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Water Resource Assessment and Management-A Review

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Abstract- Water resources being renewable, yet World's level of ground water is steadily declining. The main users of water are Agriculture, Domestic, Industries and Environment. Due to increase in unplanned urbanization, industrialization, geometric progression of population growth, change in pattern of agriculture, lack of proper technical know-how's and non-implementation of appropriate technology at river Basin level, insufficient supply of pure and fresh water has been observed in recent years. Moreover, irrigation is major consumer of water in India in addition to the water demand for industrial processing and urban day by day due to increasing economic activities. It is essential for the policy makers to work out the optimum demand of water for different purposes from available water resources. This paper reviews the prevailing approaches for assessing the water resources and its managerial aspect to get rid of the future challenges.

Key words: IWRM; WEAP; BHIWA.

1. INTRODUCTION

It is estimated that more than 60 % of the world's rivers are fragmented by hydrological alterations [1]. World Business Council for Sustainable Development estimated that (a) the countries begin to experience periodic or regular water stress when annual per capita renewable freshwater availability is less than 1,700 cubic meters, and (b) water scarcity begins to hamper economic development and human health and well-being when annual per capita renewable freshwater availability is below 1,000 cubic meters. The UN estimates that by 2050 there will be an additional 3.5 billion people with most of the growth in developing countries, and the water demand will increase unless there are corresponding increases in water conservation and recycling of this vital resource. Water for producing food will be one of the main challenges in the decades to come.

Access to the fresh water is required to be balanced with the importance of managing water itself in a sustainable way by considering the impact of climate change, and other environmental and social variables. Globally, there is a growing acceptance of the need to safeguarding ecosystems when managing waters to meet human demands so that the ecology and environmental health is maintained[2][3][4]. It is, therefore, essential to assess the available water resources for integrated water resources planning, development and management. The Integrated Water Resources Management (IWRM) is defined as "a process which promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems"[5].

Integrated hydrological model with institutional rules for water allocation, economic, and environmental aspects into a logical analytical structure are useful for managing water resources at sub-basin and basin scale. Rainfall, in the form of rain and snowfall, is an important component of hydrologic cycle that makes freshwater available for surface and ground water as renewable source. A significant part of rainfall seeps to the ground and remaining water flows through surface and stored in reservoirs. Thus, water is available in the form of surface water, groundwater and rainfall to users. Incorporating the value of water through economic analyses can provide critical information for decisions about the efficient and equitable allocation of water among competing users, efficient and equitable infrastructure investment in the water sector, and the design of appropriate economic instruments, such as water pricing schemes and water trading markets [6].

2. ROLE OF MODELING TOOLS IN WATER RESOURCES

To bring the concept of integrated water resources management into an analytical framework, modeling techniques for integrating hydrologic, agronomic, economic and institutional components have been studied and found to present opportunities for the advance of water resources management [7]. In the past several researchers have carried out detailed study on these aspects. There are several programs which are designed to simulate water development and management policies in river basins,viz, River Basin Simulation Model (RIBASIM)[8],MIKEBasin[9], Water Balance Model (WBalMo) [10], MULti-sectoral, Integrated and Operational Decision Support System (MULINO– DSS) [11] and Water Evaluation and Planning System (WEAP) [12].

2.1 WEAP model

The Water Evaluation and Planning System (WEAP), has been developed for simulating present and future water demand and supply for evaluating water management approaches in the Aral Sea region[12]. The WEAP model and its user-friendly interfaces make the simulation and analysis of several water allocation scenarios ease and promote consciousness and understanding of key issues on management of water resource and applied for the sub -basin Steelpoort of the Olifants [13]. The IWRM model Water Evaluation and Planning Version 21 (WEAP21) efforts to discourse the gap between water management and watershed hydrology and the necessities that, easy to-use, reasonable, and readily available to the broad water resource community [14]. For each scenario, the main outputs of the model were analyzed: unmet water demands for the different water sectors, stream flows at the outlet of the Olifants catchment and the water stored in the reservoirs [15]. The plan for future yield, reliability, risks and water allocation prices along with constraints, competitive uses, and priorities also are taken into account for a sustainable development of water resources in Tulkarem district and emphasized the applicability of Decision support system (DSS) tool of WEAP21 on the water resources system of Tulkarem district, in the Palestinian Territory. Stakeholders' survey, data collection and simulation for optimum use of water resources are the main components of decision support system [16]. The integrated approach that has been used to assess the water scarcity in Mahi (Gujarat),Thamiraparani (Tamilnadu) and Bhima (Maharashtra) river basins of India using WEAP,QUAL2K and MODFLOW software. The climate change impact on water scarcity was also computed and the results indicate worrying situation in all the basins with maximum influence on Thamiraparani river basin lying in Tamilnadu, India [17].

