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Construction of River Sewage Treatment System Based on Decision Tree Algorithm and Wireless Communication Technology

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Abstract: The development of wireless communication technology has made it possible for modern river sewage treatment technology to be unsupervised and remotely monitored. Nowadays, with the help of mobile internet platforms and terminals, and based on modern wireless communication technology, building a flexible and easy to control river sewage treatment network monitoring system has become the strategic goal of river sewage treatment in various countries. With the rapid development of mobile communication technology, wireless communication is being widely used. Applying this communication technology to the network control system can transform the traditional data acquisition method into remote wireless data acquisition, and realize the interconnection of Internet terminal equipment. With the development of wireless communication technology, modern river sewage treatment technology can be controlled without supervision and remote monitoring. Nowadays, the use of modern wireless communication technology, mobile Internet platform and terminals to establish a flexible and easy-to-monitor river wastewater monitoring system has become the forefront of river wastewater treatment. Based on this, this paper first proposed to establish an effective treatment system according to the river water pollution discharge situation, and focused on accelerating the construction of sewage treatment system, so as to accelerate the construction and treatment level of sewage centralized treatment facilities. The importance of strictly controlling industrial sewage discharge was discussed, and it is necessary to strengthen the treatment of tourism sewage. After that, this paper proposed to use wireless communication technology to strengthen the river sewage treatment system, and discussed the process of wireless communication technology in the river sewage treatment, thus proposed to use wireless communication technology to build the river sewage monitoring system. The improved decision tree algorithm was proposed to strengthen the construction of river sewage treatment system. Through comparison, it can be seen that the real-time monitoring perfection of the new river sewage treatment system was 0.32 higher than that of the traditional river sewage

treatment system, and the sewage discharge treatment intensity was 0.25 higher than that of the traditional river sewage treatment system. The water pollution control effect of the new river sewage treatment planning system was 29.1% higher than that of the traditional river sewage treatment planning, and the ecological restoration effect was 24.8% higher than that of the traditional river sewage treatment planning.

1. Introduction

Traditional river wastewater treatment has problems such as scattered monitoring nodes and limited data transmission of wired network. More importantly, there should be little or no monitoring. The application of wireless communication technology reduces the construction cost and improves the coverage of remote monitoring network. The network connection is more convenient. The river wastewater treatment monitoring system integrated with field sensors fundamentally solves the above problems, thus solving the problem of river wastewater treatment.

Wireless communication technology is widely used in river sewage treatment. Comber S D W proposed two distinct seasonal variation patterns. The variation of river concentration caused by seasonal fluctuation of river flow leads to the maximum value in summer and the minimum value in winter, or the observed variation can be attributed to the improvement of wastewater treatment process performance under warm conditions [1]. Xu Zuxin believed that it is necessary to improve water quality by reducing pollution, eliminating dumping and minimizing the discharge of hazardous chemicals and materials, halving the proportion of untreated wastewater and significantly increasing global recycling and safe reuse [2]. Ogunbanwo Olatayo M found that the pollution of drugs to the environment was considered a global problem. Although so far most studies have focused on Europe and North America, information from developing countries, including African countries, is still lacking [3]. Kumar Mukesh analyzed the urbanization pattern of the Yamuna River basin in India and its impact on the quality and quantity of flow. In the past few decades, the number of towns in the basin has increased significantly, resulting in an increase in water demand and a decrease in water holding capacity [4]. Scavia Donald integrated data from the United States and Canada to update and expand the total phosphorus load in and out of the Detroit River system. The most significant change is the reduction of Huron Lake load caused by mussel oligotrophication [5]. The purpose of Khan Ramsha is to assess the heavy metal pollution and health risks of millions of people using the Gomti River. The assessment results show that children are more vulnerable to health risks, and remedial measures need to be taken immediately to control the increase of heavy metal content in all sampling stations [6]. The above studies have described river sewage treatment, but there are still some deficiencies in wireless communication technology.

