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Urban Water Pollution Prevention and Protection Based on Convolutional Neural Network

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Abstract: Although China's urbanization is developing rapidly and people's quality of life has been greatly improved, the water environment of people's life is getting worse and worse. Water pollution (WP) has become a major environmental problem endangering people's daily life. Water is an indispensable resource in people's daily life. People should cherish our limited water resources and strengthen the protection of water resources. Therefore, this paper deeply analyzes the current situation of WP in A city, and combines convolutional neural network (CNN) to simulate the morphological characteristics of pollutants in water. Through this study, it is found that the industrial pollution in City A has the greatest impact on the water environment. The industrial pollutants are directly discharged into the river basin, resulting in an increase in the content of COD, ammonia nitrogen and TP in the water body. In addition, there are problems in the prevention and control of WP in City A, such as weak government supervision, weak prevention and control willingness, and low participation of citizens in the prevention and control of WP. Therefore, this paper puts forward corresponding water resources protection suggestions, I hope it can provide reference for WP control in other cities.

1. Introduction

In recent years, with the acceleration of urbanization, the living standard of the people has been greatly improved. At the same time, the problem of WP has become increasingly serious. Water eutrophication, sewage direct discharge and other water source pollution incidents occur frequently. Therefore, urban WP treatment and improvement of water environment have become an important work of local governments in all cities.

Many scholars have conducted relevant research on urban WP prevention and protection, and

have achieved good results. For example, some scholars take a river water body as an example and consider the problem from the perspective of economics. They believe that the WP problem is actually caused by economic development. At the same time, the primary cause of WP is extensive economic development. Another important reason is that the WP caused by traditional heavy industry has not been fully solved [1]. Some scholars believe that under the new ideological concept, a new theory is bound to derive. In the previous theoretical concept of WP prevention, the theory of WP prevention usually uses pollution prevention tools that violate the natural development law and the principle of sustainable development. In addition, they suggested that the existing pollution prevention system should be actively modified to improve the impact of WP prevention and solve the problem of deep-WP prevention [2-3]. The research on WP prevention and control is a topic that should be paid attention to all over the world. Every country should spare no effort to maintain the stability of the water ecosystem.

This paper first introduces the concept of CNN and uses CNN to identify the pollutant texture to simulate the characteristics of pollutants, then analyzes the current situation of WP in City A, understands the sewage discharge in the drainage basin of City A, and finally puts forward the corresponding countermeasures for WP control, fire and water resources protection by analyzing the problems of WP prevention in City A.

2. Basic Overview

2.1. CNN

CNN is a feedforward neural network, including data input layer, convolution calculation layer, convolution layer, pooling layer and full connection layer. It can use full connection neural network to process large size images [4]. Activation functions commonly used in CNN include sigmoid function, tanh function and ReLU function. The expressions are as follows:

$$f1(x) = \frac{1}{e^{-x}+1} \tag{1}$$

$$f2(x) = \frac{e^{x}-e^{-x}}{e^{x}+e^{-x}} \tag{2}$$

$$f3(x) = \max(0, x) \tag{3}$$

Where, f1 (x) represents sigmoid function, f2 (x) represents tanh function, f3 (x) represents ReLU function, and x represents input value.

Because CNN model has outstanding application effect in image recognition field and can extract image features, this paper uses CNN to build dynamic texture to simulate the morphological features of "irregular shape" and "fuzzy boundary" of pollutants in water [5]. The main idea is to understand the influence of random rotation according to the horizontal and vertical coordinates of noise pollutant texture of dynamic data, and simulate the irregular changes of water pollutants; Continuous attenuation is conducted along the alpha channel in a certain direction to continuously increase the transparency of the texture along a certain direction, so as to simulate the characteristics of fuzzy boundary of the polluted water mass [6-7].

2.2. WP Prevention

The so-called WP prevention and control refers to the formulation of scientific and reasonable

protection plans based on WP and daily treatment standards for a period of time, emphasizing the combination of "prevention" and "treatment" [8]. Generally speaking, the main objectives of WP prevention and control are: to take reasonable measures to maintain water ecology; Take appropriate wastewater treatment methods to improve water quality; Adjust the water resource utilization plan, promote the rational utilization of water resources, and avoid wasting water resources [9].

The prevention and planning of WP prevention is an important part of environmental planning, which is inseparable from the economic development of cities. Therefore, governments at all levels should follow four planning principles: first, environmental protection must be coordinated with the local economy; Second, protect the environment and monitor natural laws; Third, prevention and control of WP; Fourth, plan the time to prevent and control WP, and actively adopt different methods to improve the possibility of environmental protection according to local environmental problems [10-11].

