Prioritization of suitable axes for construction of underground dam in the Doostbeiglou watershed

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Extended abstract

Introduction

Water resources management in arid and semi-arid areas is very important to provide water for stakeholders. In recent decades, construction of underground dams has been considered for the issue, because of its advantages. These dams have many advantages, e.g., unlike a surface dam, land is not submerged to store water and there is no danger of breaching due to natural or manmade disasters. The surface area can be used in the same way both before and after construction of the underground dam. A subsurface dam is a facility that stores groundwater in the pores of strata and uses groundwater in a sustainable way. Underground dams are used for various purposes such as prevention of combining salt water and fresh water, reserve water for management using and creating an obstacle against influencing water to structures. The water gathered in subsurface dams has good quality for drinking, as it has been filtered by the sand and is stored underground away from contamination. The aim of this research is to identify the areas suitable for underground dam construction, so that in these areas there is no limit to the underground dam and then appropriate priorities in these areas.

Materials and Methods

Doostbeigloo watershed with an area of 7461 square kilometers is located in the Ardebil province (North Western Iran). In this research, we have considered several criteria for suitable site selection of underground dams in watershed, including: topography, hydrography,

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hydrogeology, geology and land use. These factors were used to initial mapping suitable regions for underground dam construction. Firstly, for this purpose we have used Boolean logic and fuzzy logic models. Then, we have also used the analytical hierarchy process to prioritize the suitable axes in appropriate areas for underground dam construction.

Boolean logic

Boolean (logic) algebra is the branch of algebra in which the values of the variables are the truth values true and false, usually denoted 1 and 0, respectively. The value 1 is for suitable areas and 0 for unsuitable areas. The maps of different factors involved in locating underground dam in the GIS environment were combined using Boolean logic. Therefore, the map of suitable areas for underground dam construction was created.

Fuzzy logic

In a Fuzzy logic the layers are weighted in values from zero to one, which gives more data than Boolean method. This method is defined as Fuzzy AHP in many studies. In this research with regarding donned studies we used 0.9 fuzzy gamma operator in order to find suitable areas for underground dam construction.

Analytic Hierarchy Process (AHP) method

The analytic hierarchy process (AHP) is a structured technique for organizing and analyzing complex decisions. It provides a comprehensive and rational framework for structuring a decision problem, for representing and quantifying its elements. In this step after determining the suitable areas for underground dam construction, AHP method was used for prioritization of appropriate axes. The AHP method is based on analysis, binary compression, summarizing, prioritizing and selection among alternatives. After determining the subject, it's divided to many criteria, and many various sub criteria. In this method assessment for selecting criteria is performed with consistency index (C.I). Based on previous studies, the (C.I) must be less than 0.1 value.

Results and Discussion

The extracted results showed that the areas in the southeast and northwest are unrestricted for underground dam construction. Site selection of the underground dam with using Boolean logic and Fuzzy logic showed that suitable areas in 3 streams are more than other stream in ranks. This is in accordance with previous studies. The compatibility rate value for AHP method was obtained 0.03 that this rate in AHP method is acceptable. The results from prioritization of the selected dams in this area showed that water criteria are the most important factor to prioritize the proposed axis. The water quantity and quality criteria with 0.11 and 0.104 weights, respectively, have the highest important than other criteria. The 9 number axes located in Meshgin shahr plain and 30, 33 and 34 number axes in Ardabil plain are more preferred than other axes.

Conclusion

Construction of underground dam and use of surface runoff is an appropriate way to secure and

expand water supplies. The Boolean logic and Fuzzy logic showed suitable areas for construction of underground dams with acceptable accuracy and between these methods the Fuzzy logic model showed higher performance than Boolean logic method. With using of AHP method, we determined the axes that are more prefered for construction of underground dam than other axis. This can be said that using GIS and satellite images to locate underground dams has a significant impact on the success of the project, because the maps produced in this process can be used at a later stage and as an executive guide for underground dam construction. Thus, with utilization of these methods we can show suitable areas and axis for underground dam construction in the Doostbeigloo Watershed.

Keywords: AHP, boolean logic, fuzzy logic, site selection, underground dam.