

Preface

The availability of water is under stress due to increase in population density, number of industries, degradation in quality of water and impact of climate change. The uneven distribution of water within different regions of the world is also attributed to be one of the reasons why water is scarce in many countries, whereas in some other countries the resource is so abundant that it is wasted for luxury. Moreover, the available resources of water is not optimally utilized. The method of water allocation followed in many countries has no specific rules or regulations. Allocation is carried out based on demand from consumers.

In most countries distribution of water happens in a uniform manner without consideration of demand, socio-economic capacity or any other attributes of a consumer. Thus the consumer with a low demand is allocated the same amount of water as a high-demand consumer. In this manner, a lot of water is either wasted or remains non-utilized. Also, there are no specific methods to monitor and track the availability of water. There are some indicators developed in this aspect but they have many limitations.

For instance, some do not consider the quality parameters. In some other indicators the temporal variation of the input parameters are not considered. However, most of the index has a common drawback, which is the allocation of importance to influence availability of water uniformly among all the parameters. Hence, the importance of rainfall as the major source of water availability is the same as the role of surface water abstractions. There is no provision to distinguish the parameters based on their influence on availability of water.

In the present study we tried to develop an indicator to estimate the status of water availability of any location considering the importance of each parameter over the other in controlling the availability of the resource. In this regard a hybrid MCDM method was utilized where fuzzy logic decision-making and analytical hierarchy process were merged to estimate the priority value or weights of importance of each of the selected input parameters; although the final value of the index was predicted with the help of artificial neural networks. The temporal variation of the input parameter is utilized. Quality parameter is also included, and each

parameter is weighted as per its importance in determination of availability of water resources in the region.

Sensitivity analysis of the index was performed. The same index was used for estimation of the severity of water scarcity in three different locations with three different levels of urban population. The value of the index was predicted based on the impact of climate change on the input parameters based on scenarios A2 and B2 of IPCC under three different time slabs.

The results show that for scenario A2 the water shortage will be higher in the location having larger population density. In A2 the impact will be most severe in the last time slab, whereas for B2 the severity will be felt only in the middle time slab.

With respect to priority value, the Frequency of Troughs in Annual Hyetograph (P) and Percentage Impervious Area (A) was found to be the higher and lower important parameters, respectively, among the selected eight input factors.

Chapter 1 gives a brief introduction to the study. It introduces to the reader the need and importance of the present investigation and describes the methodology adopted and the tools and concepts utilized.

Chapter 2 gives an overview of multi-criteria decision-making. The working procedure, two examples and their applications to solve real-life problems in water resources are discussed.

Chapter 3 describes the artificial neural network and its working principle to solve complex nonlinear problems by learning the same from the available data.

Chapter 4 explains the causes and impacts of climate change and introduces the concept of climate models, Global Climate Model (GCM) and Regional Climate Model (RCM). The study utilizes the output of an RCM, PRECIS model for generating the future climate data. PRECIS is also discussed in this chapter.

Chapter 5 depicts the detailed methodology adopted to achieve the objectives of the study, while Chap. 6 explains the results and proposes the necessary reasons for the outcome. Chapter 7 draws the conclusions with a brief summary of the study, its drawbacks and the possible future scope.

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