Dual Control Management of Groundwater Table and Groundwater Exploitation in China

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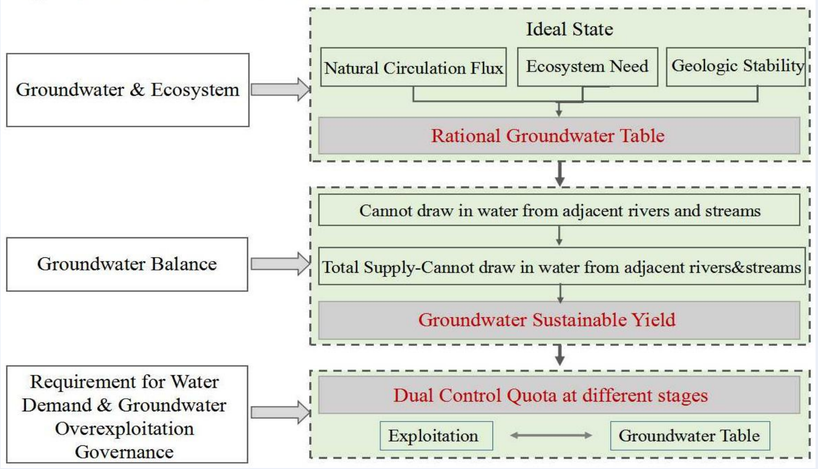
1. Framework of the "Dual Control Management"

Groundwater overexploitation is one of the problems of water resources sustainable management in China and in many regions worldwide. Under the Most Stringent Water Resources Management System, the "cap" of total water use for each province and each city has been determined in China, and in which, some provinces have also developed the "cap" of groundwater use for sub-regions. However, since the limited measuring system for groundwater pump, it is hard to only rely on the groundwater pump amount to manage groundwater use. Focusing on difficulty of groundwater management, China has been trying to carry out "dual control" management of groundwater throughout the country - it means to control both groundwater overexploitation and groundwater table.

The management and control of groundwater table is a complicated problem, the standard groundwater table is set based on the average water table in each region. On one side, the groundwater table should not be too high in order to prevent secondary soil salinization, infiltration of surface pollutants, and ensure the safety of buildings. On the other hand, the groundwater table should not be too low either therefore ensuring the groundwater supply to the watercourse, maintaining the spring discharge, conserving the vegetation growth in arid areas and preventing a series of environmental and geological problems including land subsidence, seawater intrusion and surface crack.

Affected by human activities such as groundwater overexploitation, the groundwater table in many regions of China is far from reaching the rational groundwater table. Therefore, the formulation of groundwater table control quota at different stages is requested. The determination of quota should firstly depend on the current state of groundwater exploitation and utilization, existing issues, objectives and tasks of groundwater governance. Also, the influence on seasonal variations in precipitation has to be taken into consideration when deciding the control quota for a specific year in the future, because it has direct impact on changes in groundwater table, however, it is difficult to be predicted precisely. Therefore, for a specific year, there is no need to specify control quota, giving a particular range by assuming long-term high precipitation and high precipitation can work.

Fig. 1 The Framework of "Dual Control Management"



2. Case Study

2.1. Study Area

The Xiliao River Basin of Inner Mongolia holds a central and advantageous geography that connects the Northeast Plain, the North China Plain and the Mongolian Plateau in China. It is also one of the most important basins for food production, such as high-quality corn. However, the rapid expansion of planting corn and other crops has brought disorderly increase of the area and water consumption for irrigation. As a result, the agricultural irrigation leads to severe groundwater overexploitation, watercourse depletion, and ecological problems such as grassland desertification and lake and wetland shrinkage.

Fig. 2 Changes in Groundwater and Surface Water Supply in 1980-2018 (100 million m^3)

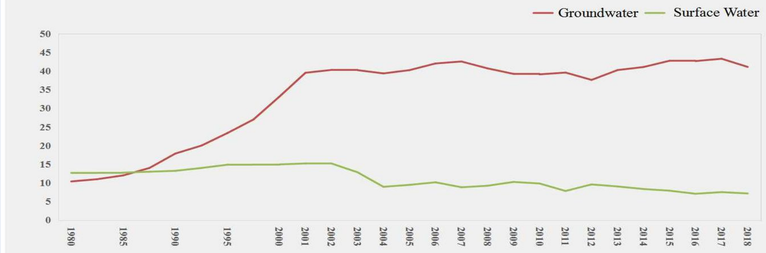
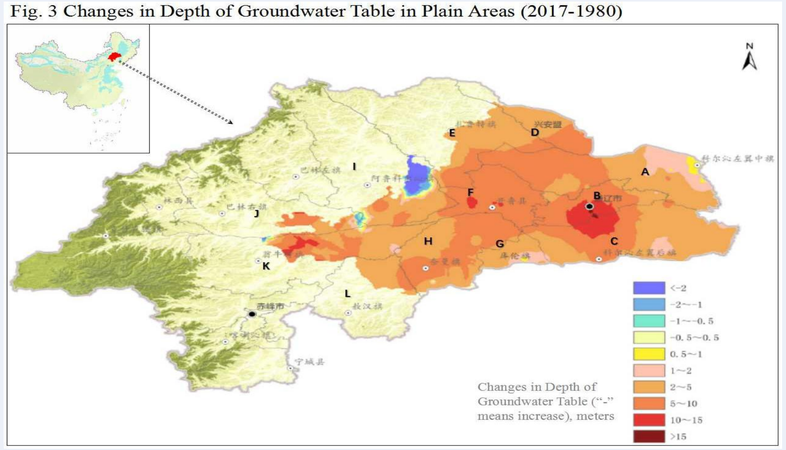


