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# Water Environment Quality Evaluation of an Inland River in Haikou City

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***Abstract:*** *In-depth and systematic research on urban water environment quality issues will provide a scientific basis for solving the sustainable use of water resources and the continuous optimization of the ecological environment quality. This study selected total nitrogen (TN), total phosphorus (TP), dissolved oxygen (DO), chemical oxygen demand (COD), five-day biochemical oxygen demand ($BOD_5$), ammonia nitrogen ($NH_3$-N) as indicators, the single-factor evaluation method was used to evaluate the water quality status of a certain section of the inland river during the highwater period after the river remediation.The purpose of the study was to determine the status quo of its water environment quality, analyze the changes of water quality and the sources of water pollutants during the monitoring period, with a view to providing certain data and technical support for Haikou's river remediation.*

***Background****: With the rapid development of cities, urban rivers, as a drainage channel for urban wastewater, sewage and surface runoff, have become one of the pools of various pollutants. In 2016, Haikou city launched a comprehensive river management project, focusing on core concepts such as 'ecological restoration' and 'serving people's livelihood', integrating water management into ecological restoration.*

***Materials and Methods****: This study selected total nitrogen (TN), total phosphorus (TP), dissolved oxygen (DO), chemical oxygen demand (COD), five-day biochemical oxygen demand ($BOD_5$), ammonia nitrogen ($NH_3$-N) as indicators, the single-factor evaluation method was used to evaluate the water quality status of a certain section of the inland river during the highwater period after the river remediation.*

***Results****: According to surface water environment quality standard, in the 30 monitoring results of the 5 monitoring sections from May 2019-October 2019, TN, TP, DO, COD, $BOD_5$, $NH_3$-N content of the water body was within the range of 1.85-5.08 mg/L, 0.05-0.36 mg/L, 2-8 mg/L, 11-20 mg/L, 1-5 mg/L, 0.35-2.91 mg/L, respectively.*

***Conclusion:*** *Water quality indicators have been improved after the pollution control of the inland river section.*

***Key Word****: Water Environment Quality, Evaluation, Single-Factor Evaluation Method.*

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## I. Introduction

With the rapid development of cities, urban rivers, as a drainage channel for urban wastewater, sewage and surface runoff, have become one of the pools of various pollutants.[1] In-depth and systematic research on urban water environment quality issues will provide a scientific basis for solving the sustainable use of water resources and the continuous optimization of the ecological environment quality.[2] In 2016, Haikou city launched a comprehensive river management project, focusing on core concepts such as 'ecological restoration' and 'serving people's livelihood', integrating water management into ecological restoration. According to the indicators involved in the relevant literature and standards,[3-5] this study selected total nitrogen (TN), total phosphorus (TP), dissolved oxygen (DO), chemical oxygen demand (COD), five-day biochemical oxygen demand ($BOD_5$), ammonia nitrogen ($NH_3$-N) as indicators, the single-factor evaluation method was used to evaluate the water quality status of a certain section of the inland river during the high water period after the river remediation. The purpose of the study was to determine the status quo of its water environment quality, analyze the changes of water quality and the sources of water pollutants during the monitoring period, with a view to providing certain data and technical support for Haikou's river remediation.

## II. Material And Methods

**Experimental drugs and instruments**

Potassium persulfate, potassium nitrate, ammonia, etc. are analytical reagents and used directly without treatment.

UV-Vis spectra were obtained on a Hitachi U-2910 spectrophotometer. pH values were measured with a pH-meter PBS-3C (Shanghai, China), etc.

**Experimental method**

Determination of total nitrogen (TN), total phosphorus (TP), dissolved oxygen (DO), chemical oxygen demand (COD), five-day biochemical oxygen demand ($BOD_5$), ammonia nitrogen ($NH_3$-N) according to alkaline persulfate potassium digestion ultraviolet spectrophotometry (GB11894-89), potassium persulfate digestion ammonium molybdate spectrophotometry (GB11893-89), iodometry (GB/T7489-87), non-dilution method and dilution inoculation method (GB/T7488 -1987), dichromate method (GB11914-89), respectively.

**Sampling method**

The setting of sampling points refers to the reported method.[6]

Water sample collection: the sampling time is from May 2019-October 2019, water sample was collected using a deep water sampler at 0.1-0.5 m below the water surface, and then was put into polyethylene plastic bottles, fixed with concentrated $H_2SO_4$ and stored at 4$^o$C.

