Study on Evaluation and Pollution Control of Chongqing Qijiang River

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Abstract. Due to the many indicators affecting the health status of the Qijiang River, an evaluation system needs to be established for evaluation. According to the 12 indicators such as the degree of variation of the flow process in the indicator layer, Qijiang was evaluated. According to the survey, the main pollution of Qijiang water quality comes from domestic sewage, industrial sewage, mining and coal mining. Through the evaluation of the grading indicators and the gradual addition, Qijiang's comprehensive score is 48.09, and the river is in a sub-health state, and finally proposes a treatment plan.

1. Introduction

The river is the product of the earth's underlying surface and the atmospheric circulation. The river has the same life as all living things. [1-3] Rivers play a vital role in the development of human beings. The growth of all things is inseparable from the miniaturization of water. Human production activities are also closely related to water. [4-8] In addition, water also has many service functions such as commercial, recreational and transportation. Rivers play an irreplaceable role in human production and life, so the health of rivers is particularly important, and river health assessment is essential. [9].

2. Hydrology and water resources index

(a). Flow process variation (FD)

The degree of variation of the flow process is defined as the difference between the estimated annual flow and the average annual flow process of the river section in the current development state, that is, the degree of deviation. It can reflect the impact of human activities on hydrological conditions during the year, and will report the monthly runoff of the year and the deviation of the average monthly runoff over the years.

$$FD = \left\{ \sum_{m=1}^{12} \left(\frac{q_m - Q_m}{\overline{Q_m}} \right)^2 \right\}^{1/2} \quad (1)$$

In the formula: $\overline{Q_m} = \frac{1}{12} \sum_{m=1}^{12} Q_m$, q_m is the measured monthly runoff of the year of assessment, Q_m is the average annual runoff of the year of assessment, and Q_m is the average annual runoff of the measured annual average. The score is determined based on the calculated FD value, and the standard is shown in Table 1.

Table 1. Flow process variation degree score table

FD value	0.05	0.1	0.3	1.5	3.5	5
Assignment	100	75	50	25	10	0

(b). Ecological flow satisfaction (EF)

River ecological flow is the minimum flow process that a river needs to maintain its structure and function, characterized by minimal ecological flow.

$$EF1 = \min\left[\frac{q_d}{\overline{Q}}\right]_{m=4}^{9}, \; EF2 = \min\left[\frac{q_d}{\overline{Q}}\right]_{m=10}^{3} \tag{2}$$

In the formula: q_d is the measured daily runoff of the assessment year, $\overline{Q}$ is the historical average annual runoff, EF1 is the lowest percentage of the daily average runoff from April to September, and EF2 is the daily runoff from October to March. The minimum percentage of average annual runoff. The average annual runoff is calculated using hydrological monitoring data of not less than 30 years.

(c). Hydrology and water resources guidelines

The water resources standard layer contains two indicators, one is the degree of ecological flow satisfaction, and the other is the degree of variation of the flow process. The weights of the two indicators are shown in Table 2.

Table 2. Hydrology and water resources

River indicator layer	Assignment	Assignment range	Weights	Recommended weight
Degree of variation in the flow process	FDr	0-100	FDw	0.3
Ecological flow satisfaction	EFr	0-100	EFw	0.7

3. Physical structure index

3.1. Riparian zone situation (RS)

The riparian zone is an important part of the river, and the status of the riparian zone is mainly affected by human activities. The evaluation indicators of riparian conditions include three aspects: riparian stability, vegetation coverage and artificial disturbance.

a). Riparian stability

The stability of the river bank is evaluated by the current situation of the river bank. This evaluation of the riparian zone includes a range of 30 m lateral extension of the river channel and river channel. Vegetation has the function of soil and water conservation, which can prevent soil erosion from happening to a certain extent. The flowing water has a certain amount of energy. If most of this energy acts on the river bank, it will definitely cause a lot of collapse on the river bank. Therefore, the evaluation of the stability of the riparian zone should proceed from the vegetation on the river bank and the scouring of the river bank.

b). Vegetation coverage

Vegetation coverage refers to the ratio of the area occupied by vegetation to the area of the entire calculation area, that is, the area occupied by vegetation per unit area. According to the basic situation of Qijiang, the survey focused on trees above 6m, shrubs and herbs of 6m. The riparian vegetation coverage is divided into the average of these three factor assignments. Table 3 shows the criteria for direct assessment of riparian vegetation coverage indicators.

