Water Pollution Problems and Prevention Strategies in Environmental Engineering Based in Artificial Intelligence Technology

Danna Zhang[*]

Philippine Christian University, Philippine

zhangdanna2022@163.com

[*]*corresponding author*

Keywords: Water Pollution Problems, Prevention and Control Strategies, Environmental Engineering, Artificial Intelligence Technology

Abstract: In recent years, the situation of water resources in many regions has been deteriorating day by day, with water quality deterioration, various kinds of pollution, water shortage and other problems coming one after another. This can not only make the industrialization and agricultural production in trouble or even unable to continue to develop, but also cause great economic losses to the society, affect the sustainable development of the society, and pose a great threat to the survival of mankind. Many researchers have provided new ideas for the study of water pollution (WP) problems and prevention strategies, and this paper takes this as the research direction and basis. This paper analyzes the content of environmental engineering with AI technology, and then carries out academic research and summary on WP problems and prevention strategies and AI technology environmental engineering related research on WP problems and prevention strategies. This paper then establishes an algorithm model, and proposes relevant algorithms to provide theoretical basis for WP problems and prevention strategies in environmental engineering based on artificial intelligence technology. At the end of the paper, the simulation experiment is carried out, and the experiment is summarized and discussed. According to the distribution of the total amount of sewage in the cities in the region, the total amount of sewage in the city has been decreasing year by year since 2018. As one of the main sources of urban sewage, industrial sewage and domestic and commercial sewage are also related. This paper takes it as an example to analyze the reasonable index of the project content of a sewage treatment plant. Among them, the reasonable index difference of pipe diameter and slope before and after use is 3, the reasonable index difference of pipe network is 5, and the reasonable index difference of quantities is 4. This paper concludes that the project of sewage treatment plant after adopting this method is more reasonable. At the same time, with the in-depth study of artificial intelligence technology and environmental engineering, the research of WP problems and prevention strategies is also facing new opportunities and challenges.

1. Introduction

At present, the problem of WP has become increasingly prominent and has become the main factor affecting the sustainable and healthy development of the economy. To promote the sustainable and healthy development of society and economy, people must strengthen the control of water resources. However, at present, the public's awareness of WP prevention and control is not strong. The relatively backward and imperfect supporting facilities for WP control lead to the low level of WP control, and the WP problem has not been effectively treated. Therefore, relevant departments should take corresponding measures to improve the treatment effect and quality according to the current situation, and prevent WP from further worsening to better adapt to the requirements of social development.

Research on WP problems and prevention and control strategies: Ahmed Shahid's research shows that citizen participation in awareness-raising campaigns and strict implementation of environmental laws by relevant institutions are appropriate solutions to control environmental degradation. It is recommended to have an appropriate waste treatment system. Waste should be treated before entering rivers and water bodies [1]. Chen Sophia Shuang studied that man-made pollution plays an important role in the deterioration of river water quality around the world, especially in urban areas where water quality monitoring is still seriously restricted by limited testing facilities and capacity [2]. Pico Yolanda believes that the analysis, prevention and removal of micro-plastic pollution in water is considered to be a major problem at present [3]. Elkhatib Dounia reviewed and 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 from collection to characterization [4]. Li Jing found during the study that industrial R&D investment, wastewater treatment investment management, education level of labor force and water price have made significant contributions to biased technological progress [5]. In his study, Quesada Heloise Beatriz summarized the pollution of pollutants to water and reviewed the recent literature on the use of low-cost adsorbents to remove the main drugs found in surface water, focusing on urban and agricultural industrial wastes as precursors [6]. The above studies have achieved good results, but with the continuous updating of technology, there are still some problems.

Research on WP problems and prevention strategies based on artificial intelligence technology and environmental engineering. The purpose of Ighalo Joshua O research is to systematically analyze the literature on the application of different types of artificial intelligence models in surface water quality monitoring [7]. Alizadeh Mohamad Javad studied and discussed the impact of river flow on the performance of machine learning model, which is used to predict the water quality parameters of the coastal waters of the Pacific Shiloh Bay [8]. The main novelty of Barzegar Rahim's research is to establish a coupled model to predict water quality variables. Two traditional machine learning models, support vector regression and decision tree, have also been developed to compare with the deep learning model [9]. Peterson Kyle T results proved the strong correlation between non-optically active variables and WP. The developed framework provides an effective and accurate empirical method for inland water quality monitoring within the region [10]. Zhi Wei's research results show that collecting more data in dissolved oxygen peaks and valleys and areas where monitoring is scarce is crucial to solve the problem of data scarcity, which is a prominent challenge for the water quality community [11]. Xu Zuxin believes that the development of sewage system has not caught up with the urbanization rate of developing countries, which has caused serious consequences for the water quality of urban rivers [12]. The above research shows that the application of AI technology has a positive effect, but there are still some problems.

