The Study Based on Intelligent Big Data Technology for Water Resources Audit

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The fast progress of science and technology has given immense ease to our lives, but it is also steadily destroying the environment in which we live. Environmental auditing was developed to safeguard the Earth we rely on for our existence, and subsequently, sustainable development was introduced to protect the planet we rely on for survival. Even though the quality of the natural environment is continuously increasing, it should not be taken for granted at this time. Therefore, in this paper, we study water resources auditing and sustainable development technologies based on AI-based big data. Specifically, we use an AI-based big data approach to construct the audit indicators of water resources and summarize the sustainable development technology of water resources. Finally, the proposed approach is used for case implementation. The experimental result shows that the BOD removal rate is about 95%, and the removal process is basically the same as removing COD.

1. Introduction

As individuals devote more and more attention to maintaining the ecological environment, an increasing number of academics devote more and more attention to the conservation of water resources [1–3]. As a result of pressing issues such as poor natural resource utilization rates in the manufacturing process and severe environmental contamination, natural resource auditing and environmental auditing have earned the backing of national policymakers [4]. The performance audit of natural resources follows the needs of contemporary development and the fundamental national circumstances of our country [5, 6].

Water resources auditing and sustainable development technologies have been the subjects of much investigation by many researchers [7–9]. Hranovska et al. [10] proposed a data-packet-based analytical approach for establishing environmental performance indicators by examining the shortcomings of current indicators, which was accepted by the scientific community. Different firms might undertake horizontal comparisons regarding a given environmental quality or characteristic set. Lipiwattanakarn et al. [11] analyzed and investigated environmental performance indicators from the standpoint of long-term sustainability. Environmental performance auditing, as used by Xu W et al. [12], is an audit activity that assists the audited department in resolving the present challenge in environmental management. The particular method is that audit institutions and auditors at all levels adhere to applicable regulations and National standards while reviewing, supervising, and evaluating funds utilized by the audited unit for building and management projects. Although academic circles have a wealth of studies on water resources auditing and sustainable development technologies, there are comparatively few studies on water resources auditing and sustainable development technologies based on computer information technology. As a result, the study on water resources audit and sustainable development technology based on computer information technology is critical.

In this paper, we first provide a brief introduction to the process of water resources protection in China, then construct a framework for water resources audit based on computer information technology and the water resources performance audit evaluation index, followed by a study of water resources sustainable development technology, and
finally use a village in this province as an example for planning and renovation.

2. Water Resources Audit and Sustainable Development Technology Based on Computer Information Technology

2.1. Water Resources Protection Work Process

2.1.1. Five Stages of Government Water Resources Protection.

Through numerous policies and programs for water resource preservation, the national government has been steadily implementing these measures in recent years. Figure 1 depicts the country’s water resources protection development process during the last 10 years. The pattern is as follows:

1. Establish water resources management system

   We can provide the most restrictive standards for the water resources management system in the history of the world, if necessary. It has established “red lines” in three areas: water resources development and exploitation, water efficiency regulation, and water function zones, all of which are intended to keep pollution to a minimum [13].

2. Promote the construction of a water-saving society

   The promotion of the development of a water-saving society [14] is the most effective way to address the core issue of my country’s water resources. Most notably, this is manifested in the following ways: adjustment of the price system for residents’ domestic water and agricultural water; technical transformation of industries with high water consumption, including the recommendation of water-saving equipment; centralized treatment of sewage; and utilization of seawater after desalination, among other things [15].

3. Ecological civilization construction

   Water ecological civilization and evaluation standards have been developed, focusing on integrating ecological civilization with the development, governance, distribution, utilization, and protection of water resources. Guiding opinions have also been issued on the construction of water ecological civilizations and evaluation standards. A few examples of specific metrics are [16] suggesting watersheds and regional rivers, lakes, and reservoirs; improving the distribution of water resources and creating a contemporary water resources network; improving the ecological architecture of local watersheds, among other things [17].

4. Special plan for water resources pollution prevention and control

   In 2015, the state announced the implementation of an action plan for water pollution prevention and control, including the general criteria for water pollution prevention and control and the targets to be achieved at different stages. The target requirements are that, by 2030, excellent water quality in the seven major domestic river basins will account for 70% or more of the total water quality, urban black and odorous water bodies will account for less than 10% of total water quality, and the high-quality water source of urban drinking water will account for more than 93% of total water quality. Table 1 contains the pertinent information.

