Optimising the allocation of groundwater carrying capacity in a data-scarce region

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Abstract

Traditional analysis approaches to water resource carrying capacity cannot be directly applied to data-deficient regions where water resources have been exploited excessively. Gross domestic products (GDPs) also cannot be used directly as objective functions of regional benefits. New objective functions should be established by analysing limited available data and mining useful implied information. Based on the principle of water resource supply-demand balance, a new evaluation criterion of regional benefits is presented using the non-linear regression analysis approach. An analysis model of ground-water carrying capacity was then established and is solved with the Lagrange multiplier method. A case study of groundwater resource carrying capacity in 2010 and 2015 in the Yaoba Oasis irrigation district, Alxa Left Prefecture, Inner Mongolia Autonomous Region, China, was performed. Results demonstrate that the model has the ability of evaluating and determining the groundwater resource carrying capacity in this overloaded and data-scarce region. The carrying capacity level of groundwater in this irrigation district is rather low and the development potential is limited. In order to reduce the exploitation of groundwater resources and achieve the sustainable development of the oasis in future, a system of agricultural watersaving irrigation must be set up to reduce the irrigation quotas and the irrigation water requirement. The arable areas should be reduced and the living standards of local people should also be raised. The results obtained from these applications have proved that the analysis model presented in this study is a new and promising method which can be employed in data-scarce and overloaded regions.

Keywords: carrying capacity, optimal allocation, groundwater resources, data-scarce region, Oasis irrigation district