Groundwater Quality Evaluation Based on Fuzzy Comprehensive Optimization Model

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Abstract: For the existing domestic water resources, underground water resources are a very important component. In recent years, with the continuous use of water resources, the use of groundwater resources has been paid more attention. As a result, environmental problems arising from the development and utilization of low-level water resources have also occurred, and the environment and other related factors have become important factors for the protection of groundwater resources. We often say that the evaluation of water environment quality is to inspect the water resources to be evaluated from the perspective of stereotypes or quantification. Whether groundwater resources are polluted or not can be determined by various means. However, the evaluation method based on fuzzy comprehensive optimization model described in this paper can intuitively show the quality of groundwater resources and the degree of pollution.

1. Introduction

The quality assessment of groundwater environment is based on the water quality factors of groundwater resources, the existing standards and the formulation of corresponding calculation and measurement methods to make certain plans for the current utilization value of groundwater and the subsequent treatment methods[1]. However, due to the reality of water resources, the assessment and investigation must be based on objective factual data, calculate the desired value through certain statistical methods, and carry out assessment and detection according to the rating and classification standards of the existing groundwater environment quality assessment methods. In this paper, the fuzzy comprehensive evaluation method of water self-evaluation is used, and the related fuzzy comprehensive optimization model is established by adding the existing water quality evaluation standards and other relationships. According to this model, groundwater resources in an urban area are evaluated and analyzed. The effect is obvious. The optimization model also solves the problems such as non-standard of the traditional fuzzy comprehensive evaluation model. It can be seen that the fuzzy comprehensive optimization model can be used and is true and reliable. As an important water resource in China, groundwater resources are safe and can be used directly[2]. At present, they are widely used in most areas. However, due to the continuous development of social economy and science and technology, certain pollutants gradually penetrate into the underground and enter the underground water, resulting in different degrees of pollution of groundwater resources. The detection and evaluation of groundwater quality analyze the water quality through the analysis of existing data and the collection of water quality and other indicators. Identify the pollution situation and distribution of underground water quality[3]. Because of the uncertainty of underground water resources, there is fuzziness in the evaluation of water quality. Because the classification standard and threshold of underground water quality do not have a specific value, the evaluation method currently used in the current field usually uses fuzzy mathematical model to use fuzzy comprehensive evaluation. Compared with other evaluation methods, this method has the characteristics of simple calculation method, fewer parameters and is beneficial to use. However, with the deepening of the problem and the continuous development of research theory, this method also shows its disadvantages. The problem of water has become a far-reaching international problem that endangers the whole world in the 21st century. As water pollution intensifies day by day, water quality assessment has become a key method in the field of environmental protection in

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our country, thus there are 20 or 30 kinds of detection methods, but there are currently standardized methods using clear comprehensive models. Both use accurate mathematical concepts to describe water quality, and use specific grading standards to praise pollution degree, thus the water environment pollution degree and water quality grading are applicable to fuzziness and the water quality changes have continuity, so the mathematical accuracy is above a certain extent.

2. The Development and Utilization of Groundwater Problems

At present, China's water resources reserve is worrying, with a per capita water resource of only 200 cubic meters, lacking 1/4 of the world average. Drought has become a key factor restricting China's economic and social transformation, especially in the northern region. Although China's water resources protection work has also achieved certain results, some problems still apply, slightly restricting the development and further reduction of China's water resources protection work. Therefore, the complete protection of water resources has also become an urgent problem to be overcome. There are many examples of cooperation between the water resources protection department and relevant departments, especially the cooperation between the environmental protection department and the basin water resources protection planning in the 1980s and the management of sewage outlets into rivers in some places in recent years is very poor. The cooperation and support of relevant departments are closely related to the achievements already achieved. But at present this kind of cooperation between departments has mixed feelings[4]. On the other hand, more and more people have realized the importance of cooperation and are gradually making harmful attempts and trying to establish a certain system. At the same time, some departments that had previously cooperated well are so irresponsible as to build roads beyond their authority and land on hectares. The conclusion has cost a lot of financial and material resources[5]. In the end, they have achieved twice the result with half the effort. After all, there are historical reasons for this situation, but the flourishing of local protectionism and trade protectionism should be the main reason, and the failure of the state to establish an appropriate consultation and cooperation system is also one of the key reasons. In recent years, the exploitation of groundwater has been vigorously carried out, resulting in a serious drop in the groundwater level in and around urban areas. However, due to the reduction in the utilization rate of deep water, the water temperature at various deep levels has also increased. However, in some areas lacking water sources, the problem of water level drop should still be paid attention to. There is a certain situation of water quality deterioration. If the garbage dump around the water source is not treated to a certain extent, then the harmful waste will emit some toxic and harmful substances with the changes of time and external factors, which also contain a large number of bacteria and viruses. These pollutants can cause irreversible harmful effects on the underground water quality. Especially in the city and its surrounding areas, there is basically no situation that has not been polluted by pollutants. In addition, some factories will discharge a certain amount of wastewater to the surrounding rivers and water sources, and the wastewater will enter the ground after dilution by the river water, thus indirectly polluting the groundwater resources[6]. However, in some areas of our country, due to the movement of the mainland and the effect of seawater, groundwater resources above a certain depth begin to change into saline water quality. Although these water qualities have a slight impact on deep-level water resources, if China continues to develop the collection and utilization of deep-level water resources, they will continuously affect the depth of groundwater, causing the shallow water currently affected to continue to seep down, resulting in the pollution of deep-level water resources. However, in the process of collection and construction, due to problems such as rusting of collection equipment, water leakage and pipeline connection, shallow surface water will continue to seep, which will also affect the salt content of underground fresh water resources.