Many scholars have analyzed and studied wireless communication technology. Feng Xiang believed that precision agriculture is an appropriate solution to the challenges of food shortage, soil degradation and water shortage. The development of modern information technology and wireless communication technology is the basis for achieving precision agriculture [7]. Mohapatra Hitesh's survey found that global climate change and rapid population growth have seriously affected water sources. The existing traditional water distribution network cannot manage the appropriate water distribution according to the consumption rate. The current situation requires an intelligent water management and treatment mode to maintain water supply for a long time [8]. Zedini Emna proposed a unified statistical model based on experimental data, which was used to characterize the characteristics of turbulence-induced fading in underwater wireless optical communication channels

with bubbles and temperature gradients in fresh water and salt water [9]. Alencar Amanda reported on an application use and gratitude framework and refugee research, which focused on smart phones to examine media use and link these with the physical, social and psychological needs of refugees [10]. Meyer Michael F made a thorough investigation of the history of pipeline leakage detection through investigating the knowledge database network and using visualization software for visual output [11]. Pichura Vitalii believed that it is necessary to develop and comply with water-saving measures, and use environment-friendly technologies to take adaptive protection measures in the case of uncontrolled increase of human impact and pollution intensity in the use of water resources [12]. The above studies have described wireless communication technology, but there are still some deficiencies in river sewage treatment.

In order to understand the specific development of the river sewage treatment system, this paper analyzed the risks existing in the river sewage treatment system, and established an effective protection system according to the river water pollution discharge situation, so as to better deepen the reform of the river sewage treatment. Compared with the current river sewage treatment system, using wireless communication technology to strengthen the river sewage treatment system is more perfect and can build a more complete treatment system.

2. Effective Protection System Established According to the River Water Pollution Discharge

2.1. Accelerated Construction of Sewage Treatment System

In Figure 1, water quality can be effectively improved by establishing effective wastewater treatment system, strengthening surface pollution control, improving centralized protection of drinking water sources, establishing water quality monitoring system, and cutting off river wastewater [13]. It is necessary to optimize the industrial structure of relevant cities in the basin and accelerate the transformation of economic growth model [14-15]. By improving the drainage basin wastewater collection system, strengthening the treatment depth of the sewage treatment plant, inheriting and improving the drainage basin water pollution control measures, and combining the point source management and non-point source management, drainage basin water pollution control and ecological restoration, the purpose of reducing pollution is achieved.

