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Evaluation on Detection Method of Lake Water Pollution Prevention and Control Based on Improved Neural Network

Sandra Edward*

Financial University under the Government of Russia Federation, 125993 Moscow, Russia

**corresponding author*

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Abstract: With the rapid development of computer vision technology, intelligent water pollution detection has been applied in the field of environmental protection, and lake water pollution detection has been a hot topic in the field of environmental protection. Based on this, this paper first discussed the elements of water ecological function zoning, focusing on the low water exchange capacity and population density of lakes, and expounded the current situation of serious non-point source pollution in lake basins. Then, this paper expounded the ideas and strategies of lake water pollution prevention and control, discussed the objectives of lake water pollution prevention and control, put forward the objectives and indicators of strengthening environmental management, and studied the policies and measures of lake water pollution control. The principle of detection and prevention of lake water pollution was analyzed, and the detection method of lake water pollution based on improved neural network was proposed. According to the experiment and investigation, in the framework of the lake water pollution prevention and control system, a new lake water pollution prevention and control system was constructed, which was 23% more satisfactory than the traditional lake water pollution prevention and control system.

1. Introduction

The traditional image-based lake water pollution technology has problems in practical application. The surface area to be detected is large, and the pixel points to be imaged are large. A large number of pixel information would be sent and processed, which leads to relatively slow detection speed of lake pollution and long detection delay, so it is difficult to quickly detect the impact of lake pollution on the environment. Therefore, it is a core issue in the field of environmental protection to quickly detect the pollution of lake water quality.

Detection and evaluation of water pollution prevention and control are widely used in lake water

pollution. Peller Julie R investigated the source and distribution of synthetic microfibers in the representative Lake Michigan basin in Indiana. Synthetic microfiber has also been quantified in the wastewater from local sewage treatment plants and laundry wastewater [1]. Misganaw Awoke assessed the situation of Tana Lake in a systematic way and applied causal analysis to water management. Primary and secondary data collection methods, as well as quantitative and qualitative methods, were used to collect the necessary data to develop a framework [2]. Rizk Roquia used multi-criteria decision-making technology and environmental impact assessment method based on physical and chemical parameters to compare with limit parameters and process data. According to the results of these methods, it is necessary to improve the water quality in the west of the lake by using several geoengineering treatment technologies [3]. KiliC Zeyneb believed that with the increase of the world population, the demand for water is also increasing. However, due to different impacts, especially human activities, water resources are being reduced, polluted and still being used unknowingly [4]. Wang Hua established a two-dimensional water environment model of Poyang Lake under the framework of the finite volume method, and calibrated it according to the field survey data. Poyang Lake is the research object to study the space-time water quality driving mechanism of Poyang Lake. The results showed that boundary input and self-purification have the most dominant effect on the water quality of Poyang Lake, followed by atmospheric sedimentation and sediment release [5]. The study of Jinadasa K. B. S. N found that the lack of regulation of urban development led to serious pollution of lakes. Comprehensive remedial measures need to be taken to improve the water quality of urban lakes in a sustainable way and serve the Kangti community and its cultural heritage [6]. The above studies have described the importance of water pollution prevention and detection, but there are still some deficiencies in the study of lake water pollution.

Many scholars have analyzed and studied lake water pollution. Elkhatib Dounia analyzed the methods used to collect, quantify and characterize microplastics in wastewater and drinking water. Researchers used different technologies to quantify the micro-plastics in the urban water system at all stages from collection to characterization [7]. Samanta Partha reviewed the latest research progress in the sensing and storage of organic pollutants in advanced porous materials. In recent years, environmental pollution and its sequelae have become a global concern. Among all types of pollution, water pollution has been considered as a major threat in recent years [8]. Pico Yolanda found that the analysis, prevention and removal of micro-plastic pollution in water was considered to be one of the main problems facing the world at present. This view also summarized and provided the latest data on the source and generation of pollutants in aquatic ecosystems [9]. Hilili M H believed that most water-borne diseases were caused by the exchange of groundwater and pollutants, and most wells were polluted by these processes. This is one of the reasons for the increase in incidence rate of cancer in most developing countries [10]. Dai Yingjie found that due to the rapid development of the antibiotic industry, the dose standard of antibiotics in most countries and regions has not been clearly defined. The overuse and wanton discharge of antibiotics have also caused serious groundwater pollution [11]. Jung Jaeyoung K believed that the lack of safe drinking water is a global problem, and the reliable and easy method of detecting pollutants may be revolutionary [12]. The above studies have analyzed lake water pollution, but there are still some deficiencies in the research of water pollution prevention and detection.