5. Dual control action

   The “Thirteenth Five-Year Plan” specifies in detail the total amount of water that will be used. Groundwater extraction should be centered on governance, and an early warning system should be put in place, according to the national yearly water consumption plan, which is limited to 670 billion cubic meters.

2.1.2. Effectiveness of Implementation of Water Resources Protection Measures. The work on water resources protection and management has yielded some significant results:
innovation in the water resources management system has essentially formed a water resources spatial allocation system with the pulse of water flow and built a modern ecological city with a good environment; through green buildings and urban drainage pipelines, water resources are used for storage, purification, and resource utilization, as well as for drought prevention and drainage, among other things.

2.2. Construction of Water Resources Audit Framework Based on Computer Information Technology

2.2.1. Water Resources Management Performance Audit Object. The freshwater resources under consideration in this article are those that can be utilized and controlled by people, namely, those that are accessible to humans. Generally speaking, water resources audits are concerned with the application of water resources management policies, the use of money, the advantages of water resources project management, the enhancement of water quality, and the social benefits of water resources management. It is possible to separate water resources management performance audit items into four categories, as shown in Figure 2: systems administration, financial administration, development of projects, and information disclosure.

Water resource accounting information and water resource situation information are the two most essential parts of information disclosure; the first is accounting information, and the second is situation information. The project’s construction is split into two sections: the construction project and the water pollution prevention and control project. The construction project is the first of the two components. Aspects of the usage of money are represented by sewage treatment fees and the conversion of funds allocated for water pollution prevention and control into capital sewage charges. Regulations, policies, and environmental management systems are the most important aspects of system management. In reality, there are pollutant discharge permit systems, emission reduction liability systems, and other such systems in place.

2.2.2. Water Resources Management Performance Audit Objectives. The goals of a performance audit of water resources management may be broken down into the following categories:

(1) Authenticity
If the data and materials under evaluation are not genuine, then all of the audit findings acquired will be incorrect and have no significance whatsoever.

(2) Legality
A succession of government documentation, such as appropriate rules and regulations, must be followed in order for all water resources management efforts to be successful.

(3) Economical
Economic objectives are concerned with whether water resources management is consistent with the notion of conservation and if funds are being used in a scientifically sound manner. In the process of water resources management, not only must the quality be met, but it must also be ensured that the investment costs are kept to a bare minimum.

(4) Efficiency
The most important aspect of efficiency is the ability to do the most useful work at the lowest possible cost. Evaluation of water resource auditing efficiency is mostly dependent on investment and return, including whether or not the investment generates a high-quality return, among other factors.

(5) Effectiveness
The effectiveness of water resources relates to whether or not the performance audit of water resources is up to the standards, whether or not the intended outcomes are obtained, and whether or not the water resources are effective once they have been managed and administered.

2.2.3. Water Resources Management Performance Audit Program Based on Computer Information Technology. In the water management performance audit program, auditors collect data using computer information technology, which is divided into four phases: the audit preparation phase, the audit implementation phase, the audit report phase, and the audit trail phase. The audit preparation phase is the first of these phases.

(1) Audit preparation phase
To prepare for this stage, auditors must first understand the audited unit’s water resources management strategy, resource allocation, and other related issues and then assess the risks associated with the audit and draft an audit plan. The audit preparation phase is continued until the audit notification is given, at which point it is terminated.

(2) Audit implementation stage
The audit of water resources is primarily concerned with this stage. The audit implementation stage is defined as the period between the time of entry into the audited unit and the time of withdrawal. It is essential to determine how each project will be implemented, collect and analyze audit data from the unit, and evaluate water resources management using performance audit indicators throughout this stage.

### Table 1: Phased improvement targets for the water environment in 2020.

| Seven key river basins          | Excellent water quality | >70% |
|--------------------------------|-------------------------|------|
| City drinking water            | High-quality water      | >93% |
| Groundwater                    | Very poor water quality | ≈15% |
| Coastal waters                 | Excellent water quality | ≈70% |
| Urban black and smelly water   | Black smelly water      | <10% |
### 2.2.4. Water Resources Management Performance Audit Method

There are generally the following methods in water resource management performance auditing:

1. **Audit methods of superiors and subordinates**
   - The higher-level agency audits the water resources managed by the lower-level agency. Under normal circumstances, this cross-audit organization mode is usually adopted. That is, under the leadership of the previous agency, two or more auditing agencies separately audit the water resources management of their own agencies.