## III. Results And Discussion

**Total nitrogen (TN)**

As shown in Table 1, it can be drawn that the total nitrogen content of the water body is within the range of 1.85-5.08 mg/L in the 30 monitoring results of the 5 monitoring sections from May 2019-October 2019, only 10% of the points reached the V quality standard according to surface water environment quality standard. According to the single factor evaluation method, the water quality of each sampling section was evaluated, and the water quality of this section of the river is inferior toClass V water.The data of each monitoring point showed that total nitrogen at points 3# and 5# are significantly lower than those of the other 3 points. The reason for this phenomenon may be due to the different environmental impacts near different sampling points. There are domestic sewage discharge points and sites with farmland nearby, and their total nitrogen content may be higher.

**Table1**Sampling results of water quality monitoring sections of the river section

| Month | River section | TP (mg/L) | TN (mg/L) | DO (mg/L) | COD (mg/L) | $BOD_5$ (mg/L) | $NH_3$-N (mg/L) |
|---|---|---|---|---|---|---|---|
| May | 1# | 0.05 | 3.24 | 7 | 14 | 3.5 | 1.01 |
| | 2# | 0.27 | 4.15 | 5 | 17 | 4.5 | 1.27 |
| | 3# | 0.20 | 2.50 | 5 | 18 | 1.8 | 1.03 |
| | 4# | 0.34 | 4.50 | 5 | 17 | 1.9 | 1.21 |
| | 5# | 0.20 | 2.00 | 5 | 14 | 3.6 | 1.28 |
| Jun | 1# | 0.09 | 3.20 | 7 | 15 | 5.0 | 1.50 |
| | 2# | 0.28 | 4.09 | 2 | 14 | 2.1 | 1.68 |
| | 3# | 0.22 | 2.53 | 3 | 11 | 1.4 | 1.02 |
| | 4# | 0.36 | 5.08 | 2 | 15 | 1.3 | 2.89 |
| | 5# | 0.18 | 1.91 | 4 | 16 | 1.4 | 0.71 |
| July | 1# | 0.05 | 3.17 | 7 | 13 | 4.3 | 1.52 |
| | 2# | 0.31 | 4.21 | 3 | 15 | 3.0 | 0.55 |
| | 3# | 0.21 | 2.55 | 3 | 20 | 3.0 | 0.55 |
| | 4# | 0.30 | 3.30 | 2 | 17 | 3.0 | 2.91 |
| | 5# | 0.25 | 1.85 | 5 | 19 | 2.0 | 0.35 |
| Aug | 1# | 0.10 | 3.18 | 6 | 14 | 4.2 | 0.66 |
| | 2# | 0.29 | 4.50 | 4 | 17 | 4.0 | 1.15 |
| | 3# | 0.22 | 2.60 | 5 | 15 | 3.5 | 0.84 |
| | 4# | 0.29 | 3.93 | 5 | 16 | 5.0 | 1.03 |
| | 5# | 0.24 | 2.51 | 6 | 20 | 4.0 | 1.71 |
| Sept | 1# | 0.07 | 3.22 | 8 | 14 | 4.2 | 1.29 |
| | 2# | 0.30 | 4.60 | 6 | 19 | 4.0 | 1.42 |
| | 3# | 0.18 | 2.48 | 4 | 16 | 2.5 | 1.28 |
| | 4# | 0.28 | 4.73 | 2 | 19 | 3.0 | 1.45 |
| | 5# | 0.23 | 2.52 | 5 | 19 | 4.2 | 1.75 |
| Oct | 1# | 0.08 | 3.33 | 5 | 15 | 3.9 | 0.92 |
| | 2# | 0.25 | 4.70 | 6 | 20 | 3.6 | 1.30 |
| | 3# | 0.19 | 2.50 | 4 | 17 | 2.0 | 0.89 |
| | 4# | 0.32 | 3.65 | 3 | 20 | 3.0 | 1.35 |
| | 5# | 0.22 | 2.47 | 6 | 18 | 1.7 | 0.36 |

**Total phosphorus (TP)**

As shown in Table 1, the measured values of total phosphorus in all monitored sections ranged from 0.05 to 0.36 mg/L. According to surface water environment quality standard, the water quality of 1# monitoring section was the best, and it was all Class II wateramong the total phosphorus detection results using the singlefactor evaluation method. The water quality of the 2# monitoring section was inferior to other monitoring sections, the proportion of Class IV water is 90.0%, and that of Class V water is 10.0%, respectively. The water quality of all monitoring points reached the surface water Class V and above standardswithin the monitoring time period. The measured values of total phosphorus content at each point are: 4#, 2#, 5#, 3#,1# from high to low.