Table 3. Riverside vegetation coverage index direct assessment score standard table

Vegetation coverage (trees, shrubs, herbs)	Vegetation coverage	Assignment
0	No such vegetation	0
0-10%	Sparse vegetation	25
10-40%	Moderate coverage	50
40-75%	Heavy coverage	75
>75%	Extremely heavy coverage	100

3.2. River connection barrier

The life of a river lies in its mobility. Once the river is blocked, the water becomes "dead water" and there is no vitality. As a result, the survival of river creatures will be affected, such as the migration and spawning of certain fish, and the water will stop flowing and the material exchange will stop. The main barriers to river connectivity include hydropower stations and river gates. Some hydropower stations and dams take into account the connectivity of rivers and the exclusive passages for fish, such as fish passes, so the channel barrier can be divided into the presence or absence of barriers and barriers.

3.3. Physical structure criterion layer assignment

The physical criteria layer contains two indicators, one is the riparian status indicator and the other is the river connectivity indicator. According to the specific situation of Qijiang, the riparian status indicator has a weight of 0.67, and the river connectivity index accounts for 0.33.

4. Water environment indicator

(a). DO water quality status

DO is the dissolved oxygen concentration in water, in mg/L. Dissolved oxygen is very important for aquatic plants and animals. DOs that are too high or too low are harmful to aquatic organisms, and the suitable value is 5-12 mg/L.

Dissolved oxygen is related to water flow velocity, morphology and temperature, so the calculation of dissolved oxygen index is that the data should be divided into flood season and non-flood period. According to the specific situation of Qijiang, the dissolving oxygen indexing criteria are shown in Table 4.

Table 4. Qijiang water quality status standard table

DO(mg/L) (>)	Saturation rate 90% (or 7.5)	6	5	3	2	0
DO Indicator assignment	100	80	60	30	10	0

(b). Oxygen-consuming organic pollution

Oxygen-consuming organic matter refers to organic pollutants that cause a large decrease in dissolved oxygen in water. Generally, four items such as permanganate index, chemical oxygen demand, five-day biochemical oxygen demand, and ammonia nitrogen are used to evaluate the oxygen consumption of rivers. Because the high-acid salt index, chemical oxygen demand and BOD5 measured values are too small, the evaluation of the oxygen-consuming organic pollution status of Qijiang is only evaluated by the ammonia nitrogen index. According to GB3838-2002 water quality evaluation standard, the oxygenation organic pollution status indexing criteria are shown in Table 5.

Table 5. Qijiang River section oxygen consumption organic matter status indicator standard table

Ammonia nitrogen (NH3-N) (mg/L)	0.15	0.5	1	1.5	2
Assignment	100	80	60	30	0

(c). Heavy metal pollution

Heavy metal pollution refers to the pollution of water by heavy metal elements and periodical compounds such as mercury, cadmium, chromium, lead and arsenic. The average monthly concentration of the 12-month evaluation year is selected, and the average is calculated according to the flood season and the non-flood period. The scores of the flood season and the non-flood period are separately evaluated. The lowest score is divided into the water quality project, and the lowest score of the five water quality projects is taken as the heavy metal. The pollution status indicator is assigned.

(d). Water environment criterion layer assignment

There are three water quality criteria indicators for the Qijiang River evaluation, including dissolved oxygen, oxygen-consuming organic pollution and heavy metal pollution indicators. The overall assignment of the final water environment is divided into the minimum of the three indicator assignments.

5. Biological indicator

(a). Benthic integrity index

Benthic animals have been widely used in ecological monitoring and evaluation. By constructing the benthic integrity index (B-IBI), a comprehensive and scientific assessment of the current status of rivers and lakes can be carried out.

The assessment of the BIB assignments in the river section is calculated using the following formula:

$$BIB_r = \frac{BIB}{BIBE} \times 100 \tag{3}$$

In the formula, BIBr is an assessment of the integrity index of benthic animals in the river section, BIB is the evaluation index of the integrity of benthic animals in the river section, and BIBE is the best expectation value of the integrity index of benthic animals in the water ecological division of the river.

(b). Fish biological loss index

Determined by biological species loss methods using biological integrity assessment. The Fish Bio-Loss Index refers to the assessment of the difference between the current status of fish species in the river section and the number of fish species in the historical reference system. The surveyed fish species do not include alien species. The index reflects the loss of top species in river ecosystems after basin development.

The establishment of fish biological loss indicator standards was determined by historical background investigation methods.

$$FOE = \frac{FO}{FE} \tag{4}$$

In the formula: FOE is the fish bio-loss index, FO is the number of fish species obtained from the river section survey, and FE is the number of fish species assessed in the river section before 1980s. The fish bio-loss indicator scores are shown in Table 6.