3. Analysis on the Current Situation of WP in City A

3.1. Comprehensive Analysis of Basin Pollution Sources

Table 1. Pollutant emissions

	COD	NH_3-N	TP	River inflow coefficient
Industrial pollution	241.2	243.7	117.42	1
Town sewage	652.3	12.5	11.4	1
Domestic sewage	5876.5	978.4	361.7	0.3

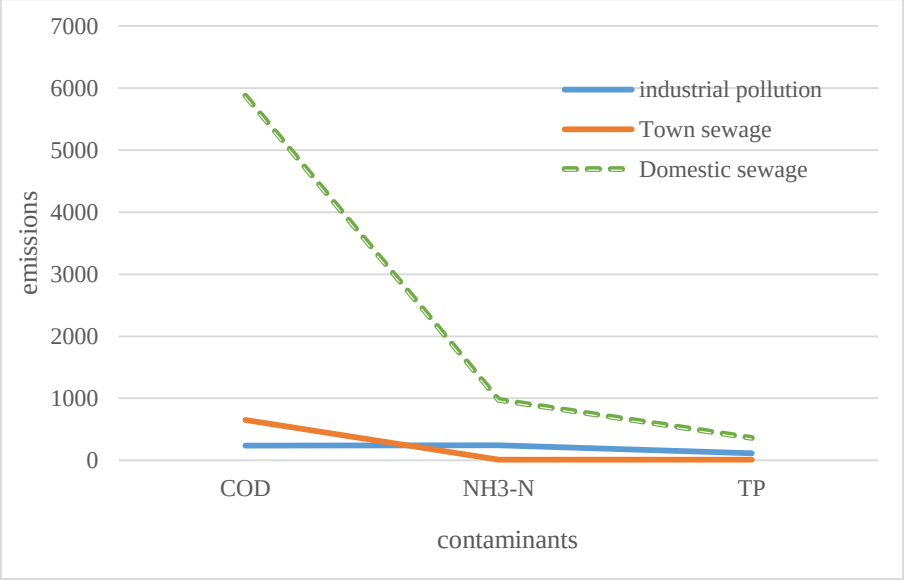

Figure 1. Pollutants of each pollution source

The emissions of COD, ammonia nitrogen and total phosphorus from different types of pollution sources in City A are shown in Table 1 and Figure 1. The river inflow coefficient of point sources (including industrial pollution sources, town sewage, urban domestic sewage, etc.) is generally taken as 0.9. The sewage treatment capacity of the town in this basin is almost zero, so the river inflow coefficient of sewage is taken as 1.

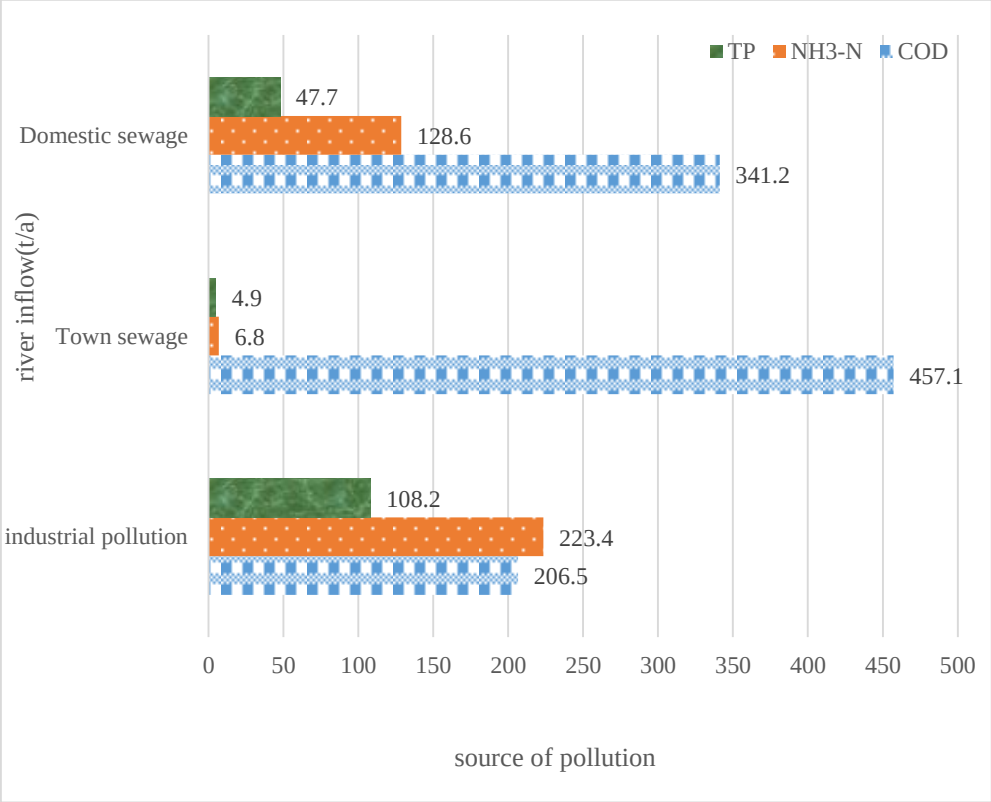

Figure 2. Pollutant discharge into the river (t/a)

