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Analysis of Spring Flow Change in the Jinan City under Influences of Recent Human Activities

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Abstract:

Jinan city, the capital of Shandong Province in China, is famous for beautiful springs. With the rapid development of economy in recent years, water demand in Jinan City has been increased rapidly. Over-exploitation of groundwater have caused decline of groundwater level, and then especially, dried up springs in extreme climate conditions. In order to keep the springs gushing perennial and sustainable use of groundwater resources, local government have implemented many measures to restore water table, for example, the Sponge City Construction Project in Jinan. Aiming at changes of spring flow and its influence factors in Jinan, this paper will analyze the change of observed spring flow in recent 40 years, and then discuss the causes of decreases of spring flow from the views of climate and human activities. The changes of spring flow can be divided into three periods: (1) natural stage with little exploitation; (2) affected seriously by the over-exploitation of groundwater; (3) rational exploitation and utilization stage. The models, including multiple regression and Artificial Neural Network (ANN) model, are developed to build the relation among spring flow, precipitation, and groundwater pumping, so as to predict the variations of spring flow under the conditions of climate change and human activities. The good agreements between the simulated and observed results demonstrate that both precipitation and exploitation are the important influence factors, and however the effective infiltration into groundwater from precipitation is the most key factor with a correlative coefficient of over 0.94. This paper will also discuss the change of groundwater budget after the implement of influences of the first-phase Sponge City Construction Project. The results can provide a guidance for groundwater resources protection in the Jinan Spring catchment.

Key words:

Spring flow; Jinan city; over-exploitation of groundwater; Sponge City; Statistical analysis