This paper studies the application of artificial intelligence technology and environmental

engineering in WP problems and prevention strategies, first analyzes the application of artificial intelligence technology in environmental protection, then gives its relevant content, and describes the application of artificial intelligence related algorithms in environmental engineering. Relevant algorithms are used to provide theoretical basis for the experiment. Finally, this paper compares and analyzes the environmental engineering of regional cities through the experiment, providing reference significance for such research.

2. Application of Artificial Intelligence Technology in Water Environment Protection

2.1. Main Problems in WP Prevention and Control

Here are some main problems related to WP prevention and control, as shown in Figure 1:
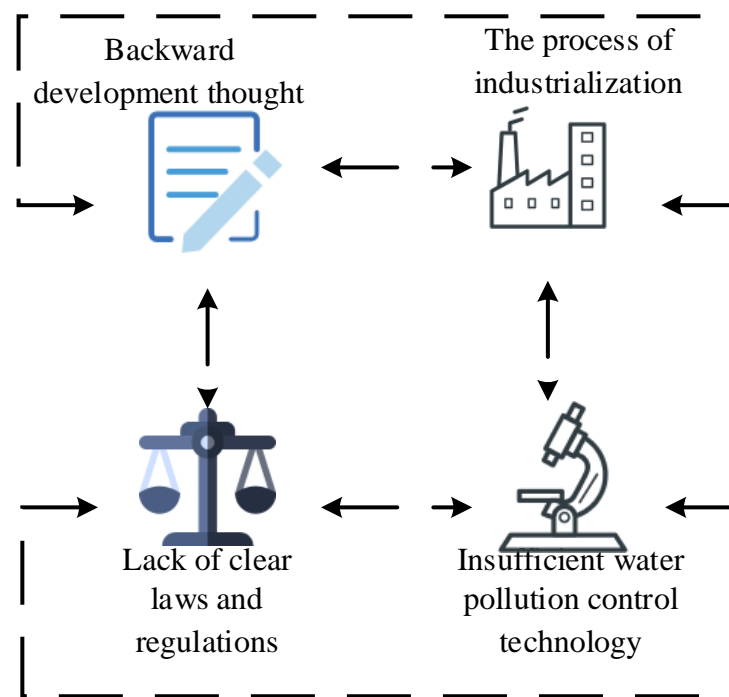
Figure 1. Major problems facing water pollution prevention and control

2.1.1. Backward Development Thought

The social and economic development of most regions has always been to develop first and then govern. Under the guidance of this ideology, many regions often ignore the impact of WP and only focus on economic development and economic benefits. The economic benefits obtained in these areas are all at the cost of the environment, and the overall benefits are not high, so that some problems occurred in the later stage, affecting the sustainable development of the economy.

2.1.2. Lack of Clear Laws and Regulations

At present, the laws and regulations on WP control are not perfect and have no clear provisions on WP. Due to the imperfection of laws and regulations on WP control, it is difficult to implement them, resulting in the lack of pertinence and operability of the control work and the failure to achieve the expected control effect.

2.1.3. Industrialization Process

The acceleration of urbanization makes the quality of urban sewage worsen continuously, and unreasonable discharge would aggravate the WP problem and seriously affect the control of WP. In addition, modern society has entered an industrialized society. The development of industry has made environmental pollution increasingly serious. The arbitrary discharge of various non-ferrous metal waste liquid and toxic gases has increased the difficulty of environmental governance [13].

2.1.4. Insufficient WP Control Technology

WP control has a long way to go. To improve environmental quality, advanced WP control technology must be adopted. At present, the WP control technology in developing regions is relatively backward and mainly depends on chemical treatment. Chemical methods have made some achievements in the treatment of water quality problems, but under the increasingly serious WP problem, chemical methods have gradually revealed their shortcomings [14].

