Scholar Publishing Group
Water Pollution Prevention and Control Project
https://doi.org/10.38007/WPPCP.2021.020103
ISSN 2790-2730 Vol. 2, Issue 1: 22-31

Contemporary Water Pollution Prevention Planning Based on Neural Network

Almothana Albukhari*

National Research and Innovation Agency (BRIN) of Indonesia, South Tangerang 15314, Indonesia

**corresponding author*

Keywords: Neural Networks, Water Pollution, Water Resources, Prevention and Control Planning

Abstract: With the rapid development of the economy, the problem of environmental pollution is becoming more and more serious, which has attracted the attention of people from all walks of life. Therefore, in the planning and construction of governance of water resources issues, a path of green environmental protection and sustainable scientific development should be taken. First of all, by starting from the protection of the natural environment, people's living standards have been continuously improved. Industrial production technology has also made great progress, and the demand for water resources is increasing; secondly, environmental protection awareness should be strengthened and measures such as rational use of resources should be taken to reduce environmental damage and waste; finally, the construction of relevant laws and regulations and governance system is urgent. In the traditional governance of water resources issues planning model, it relies too much on the professional knowledge and subjective assumptions of managers and researchers, and can not respond in time when water pollution hazards occur. The means to deal with water pollution problems are relatively simple. To solve these problems, this paper proposed a modern water pollution prevention and control planning model based on neural network technology and intelligent algorithm. Through the comparative analysis of the experimental results, it could be seen that the innovative governance of water resources issues planning model had an average increase of 10.7% in the four evaluation indicators compared with the traditional governance of water resources issues planning model.

1. Preface

Environmental problems are closely related to life. However, with the rapid economic

development, people's requirements for living conditions have become increasingly high, and various sewage discharges have also become one of the urban pollution sources. In the situation of water resource shortage, all kinds of living water bodies discharged directly or indirectly into the water system by drinkers would cause serious consequences, so it is urgent to protect and control the water quality. The protection of ecological water environment is a major event related to the sustainable development and healthy survival of human settlements. At the same time, the rational use of water resources can not only save water resources, but also play a positive role in promoting the progress of human civilization and improving people's quality of life. Therefore, the research and application of relevant prevention and control planning should be paid attention to and strengthened.

Some researchers in the field of water pollution have explored and studied the water pollution problems that have occurred in recent years, thus providing valuable insights for the prevention and control of water pollution problems. Through the study of the water pollution problems in the local surrounding waters, Akpomie Kovo G combined with the emerging pollutant adsorption technology to purify different water pollution problems, and obtained that the use of targeted pollution adsorption technology in water pollution problems was very reliable, thus enriching the local water pollution prevention and control measures [1]. Quesada Heloise Beatriz summarized and analyzed the governance of water resources issues plan of local waters, and studied more efficient and low-cost prevention and control measures to replace the costly technology in traditional prevention and control measures, which opened up a new development direction for the local water pollution prevention and control plan [2]. Li Jing studied the utilization efficiency of local water resources and the prevention and control effect of water pollution. Based on the comparison with the surrounding areas, the development direction of local water pollution prevention and control planning was summarized and the development ideas were expanded [3].

By investigating and analyzing the water resource load in the local and surrounding areas, and combining with data analysis, Mekonnen Mesfin M obtained the fact that the per capita water resource allocation was too low and the water pollution problem was becoming more and more serious, and thought about the efficient use of water resources and the prevention and control of water pollution problems [4]. Jung Jaeyoung K explored the causes of water pollution in the context of local water shortage, and combined with sensing technology to monitor the source of pollutants and classify them, thus proving the reliability of this technology in water pollution detection [5]. Pico Yolanda studied the local governance of water resources issues planning and specific measures, and combined with the latest classification standards for water pollution. He assessed the local water pollution prevention and control level, and put forward valuable suggestions on the development of local water pollution prevention and control planning, which promoted the local water pollution prevention and control planning process [6].