It can be seen from the inflow of pollution sources into the river in City A in Figure 2 that the maximum COD pollution load in the basin comes from the town sewage, and the inflow of industrial pollution COD into the river is 206.5t/a; The COD inflow of the town sewage is 457.1t/a; The COD inflow of domestic sewage is 341.2t/a. The largest ammonia nitrogen and TP pollution loads come from industrial pollution. The amount of ammonia nitrogen entering the river is 223.4t/a, and the amount of TP entering the river is 108.2t/a.

3.2. Reduction of Water Pollutants

Table 2. Safety margin (t/a)

	COD	NH_3-N	TP
Water environment capacity	3451.2	159.6	27.3
Safety margin	345.12	15.96	2.73
Current sewage discharge	4268.7	673.4	132.5
Reduction	2183.6	505.8	94.4

The safety margin is set to ensure that the water quality continues to meet the standard when predicting the environmental capacity or increasing the discharge of pollutants due to sudden environmental events. In case of unsafe (sensitive) risks and sudden environmental events in the process of environmental efficiency simulation, the safety margin of the environment shall be considered in the pollutant reduction plan to ensure that the water quality target is achieved. In this study, the safety margin is determined first, and the remaining water environment capacity is allocated. See Table 2 and Figure 3 for the results.

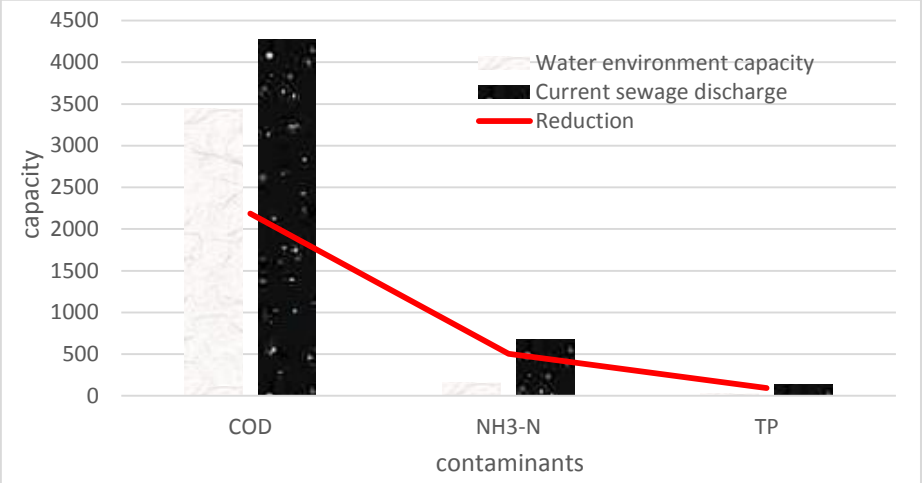

Figure 3. Water environment capacity distribution

3.3. Problems in WP Prevention

(1) The willingness of government departments to jointly prevent and control is not strong

Taking the law enforcement of enterprises' illegal pollution discharge as an example, the competent authority of the enterprise industry is the Economic and Information Commission. Pollution discharge control, water quality control and illegal pollution punishment belong to the Environmental Office. If wastewater is discharged into the river, it will also enter the Water Authority. In this way, it is usually easy to combine the transfer between departments with low operational efficiency. Especially in terms of the speed of finding and solving problems, this will lead to the lack of a complete work chain, which may lead to the existence of a vacuum zone in the work, so it is difficult to find the enterprise pollution [12-13]. Therefore, in real work, there are great difficulties in departmental coordination, and it is difficult to form resultant force.

(2) The regulatory system is not smooth, and the responsibility subject is not clear

First of all, it is manifested as the administrative system management malpractice under the strip mode. The relationship between the central government and the local government affects the administrative behavior of the government. As the central government announces administrative incentives to local governments every year to evaluate economic indicators, grass-roots governments pay more attention to economic development in WP work. City A still implements an environmental management system based on rules and regulations. The Ministry of Environmental Protection manages the resources and staff of local governments and the Ministry of Environmental Protection, determines and adjusts local government policies, which is why the Ministry of Environmental Protection faces a dilemma in performing its duties, namely, being responsible for the local government or the ecological environment [14]. As local grassroots governments often establish staff, finance and various environmental protection assessments, environmental protection departments should choose to be responsible for local governments. In other words, in WP prevention, the Ministry of Environmental Protection often considers not only WP prevention, but also the overall development of local economy, which reduces the efficiency of WP prevention [15-16].