2.2. Specific Measures for WP Prevention

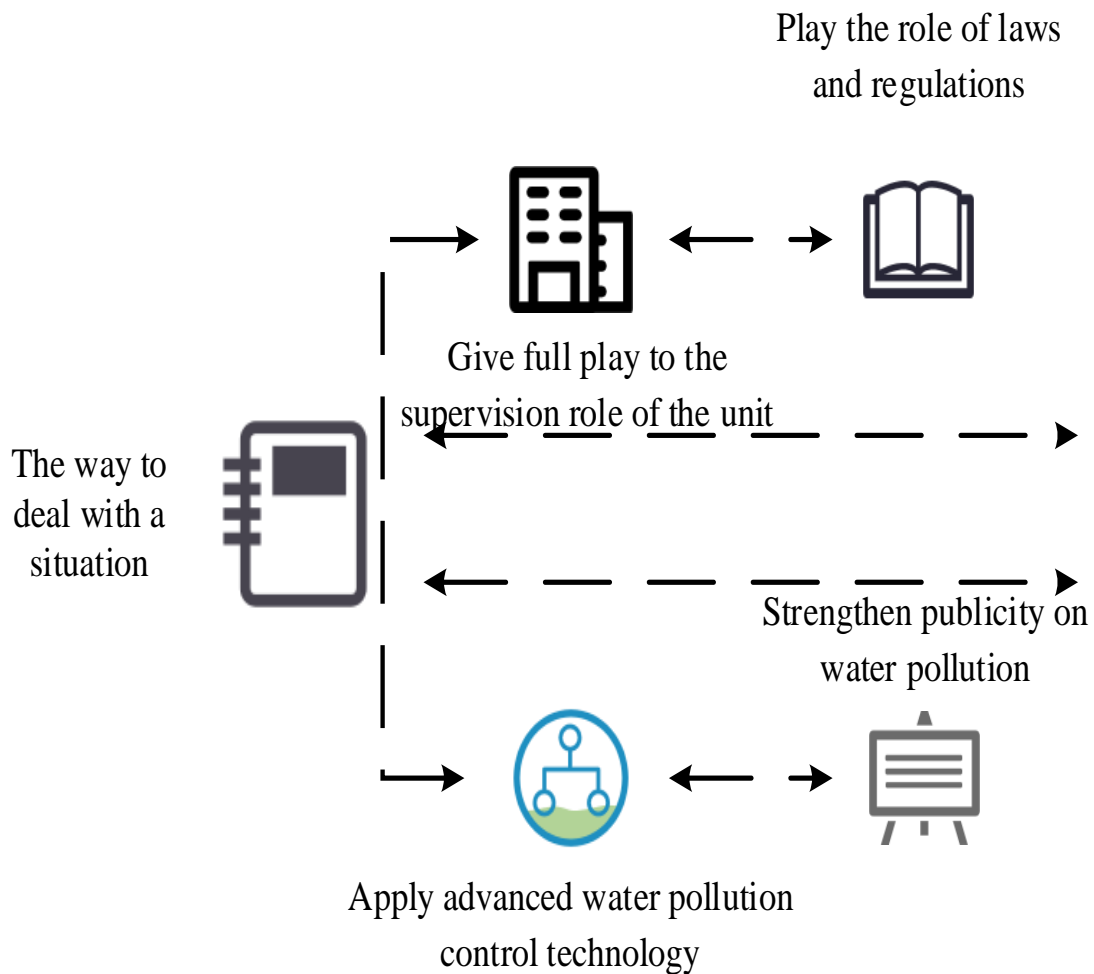Specific countermeasures for WP prevention and control are summarized here, as shown in Figure 2:

Figure 2. Specific countermeasures for water pollution prevention and control work

2.2.1. Give Full Play to the Supervision Role of the Unit

Under the current social development background, WP control has become an important part of environmental protection. This requires relevant units to improve their understanding of WP as a whole and establish the idea of coordinated development of economy and environment. The unit should combine the water environment governance with the public administration function of the unit, so that the unit can supervise the development of the market and make the behavior of enterprises and individuals more standardized; Enterprises must fully recognize the importance of sustainable development, formulate scientific and unified strategic decisions, and integrate water environment governance into the company's strategic decisions to promote the comprehensive development of environmental protection.