Elkhatib Dounia obtained the severity of local water pollution problems through the study of the water quality of local drinking water and wastewater, and put forward different water pollution improvement schemes in combination with different pollutant adsorption technologies. He obtained the optimal water pollution purification scheme through comparison, which enriched the local water pollution prevention and control measures [7]. Wang Hua observed and studied the water quality evolution process of the largest local water area, and combined with the regional sampling survey method. He obtained the change trend data of each region, and obtained the natural law of water quality evolution and the bearing capacity of water self-purification after comparative analysis, which had a significant role in promoting the construction of local water pollution prevention and control projects [8]. Singh Nirala studied the severity of the local water pollution problem, and combined with the analysis of the composition of pollution sources. He found the efficient role of electrocatalysis technology in the remediation of pollutants [9]. This contributed to the sustainable

development of local water resources utilization.

In addition, some scholars have studied and analyzed the prevention and control measures for water pollution, hoping to open up a new development direction for the prevention and control planning of water pollution. Nait Amar Menad proved the reliability of this technology in acquisition, monitoring and prediction through the optimization research of water alternating gas injection. Combined with artificial neural network technology and genetic algorithm, he opened up the field width for the development direction of water pollution prevention and control construction [10]. Picos Alain studied the impact of industrial water pollution on local water resources. By combining the artificial neural network and intelligent algorithm introduced, the theoretical framework of industrial water pollution prevention and control was proposed. The research results showed that the combination of this framework could effectively improve the impact of industrial water pollution on local water resources [11]. Abba S. I studied the impact of water pollution in locally managed healthy aquatic ecosystems. Combined with artificial neural network and computer technology, the framework of the prediction model was proposed, and the effectiveness of the model was proved through experiments, which promoted the construction process of local water pollution prevention [12]. However, none of the above studies put forward a relatively complete plan for governance of water resources issues, which needed further study.

In order to solve the traditional governance of water resources issues planning model, this paper summarized and analyzed the traditional governance of water resources issues planning, and showed its advantages and disadvantages. By combining artificial neural network and intelligent algorithm, a new governance of water resources issues planning model was proposed. This model could monitor and predict water pollution problems in a timely manner, and would have a more efficient response ability in the face of sudden water pollution problems.

2. Technical Evaluation of Water Pollution Prevention and Control Planning

Artificial neural network is composed of a large number of neurons by simulating the mechanism of human brain neural system. Its main function is to process the complex nonlinear information in human brain, and then apply it to the planning and construction of water pollution prevention. In many cases, in order to solve some water pollution monitoring and prediction problems, people usually use simple, efficient, easy to implement and large-scale integrated computing technology to complete. The artificial neural network system has strong adaptability and fault-tolerant control ability. When the water environment is affected by external pollution factors, it can automatically adjust its own state to cope with changes and conduct real-time monitoring and comparison of the water state [13].

Each neural network is formed by the interaction of multiple neural units in a specific combination way. According to the combination structure, the classification of neural networks can be roughly divided into three types of neural networks: feedforward, feedback and self-organization. According to the existence form, the classification of neural networks can be roughly divided into global approximation neural networks and local approximation neural networks. This paper adopted multilayer feedforward structure neural network, which was relatively simple in structure and easy to understand. It was more convenient for this paper to introduce into the construction of governance of water resources issues planning model [14].

In this paper, the adaptive fuzzy neural network was divided into three layers: input layer, output layer and hidden layer. The collected samples are classified and distributed in a positive and interconnected network form, and the collected samples are fuzzed into input and output signals. With the continuous update of the adaptive fuzzy neural dynamic network, the process from output to input is also continuously updated, and different outputs are obtained. The core of the model is to

fuzzify the collected original samples into calculable data, and calculate the parameters through the least squares algorithm and the error back-propagation algorithm. This process that is constantly generated by the input and output data is the learning process of the model. After training and learning, a fuzzy neural network inference model is established to predict the water quality status of the water area. The structural flow of neural network is shown in Figure 1.