In order to solve the problem of lake water pollution prevention and detection method, this paper studied the current development status of lake water pollution prevention and control, and analyzed the main problems of lake water pollution prevention and control. By introducing the neural network algorithm into the lake water pollution prevention detection method, a new lake water pollution prevention detection method was constructed. Compared with the traditional lake water pollution prevention detection method, the new lake water pollution prevention detection method constructed by using the neural network algorithm was more accurate and perfect for the monitoring

of lake water pollution.

2. Main Problems of Lake Water Pollution Prevention

2.1. Low Water Exchange Capacity and Population Density of Lakes

The low fluidity and low exchange capacity of the lake water body limit the self-purification ability of the lake, which is the objective reason for hindering the control of the water quality pollution of the lake. The lake surface is relatively large, and the water exchange is slow, which is the water body formed by the pond in low-lying land areas. The width of the lake water body is much larger than the width of the general river. The water flow is slow, and the water exchange capacity is low. The purification ability of the water itself is lower than its environmental capacity, which may cause the lake pollution. The water flow is slow and the exchange capacity is reduced, which would lead to the reduction of environmental capacity. The lake is rich in water resources, good in light and heat conditions, and good in soil conditions. Due to convenient transportation and other reasons, it has attracted a large number of population movements since ancient times. Now the important lake basin is also the most economically developed and populous area. As the population density is far higher than the average level, human activities in all lake basins are very intensive. The demand for natural resources is large, and the pollutant emissions are also large. The pollutant emissions generated in the development process cause serious load on the environment, far exceeding its ecological carrying capacity, as shown in Figure 1.

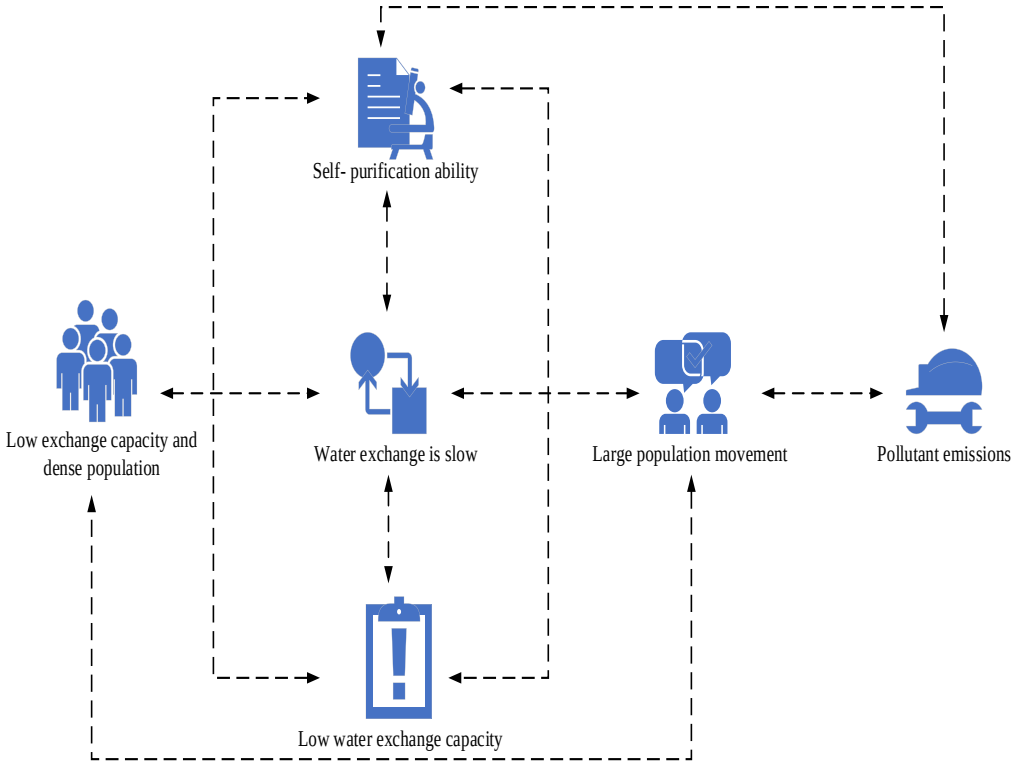


Figure 1. Low lake water exchange capacity and dense population

2.2. Serious Non-point Source Pollution in Lake Basin

Most lake basins are located in plains or valleys. This also means that there is a developed plant

and aquaculture industry, and all kinds of bait are widely used in fishery and aquaculture. Too much bait is directly put into the water body, polluting the water quality and soil, and accelerating the eutrophication of the lake. Overfishing led to the contraction of lakes, which led to a series of environmental problems, such as water quality degradation and wetland degradation. It has caused a series of ecological problems such as lake shrinkage, water quality deterioration and wetland degradation. At the same time, economically backward areas have a strong desire for development. In the conflict between economic interests and environmental protection, it is difficult to consider protecting the lake environment, and various chaotic governance phenomena continue [13].