Fig. 3 Changes in Depth of Groundwater Table in Plain Areas (2017-1980)



Tab 1. The Ratio of Area where Groundwater Table Decreases to Plain Area

Decrease in Groundwater Table	Area where Groundwater Table Decreases/Plain Area(%)
Area where Groundwater Table Decreases	98%
More than 4m	61%
More than 6m	33%
More than 8m	20%

2.2. The Dual Control Quota

Compared with 1980, groundwater table dropped in 98% of the plain area in the Xiliao River Basin, and the groundwater table in 61% of the plain area decreased more than 4 meters.

Fig. 4 The Distribution of Regions in Plain Area

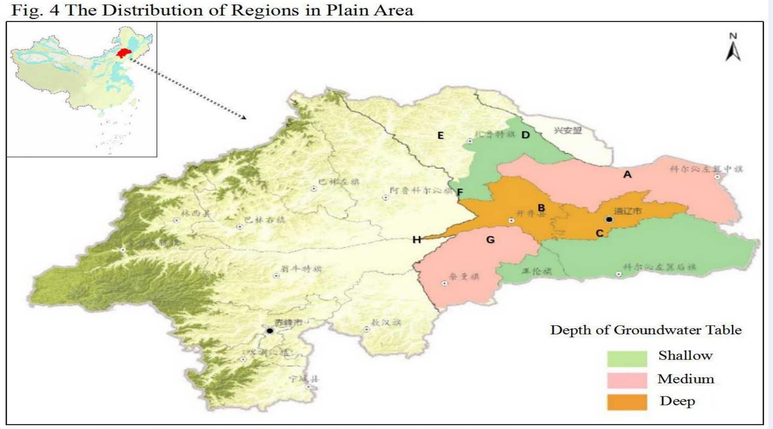
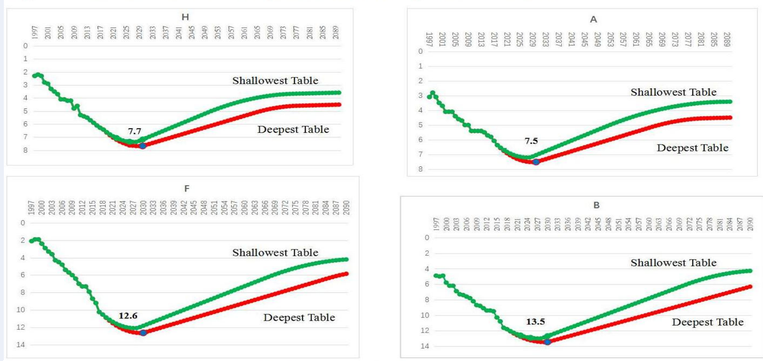


Fig 5. Groundwater Table Control Quota in Plain Area by 2030 Unit: meters



Tab 2. Groundwater Table Control Quota in Plain Area

Region	Code of the Region	Exploitation Control Quota (100 million m^3)		Groundwater Table Control Quota (m)	
		Year 2018	Year 2030	Year 2018	Year 2030 (P=75%)
Shallow	G	0.6	0.7	2.1	2.1
	C	3.2	3.3	3.8	3.8
	E	2.4	2.4	4.3	4.3
Medium	H	4.9	2.9	6.4	7.7
	A	6.2	3.6	6.4	7.5
Deep	F	4.4	3.2	10.5	12.6
	B	5.4	3.7	11.8	13.5

3. Conclusions

- For the region where has shallow depth of groundwater table, the current depth is 2-4 meters, and it should maintain the status quo for the future.
- For the region where has medium and deep depth of groundwater table, the depth of groundwater table is continuously declining. Therefore, the quantity of groundwater overexploitation should all be showing a continuous downward trend by 2030. Although the groundwater table may reach its deepest depth, the increase should not exceed 2 meters.
- The recovery of groundwater table is a long process. The region where has medium and deep depth of groundwater table normally needs 50-60 years to recover back to the state of 2000.