2. **The same level audit method**
   - The same level audit refers to the audit of the water resources management of the government at the same level.

3. **Cooperative audit**
   - The term "cooperative audit" refers to the process in which two or more audit subjects work together to complete the audit. Consider how the use of cooperative auditing may assist in promoting cross-border water resource concerns while auditing certain cross-basin water resource management.

### 2.3. Construction of Water Resources Performance Audit Evaluation Indicators Based on Computer Information Technology

#### 2.3.1. Principles for Constructing Water Resources Performance Audit Evaluation Indicators

1. **Relevance principle**
   - The user’s expectations can only be addressed by configuring indicators that are relevant to the topic; hence, the relevance principle is the most fundamental concept. After the water audit is completed, the final results are utilized to increase work efficiency and better finish the task to accomplish the audit goals.

2. **Scientific principles**
   - Indicators should be representative and used in conjunction with current computer information technology to gather data; if data is challenging to get, comparable indicators may be used instead of them. When picking indicators, they must be scientific in nature and capable of objectively reflecting the outcomes of the water resources audit, making the audit results more scientific and more accurate in their interpretation.

3. **The principle of combining flexibility and stability**
   - Because the water resource situation in each location is unique, it is possible to pick the most suitable index according to the current circumstances while generating the index, which allows for more flexibility. When building indicators, we must also consider the stability of the resulting data. The scope of indicator assessment should be comprehensive so that when assessing, there is a primarily uniform indication to measure comparison and evaluation when comparing and evaluating indicators.

4. **The principle of combining qualitative and quantitative**

#### Figure 2: Scope of water resources management performance audit objects.

| Water resources management performance statistics |
|---------------------------------------------------|
| Information disclosure | Project construction | Use of funds | System management |
| Water resource accounting information | Water quality information | Construction project | Water pollution prevention and control | Sewage treatment | Water pollution prevention and discharge | Environmental management | Regulations and policies |
The combination of qualitative and quantitative indicators may make the indicators more scientific from various viewpoints and can be used to audit water resources more entirely than either method alone. When there is no quantification of the indicator data, a qualitative and qualitative approach may be utilized for stratified scoring, and the median value is then employed as the assessment criterion.

(5) Principle of full disclosure

When developing water resources audit evaluation indicators, it is essential to include all of the relevant information about the government’s water environment-related activities so that the general public can understand the government’s relevant situation in terms of water resource protection and management.

2.3.2. Construction of Driving Force Indicators. Driving force indicators refer to the reasons that promote changes in the water resource environment. The reasons can be political, ecological, or social. The economic drive mainly refers to the adverse effects on the environment when the town is reopened for some economic activities, which drives the protection of the environment by the whole population; the social drive refers to the people’s requirements for water quality; the ecological drive should reflect the postgovernment effectiveness.

2.3.3. Construction of Pressure Indicators. The index of pressure is the most important aspect of the overall assessment index. Stress indicators may show changes in pressure generated by human actions in the environment, and they can help individuals understand how to reduce stress more intuitively.

2.3.4. Construction of Status Indicators. Indicators of water resource status include the outcome element under pressure, which refers to the typical changes in water resources as a consequence of economic, ecological, and social pressures. Ideally, state indicators should capture all of the present features of water resources, such as hydrological parameters and water quality.

2.3.5. Construction of Response Indicators. The response index serves as the focal point for the whole assessment system. It might serve as a reflection of the government’s efforts to manage water resources. It can be observed from the response index that the department is aware of and places a high value on the environment around water resources management. When the audited unit has assumed corresponding responsibilities for ecological development, the ecological response reflects whether or not it is responding to a national call and making efforts and contributions to ecological restoration; when the audited unit has responded to the masses, the economic response reflects whether or not it has assumed corresponding responsibilities for ecological development. This is in response to the mindset of urban water resources governance.

2.3.6. Construction of Impact Indicators. The impact indicator serves as a form of feedback loop for the reaction indicator and the impact indicator. The feedback is the change in the environment that occurs when the audited unit implements a set of water resource management policies and procedures. It can be determined whether or not the actions taken by the audited unit will have a significant impact on the existing situation.

