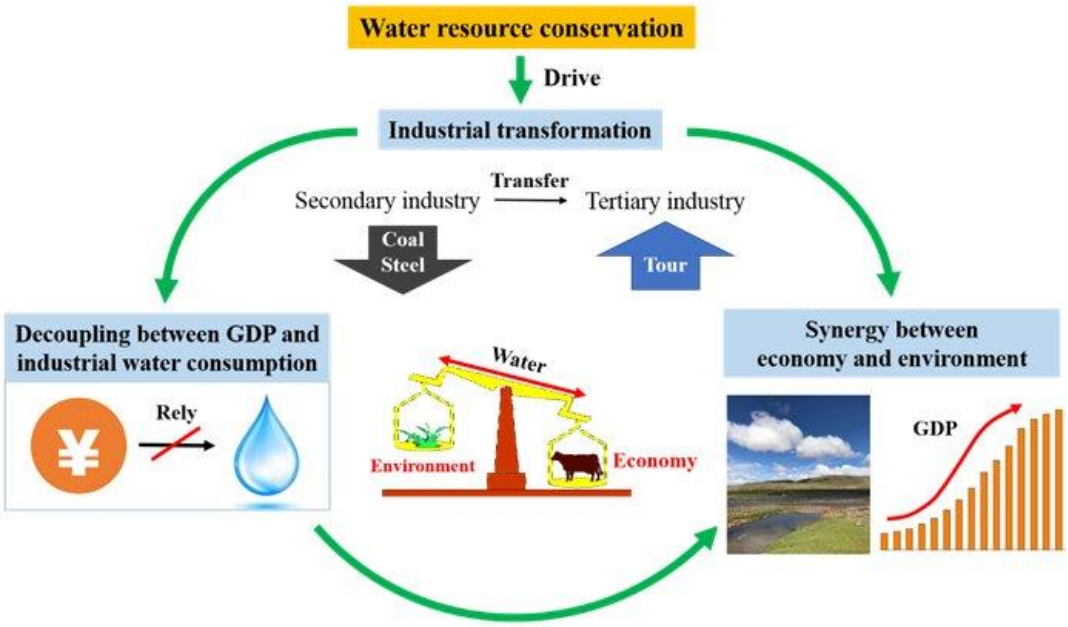
Water is precious natural resource for sustaining life and environment. Effective and sustainable management of water resources is vital for ensuring sustainable development. In view of the vital importance of water for human and animal life, for maintaining ecological balance and for economic and developmental activities of all kinds, and considering its increasing scarcity, the planning and management of water resource and its optimal, economical and equitable use has become a matter of the utmost urgency. Management of water resources in India is of paramount importance to sustain one billion plus population. Water management is a composite area with linkage to various sectors of Indian economy including the agricultural, industrial, domestic and household, power, environment, fisheries and transportation sector. The water resources management practices should be based on increasing the water supply and managing the water demand under the stressed water availability conditions. For maintaining the quality of freshwater, water quality management strategies are required to be evolved and implemented. Decision support systems are required to be developed for planning and management of the water resources project. India has 16% of the world's population and only 4% of the world's water resources, which are depleting rapidly. The demand for water is expected to grow from 40 billion cubic metres (bcm) currently to around 220 bcm in 2025. Water is one of the most important inputs essential for crops. Both its shortage and excess affects the growth and development of the plants, yields and quality of produce. There are numerous methods to reduce such losses and to improve soil moisture.

1. Introduction

Water is a very valuable resource, sustaining human life, production processes and ecosystems. The present situation is now facing a serious water crisis, including water shortages, flooding, and water pollution, due to both natural and artificial causes. This water crisis has threatened human health and economic development. Water is the main basis of the biosphere found on the earth. A Life cannot be imagined without water and water is the priority for its development, Population pressure and environmental imbalance have had the biggest impact on water resource. The 80 percent of the human body is made up of water. The Surface water is stored in rivers, lakes and ponds, which are mainly used for irrigation, hydroelectric power generation, fishing, transport, industry, drinking and recreation. Ground water is mainly used for drinking, irrigation and industrial purposes. Sea water is used only for limited purposes. The New discoveries are likely to increase the diverse use of sea water. The Scientists estimate that cobalt, copper, bromide, magnesium and iodine will be available in the future from the sea. The Primary or domestic use of water –in drinking, cooking, washing clothes, bathing and cleaning houses.