2.2.2. Play the Role of Laws and Regulations

Laws and regulations are the premise and guarantee for effective control of WP. In order to further improve the effect of WP prevention and control, the relevant departments should speed up the revision, adjustment and improvement of relevant laws and regulations, implement unified planning, management and legislation according to the characteristics of each region, especially the key control regions, and formulate corresponding pollutant discharge standards according to the characteristics of water resources and biological environment of the basin. People should bring WP control into the scope of legislation, strengthen the implementation of laws and regulations, and severely punish acts that hinder WP control.

### 2.2.3. Application of Advanced WP Control Technology

Technology is a very important aspect in WP control. The application of advanced WP control technology can effectively control water quality and achieve the purpose of water quality control. In terms of WP control technology, it is necessary to strengthen the support in this regard, commend the units and individuals that have made outstanding contributions to wastewater treatment, and continue to improve wastewater treatment technology. At the same time, people should strengthen the research and development of sewage treatment, wastewater purification and other technologies, actively learn from advanced technologies, and use advanced technologies to improve the effect of WP control.

2.2.4. Strengthen Publicity on WP

WP control needs the joint efforts of all the people, and it is difficult to control it by one. Therefore, the department should strengthen the publicity of WP, raise the public's attention to WP prevention and control, improve the public's enthusiasm for WP prevention and control, and promote the effective implementation of WP prevention and control.

2.3. Application of AI Technology in Environmental Protection

The application of AI technology in environmental protection is summarized and analyzed here, as shown in Figure 3:
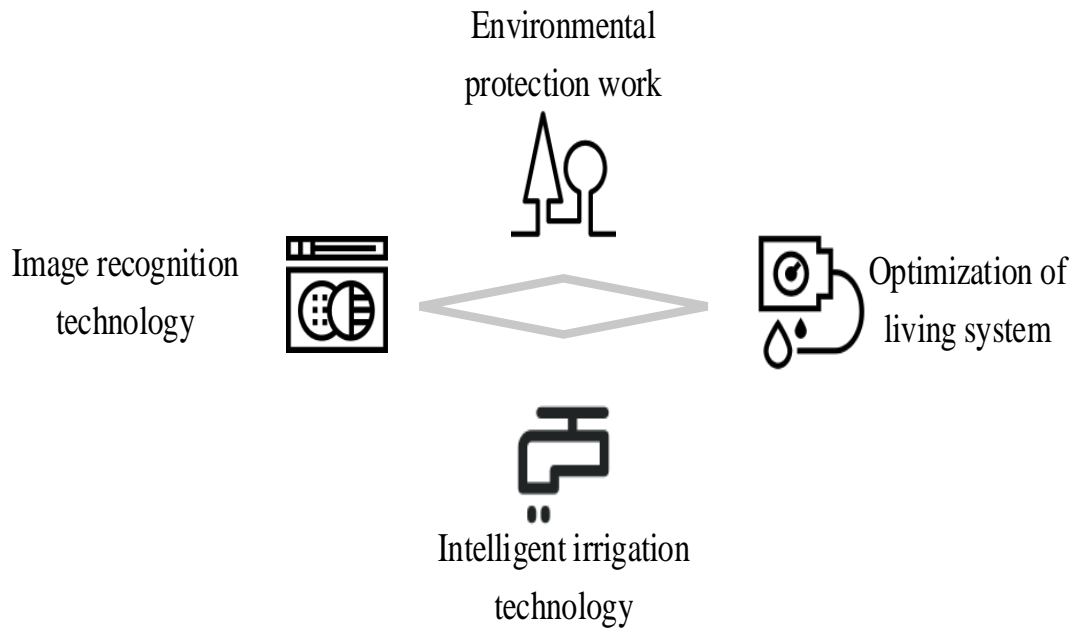
Figure 3. Application of artificial intelligence technology in environmental protection

2.3.1. Optimization of Living System

At present, the whole region is improving the situation of WP. The resource consumption in developing regions mainly comes from industrial production and domestic consumption. Urban buildings consume a lot of energy through heating and cooling every year. If the heating and cooling systems are closed, the quality of life of users would be seriously affected. However, if the system is not optimized, the energy problems and resources can not be improved at all, so as to promote sustainable development and resource protection.

