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EXTENDED ABSTRACT

Land Evaluation System for Trickle and Sprinkle Irrigation Methods Using Fuzzy Logic System

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Introduction

Limited water and soil resources and growing population have led countries around the world towards raising agricultural production per unit area and optimal utilization of these resources. Due to the population growth and rising living standards, the demand for food has increased. In this regard, identification and knowledge of the parameters that somehow affect food production is essential. Using new techniques for selecting appropriate land irrigation methods can enhance water use efficiency in farm lands. Selecting a proper irrigation method in irrigated agriculture in order to achieve a high efficiency and maximum water use. Nowadays Fuzzy systems are one of the most efficient methods in the field of forecasting and modeling (Akbarzadeh et al, 2009). Fuzzy system is able to use human language and human experiences and experts and connoisseurs (Karatalopoulos, 2000). Sys, Vanranst and Debaveye (1991) proposed parametric evaluation system to select irrigation methods based on physical and chemical properties of soil. Using fuzzy logic capabilities which stem from the ability of continuous membership function of input variables and by combination of parameters affecting irrigation methods evaluation in parametric system with fuzzy logic membership functions, it is possible to assess farm lands for choosing the right irrigation method more accurately. Therefore, this study aims to utilize the functionalities of fuzzy logic method to evaluate land suitability of the area studied based on parametric system for two drip and sprinkler irrigation methods.

Methodology

Fuzzy systems are composed of three parts: 1. Fuzzy sets, 2. Membership functions and 3. Fuzzy rules (Klein, 1999). Since in this study the parametric evaluation by Sys, Vanranst and Debaveye (1991) was used to evaluate land suitability for different irrigation methods, the effective parameters in this method are required to be fuzzified using various functions. In parametric technique, soil properties (soil texture, depth, lime, electrical conductivity, drainage and slope) are graded and used to calculate the irrigation suitability index. After the map of each factor is provided based on values specified, land evaluation index of different points was extracted by overlaying all the maps obtained.

Results and Discussion

Result shown that for sprinkle and trickle irrigation respectively, about 385.06 (7.4%) and 2941.351 hectares (56.87%) of the land are “highly suitable”, and about 286.1 (5.5%) and 246.43 hectares (4.7%) are “moderately suitable”. Nearly2810.08 (54.3%) and 2744.17 hectares (53.02%) were “marginally suitable” for sprinkle and trickle irrigation, respectively. About 1322.88 (25.5%) and 737.58 hectares (14.2%) were “currently not suitable” for sprinkle and

trickle irrigation methods, respectively, and 370.91 (7.1%) and 458.54 hectares (8.86%) matched "permanently not suitable" for the under study zone. Given that Iran is an arid and semi-arid region in terms of climatologicalconditions, we can increase under cultivation lands to seven times the current level in agriculture-prone parts of the plain studied by changing irrigation method from drip to sprinkler. Since sprinkler irrigation faces some limitations in areas with high slope and low soil depth, it appears that the restrictions imposed on these areas due to the double impact of these two parameters on each other are not considered in tables presented parametric methods. Therefore, we can guess that restrictions of using sprinkler irrigation in operating conditions and performing this method in steep lands is more than related values determined based on the parametric technique. This means that the amount of lands suitable for drip irrigation in steep areas of the plain studied is in practice more than values calculated based on parametric system. Because in case that drip system is used, we can reduce the interaction of factors limiting land slope and soil depth by setting the emitter discharge and hours of operation. The results showed that there is a major difference between the two methods in terms of highly suitable lands that area of lands highly suited for drip irrigation is almost 7.5 times the size of the lands suited for sprinkler method which reflects the significant difference between land levels suited for irrigation using the two methods.

Conclusions

(1) Using fuzzy logic in parametric evaluation of the plain's lands increases the accuracy of selecting lands suited for irrigation and their areas in both methods. because in parametric method the value of the parameter measured is represented in zero-one system for the whole unit related, (2) Considering gradual changes of soil parameters in fuzzy evaluation makes this method more accurate than parametric technique. In fuzzy method, if one of the parameters influencing the evaluation acquires a high score, the impact of other parameters will not decreased and each of them will independently affect the evaluation results, (3) the percentage of suitable lands for drip irrigation in steep areas of the plain studied is in practice more than values calculated based on parametric system. Because in case that drip system is used, we can reduce the interaction of factors limiting land slope and soil depth by setting the emitter discharge and hours of operation.

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