3. Ideas and Strategies for Prevention and Control of Lake Water Pollution

3.1. Prevention and Control Objectives of Lake Water Pollution

It usually takes decades or more to set achievable goals for the prevention and control of lake water pollution. At present, all lakes are polluted to varying degrees, and the problems faced by economic and social development may lead to the deterioration of lake pollution in a short time. At this stage, the strategic plan for monitoring and preventing lake pollution focuses on strictly ensuring the quality and safety of existing drinking water sources. It is necessary to stop the general trend of Lake Eutrophication, reduce the concentration of water quality eutrophication indicators, and gradually improve the ecological environment of the lake area. The most important control direction in the future is to open up safe reserve water sources, reduce the eutrophication of most lakes, improve water quality types, and improve the ecological environment. Total phosphorus is the key indicator to control eutrophication. In view of the population density and water quality recovery difficulties of the lake basin, it is expected that the reduction target of total emissions would be more stringent than that of other regions, as shown in Figure 2.

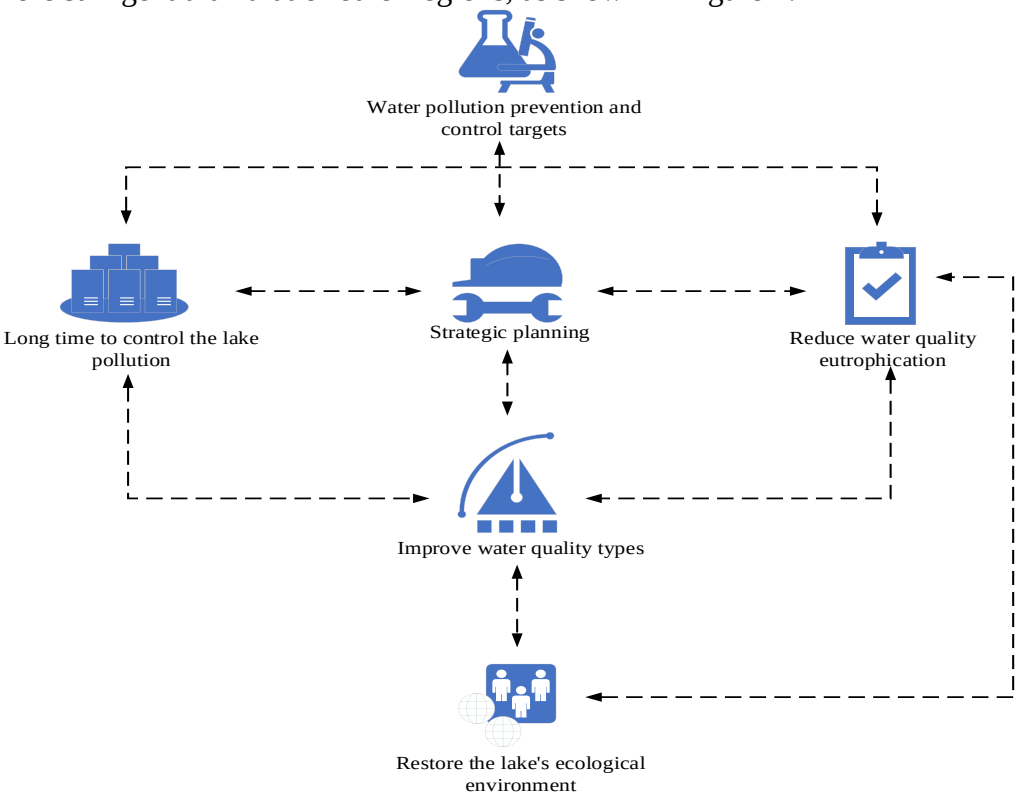


Figure 2. Lake water pollution prevention and control objectives

3.2. Strengthening Environmental Management Objectives and Indicators

In order to prevent eutrophication of water bodies, it is necessary to establish common objectives for controlling pollution sources entering the lake, and common baseline requirements for monitoring and evaluating ammonia and nitrogen. At the same time, the corrective requirements for controlling the discharge of non-point agricultural pollutants are put forward to control the aquaculture sector and aquaculture level. The source of drinking water in lakes and reservoirs is polluted and cannot be treated, so it is vital to protect water resources. It is necessary to strictly determine the scope of human activities in the reserve, determine the elimination of potential pollution risks, and develop and improve the water emergency plan. By increasing wastewater treatment and limiting pollutant discharge, lake water pollution can be reduced [14].

