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An Indicator for Ensuring a Clean India Based on the Ecological Health of Its Fresh Water Resources

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Abstract

The trash, whether liquid or solid, eventually ends up in fresh water supplies. As a result, the ecological health of water resources is the most important indication of a location's hygienic state. Furthermore, reservoir ecosystems face well-known environmental issues such as watershed erosion, irregular rainfall, changes in runoff patterns, alien species introduction, overexploitation, and the movement of airborne and waterborne nutrients and toxins. IWRM principles used in system engineering methodologies are a useful and practical tool for sustaining life-supporting reservoir environments.

Keywords: *Fresh Water Resources, IWRM, River Basins,Systems Approach*

INTRODUCTION

The Government of India has launched a nationwide drive, ek kadam swachhtakiaur, to achieve comprehensive sanitation by 2019. This is in support of and an extension of the United Nations' International Decade for Action - 'Water for Life' as the first and primary necessity; and an indication of this is the cleanliness and sustainability of freshwater resources. The United Nations also designated 2013 as the International Year of Water Cooperation. Total sanitation is only possible with the functional collaboration and dynamic engagement of all stakeholders in the preservation, safeguarding, and management of water resources.

Fresh water, which is necessary for life, accounts for about 0.01 percent of the world's water and around 0.8 percent of the earth's area yet sustains 6% of all documented species (Anonymous, 2005). Reservoirs, which hold 90% of fresh water and 14% of worldwide annual runoff, play a vital role in the hydrological and biological cycles. Their action-based conservation and management of inland water reservoirs is important to humanity's interest, existence, and subsistence.

Reservoirs are crucial for human progress and the preservation of healthy ecosystems and bio-diversity. They are typically developed in areas where there are few lakes owing to geology and climatic limits. Reservoirs are impoundments of water against an embankment in the valley of a river basin to contain stream flow so that stored water may be utilised to satisfy diverse demands.

Reservoirs offer people with several applications of varying value. They provide water for drinking, agriculture, industry, livestock, and energy generation, as well as playing an important role in ground-water recharge, flood control and drought mitigation, microclimate management, and ecosystem subsistence. Man-made reservoirs gradually transform into lake and wetland habitats as time passes. They do not remain just water storage tanks; instead, a gradual shift to 'ecology' occurs, and they therefore become a crucial component of the water and ecological cycle (Mehta, 2009, unpublished M.E. Thesis, MPUAT, Udaipur).

Reservoir ecosystems are non-resilient and vulnerable, facing morphometrical, hydrological, limnological, and ecological issues such as shrinkage, waste discharge, catchment deterioration, erratic rainfall, changes in runoff patterns, exotic species introduction, transport of airborne and waterborne nutrients and contaminants, and so on.

According to the "World Lake Vision" (Anonymous, 2003), excessive water extraction from reservoirs endangers the biological communities they support and changes the coast line features. As a result, a suitable volume of water free of pollution is critical for human existence and, more critically, for maintaining and preserving the reservoir's environment.

The World Lake Vision emphasises the importance of efficient water budgeting in order to control water withdrawals from reservoirs in order to satisfy diverse

demands, including the amount of water required to maintain ecological functioning.

The National Water Policy (NWP) of 2012 emphasises the need and necessity for basin-based integrated water resource management, and calls for interdisciplinary study on the issue.

The National Disaster Management Guidelines also indicate that IWRM is a vital framework for both water resource sustainability and flood and draught mitigation.

The NWP has also identified ecological demand as one of the allocation priorities, namely maintaining a minimum flow in rivers and a minimum essential water level in reservoirs.

UNPLANNED URBANIZATION: MAJOR THREAT TO WATER RESOURCES

The world population is expected to increase from six billion now to almost nine billion by 2050. India and China will account for about one-third of the global population. Our country's population is expected to increase from 1.2 billion to 1.62 billion people. It is also expected that the bulk of this people would live in peri-urban regions. In the last 10-15 years, India has seen a major expansion in peri-urban regions. According to a study by the Planning Commission of India, India's urban population in 2001 was roughly 285 million people residing in approximately 5,200 urban agglomerations. In 2011, it was about 400 million, and forecasts show that by 2030, more than 600 million people out of a total population of 1.4 billion will be living in cities.