(3) Insufficient public participation and lack of mass foundation

Public participation in WP prevention and control should be a spontaneous act of public and social organizations. However, based on the actual situation of City A, the integration of social forces into WP prevention is mostly from top to bottom [16]. It is difficult for citizens to do a good job of supervision, and their actions have no initiative or position. In addition, some citizens have

weak knowledge of environmental protection. They believe that environmental management is a problem of the government and has nothing to do with it [17]. Although the government organizes publicity and education through different activities every year, most of them are superficial and have little impact on arousing the public's awareness of environmental protection. According to the current situation of City A, there is no institutional arrangement for public participation in WP prevention. In addition to participating in various public activities organized by the government and a series of complaint reporting platforms, there is no effective communication and participation platform to make major decisions, plans, project implementation, etc. Without a mass base, the public cannot effectively participate in WP prevention [18].

4. Suggestions on Urban WP Control and Water Body Protection

According to the problems of WP prevention in City A analyzed above, corresponding suggestions are given, and its system structure is shown in Figure 4.

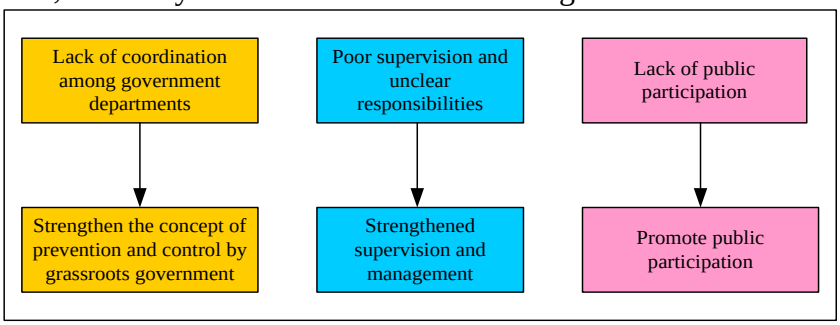

Figure 4. WP control countermeasure system

4.1. Focusing on the Combination of Prevention and Control, Promote the Comprehensive Management of Ecological Waters

Grass roots governments regard WP prevention and control as a systematic public management project. Therefore, before starting WP prevention and control, they should establish an effective leadership concept based on green assessment indicators and take comprehensive WP prevention and control measures. They should not only consider WP control issues, but ignore WP prevention issues. The general root and other key institutions involved in WP prevention and control should establish the concept of prevention and control.

4.2. Strengthen Supervision and Management in Multiple Ways

Monitoring, evaluation and efficiency are important tools to ensure efficiency. The effectiveness of WP prevention is closely related to the quality of people's life, so City A should attach importance to the role of monitoring and evaluation. Strengthen the monitoring of pollutants by enterprises and individuals, and impose strict administrative penalties on violators. In order to strengthen the internal supervision of the government, it is necessary to strengthen specific supervision, regularly report the problems found, unify the accounts and include them in the supervision list; Establish a scientific evaluation and implementation mechanism, evaluate standardized indicators, incorporate "green GDP" into the implementation assessment of urban managers, and improve the implementation assessment system of some water use indicators. The assessment is not only based on the field assessment, but also based on daily work. In addition, the evaluation of third-party organizations should be combined to emphasize the fairness, scientificity and efficiency of the evaluation; Give full play to the role of public opinion supervision, make use

of media monitoring, monitoring and systematic reporting, expose some typical negative enterprises for WP prevention, and appeal to the society to solve the WP problem.

4.3. Vigorously Promote the Public Participation Mechanism of WP Prevention

The formulation of a public participation mechanism in line with local conditions will effectively enhance the public's enthusiasm for WP prevention and control, effectively improve the effectiveness of WP prevention and monitoring, increase the government's confidence and attraction in this work, promote it to other work, and affect the environmental protection of the whole alliance. The prevention and control of WP has a strong public welfare nature and has a great impact on the environment. In recent years, this work has been constantly emphasized, only with the restriction and insufficient strength in the government led work. Therefore, it is more necessary to change the multi-level governance model led by the government, relevant departments, corporate governance, media and public supervision, and guide more stakeholders to participate. We should increase policy guidance and interpretation, strengthen public power, further change public attitudes, enable the public to participate in monitoring WP prevention and control, actively fulfill the obligation to protect water resources, and protect their interests through monitoring and reporting.

5. Conclusion

The urban water environment protection should be based on the existing development foundation and resources and environment endowment of the city, with the promotion of the health of the urban water environment ecosystem as the core, and the maintenance of public welfare functions as the overall goal, scientifically build the spatial development pattern of water and soil resources, optimize the urban industrial pattern, change the economic development mode, and form an intensive and economical ecological economic system, a harmonious and safe ecological environmental system. The WP control of City A should also follow this concept, so that the water environment of City A can be in a stable state.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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