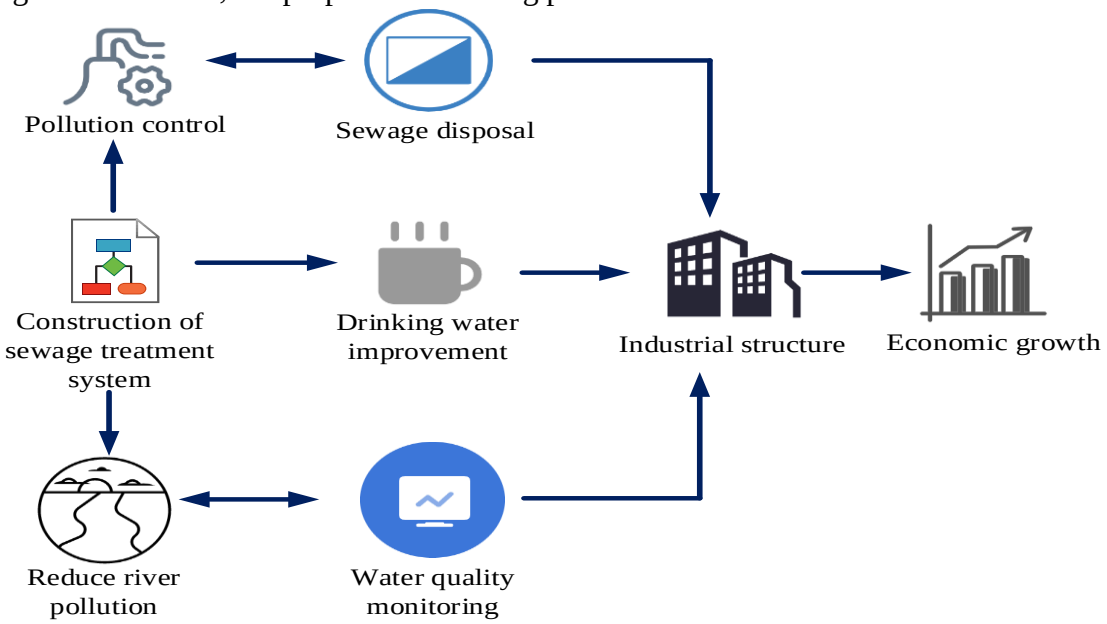


Figure 1. Construction of sewage treatment system

2.2. Accelerated Construction of Sewage Centralized Treatment Facilities and Treatment Level

According to the overall urban planning and detailed control plan, priority should be given to the establishment of sewage treatment plants in areas with serious pollution, and the construction of sewage system in the urban market should be improved, as shown in Figure 2. By the end of the planning period, all villages and towns in the basin should have infrastructure. For example, the concentration of urban wastewater from urban sewage treatment plants and sewage pipes is high, and the wastewater discharged into the pool meets the comprehensive sewage treatment standard after the treatment of the sewage treatment plant. Domestic sewage in rural areas is mainly a non-point pollution source of domestic sewage. The two main methods to solve the problem of rural domestic sewage pollution are centralized treatment and decentralized treatment. "Watershed ecotourism development corridor" and "Watershed environmental protection control corridor" suggest the construction of small sewage treatment plants in central scenic tourist villages; during the planning period, other villages would gradually promote biogas fermentation tanks or rural sewage treatment plants; before discharge, domestic wastewater must be treated through biogas fermentation tank or three-grid wastewater treatment plant, so as to reduce the discharge of domestic wastewater and increase the feasibility of wastewater recycling.