Table 6. Fish biological loss index score table

Fish biological loss index	1	0.85	0.75	0.6	0.5	0.25	0
Assignment	100	80	60	40	30	10	0

(c). Phytoplankton diversity index

Phytoplankton refers to tiny plants that float in the water. Usually phytoplankton refers to planktonic algae, including cyanobacteria, green algae, diatoms, algae, yellow algae, dinoflagellate, cryptophyta

and eucalypts. There are about 40,000 algae plants, of which about 25,000 are freshwater algae, and about 9,000 are freshwater algae found in China. Phytoplankton is the food of many fish. The quantity and variety of phytoplankton determine the production of fish to some extent. The factors that determine phytoplankton are mainly water quality, and the types of plankton in water bodies with serious water pollution may be reduced.

6. Qijiang River Health Assessment Results

Table 7. Qijiang Health Evaluation Calculation and Results Table

	Hydrology and water resources index	Physical structure index	Water environment indicator	Biological indicator	Social service function indicator	River weight
River section 1	6.31	77.4	44	69.6	75	0.09
River section 2	6.31	37.8	46			0.15
River section 3	4.77	38.0	46			0.14
River section 4	3.24	46.0	46			0.13
River section 5	1.70	46.2	46			0.49
Criteria layer assignment	3.44	46.57	45.82	69.60	75.00	
Qijiang comprehensive score	48.09					

In the health evaluation system, hydrological and water resources indicators, river physical structure indicators, flood control safety and other indicators characterize the impact of river fluency on river health; water resources, water resources utilization, water chemical integrity and other indicators characterize the river The health requirements of resource characteristics; the physical structure indicators of rivers and the integrity of social service functions reflect the health requirements of rivers in terms of human interaction. The comprehensive score of Qijiang is 48.09. According to the evaluation grading standard of Section 2.2.1, the Qijiang River is in a sub-health state.

7. Measures to improve the health of Qijiang

(a). Water engineering

In order to maximize the utilization of water resources, many hydropower stations and large dams have been built on the Qijiang River. The construction of these water conservancy buildings has blocked the continuity of the river, causing the river's ecological flow to be unsatisfactory for some time periods; in addition, it will also block the migration of fish and other creatures, resulting in a decrease in the number of fish, even some kind of the demise of fish and so on. It is conceivable to construct fish passages for fish migration in the above-mentioned hydraulic structures. The fish passages can also be opened during the fish spawning period and closed for the rest of the time. This is convenient for management. In order to meet the ecological flow demand of rivers, the dispatching system for hydropower stations and dams can be strengthened, and water can be discharged downstream in due course.

(b). Water environment

Do a good job in the total control of Qijiang pollutants, formulate a higher level and stricter water pollution prevention and control standards in the Weihe River Basin, and form a complete scientific monitoring and evaluation system. Develop more stringent pollutant discharge standards for key polluting industries and sewage disposal plants; improve market access conditions, improve industrial enterprises' environmental access system and emission permit system, and formulate agricultural non-point source pollution control standards. In view of the actual situation of the existing regulations on

water resources protection and water environment management in Qijiang River Basin, it is necessary to improve the relevant legal system of water environment management in the river basin, improve the legal responsibility, and ensure that the river health assessment system is implemented in accordance with the law.

(c). Public aspect

First of all, residents should strictly demand themselves, resolutely do not do things that are harmful to the environment, and comply with relevant laws and regulations, play a role in protecting the water environment, and make the Qijiang environment better and better. Seriously implement the government affairs announcement system related to Qijiang health management policies and regulations, construction project approval, environmental protection case handling, etc., establish an information release system, and perform the procedures of hearings and demonstration meetings. Promote the disclosure of corporate environmental information and publicize the pollution discharge of key polluting enterprises in the basin. Maintain the public's right to know, participate and supervise the public, and mobilize the masses to participate in pollution control. Make full use of the news media such as television, radio, newspapers and the Internet to give full play to its role of supervision and guidance, and enhance corporate social responsibility. Let the concept of river health be deeply rooted in the hearts of the people, so that everyone can lead the way to protect the water environment, and use regular river health assessment reports as an important basis for measuring environmental protection.

8. Summary

This paper mainly establishes an evaluation system to evaluate the health status of rivers. The evaluation system consists of a target layer, a criteria layer, and an indicator layer. The criteria layer includes five aspects: hydrological integrity, physical structural integrity, chemical integrity, biological integrity, and social service functional integrity. Finally, based on the evaluation results, the governance opinions are given.

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