2.3.2. Intelligent Irrigation Technology

Many developing areas are mainly agricultural, and a large amount of water resources are used for irrigation every year. However, due to the relatively backward irrigation methods in the past, the annual consumption of water resources is very large, which has seriously affected the production and life of some water shortage areas. In order to solve this problem after the advent of artificial intelligence technology, many experts and scholars began to study intelligent irrigation technology. At present, intelligent irrigation software has become the key technology of modern agricultural well irrigation management. Through it, farmers can realize automatic irrigation, reduce artificial waste, reduce planting costs, improve production efficiency and save water resources [15].

2.3.3. Image Recognition Technology

Using image recognition technology to identify specific insects can effectively reduce user consumption as an effective pest control method without affecting the surrounding natural and social environment. The intelligent pest control system is equipped with automatic identification function. Once the user captures the pest and uploads it to the system, the system would automatically provide all information about the pest and how to control the pest, so as to provide the user with a better control plan.

2.3.4. Environmental Protection

With the continuous development of artificial intelligence technology, the quality and efficiency of environmental protection work have been further improved, environmental protection management is more simple, and the work pressure and burden of employees have also been reduced. However, how to deal with the environmental protection problems caused by climate change is still a problem that relevant people should think about. For example, intelligent thermostat is more suitable for indoor environment than outdoor. Therefore, environmental protection people combine artificial intelligence technology with unmanned aerial vehicle technology to conduct comprehensive monitoring of atmospheric, soil, WP, solid waste and other pollution.

3. Application of AI Related Algorithms in Environmental Engineering

The basic idea of support vector machine is to use nonlinear mapping function to map samples to high-dimensional feature space, and then obtain the best classification surface in high-dimensional feature space, so as to separate the training sample points from the best state, so as to achieve the maximum goal.

The basic principle is: the specified sampling set:

$$T = \{x_n, y_n \mid i = 1, 2, ..., l\} \tag{1}$$

x_n is an input vector, y_n is a corresponding desired output, and l is a sampling number.

A relaxation variable that can measure the actual index and the maximum support point l is proposed. Then, the best hierarchical hyperplane can be described as:

$$\min \frac{|w|^2}{2} + b \sum_{n=1}^{l} \tag{2}$$

In the formula, the weight carrier $|w|$ is the Euler norm of; B is the penalty coefficient used to verify the penalty coefficient of improper sampling distribution. The introduction of Lagrange coefficient transforms the above optimization problem into an optimization problem in square programming. Because the environment data is not linear, it is necessary to map the sample from the original input space to the space of the towering function, and then construct the optimal classification hyperplane.

Finally, the classification decision function is obtained:

$$f(x) = sign\left(\sum_{n=1}^{l} a_n y_n k(x_n, y_n) + b\right) \tag{3}$$

The radio function with global convergence and strong adaptability is selected here:

$$k(x_n, x_m) = \exp\left(-\frac{|x_n - x_m|}{2g^2}\right) \tag{4}$$

The idea of particle swarm optimization algorithm comes from the imitation of bird feeding behavior, and seeks the optimal solution through the cooperation and information exchange between population units. The principle is as follows: In search space D, the population $X = (X_1, X_2, ..., X_n)$ composed of n particles can calculate the efficiency value corresponding to the position of each particle according to the objective function. During each iteration, particles

update their speed and position through individual extremum and group extremum:

$$X_{nd}^{k+1} = X_{nd}^k + V_{nd}^{k+1} \quad (5)$$

In the formula: P is the inertia weight; $d = 1,2,...,D$; $n = 1,2,...,k$; K is the current iteration number; V_{nd} is the velocity of the particle.

4. WP Environmental Engineering

All kinds of sources in the environment are subject human beings. Because there is an optimal fairness or an optimal point to carry environmental capacity at different production levels. If it is strengthened, the environmental quality would decline. Therefore, in the process of changing the environment, people need to maintain a dynamic balance between themselves and the environment. Randomly select a city in a certain region as the experimental object, analyze the total amount of urban sewage and the respective share of industry and domestic commerce, and then based on the above analysis of artificial intelligence technology and environmental engineering, analyze the rationality of sewage treatment plants in the target city before and after the use of this method. Table 1 shows the wastewater discharge in the region from 2018 to 2022

