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The Mechanism of Water Pollution Control in Xiangjiang River Basin Based on Machine Learning

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Abstract: Although the government is committed to the water pollution control of Xiangjiang River, due to the heavy pollution in the Xiangjiang River Basin, the control mechanism is not very scientific, resulting in poor pollution control effect. Therefore, it is particularly important to establish a complete set of governance mechanisms for water pollution control in the Xiangjiang River Basin. The purpose of this paper is to study the mechanism of water pollution control in the Xiangjiang River Basin based on machine learning. The countermeasures and suggestions for improving the water pollution control mechanism in the Xiangjiang River Basin are put forward. For the emergency management of water pollution, researches are carried out based on methods such as machine learning anomaly detection. Using case reasoning and rule reasoning to build an expert system for sudden water environmental pollution, it provides valuable opinions and solutions in dealing with sudden water environmental pollution. According to the accuracy and recall rate of the two algorithms, CART is better than the other two algorithms through comparative evaluation, so CART is adopted for rule reasoning.

1. Introduction

The governance of the Xiangjiang River must be implemented by policies, and the new Xiangjiang River pollution control policy is inseparable from the construction of the Xiangjiang River pollution control mechanism. A society can only establish a reasonable order through mechanisms, and the system of Xiangjiang River pollution control reflects the essence of Xiangjiang River pollution control policy and moral construction [1-2]. In order to ensure the correctness of the wording and make up for the insufficiency of the forced wording or application of the state power, consultation and cooperation are required in the process of formulation and implementation [3]. In the same way, only through consultation and cooperation can the mechanism

for pollution control of the Xiangjiang River be standardized and reasonable, and it can be effectively implemented [4-5].

Water is the source of life and an indispensable natural resource to maintain a good ecological environment [6-7]. Gad M uses the Air Pollution Index, Heavy Metal Assessment Index, Pollutant Index, and DRASTIC models to assess groundwater quality and watershed impacts. El Fayoum, Western Desert, Egypt. Groundwater measurements were made in 27 observation wells, and groundwater samples were collected in 38 wells at a depth of 60 m, and the results were processed using quantitative analysis and GIS techniques. The HPI results showed that 74% of the groundwater had HPI values above the critical level of contamination. HEI values indicate the level of heavy metal contamination of groundwater [8]. Banyyaseen I To assess the potential for groundwater contamination near the Al-akaider waste, heavy metals were used in the well. Sources of soil pollution come from natural or anthropogenic sources associated with rock formation, including fertilizer and pesticide use or irrigation, and human energy activities during water treatment. Analysis showed that the concentrations of Zn, Cu, Mn, Pb and Cd in all samples were within acceptable limits for Jordanian water as determined by the Jordanian Quality and Scientific Agency [9]. In the same way, only through consultation and cooperation can the laws on pollution control of the Xiangjiang River be formulated, standardized and reasonable, and effectively implemented [10].

The greatest research significance of this paper is that on the basis of establishing a comprehensive test of water pollution control in the Xiangjiang River Basin in Chang-Zhu-Tan City, rationally designing a suitable Xiangjiang River pollution control system and process, the financial system of Hunan Province directly under the central government has solved the pollution problem of some Xiangjiang River Basin. Of course, it is a very systematic work to comprehensively solve the problem of water pollution. Therefore, the significance of this work is to formulate a feasible solution to the pollution problem in the Xiangjiang River basin on the basis of the previous research results and foreign government management experience, and try to make a little contribution to the pollution control of the basin.

2. Research on Water Pollution Control Mechanism in Xiangjiang River Basin

2.1. Watershed Pollution Control

A watershed is the entire area through which the main and tributaries of a water body flow [11-12]. Governance involves both the public and private sectors; governance is a top-down interactive process, primarily through collaboration, negotiation, partnership, identity building, and shared goals, among others. The essence of watershed pollution control is based on market principles, public interests and recognized cooperation [13].