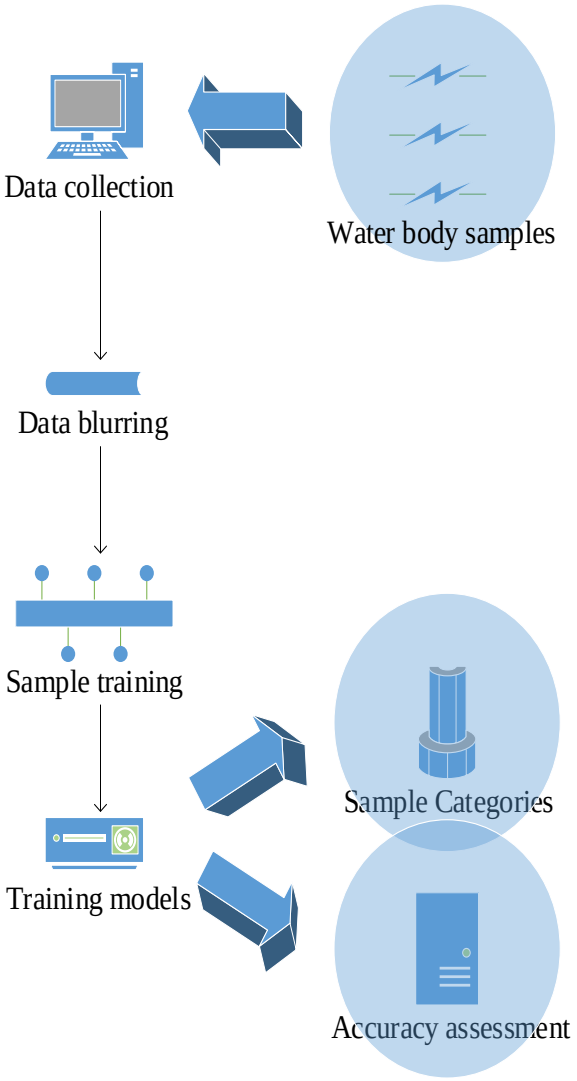


Figure 1. Neural network architecture flow

3. Development Evaluation of Governance of Water Resources Issues Plan

With the change of times and the development of society, water resources are still the basis of people's survival. It can provide material basis and living needs for people's survival. However, the increasingly serious water pollution problem would affect people's normal work, study and physical health. Water pollution refers to a series of problems caused by water pollution, such as sewage discharge and living water. Industrial wastewater contains a large number of harmful substances, and drinking water contains heavy metal ions. These harmful substances would cause great threat and damage to people's health, and the polluted water would also cause some diseases and other harmful diseases. The traditional water pollution control planning structure is shown in Figure 2.

