

Countermeasures and Measures for Groundwater Overload Control in Typical Areas of the Yellow River Basin

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Objectives

Kundulun District of Baotou City, Inner Mongolia Autonomous Region of China, is a heavy industrial city with rapid social and economic development. Uncontrolled groundwater exploitation has caused serious ecological and environmental damage. Historical data analysis shows that the total use of groundwater in the region increased by 30% from 2007 to 2014. The long-term centralized exploitation of groundwater led to a continuous decline in the groundwater level, with the maximum water level decline reaching 17 meters. There is an urgent need to carry out groundwater overload control and reduce human activities damage to groundwater.

Methods

Make specific measures based on the judgment of overload.

$$k = Q_{Act} / Q_{Con}$$

Where Q_{Act} is the actual groundwater mining output; Q_{Con} is the maximum allowable mining output of groundwater; k is the groundwater extraction coefficient;

If one of the following conditions is met, it is determined as a groundwater overload area: ① When $k > 1.0$, groundwater overload; ② When the groundwater level continues to decline; ③ Ecological and environmental issues caused by groundwater extraction.

In response to the overloading situation of Kundulun District, the following measures have been made: ① More than 100 underground wells have been shut down within the scope of the overdrawn area; ② The pipeline network construction of the Yellow River surface water replacement project exceeds 10 kilometres; ③ The implementation of modern agricultural efficient water-saving irrigation technology covers an area of 9990 Mu; ④ All groundwater users with an annual water intake of more than 10000 cubic meters have been installed with metering facilities.

Results

The performance of different control measures for the area was calculated based on the groundwater abstraction rate change analysis before and after the comprehensive governance. The analysis of the effect of overexploitation control shows that cumulative reduction of groundwater mining output is 9 million cubic meter, which is lower than the mining output amount of regional groundwater. The groundwater level in overdrawn area has significantly increased, with a rising area of 118.9 km² and a maximum rising range of 8 meters.

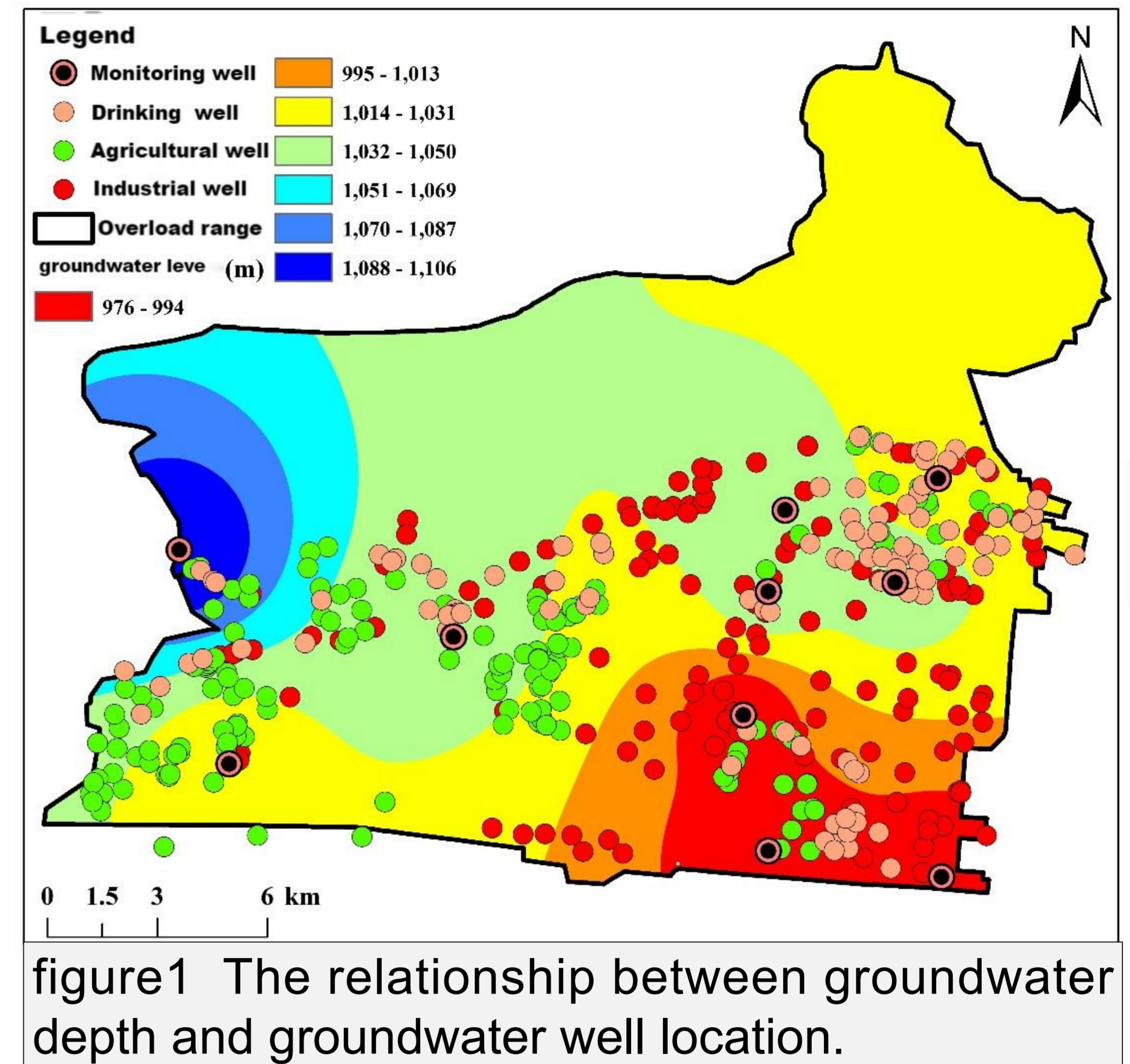


figure1 The relationship between groundwater depth and groundwater well location.