Watershed pollution control refers to the adoption of a series of technical methods, administrative systems and measures, legal systems, etc., in order to protect and improve water quality in the watershed and protect human health. means to effectively prevent and control watershed pollution [14].

2.2. Countermeasures to Improve the Water Pollution Control Mechanism in the Xiangjiang River Basin

(1) Improve the organizational mechanism

The key to implementing the comprehensive management of the Xiangjiang River Basin is to

establish a comprehensive watershed management bureau. The Xiangjiang River Basin Administration, which represents the ecological interests of the basin, has a heavy responsibility. Under its management, not only can the overall ecological interests of the Xiangjiang River Basin not be damaged, but also the water environment resources should be used sustainably to achieve a healthy balance of the water ecological environment. This is beyond regional interests, thus making it possible for the local interests of local governments to give way to the overall interests of the basin[15].

(2) Establish and establish an ecological compensation mechanism in the Xiangjiang River Basin

This will play a central role once the ecological compensation mechanism is established. First of all, it is conducive to the restoration and management of environmental pollution and ecological functions. The second is to help break the imbalance in the management or destruction of ecological environment damage and interests between the upstream and downstream of the Xiangjiang River, and promote better economic and social development of the upstream and downstream. Thirdly, it provides institutional guarantee for the sustainable development of the Xiangjiang River Basin. The establishment of the ecological compensation mechanism will have a profound impact on enterprise production and even social development: enterprises will no longer use ecological resources for free in the production process, but will improve technology, optimize management, and rationally and effectively utilize resources damage is minimized [16-17].

(3) Improve the environmental information disclosure system

Watershed management involves a wide range of issues and complex issues. It is necessary to integrate information on watershed environment and management to better provide information support for watershed decision-making and enable more public participation in watershed management. The construction of environmental information disclosure system is not only conducive to the grasp of environmental protection information in the public area, but also provides a good information environment for the public to participate in protection management [18].

3. The Status Quo of the Natural Environment in the Xiangjiang River Basin

As the largest river in the basin of Hunan Province, the Xiangjiang River is the mother river of the Hunan people. The Xiangjiang River system is located south of the Yangtze River and north of the Nanling Mountains. It is one of the main tributaries of the south bank of the middle reaches of the Yangtze River. The main stream of the Xiangjiang River is 856 kilometers long, with a drainage area of 9.46 million square kilometers, and receives more than 1,300 tributaries along the way. The Xiangjiang River Basin is mostly rolling hills, valleys, plains and basins, with abundant water-saving and water-energy resources.

The optimization of water resources dispatching implemented by the Hunan Provincial Government has achieved certain results in improving the water environment. However, while we are happy for the environmental improvement of the Xiangjiang River Basin, we should also be soberly aware that the water pollution problem in the Xiangjiang River Basin is still relatively common, the pollution sources are more complex, and the formation path of the watershed pollution is shown in Figure 1.