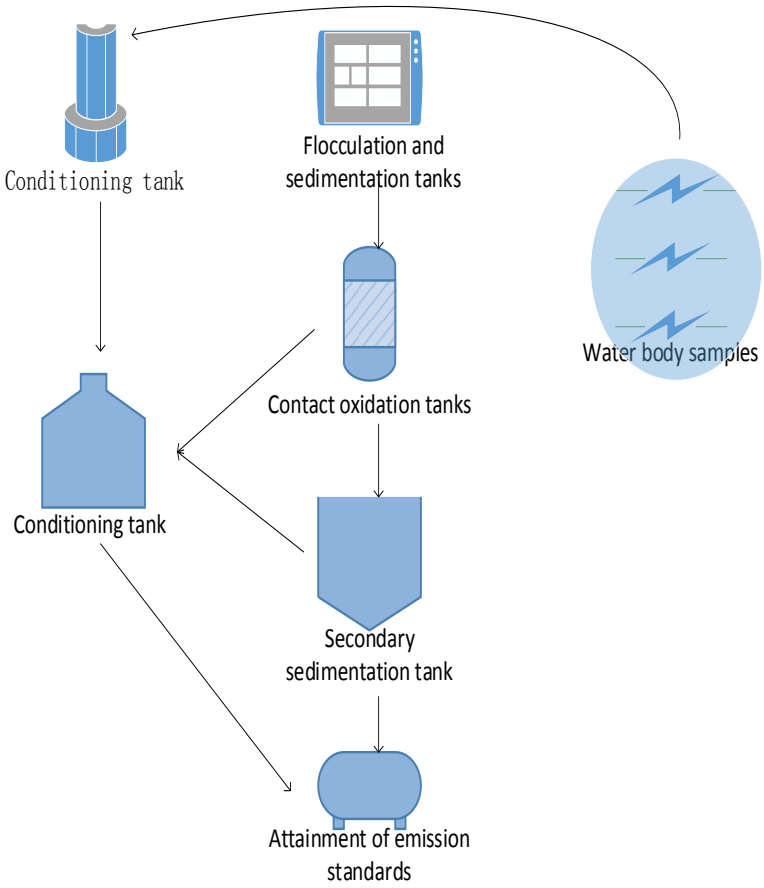


Figure 2. Traditional water pollution control planning structure

When the concentration of nitrogen and oxygen in the water is too high, it may induce the human body to react to harmful gases and cause diseases. When the water contains too much phosphate, it would lead to a large change in the cytoplasm. When people drink too much melamine solution, it would cause mental disorders, and even cause a series of symptoms such as cancer, which would cause psychological abnormalities and significant changes in physiology. The quality of water environment is closely related to whether people can live a healthy life, so it is urgent to improve the water pollution prevention and control plan. In recent years, most of the governance of water resources issues plans planned are to add chemical precipitators and drugs to the water system to purify the water quality, so as to maintain the water quality and prevent the occurrence of disasters such as diseases.

However, with the progress of industrial production and the advancement of urbanization, the composition of pollution sources of water pollution has become increasingly complex, and the main body of pollution has become more and more. This has led to the more bizarre and stubborn pollution capacity of pollutants, which has exceeded the current upper limit of governance of water resources issues capacity. Under the background that the current governance of water resources issues planning cannot meet the increasing pollution power hazards, it is necessary to build a new water pollution prevention and control planning and construction model. On the one hand, in addition to actively responding to the governance of water resources issues policies and formulating measures and management measures that are consistent with the coordination of water resources protection and development and utilization, it is also necessary to improve the relevant laws and

regulations on the damage to the ecological environment of the water system and strengthen the supervision. On the other hand, the development of the times should be followed by the introduction of science and technology to optimize the construction of the governance of water resources issues planning system.

4. Artificial Intelligence Algorithm Evaluation

4.1 Least Square Method

When the adaptive neural network has only one output, Formula (1) is used to calculate the output [15].

$$Out = F(\bar{A}, X) \tag{1}$$

Among them, F is a function of the input variable $\bar{A}$ and its corresponding parameter set X. It is assumed that there is a function W that satisfies the quantity relationship in Formula (2), and the function is calculated by Formula (3) if it satisfies the conditions for using the least squares method.

$$X = X_1 \oplus X_2 \tag{2}$$

$$W(Out) = W \circ F(\bar{A}, X) = W \circ F(\bar{A}, X_1 \oplus X_2) \tag{3}$$

According to Formula (3), when X_1 is determined, the least square method can be used to solve X_2. It is assumed that Y represents the unknown vector set of parameter X_2, and there is matrix formula $IY = S$. Among them, I and S are matrices, and matrix Y can be calculated by Formula (4).

$$Y = (I^T I)^{-1} I^T S \tag{4}$$

4.2 Backpropagation Algorithm

Each distribution layer of the adaptive network model contains many different distribution nodes. The back-propagation algorithm is mainly optimized for the update of training data. The operation flow of the algorithm is shown in Figure 3. It is assumed that the adaptive network model contains an C-layer structure, and there are $\#(V)$ nodes on the V th layer. It is assumed that the a th node on layer V is defined as (V, a) and the output is recorded as O, the output can be calculated by Formula (5).

$$O_a^V = O_a^V(O_1^{V-1}, \Lambda, O_{\#(v-1)}^V, \Lambda) \tag{5}$$

Among them, O_a^V represents not only the output of these points, but also the function of this node. The error change rate for nodes is shown by Formula (6).