Conclusions

The causes of regional groundwater overexploitation are complex, including water shortage, water waste, population aggregation, and insufficient measurement. Different research methods had been used synergistically including data analysis, surveys, technical and economic analysis, and comprehensive control measures for groundwater overdraft have been proposed and implemented. It's indicated that local groundwater overexploitation has been comprehensively curbed, which is of great significance for improving the regional ecological environment.

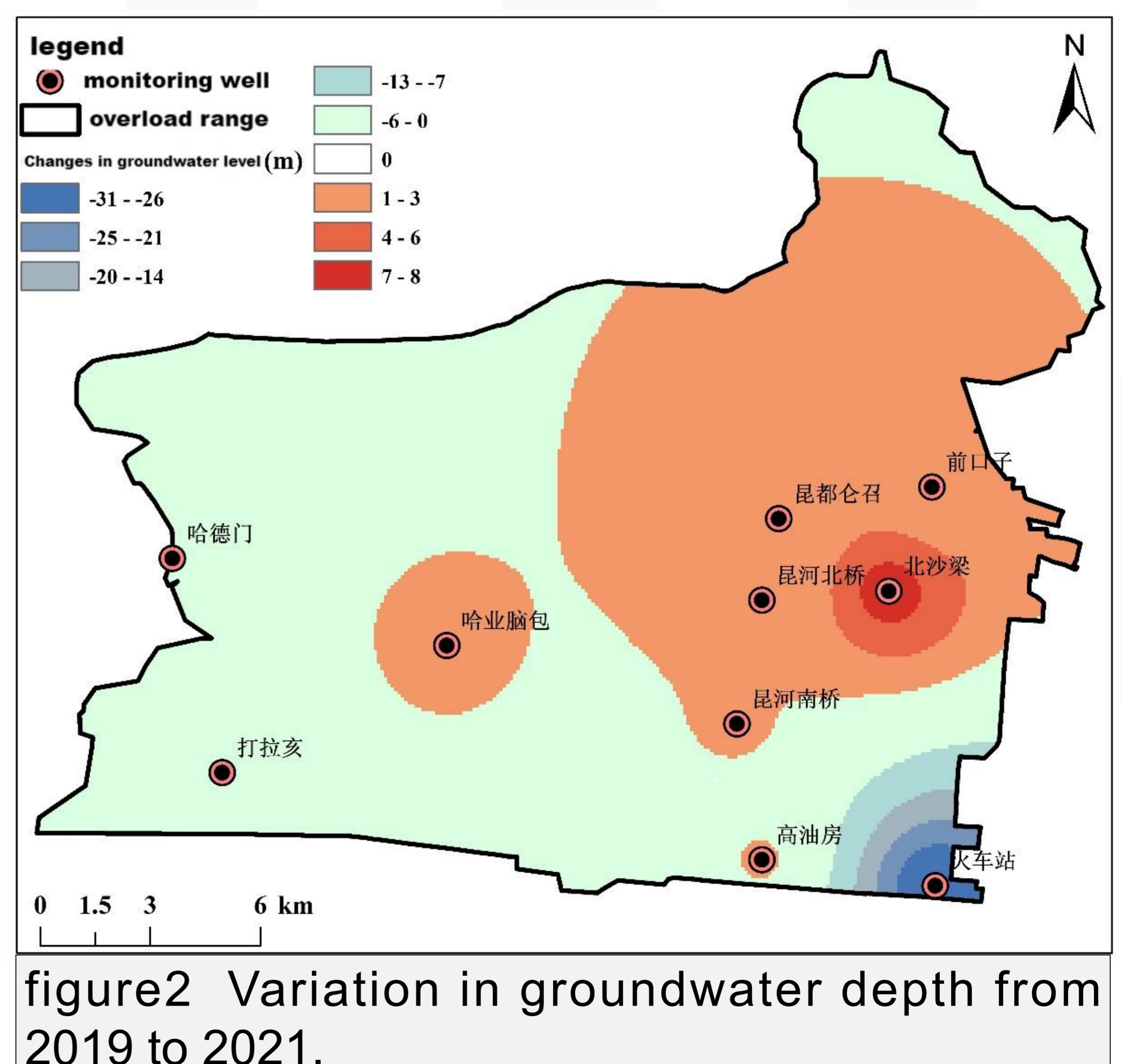


figure2 Variation in groundwater depth from 2019 to 2021.