The Municipality of Nablus is considering for dealing with the on-going water crisis in the City of Nablus. The study methodology consists of three components: data gathering; knowledge acquisition on WEAP and its applications; and WEAP modeling that aided to evaluate water resources management options for Nablus City. The results revealed that the unmet water demand will continue to increase over the approaching years [18]. WEAP21 as seamlessly integrate both the hydrological and management model to provide a better platform for IWRM analysis. The model can perform both lumped to distributed catchment hydrological simulation and to handle aggregated to disaggregated water management demands of various sectors. For studying catchments with minimum to moderate data availability this is appropriate to use [19]. All demands such as municipal and irrigation were considered and different scenarios were developed such as reference scenario, quality added scenario, groundwater added scenario, reservoir added scenario, climate change scenario, irrigation scenario and downstream water requirement scenarios and used WEAP21 for management of water resources of Alana valley [20]. The WEAP21 (Water Evaluation and Planning) software was used to evaluate the future water demands in the two region of the Niger River (Niamey city and Tillabéry) [21]. The Water Evaluation and Planning System (WEAP) both municipal and agricultural systems and can address a wide range of issues including: sectorial demand analyses, water conservation, water rights and allocation priorities, stream flow simulation, reservoir operation, ecosystem requirements and project cost benefit analyses[22]. The implementation and calibration of the WEAP model against dam operating rules showed that it is possible to reproduce historical dam volumes accurately enough by analysis. Five alternative water supply scenarios for the JV: business-as-usual, increasing treated wastewater in irrigation, climate change, and two combined scenarios—climate change with increasing reuse, and altered patterns of agriculture to calculate the impact on the demand-supply gap by the year 2050 were developed [23].The schematic view of WEAP model is shown in fig-1.However WEAP unable to perform daily operations and least cost of optimization of supply and demand.

However developing country like India, a' Basin-wide Holistic Integrated Water Assessment' (BHIWA) model used to study the effect of varying land and water use on the resources, considering interdependencies between different elements of the land phase of the hydrological cycle, to measure and integrate sectorial water uses, and to formulate and analyze scenarios to assess various policy preferences for development and management of water and related land resources [24].This model has been applied to both Brahmani river basin and Sabarmati river basin.

The Water Resources Department has done an exercise under the World Bank aided project that is WRCP in which State Water Plan for Orissa has been prepared. The above has considered that the Integrated Water Resources Management is the latest prescription on the subject. The Department of Water Resources, Orissa Government accepted the task of coordinating the various requirements allied to water sector with the stake holder departments and other water users organizations. Following to above, the State Water Plan has freshly been prepared. This has been endorsed by the State Water Resources Board, the apex body of Orissa Govt. The upon achievement will be a milestone in the development into the Integrated Water Resources Management, which will ensure viable and equable supply of water to all sectors including establish ecological balance of the hydrological system. However the Integrated Water Resource Management will associate primarily the institutional strengthening along with other managerial re-structuring which is an imperative for achieving the viable management of the crucial natural resource.

3. CONCLUSION

Water demand will increase unless there are corresponding increases in water conservation and recycling of this vital resource. Water for producing food will be one of the main challenges in the decades to come.

These models have used biophysical and socioeconomic aspects of water allocations among multiple sectors such as agriculture, residential, and industrial users and helped decision-makers to have a better understanding of water availability, water demand, and potential environmental or socioeconomic impacts that could be faced in a particular region. However, these models do not consider the deficiencies in water allocation and to demonstrate how the existing water supply might be integrated into the overall water supply system at sub-basin and basin scale.

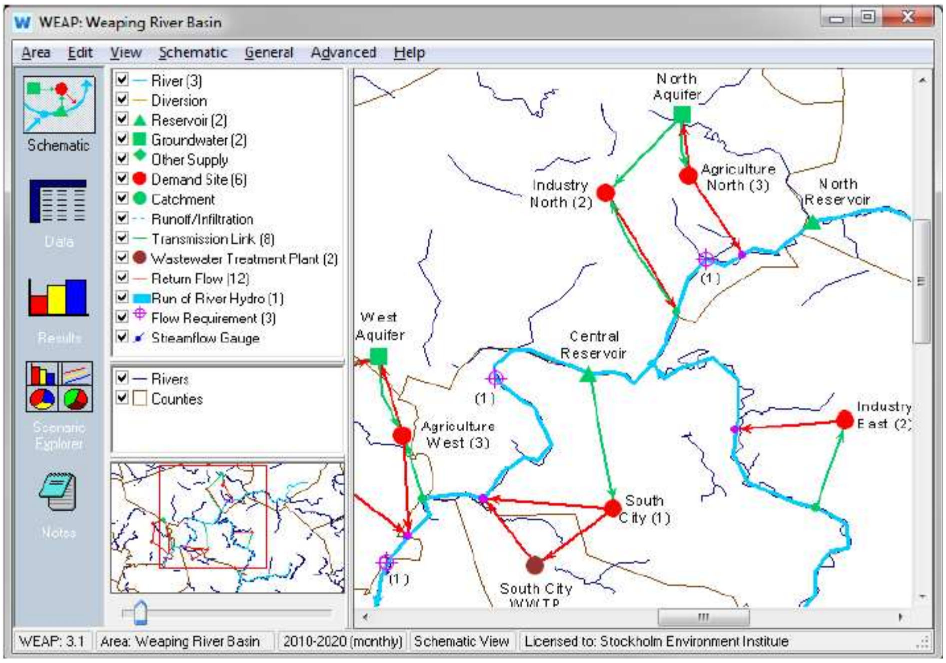

Fig-1 Schematic view of WEAP model [22]

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