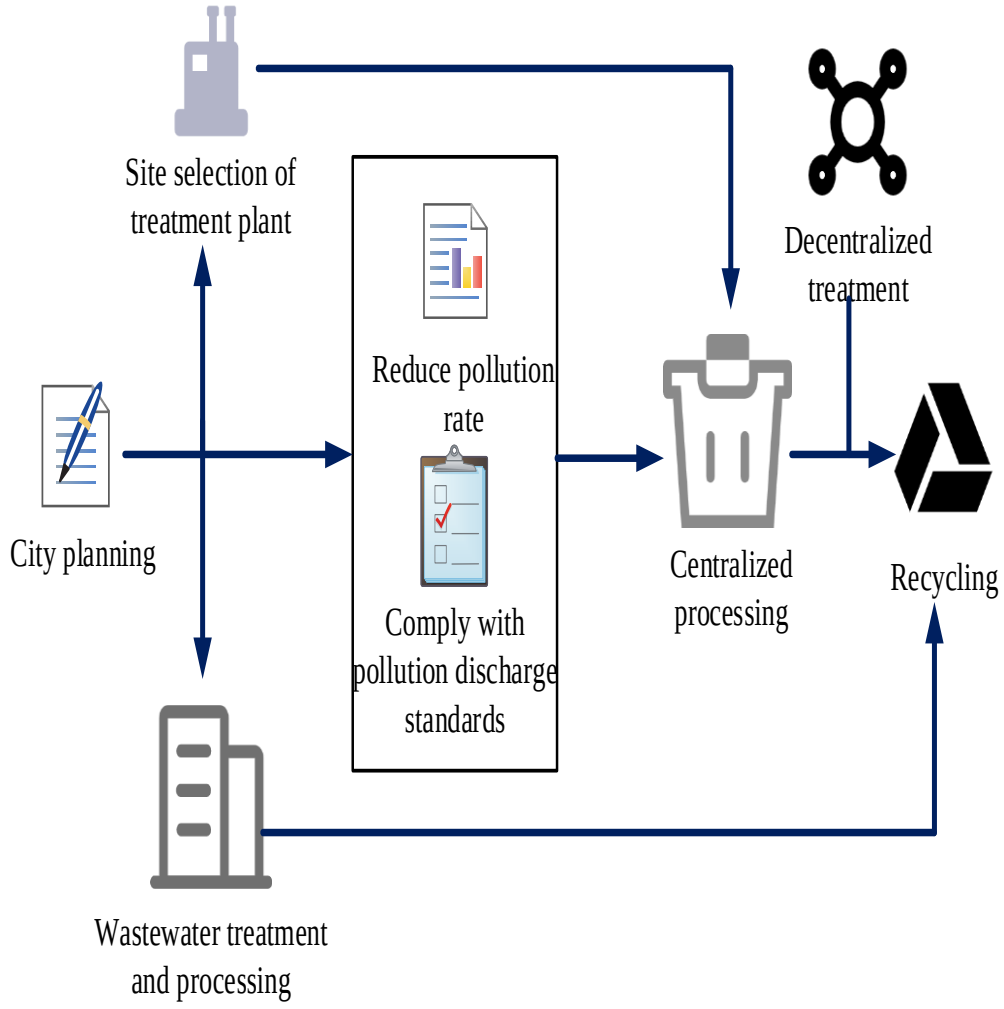


Figure 2. Analysis of construction and treatment level of centralized sewage treatment facilities

2.3. Strict Control of Industrial Sewage Discharge

It is prohibited to introduce heavy industry into the water area, and to build processing plants in plant nature reserves, scenic spots and forest parks; processes and equipment that seriously pollute the environment need to be phased out, and the use of old processes and equipment in new or modern projects is prohibited. The new treatment plant is based on low-pollution industries and focuses on industrial wastewater treatment in urban areas to facilitate centralized collection and treatment. For industrial facilities that produce industrial wastewater, the wastewater shall be treated according to the comprehensive wastewater treatment standard. With regard to the pollution of water resources in the river basin, many of them are caused by the waste water problem of enterprises. Therefore, it is necessary to establish a system to control and punish the waste water discharge of enterprises, improve the waste water authority mechanism of enterprises, levy tariffs on waste water pollution, and impose sanctions on measures that exceed the waste water target.

2.4. Strengthening of Sewage Treatment in Tourism Industry

Local environmental management and central management of tourism development activities should be strengthened in the “river basin ecotourism development corridor” and “ecotourism development ecological control area”. Other ecological functional areas are not suitable for carrying out high-intensity tourism development activities. Due to the concern about the possibility of building, rebuilding and expanding water pollution projects in the region, and limiting the discharge in a limited time according to the existing water pollution source management standards, the projects with management difficulties would be postponed or terminated in a limited time, so as to eliminate tourism pollution sources and inorganic emissions. It is necessary to clean up the existing unorganized food stalls along the Yangtze River, and control the development scale and reasonable layout of catering and hotels, so as to promote the centralized treatment of tourism wastewater. The establishment of wastewater treatment system and the implementation of central treatment measures can effectively solve a series of problems such as low resource efficiency, water pollution and water environment damage in other catchment areas. Therefore, when using river water resources, people should change the concept and behavior of using water and save water. By promoting the promotion of the concept of water conservation and properly adjusting the water price, a long-term mechanism for monitoring water resources is established to solve the problem of water pollution.

3. River Sewage Treatment System Strengthened by Wireless Communication Technology

Compared with developed countries, China’s river wastewater treatment started late. According to the actual situation, advanced technology and experience of other countries can be used for reference. Good river wastewater treatment can save investment, reduce costs and reduce land use, as shown in Figure 3. The river sewage treatment network management system adopts hierarchical treatment, which is divided into primary and secondary treatment. Primary treatment uses physical and chemical methods to remove large amounts of suspended solids, sand and other substances from raw water through screening, sedimentation and other methods. The secondary treatment uses biological methods to remove suspended solids, dissolved solids, nitrogen and other nutrients. Phosphorus and other substances in raw water would be exposed to water due to the influence of microorganisms on oxidation.