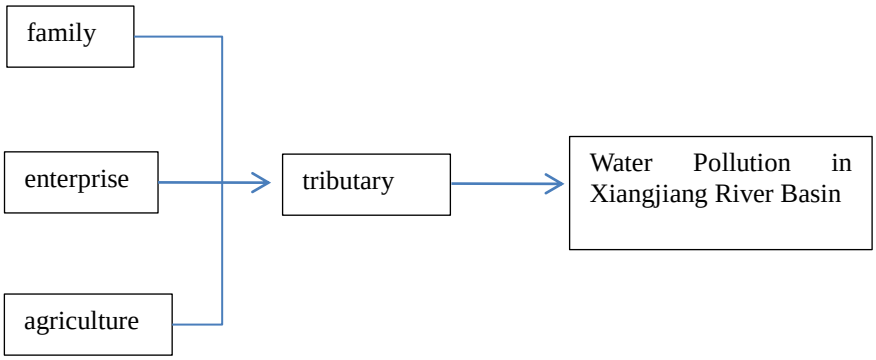

Figure 1. Pathways of water pollution in the basin

Overall, with the rapid development of urbanization and industrialization in Hunan and the large-scale development of agriculture, livestock and poultry industries in recent years, the Xiangjiang River has been polluted in a large area and has a wide range of pollution sources, making the environmental pollution problem of the Xiangjiang River more serious. Various types of water pollution are characterized by organic pollution, agricultural pollution, domestic sewage and heavy metals coexisting. In terms of pollutant structure, large and medium-sized cities have successively entered a stage of increasing domestic pollution and gradually decreasing industrial pollution rates, and the pollution of urban river sections by domestic sewage and domestic waste is increasing.

4. Analysis and Research of Water Pollution Control Mechanism in Xiangjiang River Basin Based on Machine Learning

4.1. Water Pollution Anomaly Detection Based on Machine Learning Method

Anomaly detection methods based on machine learning are mainly divided into machine learning methods based on density/distance, clustering, support vector machines (SVM) and partition ideas.

Density/distance-based machine learning methods mainly include algorithms that classify according to Euclidean, Manhattan distance and other distance metrics, such as K-nearest neighbor algorithm, and algorithms that classify according to reachable distance, such as local anomalies Factor algorithm (local outlier factor).

The process of anomaly detection using clustering methods usually includes two steps: first, clustering historical data using clustering algorithm; second, implementing anomaly detection based on the distance between the data to be discriminated and the cluster center. The most commonly used clustering algorithm is the K-means clustering algorithm, which creates k clusters with similar data points and marks data that are far away from these clusters as anomalies.

4.2. Decision Tree Rule Inference Based on Machine Learning Method for Environmental Treatment of Water Pollution

Using the three algorithms ID3, C4.5 and CART, by training the same data set, the performance evaluation of three different algorithms is carried out, and the evaluation is carried out according to

the precision rate and recall rate. According to the evaluation indicators of precision rate and recall rate, its related concepts The optimal algorithm is selected as shown in Table 1 below.

Table 1. Performance evaluation concept table

	True to positive/correct classification of sudden water pollution	True negative/false sudden water pollution classification
Determined to be positive/correct sudden water pollution classification	TP	FP
Sudden water pollution classification determined as negative/wrong	FN	TN

There are a total of 200 datasets in this paper, and 150 datasets are used for training. These 150 datasets are tested, and these three algorithms are used respectively. There are three algorithms to obtain the following TP (true positives), FP (false) positives), FN (false negatives), TN (true negatives) data, the running data is shown in Figure 2.

