Abstract

Due to the lack of rainfall in arid and semi-arid regions such as Iran and also to the limited surface water resources in these areas, agricultural domestic and industrial water is heavily depeand on groundwater. Therefore, managing and evaluating the quality of these resources are very important. Problems encountered in management of groundwater quality are the widespread availability and scattering of available data.The scattering of the data practically limits the analysis of classical evaluation methods, takes time and costs and makes difficult the analysis of the results difficult. Other problems include uncertainty at all steps from sampling to analyzing results. In recent years, the ability of fuzzy logic-based approaches to address uncertainties and various environmental and agricultural issues has been demonstrated. For this purpose, researchers have recently used clustering as a powerful tool. The purpose of this study is to investigate the feasibility of FCM and K-means models on qualitative indices for clustering and identification of homogeneous regions in terms of groundwater quality in Mazandaran province. In this study, measured data of 14 water quality indices by sampling of deep and semi-deep wells in 2011 and 2016 in two periods of dehydray (November) and wet period (May) were used. Therefore, a matrix including the number of wells and quality parameters evaluated is introduced as input to FCM and K-means clustering algorithms. Multivariate MVO algorithm is also used to optimize the number of clusters and Davies Bouldin Weilaut indices are used to evaluate the optimal number of clusters. Finally, the WQI index is used to assess the water quality for domestic use and the Wilcox diagram for agriculture. The results of FCM algorithm show the superiority of this algorithm in optimal cluster identification over K-means algorithm and it is observed that the optimum number of clusters in the two periods of 2012-2011 are 12 and 2 respectively and also 64% of the clusters in the upper range in the period. 89% were in the dehydray period and 2% and 2% in the two periods of 1395-1386, respectively, as well as 100% in the irrigation period and 21% in the high dehydray period, respectively. The Noshahr-Neka and Behshahr-Bandar Gaz areas were also poor for domestic use. Also, considering the zoning of the area based on the water periods, it can be concluded that the quality of domestic water was better in the periods of 1395-1956 than in the years 2011-2011.

Keywords: Groundwater Quality, Fuzzy Clustering, Mazandaran Province, K-means algorithm, C-means algorithm, MVO algorithm.

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**Identification of Homogeneous Groundwater Quality Regions using Fuzzy Clustering
(Case Study: Mazandaran Province)**

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