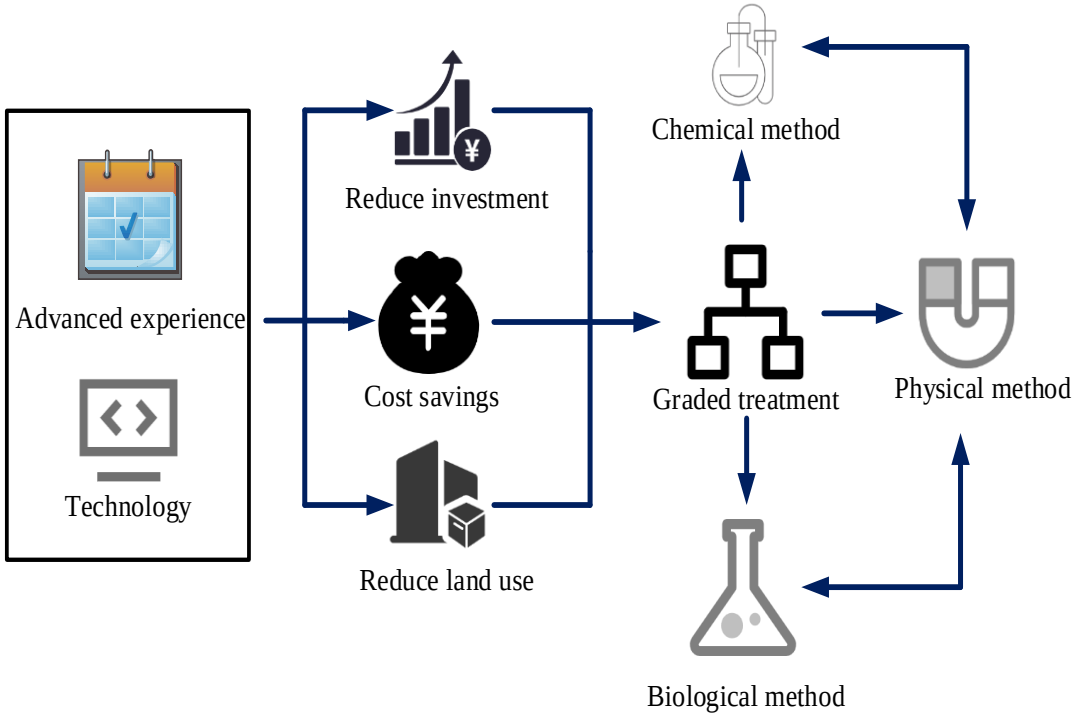


Figure 3. System analysis of river sewage treatment network management

3.1. Wireless Communication Technology in River Sewage Treatment Process

For river wastewater treatment, there are many field devices such as controllers and sensors, which are generally distributed on a large area and form a lower control network, resulting in less control information at a node and easier information transmission. However, the requirements for real-time information transmission and speed are very high. Moreover, the catchment area is large, the data collection points are relatively scattered, and the distance is relatively far, so it is difficult to fully conduct centralized management remotely. Each intelligent water pollution control equipment acts as a network node and provides information transmission and communication between nodes, bus and rail system through water area bus. Uplink information includes resource sharing and centralized management. Downlink is mainly responsible for scale control, distributed management and complex automation functions. The terminal station is mainly responsible for the communication between the monitoring system installed on the upper part and the specific process of sewage treatment, such as water pump startup and engine operation.

3.2. River Sewage Monitoring System Constructed by Wireless Communication Technology

Many process indicators of river wastewater treatment need real-time monitoring to ensure process requirements. The site conditions are very complex and not suitable for long-term on-site operation. Employees can use wireless communication technology to remotely monitor the site. The monitoring system configuration software can be generated using the configuration software that is easy to manage, including a variety of device driver sets, providing flexible configuration and data transmission functions. Due to its structure, the monitoring system can significantly shorten the development time and ensure the system quality. The operator can send various control commands to the water pollution monitor through the computer monitoring screen, and the water area monitoring data can be represented by dynamic graphics and state diagrams. There are various

control commands in the water pollution monitor, and a real-time data can also be extracted at the same time.

In order to realize the comprehensive monitoring of the production process, the simple software control system also has the functions of real-time alarm and historical data storage. Therefore, the real-time monitoring interface can reflect the water quality of all aspects of the river wastewater treatment process. The curve, historical curve and report would be automatically recorded in three days and used as the basic format for management, analysis and decision-making. When creating the configuration software, it is necessary to realize the same manual and automatic switching functions as the real-time human-computer interface. The network monitoring system has developed a connection management mechanism for software operators and defined multiple permission levels, thus implementing multiple water quality monitoring data management levels. Therefore, the monitoring system is applicable to multiple levels of water management organizations, thus saving resources.