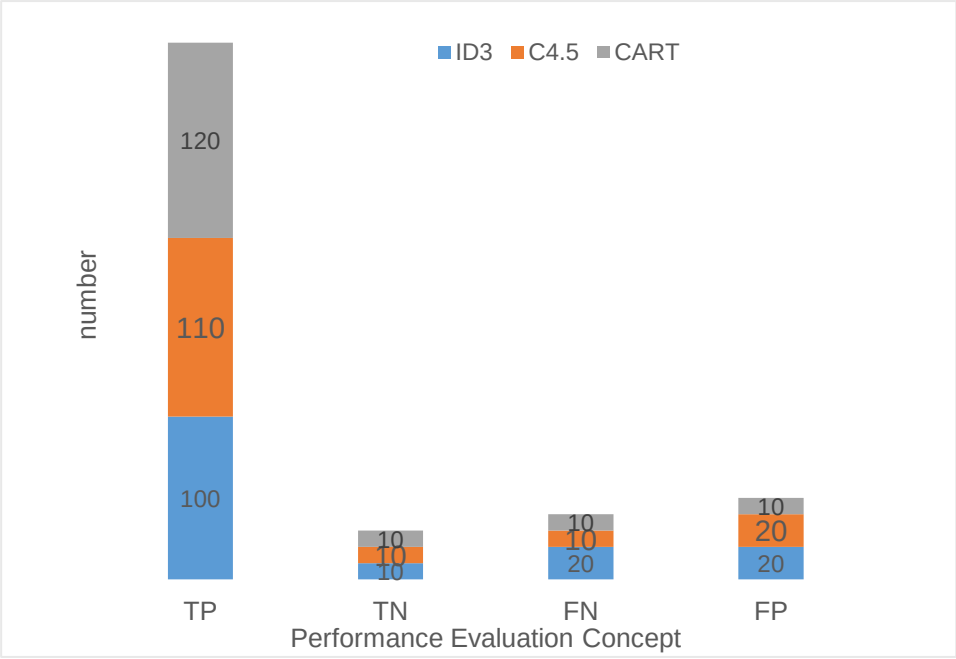

Figure 2. Operational data

Recall rate (Recall): Indicates the proportion of all true positive classes that are judged to be positive classes. The calculation formula is as follows:

$$\mathrm{Re}call = TP/(TP+FN) \quad (1)$$

According to the data in Figure 2, the recall rates of the three algorithms are calculated, and the precision rates obtained by the three algorithms are shown in Table 2. According to the comparison

of recall rates, the recall rates of ID3, C4.5 and CART algorithms are roughly the same. Slightly better.

Table 2. Comparison of recall rates

Algorithm	Recall
ID3	92
C4.5	93
CART	95

Accurary: It indicates the proportion of the number of correct classifications in the training samples. The calculation formula is as follows:

$$Accurary = (TP + TN)/(TP + FN + FP + TN) \quad (2)$$

Calculate the accuracy of the three algorithms. The accuracy comparison is shown in Table 3. The accuracy of the CART algorithm is higher than that of ID3 and C4.5.

Table 3. Accuracy comparison

Algorithm	Accuracy
ID3	94
C4.5	94
CART	97

The expert system based on decision tree rules is based on machine learning, because the decision tree is a typical algorithm of machine learning and has a very good inference effect. In this paper, leaf nodes represent the inference results of the expert system, and all non-leaf nodes represent inference rules.

According to the algorithm of rule inference, the system is finally realized by training the cases of sudden water environment pollution, and using the CART tree to train the cases of sudden water environment pollution. The algorithm is also based on human-computer interaction, and continuously enters the characteristics of the case to be queried according to the system prompts, and finally obtains the solution in the case.

From the user's point of view, the operating interface of the rule-based reasoning algorithm and the case-based reasoning algorithm is the same. Therefore, the user will not feel uncomfortable when the two algorithms are alternated.

From the developer's point of view, the rule-based reasoning algorithm attaches great importance to the segmentation point, so the developer must balance the different data in the data set, so that there are more cases of one type of water pollution and fewer cases of another. Moreover, the training process and the testing process of the decision tree should be separated, so that there is no need to retrain each time in the query, thereby improving the query speed. The biggest difference between rule-based methods and case-based methods is whether there is an explicit training process. Rule-based methods require an explicit inference model to be trained, and thus should be trained before testing. But the training process is invisible to the user.

5. Conclusion

Humans need water, and water affects our production and life; it affects our physical health. With the social activities of human beings, environmental problems have become increasingly prominent,

and the pollution problems and potential risks of all available water resources, such as rivers, lakes, and oceans, cannot be ignored. Therefore, this paper seeks to improve the path of the legal system construction of Xiangjiang River pollution control, in order to provide reference opinions for improving the legal system construction of Xiangjiang River pollution control. Looking at the development of science and technology, in order to better solve various scientific and technological problems, the future trend must be: the use of multi-disciplinary and multi-technology combination, multi-field cooperation, complement and improve each other. With the continuous development of machine learning, it has new exploration applications in many fields, and it has gradually demonstrated its technical advantages. By fully combining machine learning with water quality analysis, simulation, and prediction research, better research results will be obtained in the future.

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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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