The world population is expected to increase from 7113 million to 7877 million by 2025, altering the overall water dynamics due to increased agricultural, municipal, and industrial water needs (Table 1) The expanding population is putting a strain on water reservoirs, and excessive, unplanned, wasteful extraction is having an irreversible impact on reservoir life and sustenance. Climate and topographical changes, on the other hand, have had a negative impact on reservoir inflow.

According to the "Intergovernmental Panel on Climate Change" (IPCC Report 2001), yearly run off in the western area of India would increase by 50 to 150 mm per year. This will result in excessive water withdrawal. Reduced inflows and overexploitation of water without regard

for reservoir biological demands hasten the demise of these delicate, sensitive ecosystems. Furthermore, water is seen as the fundamental medium via which all climate change-related problems appear, impacting people, ecosystems, and economies. As a result, integrated water resource management is the only option to adapt to and mitigate climate change challenges, as well as to promote the socioeconomic development of all creatures living in any basin.

Unplanned urbanisation is a major issue in river basins, threatening water, food, and ecological security in urban and peri-urban regions. The planning process is frequently barren of trustworthy and accurate topographic, hydrologic, hydro-geologic, sociological, and economic ground assessments, as well as the actual and continuous engagement of stakeholders.

The terrain, lakes, water bodies, and other biological areas, as well as humans, particularly the impoverished, are not prioritised in planning and development.

As a result, we must use an Integrated Water Resources Management approach as the foundation for all development strategies, including sector-based land use planning, poverty alleviation, and migration control; recycling of domestic and industrial wastewater to meet industrial and agricultural water needs; eco-technological management and operation of existing water resources involving structural and non-structural measures; and promoting water and land saving mix-culture.

Table I. Dynamics of World Water Use (KM3 /YEAR)

Sector/Year	1960	1995	2010	2025
Population (Million)	3029	5735	7113	7877
Agricultural Use	1481	2504	2817	3189
Municipal Use	118	344	472	607
Industrial Use	339	752	908	11170

In the context of reservoirs, the IWRM approach requires four essential elements viz., enabling environment, stakeholder participation, good governance and eco-technology. The IWRM plans developed on systems approach can incorporate these four elements and thereby bring water reliance,growth and development, and most importantly, sustenance of life supporting, ecosystems. To achieve this goal, the ecological water needs of the reservoirs of river basins should be given the equally important priority in water allocation, and accordingly optimization models should be drawn.

IWRM & SYSTEMS APPROACH:

If effective, long lasting solutions to water problems are to be found, an improved water governance and management paradigm termed as IWRM concept is to be brought in. An IWRM approach requires positive change in the enabling environment, in institutional roles, and in management instruments. Further, for an effective and efficient development and management of water resources, all water sector programs should be planned and executed on the basis of river basins. Integrated Water Resource Management (IWRM) is the appropriate frame-work for managing water resources in river basins, as it takes account of the interrelation and integrating nature of the water resources, especially reservoirs that lie within the basin (GWP,2005).Using Systems approach for IWRM is not a new idea or invention. Various techniques have already being used to improve the water efficiency and management. These techniques include Linear Programming (LP); Nonlinear Programming (NLP); Dynamic Programming (DP); Stochastic Dynamic Programming (SDP); and Heuristic Programming such as Genetic algorithms, Shuffled Complex Evolution, Fuzzy logic, and Neural Networks etc.

CONCLUSION

The Government of India's Swach Bharat initiative seeks the attention and participation of the scientific community, and imposes responsibilities on water technologists and managers to develop appropriate action plans for integrated water resources management (IWRM) in all river basins and sub-basins across the country. A healthy eco-system of fresh water resources ensures a clean India. The methodology of Integrated Water Resources Management provides the way forward. Applying SA tools while taking into account the riverbasin's ecological demand, eco-technological solutions, and active engagement of all stakeholder groups is undoubtedly an important and

timely inter-disciplinary intervention to conserve and protect all of the country's water resources.

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