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Ecological Health of Fresh Water Resources: Indicator for Ensuring Clean India

An IWRM Perspective

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Abstract: **The waste, liquid or solid eventually find its way to fresh water resources. Therefore, ecological health of water resources is the key indicator of sanitary situation of any place. Further, Reservoir ecosystems are facing well known environmental problems like catchment deterioration, erratic rainfall, change in runoff patterns, introduction of exotic species, overexploitation, transport of airborne and water borne nutrients and contaminants. IWRM concepts applied through system engineering approaches is an effective and practical tool for sustenance of life supporting reservoir ecosystems.**

Key words: Fresh Water Resources, IWRM, River Basins,Systems Approach

I. INTRODUCTION

Government of India has initiated a nationwide mission,ekkadamswachhtakiaur, to ensure total sanitation by the year 2019. This is in support and inextensionto United nations 'International Decade (2005-2015) for Action - 'Water for Life' as the first and foremost requirement; and an indicator for this is cleanliness and sustenance of freshwater resources. The UNO had also observed the year 2013 as the international year of water cooperation. The total sanitation can only be achieved by the functional cooperation as well as dynamic participation of all stakeholders for protection, safeguarding and management of water resources.

Fresh Water, essential for life, makes up only 0.01percent of the world water and approximately 0.8 percent of the earth surface but supports 6 percent of the all described species (Anonymous, 2005).Reservoirs, which contain 90 percent of the fresh water and 14 percent of the global annual runoff, play an important role in hydrological and ecological cycle. Their action based conservation of inland water reservoirs and management is critical to the interest, survival and sustenance of mankind.

Reservoirs are important for human development and for the preservation of sound ecosystems and bio-diversity, most often built in regions that lack a substantial number of lakes due to geologic and climatic constraints. Reservoirs are impoundment of water against an embankment in the valley of a river basin for the purpose of holding stream flow so that stored water may be used to meet various demands associated with it. Reservoirs provide multi-purpose uses of different values to humans. They supply water for drinking, agriculture, industry, live stock uses and energy generation; and play an essential role in ground - water recharge, flood control and drought mitigation, maintenance of microclimate and sustenance of ecosystems.

With the passage of time, the man made reservoirs converts into lake and wetland environments. They do not remain just water holding tanks, a gradual transition to 'ecosystem' takes place and they thus become critical element of water and ecological cycle (Mehta, 2009, unpublished M.E. Thesis, MPUAT, Udaipur).

Reservoir ecosystems are non resilient and vulnerable ,facing morphometrical, hydrological, limnological ,ecological problems like shrinkage, waste discharge, catchment deterioration, erratic rainfall, change in runoff patterns, introduction of exotic species, transport of airborne and water borne nutrients and contaminants etc.

The "World Lake Vision" (Anonymous, 2003) warns that excessive water withdrawal from reservoirs seriously threatens the biological community they support and alter the shore line characteristics. Therefore, adequate level of water, free from any contamination is essential for human survival and, most importantly, for maintaining and sustaining the life supporting reservoir's ecosystem. The World Lake Vision emphasize the need of proper water budgeting to manage water withdrawals from reservoirs so as to meet various demands including the quantity of water needed to preserve ecosystem functions.

The National Water Policy(NWP),2012 underlines the importance and need for the Integrated Water Resources Management based on basin approach; and inter alia ask for multidisciplinary research on the subject**.**The National Disaster Management Guidelines also recommend that IWRM is an essential framework for both the sustenance of water resources and mitigation of flood and draught.The NWP has further recognized the ecological demand as one of the allocation priority i.e.maintaining minimum flow in rivers ;and maintaining minimum necessary water level in the reservoirs.

II. UNPLANNED URBANIZATION: MAJOR THREAT TO WATER RESOURCES.

The world population is predicted to grow from six billion at present, to about nine billion by the year 2050. India and China will share almost 33 percent of the total population. The population of our country is estimated to grow from 1.2 billion to 1.62 billion. It is further estimated that majority of this population will reside in peri- urban areas. India has witnessed significant increase in the peri-urban areas in the last 10-15 years. As per the Planning Commission of India report, in the year 2001, India's urban population, living in approximately 5,200 urban agglomerations, was about 285 million. In 2011, it has increased to almost 400 million; and projections are that by 2030, out of a total population of 1.4 billion, over 600 million people are likely to be living in urban areas.

The world population is predicted to grow from present 7113 million to 7877 million by the year 2025; this will alter the entire water dynamics because of rise in agricultural, municipal and industrial water demands (Table 1) The growing population is exerting great pressure on water reservoirs and excessive, unplanned, wasteful withdrawal is resulting in irreparable effect on life and sustenance of reservoirs. On the other hand, the climatic and topographical changes have adversely affected the inflow to the reservoirs. The "Intergovernmental Panel on Climate Change" (IPCC Report 2001) has predicted that for the western region of India, there will be changes in annual run off from 50 to 150 mm per year. This will result in excessive withdrawal of water. The reduced inflows and overexploitation of water without any considerations for ecological needs of reservoirs are accelerating the death process of these fragile, sensitive ecosystems. Further, water is considered to be the primary medium through which all problems related to climate change manifests affecting people, ecosystems and economies. Hence, integrated water resources management is the only way for adaption and mitigation of climate change problems, and for socio-economic development of all beings living in any basin.

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

Shiklowmanov, 2000.

The river basins are facing the great problem of unplanned urbanization , adversely affecting the water, food and ecological security in urban and peri urban areas. The process of planning is usually devoid of reliable and true topographic, hydrologic, hydro-geologic ,social and economic ground surveys and most importantly the actual and sustained participation of stakeholders. The topography, lakes, water bodies, and other ecological spaces as well as the human beings especially the poor are not at the center of planning and development.

Therefore, we need to use Integrated Water Resources Management approach as basis for all development strategies; which include sector based land use planning, poverty alleviation, checking the migration; recycling of domestic and industrial wastewater to meet the industrial and agriculture water needs; eco-technological management and operation of existing water resources involving structural and non-structural measures; promoting water and land saving mix-culture; and promotion of energy efficient, eco-centric development.

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.

III. 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.

IV. CONCLUSION

The Government of India's initiative of Swach Bharat invite attention and interventions of scientist's community, and imposes responsibilities on water technologists and managers to draw suitable action plan for integrated water resources management(IWRM) in all river basins and sub basins of the country**.** Ensuring healthy eco-system of fresh water resources ensure clean India. Integrated water Resources Management approach shows the way forward for it. Applying SA tools considering ecological demand of the riverbasin, eco-technological solutions and active participation of all stakeholders groups is certainly a significant and timely inter-disciplinary intervention to conserve and maintain all water resources of the country..

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