Water Resources Management (WRM) is the process of planning, developing, and managing water resources, in terms of both water quantity and quality, across all water uses. It requires the support and guidance of institutions, infrastructure, incentives, and information systems. Water resource management also entails managing water-related risks, including floods, drought, and contamination. The sustainability of water resources is a significant challenge for most countries, and especially for those that are located in arid regions. Here, we define a sustainable water resource as a flux of water that is managed with the objective of maintaining the availability and quality of water for as long as the current

Figure-1. Water resource conservation promotes sustainable development



Source: Yali Liu et al, (2021)

climate prevails. An identify three main threats to sustainability of water resource, climate change, water pollution, and the adverse impacts of water resource management practices.

The objective of this framework is to close the gap between demand and sustainable water resource by developing new sustainable resources, to summarize the sustainable Water Conservation, Integrated Water Resource Management study, Environmental Monitoring And Assessment and to Study Societal, Economic, Institutional And Policy Aspects Of Strategies.

2. Materials and Methods

Sustainable water management is a complex issue with social, economic, and environmental consequences. In essence, everyone on the planet should have access to an adequate water resource for drinking, sanitation purposes, and other vital uses for sustaining life. The research study is exploratory in nature. The objectives of the study is to understand the present status and future demand for water in the country for various sectors, as well as the role of government and external agencies in conservation of water to meet this requirement

3.1 Source of Water Resources:

The main sources of water resources on earth are rain and snow based rivers, lakes, wells, reservoirs and seas etc. Due to these, water seeps inside the ground and goes under ground. It is estimated that 11.6 c/o part of the rain water flows on the surface and 88.4 c/o part goes to the sea through the rivers. On this basis the water sources have been divided into 3 parts:-

1. Ground water
2. Underground water
3. Sea water

In addition to his domestic needs for industry, boating, irrigation, sewage disposal, water power etc. Rivers play a major role in this. Rivers level the land surface. The water of rivers is used for many purposes. The availability and purity of water is considered a proof of ecological quality.CG Medicinal properties have been found in the water of some springs, such as they provide benefits in diseases like skin diseases, abdominal disorders. Due to its quality, Ganga water has been considered sacred in Indian culture. The facility of sailing and fish production has also attracted man towards the surface water. Natural vegetation is nurtured along the banks of the river. Most of the world's water is Akashi, 50 c/o of rain water is related to evaporation. One-third of the rainfall flows as surface water and 15c/o is absorbed by the land. This soaked water gets accumulated in the rock beds. Soaked water forms surface water.

3. Results and Discussions

3.1 The Importance of Sustainable Water Management

The Sustainable water management is vital for several reasons:

- **Ensuring water availability**: As the global population grows, the demand for water increases. Sustainable management helps maintain adequate water supply for present and future generations.
- **Protecting Ecosystems**: Healthy aquatic ecosystems are essential for biodiversity and ecological balance. Sustainable water management ensures the preservation of rivers, lakes, wetlands, and other water bodies.
- **Mitigating Climate Change Impacts**: Climate change leads to more frequent and severe droughts and floods. Sustainable water management strategies can help communities adapt to these changes and build resilience.
- **Promoting Social Equity**: Equitable water distribution ensures that all communities have access to safe and clean water for drinking, sanitation, and other essential needs.
- **Supporting Economic Growth**: Industries and agriculture depend on water for production processes. Sustainable management ensures that water resources are used

efficiently to support economic growth without compromising the environment.

3.2 Challenges in Sustainable Water Management

- **Water Scarcity**: Many regions face water scarcity due to over-extraction, pollution, and climate change. Addressing this challenge requires careful planning and conservation efforts.
- **Pollution and Contamination**: Industrial discharges, agricultural runoff, and untreated sewage pollute water bodies, making them unsuitable for consumption and harming aquatic life.
- **Aging Infrastructure**: Many countries have outdated water infrastructure, leading to water losses and inefficiencies.
- **Climate Change**: Altered precipitation patterns and rising temperatures exacerbate water availability issues, making it crucial to adapt to changing climatic conditions.
- **Population Growth**: Rapid urbanization and population growth strain existing water resources, necessitating innovative solutions to meet increasing demands.