4. Application of Improved Decision Tree Algorithm in River Sewage Quality Evaluation

4.1. Data Preprocessing before Data Mining

Information such as data integration, data exchange and data record must be pre-processed before data analysis. The efficiency of data mining is improved by deleting attributes irrelevant to data mining, so as to provide more accurate data for data mining algorithms. The data preprocessing step needs to be performed, so that the relevant attributes are displayed as numbers to eliminate inconsistent data and create new data columns.

4.2. Application of Decision Tree Algorithm in River Sewage Quality System

The improved decision tree algorithm can be used to build a decision tree. First, the root node is classified. Assuming that each node is a root node, the entropy of node information is calculated. In the improved decision tree formula, the information entropy of each parameter can be calculated. The gain information can be viewed by running the optimization algorithm. After calculation, a new node is selected, and attribute values are separated. The entire decision tree is created through repeated calculation.

When selecting new attributes, the decision tree algorithm considers both nodes of the tree.

It is supposed that α is a candidate attribute, and α has k attribute values, and the corresponding probability is $p_1, p_2,..., pk$. According to the principle of minimum information entropy, α is expanded, $\{\beta_1, \beta_2,..., \beta_k\}$ is the attribute of k sub-node, and the corresponding information entropy is $T(\beta_1),..., T(\beta_k)$, then there are:

$$T'(\alpha) = \sum_{i=1}^{k} p_i \cdot T(\beta_i) \tag{1}$$

The standard of α is:

$$\alpha' = \min(T'(\alpha)) \tag{2}$$

By introducing the algorithm into quality evaluation, it can be obtained:

$$T'(\alpha)=\sum_{i=1}^{k}(p_i+\alpha)\cdot T(\beta_i) \tag{3}$$

5. Experimental Investigation Based on Decision Tree Algorithm

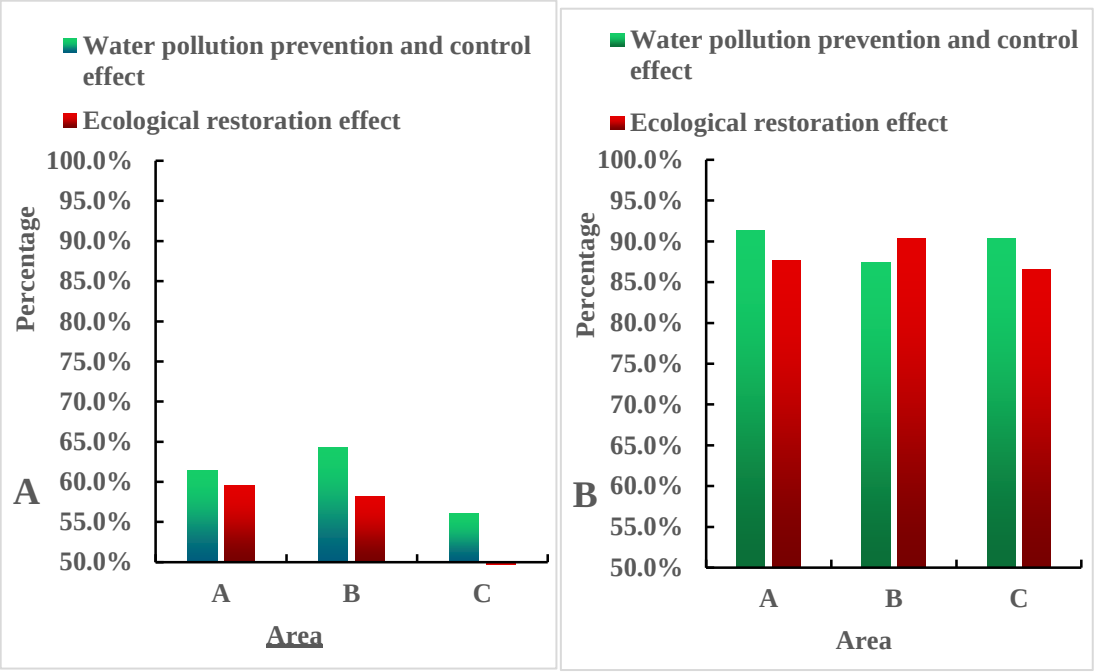
In order to study the specific effect of the application of the river sewage treatment system under wireless communication technology, this paper analyzed the real-time monitoring perfection of the river sewage treatment system and the sewage discharge treatment strength.This paper investigated and analyzed the real-time monitoring perfection of the river sewage treatment planning and the sewage discharge treatment intensity under the wireless communication technology in three river regions, and compared and analyzed with the traditional river sewage treatment system. The three river regions were set as A, B and C. Specific comparison is shown in Table 1.

