Conjunctive Optimization of Surface Water and Groundwater Resources by Fuzzy Dynamic Programming

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Abstract

The shortage of water resources is lead that the conjunctive use of surface water and groundwater has been extended recently. So the allocation of available water resources with attention to interaction between surface water and groundwater is so important in optimization of these problems. On the other hand, some uncertainties such as uncertainty in perfect estimation of demands or consideration of experts' ideas could be useful for approaching to a realistic programming which is near to natural conditions. There are some methods for considering of uncertainties that Fuzzy Logic is one of them. In this research, we have spatially focused on conjunctive use of surface water and groundwater resources of Najafabad plain in Isfahan province and used of Fuzzy Dynamic Programming (FDP) for considering of uncertainties. The objective function in this research is the minimization of difference between demands and available water resources.

Keywords: Conjunctive Use, Surface Water, Groundwater, Fuzzy Dynamic Programming.

1. INTRODUCTION

The conjunctive studies and using of simulation and optimization conjunctive models of surface water and groundwater are widely used. This kind of studies was started by Buras's studies [1] and till now have a lot of changes. Nowadays the critical situation of water in Iran is approached that interrogators have focused on this problems, like as Samani and Safavi's studies [2, 3].

The conjunctive studies have two major parts, simulation and optimization. Using of improved general models on the base of superposition and steady flow for considering of situations, and parameters of different areas is developed recently. These methods are used in software that simulates groundwater flows. The most important goal of one programming research is setting up an optimization plan. There are some different methods for optimization. Yeh divided these methods to [4]:

1) Linear programming
2) Dynamic programming
3) Non Linear programming
4) Simulation

In all of these methods, the decision is on the cropping area, the amount of release from the reservoir, or both of them. The major problem in the optimization of water usage in one aquifer is the estimating of demand and the approach of supply of it. A lot of methods are used for estimating water requirement, but because of uncertainty in basic variables which are needed in these models, the solution may be complicated. The uncertainty is related to some identities of variables beyond of our knowledge and control. So considering these situations in programming of hydrosystems would be useful. Some different uncertainty and vague situations like the uncertainty in simulation parameters, the error in input data, or the ambiguity in water requirement because of various climate conditions may be existed in optimization. For considering the uncertainty the statistics and stochastic methods are used, also recently the fuzzy logic is used widely for considering ambiguity significant.

Leung perused the allocation of water to the three farming area by Fuzzy Linear Programming (FLP). The goal was programming of water consumption for receiving to better benefit [5]. Huang et al. developed Grey Dynamic Programming (GDP) and used their method for rounding up programming of urban garbage [6]. Chang et al. used Grey Fuzzy Multiobjective Programming (GFMP) for optimization of reservoir programming [7]. Musavi improved Fuzzy Stochastic Dynamic Programming for reservoir programming [8]. Liu and Odanaka used Dynamic Fuzzy Criterion model for dam exploiting [9]. Bender and Simonovic used Fuzzy Compromise method for water resources programming under uncertainty [10]. Dubrovin et al. developed a fuzzy rule based on multi criteria model of reservoir exploiting which is worked by Fuzzy Inference method [11]. McPhee and Yeh studied on simulation and optimization of groundwater usage based