Table 1. shows: wastewater displacement in this area from 2018 to 2022

	Total sewage (100 million tons)	Industry (100 million tons)	Domestic commerce (100 million tons)
2018	813.5	642.1	171.4
2019	804.8	596.5	208.3
2020	782.6	512.4	270.2
2021	768.4	395.5	372.9
2022	754.6	346.4	408.2

It can be seen from Table 1 that the total amount of sewage in the city has been decreasing year by year since 2018. As one of the main sources of urban sewage, industrial sewage and domestic and commercial sewage are also related. Among them, the total industrial sewage in 2018 was 78.9% of the total, in 2019 was 74.1% of the total, and in 2020 was 65.5% of the total. By 2021, the total industrial sewage began to decline rapidly, accounting for 51.5% of the total, which was 14% lower than that in 2020, and until 2022, the total industrial sewage was 45.9% of the total. At this time, the total industrial sewage began to be countered by domestic and commercial sewage. From the above relevant data, it can be inferred that the city should be an industrialized city with the secondary industry as the main industry before 2020, and gradually develop to the tertiary industry from 2021.

Apply the artificial intelligence technology mentioned above to a sewage treatment plant in the city, and compare the reasonable indexes of the four environmental engineering contents before and after their use, as shown in Figure 4:
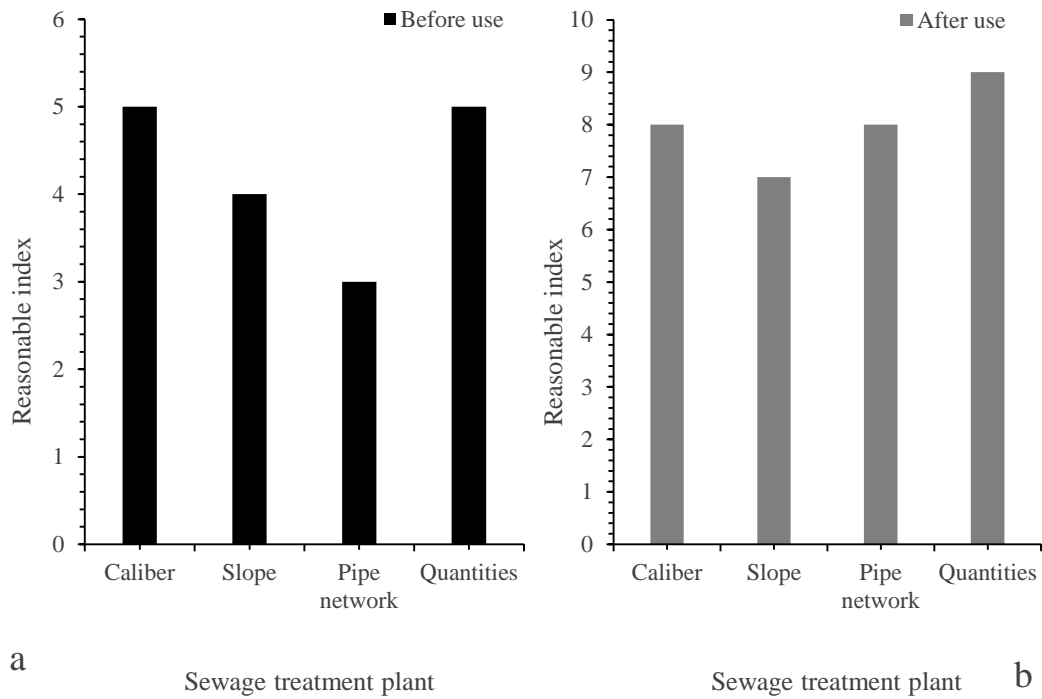
Figure 4a. Reasonable index of the sewage treatment plant before use
Figure 4b. Reasonable index of sewage treatment plant after use

Figure 4. Reasonable index of the sewage treatment plant before and after the use

Figure 4a shows the reasonable index of the four environmental projects in the sewage treatment plant before the use of AI technology, and Figure 4b shows the reasonable index of the four environmental projects in the sewage treatment plant after the use of AI technology. It can be seen from Figure 4 that the reasonable index of pipe diameter, slope, pipe network and quantity in the project content of the sewage treatment plant before use is 5, 4, 3 and 5 respectively; However, the reasonable index of pipe diameter is 8, the reasonable index of slope is 7, the reasonable index of pipe network is 8, and the reasonable index of work quantity is 9 in the project content of the sewage treatment plant after using the relevant methods of artificial intelligence.