$$\frac{\partial E_z}{\partial O_{n,z}{}^V} = -2(T_{a,z} - O_{a,z}{}^V) \tag{6}$$

Among them, $O_{n,z}^{V}$ is the output of the n th component of the z th group of data on the V th layer; $O_{a,z}^{V}$ is the output of the a th component of the z th group of data on the V th layer; $T_{a,z}$ is the a th component of the z th group of data on the V th layer; E_z is the objective function of the z th group of data. The above are some of the algorithms used in this paper. By using these algorithms, the model can run more efficiently and quickly.

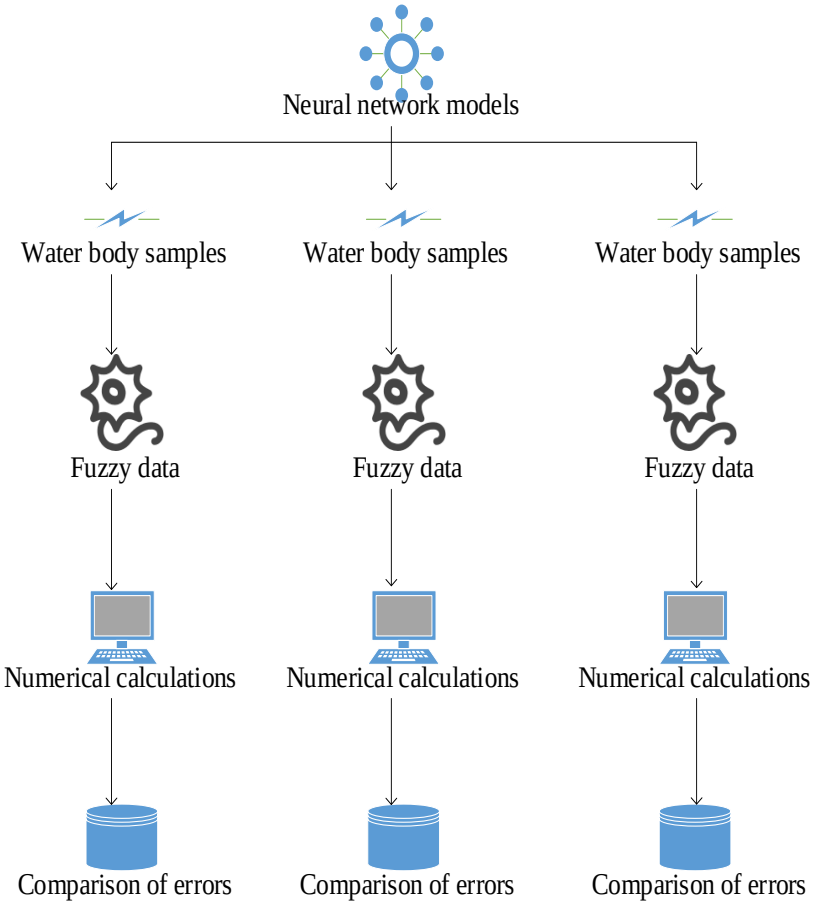


Figure 3. Flow structure of the back propagation algorithm

5. Experimental Evaluation of Contemporary Water Pollution Prevention and Control Planning Model Based on Neural Network

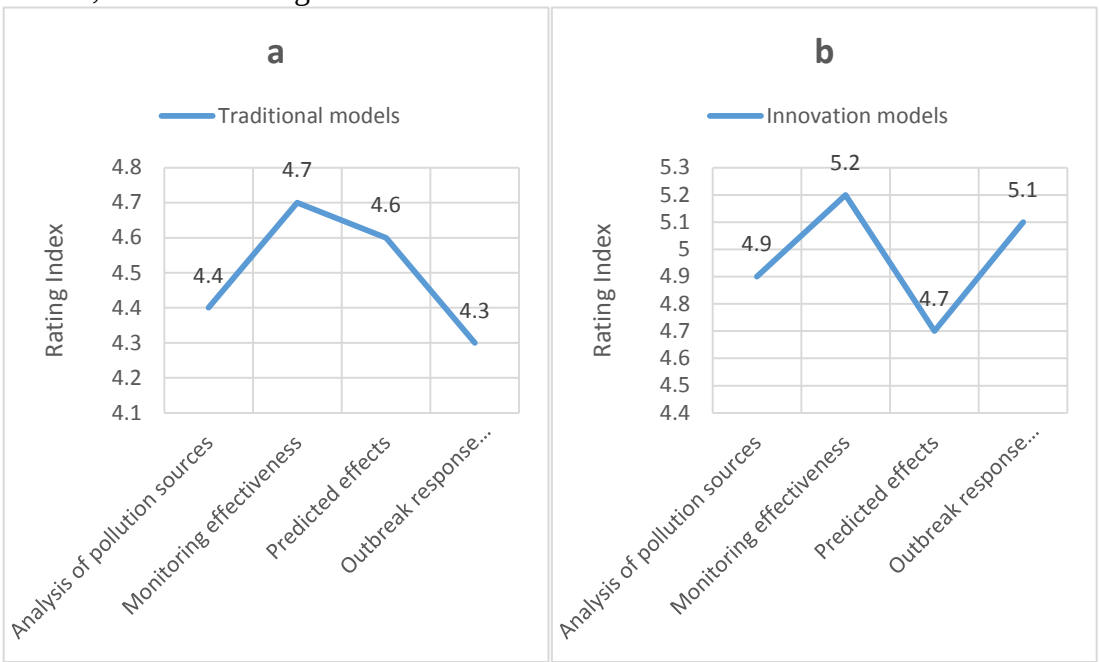
The main purpose of the water pollution prevention and control plan is to improve the living environment of human beings, and protect the ecological balance, so as to promote the harmonious coexistence between human beings and nature. Therefore, full investigation and research should be done before the development and utilization of water resources. First of all, the waste water produced in human life contains all kinds of harmful substances and toxic ingredients, which should be controlled and treated by corresponding measures. Through the formulation of relevant laws and regulations, people's behavior is constrained, so as to reduce the emissions of pollutants from industrial enterprises and production activities of other pollution sources to achieve the goal of protecting the ecological environment, improving the living environment, and promoting the harmonious coexistence of human and nature. In order to intuitively evaluate the performance and effect of the water pollution planning model, the establishment of evaluation criteria is very