3.3 Strategies for Sustainable Water Management

- **Water Conservation**: Implementing water conservation practices at the individual, community, and industrial levels can significantly reduce water consumption.
- **Integrated Water Resource Management (IWRM)**: IWRM is a holistic approach that considers the social, economic, and environmental aspects of water use, and promotes coordinated planning and management.
- **Rainwater Harvesting**: Collecting rainwater can augment water supply, especially in regions prone to droughts.
- **Water Reuse and Recycling**: Treating and reusing wastewater for non-potable purposes reduces pressure on freshwater sources.
- **Desalination**: Coastal areas can explore desalination technologies to convert seawater into freshwater, but it must be done sustainably to mitigate environmental impacts.
- **Reforestation**: Forests play a vital role in regulating the water cycle. Restoring and protecting forests helps maintain water availability and quality.
- **Smart Water Technologies**: Utilizing IoT-based sensors and advanced data analytics can optimize water use, detect leaks, and enhance water-management efficiency.

3.4 Sustainable water resources management and governance

Water demand management, water resources system monitoring and modelling; water resources protection and planning; water economics, water allocation and water recycling; water harvesting; river basin closure; regional and international water-related policy.

3.5 Quality of Water and Environment:

While good-quality water is a boon and helps in environmental and spiritual rejuvenation, poor-quality water is a curse. Due to dumping of untreated or partially treated wastes from municipal and industrial areas as well as return flow from agricultural areas, orchards and plantations carrying polluted water, water in many of our natural water bodies such as rivers, lakes and ponds is highly pollutede (Srinivas and Estari, 2013). Estimates indicate that over 50% of urban India's sewage enters water bodies untreated. Dumping of industrial and other wastes in subsurface zone has resulted in contamination of the top 10–20 m of subsurface zone. Highly polluted water from hand pumps at many places is evidence of this contamination. Some big and medium industries are doing appreciable service by carefully treating wastewater, but we also have industrial units which are injecting waste in aquifers to save sewage treatment costs. Needless to say, contaminated aquifers will be a curse for future generations.

3.6 Water governance and institutions

The main reason is that practice of water management has undergone large changes over the past four decades or so, and the profession is gradually becoming more multidisciplinary. Besides having knowledge of hydrological principles, water professionals need to know about the environment, forestry, agriculture, geology, meteorology, soil science, sociology, economics, law, management and so on. It would be necessary to transform the existing organizations by inducting persons.

3.7 Climate change

India is highly vulnerable to impacts of climate change on water resources due to its unique climate, geography and topography. The Warming of the lower atmosphere will impact snowfall. glaciers and snow cover, and crop water requirements; increase in extreme weather will impact incidence of floods and droughts, rising sea levels will increase flooding in coastal areas and seawater intrusion,rising temperatures will impact the quality of water in rivers and lakes, and so on. Remedies suggested here will be helpful in lessening the vulnerabilities due to climate change and increase resilience of the society. In addition, more focused R&D is needed to identify what changes are expected, and where and how to initiate specific adaptations.

All these programmes under water conservation created huge infrastructure and irrigation potential for agriculture and are trying to improve the water and food security situations in the country. In addition, they not only protect and conserve environment but also contribute to livelihood security of rural poor. Therefore, the country still requires continued efforts of the government along with external aids especially in the issues of global climate change and consumer awareness on water conservation. Government should come up with a new water policy prescribing the role and involvement of individuals, community and government for conservation of water.

- Need for efficient management practices such as adoption of improved technologies such as drought tolerant varieties, use of drip/sprinkler irrigation systems and mulching techniques in agriculture, preserving water quality, protecting water catchment areas etc.
- Continued efforts of government and other external agencies in water conservation and management.
- Artificial recharge to ground water both in rural and urban areas.
- Evaluation of all watershed projects/programs for understanding possible positive and negative impacts to make necessary corrections.
- Incentivise farmers for up taking of conservation practices and discouraging water waste in their fields.
- Encouragement of R&D on global climate change.

4 Conclusion

The sustainable water management is an urgent global priority to secure water resources for future generations and

protect the environment. By adopting integrated strategies, harnessing advanced technologies, and promoting water-conscious behavior, we can overcome the challenges posed by water scarcity, pollution, and climate change.

Conflicting Interests

The authors have declared that no conflicting interests exist.

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