3. Fuzzy Comprehensive Optimization Model

Everything has certain fuzziness. Aiming at the different objective things or the presentation of different states at the same time, in order to better describe and analyze things, fuzzy mathematics method realizes the quantitative transformation of fuzziness between things, thus filling in the blank that some objective phenomena cannot be clearly displayed[7]. In order to build the model, firstly, the observed objects should be evaluated in target grade, and divided into n different grades according to the different states and other properties, which are expressed as $V=\{V1,V2,\cdots VN\}$. secondly, according to the attributes and other factors of the objects, the representative factors among them should be selected to form another set, which can be expressed as $U=\{U1,U2\cdots UM\}$. thirdly, the relation matrix and the weight matrix should be constructed through the reduced semi-trapezoidal distribution method. According to the investigation and selection of the supervisor and the objective to determine the importance of various indicators to express them and to carry out matrix planning, finally to evaluate the grade, there are obtained weight matrix and relation matrix to conform to the operation $B=A\times R=[B1,B2,B3\cdots BM]$, this method combines all the target index information together, thus further obtaining the situation and grade $h=B1'\times 1(B2'\times 2)(B3'\times 3)\cdots(BM'\times m)$ and $BM=BM/(B1\times B2\times\cdots BM)$. The next step is to establish a single-factor evaluation matrix. We can assume that there are H evaluation factors that play a role in water quality evaluation and J grades for underground water quality standards. However, since the status and specific grades of underground water quality pollution are generally very vague, assuming that there is rmn within the possibility that M pollutants in the ground are determined by the nth evaluation category, we can use this matrix to form a fuzzy relation matrix between water quality evaluation factors and groundwater resource categories, and finally obtain a comprehensive discrimination model of underground water quality pollution in a certain area[8].

4. Application Analysis

Taking groundwater resources in an urban area as an example, in order to reflect the quality and other characteristics of effluent resources from various aspects, a number of monitoring points were set up in different sections and depths during the implementation of the project to measure the total hardness of index water body, solid minerals dissolved in water, sulfate, chloride, fluoride, iron content, manganese content, etc[9]. The obtained detection and analysis results are shown in the following figure. It can be seen that the current water quality situation is acceptable and has not reached the point where it cannot be used. At the same time, the specific pollution range of underground water sources can be determined through this standard, and corresponding countermeasures and solutions can be formulated according to the corresponding situation. The result data obtained by the method is relatively clear and systematic, can give a clear definition for the fuzziness of the pollution degree of groundwater resources, can well solve the problems of fuzziness of the quantity to be inspected and difficulty in quantitative calculation, is relatively simple to operate, is fast and accurate in calculation, reduces the occurrence of human errors, and has good effect.

Table 1 Results of underground water quality at various monitoring points

Detection position	Solid mineral	Sulfate	Chloride	Fluoride	Iron content	Manganese content
1	150	11.22	15.41	0.28	0.203	0.001
2	189	10.57	15.22	0.11	0.22	0.02
3	135	15.20	8.9	0.05	0.151	0.0015

5. Conclusion

The analysis results show that the evaluation results of the clear mathematical model accord with the characteristics of the water quality, and focus on how the important cadmium solute in the groundwater improves the water quality of the groundwater. In addition, other non-major over-standard components are also included in the influencing factors. The evaluation results can accurately and naturally reflect the evolution of the water quality. Therefore, the evaluation results of this method are in line with the current development and utilization of groundwater, and can be applied to appropriate fields or analysis.

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