ABSTRACT

Until the last two and a half decades, global perception of how to control water bodies (i.e., water management) was organised on a sectorial basis. It was in the 1970's that the people actually responsible for implementing the results of this approach became aware of the serious implications of such an approach and realised the need to identify and consider simultaneously several objectives in the analysis and solution of problems, in particular those derived from large-scale systems. It was this growing awareness that led to the formation of "the concept of Multi Criterion (i.e., multi objective) Decision Making" (MCDM) in water management - Integrated Water Management, a concept almost universally accepted today as the way forward.

Decision making under risk and uncertainty is one of the major problems facing the planners and decision makers. In most of the complicated cases, quantitative basis for decision making may be obtained by mathematical programming while the final decision making should give adequate consideration to qualitative aspects, which cannot be mathematically formulated. Therefore, proper combination of mathematical approach of operations research and intuitive knowledge and experience of the experts is the only possible method for resolving such multi disciplined and multi criterion problems.

Traditionally, in water resources development, the design of projects and programs were focused on the estimation of benefits and costs. A more realistic analysis would include environmental, social and regional objectives as well. Therefore, water resources planning processes, over the years, have become increasingly complex and will become more so in future and there is an urgent need for new concepts and tools to resolve these complexities.

The purpose of MCDM methods is to help improve the quality of decision making more explicit, rational and efficient by providing information on trade-offs for the better understanding of the nature of choices made by the decision maker. Development and application of MCDM methods to assist decision makers in evaluating project alternatives having more than one objective, in river basin planning, is of recent origin.

Most of these MCDM methodologies, for ranking alternative plans, contain some confusion and occasionally conflict with intuition. To overcome some of these difficulties, a new method (viz., RANFUW: RANking FUzzy Weights), which is intuitive, computationally simple and easy to implement, has been proposed in this study. This method is a multiple criteria, multiple judges and fuzzy logic based decision making tool, and is a potential tool for planners and decision makers.

Applicability of RANFUW and its advantages over the earlier methods are demonstrated through a case study of a major peninsular river basin, Krishna river basin, in India. The purpose of the case study is to find the most suitable planning of the reservoirs, with their associated purposes, aimed at the sustainable development of the basin. Problem is formulated with 7 reservoirs and a diversion headwork for the development of 24 alternative sub-systems (i.e., various combinations of reservoirs) with 8 main objectives, which were further subdivided into 18 criteria. Of these 24 alternatives a sub-set of 7 alternatives were found to be preferred over the others. Using RANFUW these 7 alternatives are ranked.

Also, formulation and the development of a monthly Multi Objective Fuzzy Linear Programming (MOFLP) model for the optimal utilisation of the water resources for the best alternative found from RANFUW, is presented followed by its application. Discussions on the results, conclusions, recommendations of the study and scope for future developments are presented at the end.