Among them, the reasonable index difference of pipe diameter and slope before and after the use of artificial intelligence technology is 3, the reasonable index difference of pipe network is 5, and the reasonable index difference of engineering quantity is 4. It is concluded that the project of sewage treatment plant after adopting this method is more reasonable.

5. Conclusion

WP is an important reason for the shortage of water resources, and seriously affects the use of water resources, resulting in water shortage in many areas. WP in many areas has become more common, so it is necessary to study the prevention and control of WP and its countermeasures to realize the sustainable use of water resources. This paper studies the WP problems and prevention strategies in environmental engineering based on artificial intelligence technology, starting with the analysis of the application of artificial intelligence technology in water environmental protection, providing a theoretical basis for the research of methods, and then studies the relevant algorithms of artificial intelligence to provide a reference for the later study of environmental engineering. Finally, based on a sewage treatment plant in the city above, it compares and analyzes the reasonable values before and after using this method, It is concluded that the project of sewage treatment plant after

adopting this method is more reasonable.

Funding

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.

References

[1] Ahmed, Shahid, and Saba Ismail. "Water pollution and its sources, effects & management: a case study of Delhi." Shahid Ahmed and Saba Ismail (2018)'Water Pollution and its Sources, Effects & Management: A Case Study of Delhi', International Journal of Current Advanced Research 7.2 (2018): 10436-10442.

[2] Chen, Sophia Shuang. "Assessment of urban river water pollution with urbanization in East Africa." Environmental Science and Pollution Research 29.27 (2022): 40812-40825.

[3] Pico, Yolanda, and Damia Barcelo. "Analysis and prevention of microplastics pollution in water: current perspectives and future directions." ACS omega 4.4 (2019): 6709-6719.

[4] Elkhatib, Dounia, and Vinka Oyanedel-Craver. "A critical review of extraction and identification methods of microplastics in wastewater and drinking water." Environmental Science & Technology 54.12 (2020): 7037-7049.

[5] Li, Jing, Kok Fong See, and Jin Chi. "Water resources and water pollution emissions in China's industrial sector: A green-biased technological progress analysis." Journal of cleaner production 229.8 (2019): 1412-1426.

[6] Quesada, Heloise Beatriz. "Surface water pollution by pharmaceuticals and an alternative of removal by low-cost adsorbents: A review." Chemosphere 222.5 (2019): 766-780.

[7] Ighalo, Joshua O., Adewale George Adeniyi, and Gonçalo Marques. "Artificial intelligence for surface water quality monitoring and assessment: A systematic literature analysis." Modeling Earth Systems and Environment 7.2 (2021): 669-681.

[8] Alizadeh, Mohamad Javad. "Effect of river flow on the quality of estuarine and coastal waters using machine learning models." Engineering Applications of Computational Fluid Mechanics 12.1 (2018): 810-823.

[9] Barzegar, Rahim, Mohammad Taghi Aalami, and Jan Adamowski. "Short-term water quality variable prediction using a hybrid CNN–LSTM deep learning model." Stochastic Environmental Research and Risk Assessment 34.2 (2020): 415-433.

[10] Peterson, Kyle T., Vasit Sagan, and John J. Sloan. "Deep learning-based water quality estimation and anomaly detection using Landsat-8/Sentinel-2 virtual constellation and cloud computing." GIScience & Remote Sensing 57.4 (2020): 510-525.

[11] Zhi, Wei. "From hydrometeorology to river water quality: can a deep learning model predict dissolved oxygen at the continental scale?." Environmental science & technology 55.4 (2021): 2357-2368.

[12] Xu, Zuxin. "Urban river pollution control in developing countries." *Nature Sustainability* 2.3 (2019): 158-160.

[13] Dwivedi, Sanjay, Seema Mishra, and Rudra Deo Tripathi. "Ganga water pollution: a potential health threat to inhabitants of Ganga basin." *Environment international* 117.8 (2018): 327-338.

[14] Tang, Yankui. "Emerging pollutants in water environment: Occurrence, monitoring, fate, and risk assessment." *Water Environment Research* 91.10 (2019): 984-991.

[15] Rink, Karsten. "Virtual geographic environments for water pollution control." *International Journal of Digital Earth* 11.4 (2018): 397-407