Analysis on the Temporal and Spatial Changes of Water Resources in Shaanxi Section of the Weihe River during 2005-2014

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Abstract: In 2011, Shaanxi Provincial Government launched the three-year action to prevent and control water pollution in the Weihe River Basin. 2014 was the year of the end of the three-year operation of the Weihe River water pollution prevention and control. In order to evaluate the effectiveness of the Wei River water pollution prevention and control action, according to the monitoring data of Weihe River water quality from 2005 to 2014, the temporal and spatial variation characteristics of ammonia nitrogen, CODcr, total phosphorus and total nitrogen in 13 national monitoring sections of Weihe River were analyzed. The results show that the water quality of the four sections of the 13 sections of the Shaanxi section of the Weihe River from 2005 to 2010, except the Linjia Village to Changxing Bridge, meets the water quality functional standards, and the water quality of the other 9 sections exceeds their functional standards for water quality. All of them are inferior category V and the pollution is extremely serious. From 2011 to 2014, the water quality of the Weihe River's main stream improved significantly. The three-year "iron fistula treatment" effect was obvious. The continuous improvement of water quality in the Weihe River also indicated that the water quality in the Guanzhong area of the Yellow River Basin in Shaanxi Province has been improving year by year.

1. Introduction

The Weihe River Basin is an important industrial, agricultural, scientific research and production base in Shaanxi Province with a dense population. However, the water quality of the dry and tributary rivers of the Weihe River has been deteriorating, and the living and production water of urban residents have been seriously affected. Therefore, the prevention and control of water pollution cannot be delayed. According to statistics, the amount of waste water flowing into the Weihe River accounts for about 80% of the Yellow River Basin in Shaanxi [1-3]. In order to ensure the Yellow River water quality and water supply security, the Shaanxi Provincial Government launched the three-year campaign to prevent and control water pollution in the Weihe River Basin in 2011 from the objectives of management requirements and water quality protection. In 2014, it was the end of the three-year campaign to control water pollution in the Weihe River. In order to evaluate the effectiveness of the Wei River water pollution prevention and control action, 13 nationally controlled monitoring sections in the Shaanxi section of the Weihe River were used as research sections. According to the monitoring data of the Weihe River from 2005 to 2014, four types of ammonia nitrogen, CODcr, total phosphorus and total nitrogen were used. The characteristics of spatio-temporal changes of major pollution indicators and changes in pollutant concentrations along the route were analyzed to provide a basis for the comprehensive management

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of the Weihe River Basin and to promote the sustainable development of Shaanxi Guanzhong Region [4-5].

2. Assessment section and method

2.1 Evaluation section selection

Weihe River pollution mainly occurred in Shaanxi province, Shaanxi linjia village section upstream canyon, shoal, water flow is urgent, less industrial and agricultural pollution, river water quality is good. Therefore, in order to reflect the water environment pollution of Weihe River, 13 monitoring sections of Shaanxi section of Weihe River were selected as evaluation sections. These sections fully take into account the distribution of water systems, the location of major pollution sources and river functional zoning in the Weihe River basin, and can accurately represent the water quality status of the Weihe River mainstream.

2.2 Water function division and water quality objectives

With reference to the Shaanxi Provincial Environmental Protection Bureau's water environment functional zoning, that is, “The Surface Water Function Regionalization Plan for the Weihe River Mainstream (Shaanxi Section)” (DB61-224-1996), the surface water environmental quality standard to be implemented is “Surface Water Environmental Quality Standard” (GB3838-2002), The division of the functional sections of the Shaanxi section of the Weihe River and the water quality target requirements are shown in Table 1.

Table 1. Water function section differentiation and water quality target of Shannxi reach of the Weihe River

No.	Grade 1 water function zone name	Secondary water function zone name	Starting - End section	length (km)	Water quality aims
1	Weihe Baoji, Weinan development and utilization zone	Weihe river Baoji agricultural water district	Yan Jiahe	43.9	Ⅲ
2	Weihe Baoji, Weinan development and utilization zone	Weihe Baoji Landscape Water district	Lin Jiacun	20.0	Ⅲ
3	Weihe Baoji, Weinan development and utilization zone	Weihe river Baoji sewage control area	Wolong Temple	12.0	Ⅳ
4	Weihe Baoji, Weinan development and utilization zone	Weihe river Baoji transition zone	Guo Town	22.0	Ⅳ
5	Weihe Baoji, Weinan development and utilization zone	Weihe river Baoji industrial and agricultural water area	Cai Jiapo	44.0	Ⅲ
6	Weihe Baoji, Weinan development and utilization zone	Weihe river Yangling agricultural water district	Yongan Village	16.0	Ⅲ
7	Weihe Baoji, Weinan development and utilization zone	Weihe river Xianyang industrial and agricultural water district	Qishui River Entrance	63.0	Ⅳ
8	Weihe Baoji, Weinan development and utilization zone	Weihe river Xianyang landscape entertainment water area	Xianyang Highway Bridge	3.8	Ⅳ
9	Weihe Baoji, Weinan development and utilization zone	Weihe river Xianyang Sewage Disposal Control Area	Xianyang Railway Bridge	5.4	Ⅳ
10	Weihe Baoji, Weinan development and utilization zone	Weihe river Xianyang transitional area	Fenghe River entrance	19.0	Ⅳ
11	Weihe Baoji, Weinan development and utilization zone	Weihe Xi'an Agricultural Water District	Caotan town	56.4	Ⅳ
12	Weihe Baoji, Weinan development and utilization zone	Weihe river Weinan agricultural water area	Zero River Entrance	96.8	Ⅳ
13	Weihe river Huayin buffer zone	Huayin into the yellow buffer	Luo River Entrance-Yellow entrance	29.7	Ⅳ

2.3 Water quality evaluation method

In order to evaluate the impact of multiple pollutants on the integrated pollution of water quality, comprehensive pollution index method was used to evaluate the selected areas [6]. Calculated as follows:

$$P_j = \frac{1}{n}\sum_{i=1}^{n} P_{ij} \tag{1}$$

$$P_{ij} = \frac{C_{ij}}{C_{i0}} \tag{2}$$

Where:Pj—j river water pollution composite index;Pij—j river pollution index of the i pollution index;Cij—i pollution index of the average concentration of each water period of the j river course;Ci0—Evaluation criteria value of the i pollution index of the 0 river course;n—Number of pollution indicators.