important. Table 1 shows the rules of conduct for some evaluation criteria. In order to optimize the existing water pollution prevention and control plan and make the development and utilization of water resources sustainable, the water area in the water system is divided into sample areas, and the water samples in each area are collected. The collected water samples are fuzzed and output by the adaptive fuzzy neural network, and the data classification and training optimization are carried out by the least squares algorithm and the back-propagation algorithm in the three-layer network model. The final training model is used to evaluate and predict the water quality of the sample area, so as to find the hidden dangers of water pollution problems in time, but it still needs some experiments to verify the effectiveness of the model.

Table 1. Evaluation criteria and their evaluation rules

Evaluation indicators	Rules of Conduct
Analysis of pollution sources	Analysis of pollutant composition Source analysis of pollutants
Monitoring effectiveness	Speed of sample collection Sample assessment quality

First of all, the water body in a certain water area system was divided into sections. The system management personnel collected the water body samples in the sample section. After a period of experiment, the water body samples in the sample section were collected again to evaluate the status of the two water body quality and carry out comparative analysis. According to the results of many comparisons, the system management personnel were assessed on the satisfaction of using the governance of water resources issues planning model. The performance of the proposed governance of water resources issues planning model based on neural network and the traditional water pollution prevention and control planning model were compared and analyzed according to the evaluation rules, as shown in Figure 4.



a.Performance analysis of traditional models
b.Performance analysis of innovative models

Figure 4. Comparative analysis of the performance of traditional and innovative models for water pollution control planning