**Dissolved oxygen (DO)**

From Table 1, it can be seen that the dissolved oxygen content of the water sample is within the range of 2-8 mg/L in the monitoring section of the river section, and all monitoring points are to meet Class V water and above standard according to Surface Water Environmental Quality Standards within the monitoring time period.The single-factor evaluation method is used to evaluate the water quality of each sampling section, among them, 1# monitoring section had the best water quality, Class I water accounts for 20%, and Class II water accounts for 80%. The water quality in the 4# monitoring section is the worst, Class II water accounts for 10%, Class III water accounts for 40%, Class IV water accounts for 10%, and Class V water accounts for 40%, which showed that the monitoring section had good growth activity of aquatic organisms, and the aquatic ecological community is relatively stable.The measured values of each point are: 1#, 2#, 5#, 3#, 4# from high to low.

**Chemical oxygen demand (COD)**

As shown in Table 1, the monitoring COD values of each section are within the range of 11-20 mg/L. According to the Surface Water Environmental Quality Standards, the singlefactor evaluation method is used to evaluate the water quality of each sampling section. The rivers meet the Class III water standard in all sections.Among them, the water quality of 1# monitoring section is the best, and the proportion of Class I and Class II water is 100%. The water quality of 4# monitoring section water samples is worse than other monitoring sections, with Class I and Class II water accounting for 10% and Class III water accounting for 90%.It can be seen that most of the water quality is better after the monitoring section of the river section was reformed.The monitoring chemical oxygen demand content of the monitoring section water samples was: 5#, 4#, 2#, 3#, 1# from high to low.

**Five-day biochemical oxygen demand ($BOD_5$)**

The measurement results of $BOD_5$were shown in Table 1. The monitoring water samples in this river section had $BOD_5$ content in the range of 1-5 mg/L. According to the Surface Water Environmental Quality Standards, most of the points in this section of the river meet the Class IV water standard by a single factor evaluation method. According to the evaluation,Class I and Class II water accounted for 90% and Class III water accounted for 10% in 3# monitoring water samples. The water quality of the 1# monitoring section was worse than other monitoring sections,Class I and Class II water accounted for 40%, Class III water accounted for 20%, and Class IV water accounted for 40%.The monitoring section 1# was located in the upper reaches of the river, and the water quality was good. 1#Monitoring section's $BOD_5$was higher than that of other monitoring sections, which may be caused by high aerobic microorganism content and more organic matter in the water.

**Ammonia nitrogen ($NH_3$-N)**

From Table 1, it could be seen that the ammonia nitrogen content reached 0.35-2.91 mg/L. According to the Surface Water Environmental Quality Standards, the river water quality was classified as inferior toClass V water by a singlefactor evaluation method.According to the evaluation of different sections, the 1# monitoring section had 10% of Class I water, 20% of Class II water, 30% of Class III water, 30% of Class IV water, and 10% of Class V water. The quality of the 4#water sample was worse than that in other reconstructed river sections, of which Class III water accounted for 10%, Class IV water accounted for 70%, and inferior Class V water accounted for 20%. The water quality of the cross-section water samples varied greatly.

## IV. Conclusion

This study conducted a 6-month sampling monitoring of an inland river in Haikou city, and analyzed the indicators of different monitoring points. The research results showed that:

1) With reference to the relevant indicator standards of the 'Surface Water Environmental Quality

Standards', some water quality indicators have been improved after the pollution control of the inland river section, but the river section was still classified as inferior Class V water body in 2019 according to the single-factor index evaluation, and the main pollution factor wastotal nitrogen and ammonia nitrogen.

2) After the inland river was treated by the Haikou River Comprehensive Treatment Project, indicators such as TP, COD, $BOD_5$ and DO have all been greatly improved. The most monitoring data of the above indicators at different time periods showed that they meet the water quality standards of Class III and Class IV and above.

3) During the monitoring period, the monitoring dataof the same monitoring point in different month were not much different, indicating that the water quality of the river section was relatively stable.The measured values of different monitoring points differed greatly, and there was no trend of gradually improving water quality from upstream to downstream, indicating that some pollutants from point pollution sources or area pollution sources entered the river in different areas of the river.

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