From the actual situation of rivers in China, when the comprehensive pollution index of the river is P≤2.0, the river is dominated by type I~II water, and the water quality is excellent; at 2.0<P≤4.0, the river is mainly type II~III water, and the water quality is good; at 4.0<P≤8.0, The river is dominated by Type IV water and its water quality is generally good. At 8.0<P≤12.0, the river is dominated by Type V water and the water quality is poor. At P>12.0, the river is dominated by poor Type V water and the water quality is very poor.

When using the above formula, the following formula is used for DO with a decreasing degree of pollution as the concentration increases[7]:

$$P_{ij} = \frac{C_{\max} - C_{ij}}{C_{\max} - C_{i0}} \tag{3}$$

Where: C_{max} is the maximum possible DO concentration in water.

3. Evaluation Results and Analysis

This paper focuses on the increasingly intensified pollution in the Shaanxi section of the Weihe River basin, and uses the Statistical Yearbook and the Environmental Statistics Yearbook of Shaanxi from 2005 to 2014 as the basic data. At the same time, according to the principle of selection of water quality assessment parameters, refer to relevant sections of Shaanxi Provincial Environmental Protection Bureau from 2005 to 2014. Analysis of water quality monitoring data found that the water pollution of the Weihe River is mainly organic pollution [9]. Therefore, four kinds of water quality indicators are selected in this paper: dissolved oxygen (DO), volatile phenol, permanganate index (COD_{Mn}), and ammonia nitrogen (NH3-N) as an evaluation parameter. According to the needs of the evaluation, the four kinds were numerically collated and reorganized to obtain the average value of the monitoring indicators for 10 years. Analysis on water quality of Weihe river from 2005 to 2014 in figure 1.

According to the analysis, from 2004 to 2010, the water quality of the four sections of the 13 sections of the Shaanxi section of the Weihe River, except Linjia Village to Changxing Bridge, met the water quality functional standards, and the water quality of the other 9 sections exceeded their water quality functional standards. The water quality is inferior to Grade V, and the water pollution is extremely serious from 2008 to 2010. From 2011 to 2014, the water quality of the Weihe River's main stream improved significantly. Among them, seven sections of the water quality all met the water quality functional standards. The remaining six sections were classified as IV or V, belonging to mild pollution.

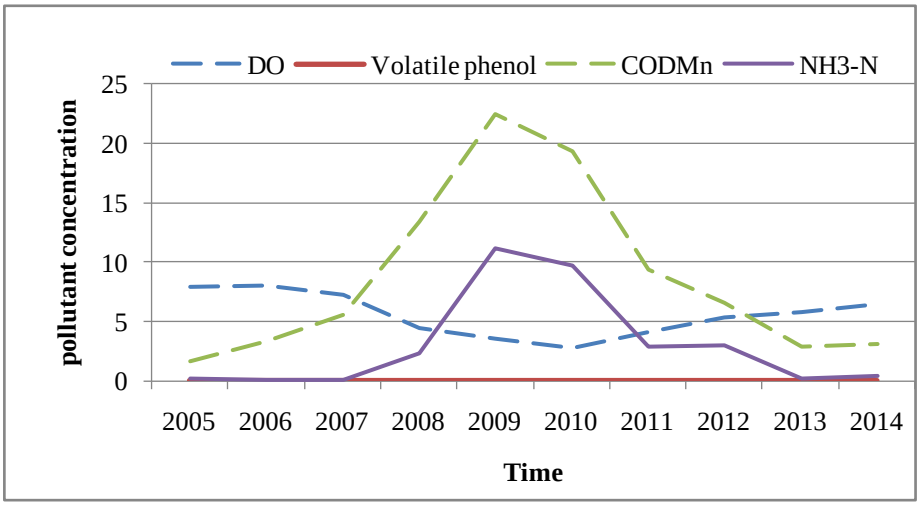

Figure 1.The trend of water quality in the Weihe River from 2005 to 2014

4. Conclusion

The basic requirement of river water quality assessment is to understand the law of movement of major river pollutants. Therefore, it is necessary to master the dynamic changes of pollutants in different periods and seasons in time; in the space, it is necessary to grasp the environmental changes of different river sections, different parts of upstream and downstream, and the contrast of quality changes. Only by understanding and mastering these basic laws can the river water quality evaluation be typical and representative, so as to accurately reflect the basic characteristics of different river water quality[9].

In summary, the water quality was mildly polluted from 2005 to 2007. From 2008 to 2010, 9 sections of the Shaanxi section of the Weihe River had exceeded their water quality functional standards, and the water quality was inferior to the V class. The pollution was extremely serious. From 2011 to 2014, the water quality of the Weihe River's main stream improved significantly. The three-year “iron fistula treatment” effect was obvious. The continuous improvement of water quality in the Weihe River also indicated that the water quality of the Guanzhong area in the Yellow River Basin in Shaanxi province has been improving year by year.

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