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Study on Zones Classification, Management and Control Methods Based on Groundwater Functions in China

Fengyue Sun, Yuanyuan Li, Lili Yu, et al.
(General Institute of Water Resources and Hydropower Planning and Design, Ministry of Water Resources)

Objectives

China has a vast territory with its natural conditions of groundwater varying greatly from place to place. In order to scientifically and rationally manage groundwater according to the different characteristics in each region, this research tries to identify the dominant function of groundwater at the regional level, and classify the groundwater functional zones. Based on an analysis of the current state of groundwater exploitation and future development needs, an overall groundwater management framework, along with control indicators of groundwater exploitation and water table, have been formulated for each functional zone accordingly. This paper is the summary of concerns arising from the definition, classification method, status evaluation and management measures of groundwater function zoning, based on the work of national groundwater function zoning in China from 2005 to 2013.

Method

1. Protection Zone

(1) The ecological fragile zone applies where groundwater has great importance for ecological conservation and the ecological system is very sensitive to groundwater changes. (2) The geologically and environmentally sensitive zone is found where a decrease in groundwater table as an effect of groundwater exploitation. (3) The groundwater conservation zone is where groundwater exploitation and human activities are constrained in order to safeguard water and important spring water supply. The zone is mainly located in hilly areas. Vital springs, rivers with important ecological significance and riverside areas should also be categorized as groundwater conservation zones.

2. Exploitation zone

(1) The centralized water supply zone is where the water output of a single well is no less than 30 m^3/h. This zone normally consists of centralized water supply for domestic water uses and industrial production water uses. (2) The distributed exploitation zone is applied where groundwater is mainly exploited by distributed pumping wells for rural life, farmland irrigation and small rural industry. Except for centralized water supplies.

3. Reserve Zone

(1) The unsuitable exploitation zone is where the poor water quality and poor groundwater exploitation conditions cannot meet the requirements of water uses. (2) The water reserve zone has good recharge and storage conditions, and there are few human activities at present or anticipated within a certain period of time. (3) The emergency water supply zone has relatively good conditions for groundwater reserve, exploitation and water quality. It is generally prohibited for exploitation; water supply is provided only when emergencies or extreme drought occurs.

Table 1. Classification of groundwater functional zones

Primary	Secondary	Main Function
Protection Zone	Ecological fragile zone	Ecological maintenance
	Geologically and environmentally sensitive zone	Geology and environment
	Groundwater conservation zone	Circulation and reserve
Exploitation Zone	Centralized water supply zone	Centralized water supply for urban areas
	Distributed exploitation zone	Distributed water supply for rural areas
Reserve Zone	Emergency water supply zone	Emergency water supply
	Water reserve zone	Resources reserve
	Unsuitable exploitation zone	No particular functions

Results

67% of the land is protection zone, 18% is exploitation zone and the remaining 15% is reserve zone. For hilly areas, the protection zone accounts for 89%, the exploitation zone accounts for 7%, and the reserve zone is 4%. For plain areas, the exploitation zone takes up 44%, the protection zone is 17% and the reserve zone accounts for 39%

Conclusion

Groundwater functional zones are viewed as a fundamental concept for groundwater management. There are some specific management and control indicators: control indicators of groundwater exploitation and the groundwater table that should be formulated for groundwater functional zones.

1. Control indicators of groundwater exploitation

Regional groundwater exploitation should not exceed 90% of the total recharge. The sustainable yield in ecological fragile zones and coastal zones should not exceed 50% of the total recharge. Groundwater exploitation in hilly areas may reduce river baseflows, causing reduction in surface water flows. Thus, groundwater exploitation in hilly areas should also consider surface water exploitation in order not to cause significant decline in surface runoff.

2. Control indicators of groundwater table

Usually, the maximum depth of groundwater table should be maintained above the critical depth of phreatic evaporation and surface water discharge to rivers and lakes (generally 4 m). The maximum depth of groundwater table is determined to maintain the flexibility of groundwater reserve space for groundwater discharge and recharge, prevent soil salinization and should be deeper than where pollutants can reach. For wetlands or marshy areas, groundwater table depth should be less than 1 meter. For oases in arid areas, groundwater table depth should above the depth of vegetation roots plus the height of capillary rise. For areas that are prone to geological disaster, the groundwater table should above the critical depth of land subsidence, seawater intrusion, land collapse and other geological disasters. For areas that have important buildings in the region, groundwater table depth should be below the designed protection depth for urban building foundations.