3.3. Lake Water Pollution Control Policies and Measures

The discharge license includes industrial wastewater, medical wastewater, etc. Since the pollution sources of lakes are often more intensive, the lake authority must issue a limited pollutant discharge license according to the environment and its own treatment capacity, strictly control the discharge of pollutants into the lake basin, and allow the use of regulatory means. In other words, according to the market regulations on pollution use and trade, the corresponding funds for the total amount of water pollution must be paid. At present, the sewage exchange system has achieved preliminary results. It is exploring experience, improving the market system, and gradually standardizing. The emissions are truly coordinated in the market, and the transaction reaches the optimal allocation. In order to achieve reasonable distribution, green river basin means organizing the construction process of industrial structure according to the capacity of water environment in the river basin, and discharging various pollutants mainly from the land into the river basin. In order to solve the environmental problems of lakes and control water pollution, the pollution sources should also be transported to the shore for treatment to control the pollution sources. People should control and strengthen the technological upgrading of industrial enterprises, increase the reuse of wastewater, and strictly control the discharge standards. They also should promote cleaner production, improve the technology of wastewater nitrification and dephosphorization, and expand the proportion of supporting pipe networks [15]. A basin water pollution control strategy based on “classification, region, classification and stage” should be put forward to build a green basin and reduce the material burden of lake pollution.

4. Detection and Prevention Principle of Lake Water Pollution

The lake water pollution detection technology is based on the average gray level of the image, which is to sense the lake water pollution in an intelligent way and reduce the losses caused by the lake pollution. The principle is as follows: in order to obtain the plane image of lake water pollution using the image recorder, the degree of lake pollution is inversely proportional to the gray level of the image, so the imported image can be divided into gray levels. It is necessary to determine the detection spatial location to obtain the spatial location of the lake water quality pollution to be detected. Using the known lake water quality information, the lake water quality range center would be used as the starting point for the test, and a circle would be set at this point. Using Formula (1) and Formula (2), this paper can calculate the gray mean value $Jave$ of the polluted area of lake water quality:

$$K = \sum \beta' \geq \beta \geq \alpha\delta' \geq \delta \geq \delta' - h(\alpha, \beta) \tag{1}$$

$$Jave = k(\alpha' + i') \tag{2}$$

The number of data transmission required can be calculated by using Formula (3):

$$T = Jave \cdot k \tag{3}$$

The size of the lake water pollution image set for data transmission is P. Using Formula (4), it is possible to calculate the time required for lake water pollution detection:

$$P = T / \beta \tag{4}$$

As mentioned above, assuming that the water quality area of a large number of lakes collected is relatively large, the amount of gray data in the lake pollution image calculated using Formulas (1) and (2) is relatively large. As a result, the number of information related to the lake water pollution image that needs data transmission calculated by Formula (3) is relatively large, which leads to a long time for Formula (4) to use the transmitted data. Therefore, lake water pollution cannot be detected quickly.

4.1. Detection Method of Lake Water Pollution Based on Improved Neural Network

When transmitting data related to lake water pollution, a large amount of data may need to be transmitted. These data can be represented by 0 and 1 strings. Therefore, it can compress data and speed up data transmission. Finally, the water quality pollution of the lake would be quickly detected. First, the data to be transferred is displayed as a string of 0 and 1. Generally, because the amount of data related to the lake water pollution image is relatively large, the document should set a string measurement standard, and only consider strings higher than this measurement standard. The general chain can be divided into standard length and compressed length chains. The marked string metric can be sorted by the sequence number of array rows through binary coding. Finally, people can create information about lake water pollution image and matrix mathematical model, as shown in Figure 3.