As shown in Figure 4, Figure a showed the performance analysis of the traditional governance of water resources issues planning model. The four performance indicators were pollution source analysis, monitoring effect, prediction effect and emergency response. The performance indicators of the four performance indicators were 4.4, 4.7, 4.6 and 4.3 respectively. Figure b showed the performance analysis of the innovative governance of water resources issues planning model. The four performance indicators were pollution source analysis, monitoring effect, prediction effect and emergency response. The performance indexes of the four performance indicators were 4.9, 5.2, 4.7 and 5.1 respectively. According to the comparative analysis of the four performance indicators, the innovative governance of water resources issues planning model was better than the traditional water pollution prevention and control planning model. Compared with the traditional water pollution prevention planning model, the innovative water pollution prevention planning model proposed in this paper had an average improvement of 10.7% in four aspects of performance.

6. Conclusion

Under the background of the gradual advancement of urbanization and with the development of the times and the progress of science and technology, people pay more and more attention to the prevention and control of water pollution. In the traditional governance of water resources issues planning model, it relies too much on the professional knowledge and subjective assumptions of managers and researchers, and can not respond in time when water pollution hazards occur. The means to deal with water pollution problems are relatively simple. To solve these problems, this paper proposed a modern water pollution prevention and control planning model based on neural network technology and intelligent algorithm. The model would fuzzily quantify the collected water samples and carry out data operation and parameter optimization through the least square method and back-propagation algorithm. Finally, the neural network training model was used to predict water pollution problems. The reliability of the model was verified by experiments. Compared with the traditional water pollution prevention planning model, it fundamentally solved many problems.

Funding

This article is not supported by any foundation.

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] Akpomie, Kovo G., and Jeanet Conradie. "Banana peel as a biosorbent for the decontamination of water pollutants. A review." Environmental Chemistry Letters 18.4 (2020): 1085-1112.

[2] 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.

[3] 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.

[4] Mekonnen, Mesfin M., and Arjen Y. Hoekstra. "Global anthropogenic phosphorus loads to freshwater and associated grey water footprints and water pollution levels: A high‐resolution global study." Water resources research 54.1 (2018): 345-358.

[5] Jung, Jaeyoung K. "Cell-free biosensors for rapid detection of water contaminants." Nature biotechnology 38.12 (2020): 1451-1459.

[6] 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.

[7] 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.

[8] Wang, Hua. "Exploring the water quality driving mechanism in Poyang Lake, the largest freshwater lake in China." Water Supply 20.2 (2020): 700-711.

[9] Singh, Nirala, and Bryan R. Goldsmith. "Role of electrocatalysis in the remediation of water pollutants." ACS Catalysis 10.5 (2020): 3365-3371.

[10] Nait Amar, Menad, Nourddine Zeraibi, and Kheireddine Redouane. "Optimization of WAG process using dynamic proxy, genetic algorithm and ant colony optimization." Arabian Journal for Science and Engineering 43.11 (2018): 6399-6412.

[11] Picos, Alain. "Genetic algorithm and artificial neural network model for prediction of discoloration dye from an electro-oxidation process in a press-type reactor." Water Science and Technology 78.4 (2018): 925-935.

[12] Abba, S. I."Comparative implementation between neuro-emotional genetic algorithm and novel ensemble computing techniques for modelling dissolved oxygen concentration." Hydrological Sciences Journal 66.10 (2021): 1584-1596.

[13] Cao, Bin. "Multiobjective evolution of fuzzy rough neural network via distributed parallelism for stock prediction." IEEE Transactions on Fuzzy Systems 28.5 (2020): 939-952.

[14] Yu, Ziquan. "Distributed adaptive fractional‐order fault‐tolerant cooperative control of networked unmanned aerial vehicles via fuzzy neural networks." IET Control Theory & Applications 13.17 (2019): 2917-2929.

[15] Hair, Joseph F., Marko Sarstedt, and Christian M. Ringle. "Rethinking some of the rethinking of partial least squares." European Journal of Marketing 53.4 (2019): 566-584.