Table 1. Comparison between traditional and new river flow sewage treatment systems

	Real-time monitoring of perfection		Sewage discharge and treatment efforts	
	Traditional governance	New governance	Traditional governance	New governance
A	0.54	0.86	0.65	0.94
B	0.61	0.81	0.71	0.96
C	0.43	0.87	0.69	0.90

According to the data in Table 1, under the traditional river sewage treatment system, the real-time monitoring perfection of A was 0.54, and the sewage discharge treatment intensity was 0.65; the real-time monitoring perfection of B was 0.61, and the sewage discharge treatment was 0.71; the real-time monitoring perfection of C was 0.43, and the sewage discharge treatment was 0.69. In the new river sewage treatment system, the real-time monitoring perfection degree of A was 0.86, and the sewage discharge treatment degree was 0.94; the real-time monitoring perfection of B was 0.81, and the sewage discharge treatment was 0.96; the real-time monitoring perfection degree of C was 0.87, and the sewage discharge treatment intensity was 0.90. On the whole, the real-time monitoring perfection of the traditional river sewage treatment system was 0.53, and the sewage discharge treatment intensity was 0.68; the real-time monitoring perfection of the new river sewage treatment system was 0.85, and the sewage discharge treatment intensity was 0.93. Through comparison, it can be seen that the real-time monitoring perfection of the new river sewage treatment system was 0.32 higher than that of the traditional river sewage treatment system, and the sewage discharge treatment intensity was 0.25 higher than that of the traditional river sewage treatment system.

The decision tree algorithm was used to analyze the water pollution control effect and ecological restoration effect of three river regions under the planning and construction of river sewage treatment under wireless communication technology. The specific investigation results are shown in Figure 4.



A. Effect of the traditional river flow sewage treatment system
B. Effect of the new river-flow sewage treatment system

Figure 4. Traditional and new river flow sewage treatment system effect

Figure 4a shows the effect of traditional river sewage treatment system, and Figure 4b shows the effect of new river sewage treatment system. According to Figure 4a, under the traditional river sewage treatment system, the water pollution control effect of A was 61.4%, and the ecological restoration effect was 59.6%; the water pollution control effect of B was 64.3%, and the ecological restoration effect was 58.2%; the water pollution control effect of C was 56.1%, and the ecological restoration effect was 42.4%. According to Figure 4b, under the new river sewage treatment system, the water pollution control effect of A was 91.3%, and the ecological restoration effect was 87.6%; the water pollution control effect of B was 87.4%, and the ecological restoration effect was 90.4%; the water pollution control effect of C was 90.3%, and the ecological restoration effect was 86.6%. On the whole, the water pollution control effect under the traditional river sewage treatment system was 60.6%, and the ecological restoration effect was 53.4%; the water pollution control effect of the new river sewage treatment was 89.7%, and the ecological restoration effect was 88.2%. Through comparison, it can be seen that the water pollution control effect of the new river sewage treatment planning system was 29.1% higher than that of the traditional river sewage treatment planning, and the ecological restoration effect was 24.8% higher than that of the traditional river sewage treatment planning.

6. Conclusion

With wireless communication technology, the control system is more flexible and easy to operate, and the control range is expanded. Remote monitoring and excellent video machine monitoring can be realized. With wireless communication technology, these nodes form a sensor network of a certain size. The bidirectional transmission of data and control signals is completed by the base station network and the upper computer. A typical network terminal is formed by combining the ground monitoring platform with the Internet, and a flexible and easy-to-manage river sewage treatment system is constructed by using the mobile Internet platform and terminal.

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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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