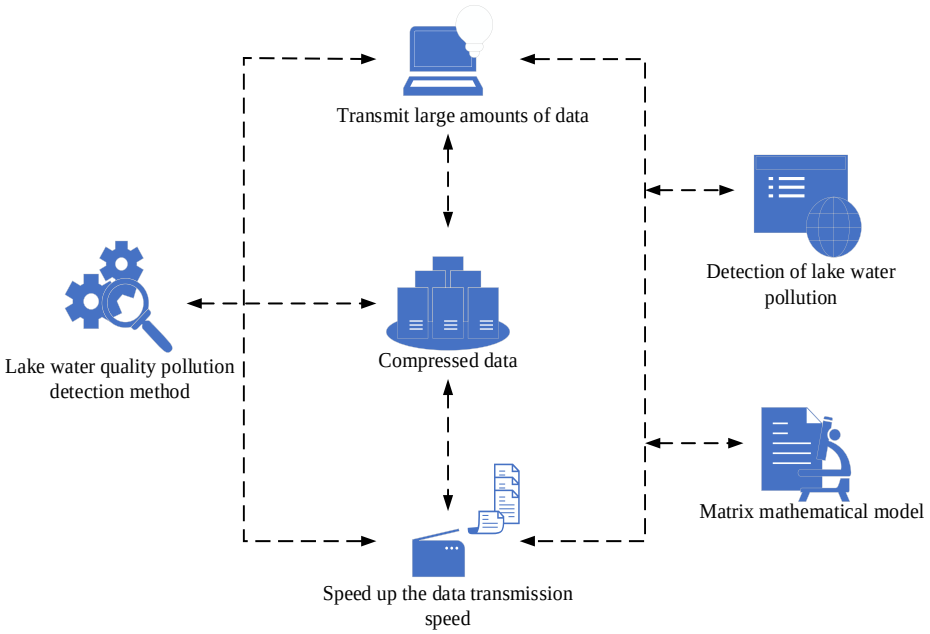
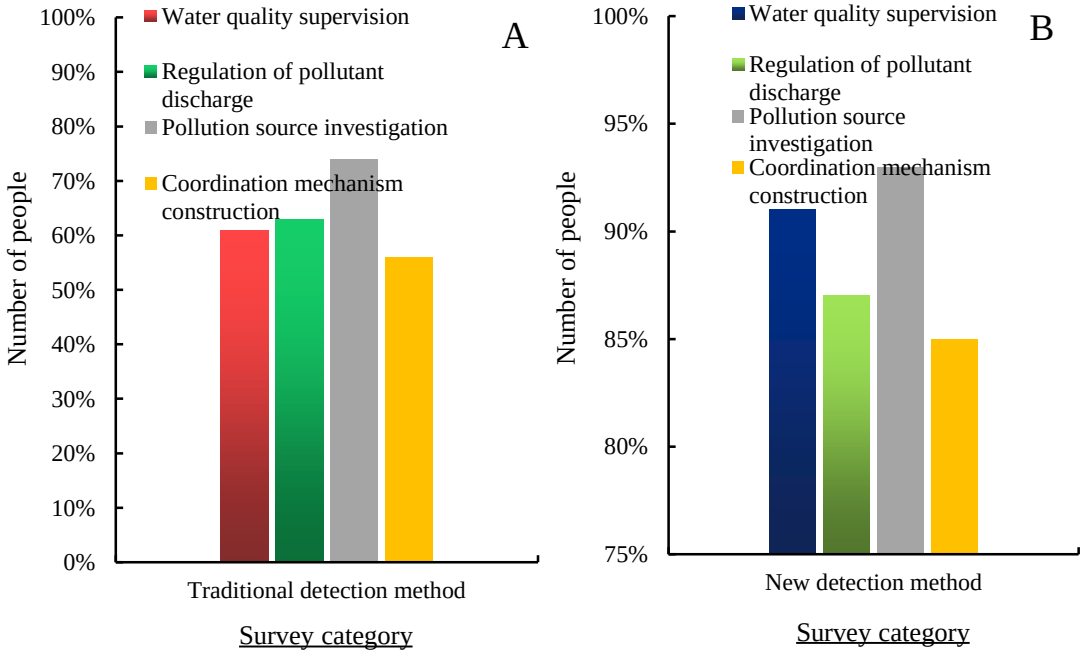


Figure 3. Lake water pollution detection method based on the improved neural network

5. Based on Neural Network Algorithm and Experimental Investigation and Evaluation

With the development of society, the water quality of lakes has been greatly damaged and polluted. The protection and improvement of lake water quality has become an important issue in development. In order to investigate the problems existing in the prevention and control of traditional lake water pollution, this paper conducted a survey on the employees of a certain environmental regulatory agency, and surveyed 100 employees. In the form of questionnaire survey, the staff's recognition of the traditional lake water pollution prevention and detection method was investigated, and the neural network algorithm was introduced into the framework of the lake water pollution prevention and detection method to build a new lake water pollution prevention and detection method. After practical application, the survey contents include the recognition of water quality supervision, pollutant discharge supervision, pollution source inspection and coordination mechanism construction. The proportion of the four issues is shown in Figure 4.



A. Staff recognition of the traditional lake water pollution prevention and control testing method

B. Staff recognition of the new lake water pollution prevention and control testing method

Figure 4. Staff recognition of the traditional and new lake water pollution prevention and control testing methods

Figure 4A shows the recognition rate of 100 employees of an environmental supervision and control institution surveyed in four aspects of water quality supervision, pollutant discharge supervision, pollution source investigation and coordination mechanism construction in traditional lake water pollution prevention and control. Figure 4B shows the proportion of recognition of 100 employees of an environmental regulatory agency surveyed in the four aspects of water quality supervision, pollutant discharge supervision, pollution source inspection and coordination mechanism construction in the prevention and control of water pollution in new lakes. Figure 4A shows that the employees of an environmental regulatory agency had different recognition levels for the four aspects of water quality supervision, pollutant discharge supervision, pollution source

inspection and coordination mechanism construction in the traditional lake water pollution prevention and control. Among them, 61% of the employees of the regulatory agency have recognized the water quality supervision in the traditional lake water pollution prevention and control, 63% of the pollutant discharge supervision, 74% of the pollution source inspection and 56% of the coordination mechanism construction. It can be seen from Figure 4B that the employees of an environmental regulatory agency had different recognition ratios for pollution source inspection and coordination mechanism construction in the prevention and control of water pollution in new lakes. Among them, 91% of the staff of the regulatory agency recognized the water quality supervision in the prevention and control of water pollution in new lakes; the proportion of pollutant emission supervision was 87%; 93% of pollution sources were identified and approved; the recognition of the construction of coordination mechanism accounted for 85%.

In order to investigate the effect of introducing neural network algorithm into the framework of lake water pollution prevention and detection method to construct a new lake water pollution prevention and detection method, 150 researchers from three environmental regulatory agencies were investigated. After applying the new lake water pollution prevention and detection method to lake water quality supervision, a questionnaire survey was conducted to compare the satisfaction of researchers with the traditional and new lake water pollution prevention and detection methods. The three environmental supervision institutions were set as A, B, and C, with satisfactory and unsatisfactory satisfaction respectively. The specific results are shown in Table 1.

Table 1. The researchers' satisfaction with the traditional and new lake water pollution prevention and control testing methods

	Traditional detection method		New detection method	
	Satisfied	Discontent	Satisfied	Discontent
A	71%	29%	91%	9%
B	68%	32%	93%	7%
C	65%	35%	89%	11%

It can be seen from Table 1 that the researchers of Institution A were 71% satisfied with the traditional lake water pollution prevention system and 29% dissatisfied with it. The researchers of Institution B were 68% satisfied with the traditional lake water pollution prevention system and 32% dissatisfied with it. The satisfaction rate of researchers from Institution C with the traditional lake water pollution prevention system was 65%, and the dissatisfaction rate was 35%. The satisfaction rate of researchers from Institution A with the new lake water pollution prevention system was 91%, and the dissatisfaction rate was 9%. The satisfaction rate of the researchers of Institution B with the new lake water pollution prevention system was 93%, and the dissatisfaction rate was 7%. The satisfaction rate of the researchers of Institution C with the new lake water pollution prevention system was 89%, and the dissatisfaction rate was 11%. According to the experiment and investigation, the neural network algorithm was incorporated into the framework of the lake water pollution prevention and control system, and a new lake water pollution prevention and control system was constructed, which was 23% more satisfactory than the traditional lake water pollution prevention and control system.

6. Conclusion

The disappearance of lakes is a natural phenomenon. The purpose of human production should be to prevent its accelerated disappearance and reduce its impact on the lake to the equilibrium point where the lake can be restored. This is the original intention and basic management concept. Long-term and sustainable improvement measures have been taken to achieve results. This paper

proposed a lake pollution detection and control method based on improved neural network. The mathematical model of neural network was used to preprocess the information related to the lake pollution image, and binary coding was carried out to avoid the problem that the detection and control speed of traditional detection and control methods was relatively slow when the lake water pollution was serious, and improve the detection and control speed of lake pollution.

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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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