2.4. Sustainable Development Technology of Water Resources

2.4.1. Water Supply Security Technology.

(1) Drinking water safety guarantee technology

Uncontaminated drinking water may be cleaned using standard treatment procedures to eliminate turbidity in the raw water and destroy microorganisms that are present in the water supply system. Precipitation, sand filtering, and chlorination disinfection are the three phases that make up the regular treatment procedure.

(2) Micro-polluted water source treatment technology

Because traditional water purification procedures can no longer efficiently treat micro-polluted water sources, new technologies for treating micro-polluted water sources have been developed, with promising results.

2.4.2. Sewage Treatment and Reuse Technology.

(1) Urban sewage treatment and reuse

In most cases, relatively developed methods are employed, such as the traditional Martian sludge process and the oxidation ditch method. Examples include the following: according to the government, it is essential to expedite the building of urban sewage treatment facilities while also choosing cost-efficient, acceptable, and effective treatment methods and boosting the rate of sewage treatment as well as the rate of reclaimed water consumption.

(2) Industrial wastewater treatment

Because the water quality and quantity of wastewater in each industry are different, different industrial wastewater treatment processes should also adopt different technological processes. Tannery wastewater treatment includes a single treatment process and a comprehensive treatment process. The only process used for this type of wastewater treatment is physicochemical + SBR + air flotation. First, the chromium-containing wastewater is precipitated to remove the precipitable solids in the water, and then alkali can be added to precipitate the chromium, and then through the concentration and dehydration process, the precipitated solids are further processed,
and the abovementioned wastewater after the chromium recovery enters the integrated wastewater treatment system.

2.4.3. Remediation Technology for Polluted Water Bodies. Water restoration technology is primarily defined as the process of implementing physical, chemical, and biological technological procedures on a contaminated water body in order to lower the amount or concentration of pollutants in the water body until the water body is fully safe to drink.

2.4.4. Water Saving Technology.

(1) Agricultural water-saving technology

Technology for delivering water via low-pressure pipelines is known as "pipe irrigation," and low-pressure pipeline water delivery technology is a water-saving technique that uses low-pressure water pipelines to transport water directly to field furrows and borders to irrigate crops while reducing water leakage and evaporation losses during transportation. Among the many benefits of this water-saving technology is its ability to save water, save energy, and be simple to administer. The investment is also relatively modest, the land utilization rate is increased, machine farming and maintenance are simple, and the irrigation efficiency may be considerably enhanced.

Drop irrigation, which is shown in the video, is a water-saving technique that involves delivering water directly to crop roots using a series of plastic pipe systems to reduce water use. Each faucet drips water directly onto the surface of the roots, which allows it to penetrate deeper into the soil and nourish the plants.

(2) Industrial water-saving technology

Because water has the advantages of being easy to use, having a large heat capacity, being easily transported through pipelines, and having good chemical stability, many industries use it as a cooling substance in their manufacturing processes, either directly or indirectly. Circulating cooling water-saving technology, the implementation of cooling water recycling, particularly indirect cooling water recycling, and improving the cooling water recycling rate have become the primary goals of industrial water conservation.

(3) Building water-saving technology

To conserve water, make use of water-saving household appliances in the home. The facility’s faucets, showers, toilet flushing equipment, and tap water pipelines are the most critical water-saving appliances and equipment in the structure. Using water-saving appliances for a short time and with a restricted quantity of water is the most effective technique for conserving water.

2.4.5. Rainwater Utilization Technology. It is primarily based on the ecological system composed of soil, plants, and microorganisms to purify rainwater in urban areas, which can help maintain the natural ecology of cities, reduce energy consumption caused by artificial rainwater treatment, and achieve better economic, social, and environmental benefits.

3. Construction of Water Resources Sustainable Development Case

It is believed that the river flowing through the village region is part of the Yangtze. Among them are the Qingxi and Huatang rivers, which are permanent rivers on the Tibetan Plateau. From the Yangtze River, it runs down to Chaohu Lake, emptying into several rivers. Floods are a common occurrence in the city during the wet season, despite having enormous water supplies. The community is surrounded by water on all sides, and the rainfall will eventually flow into a neighboring river when it has been collected and treated.

3.1. Sewage Volume Measurement. The following is the estimation principle for sewage volume: the region’s population and water consumption status should be thoroughly researched, and the sewage volume of the area should be adequately assessed. The per capita comprehensive water consumption indicator approach should estimate the sewage volume for plots that do not have data on their water use.

The following is the method for calculating the average daily sewage volume in cities and municipalities based on population density:

\[ Q = \frac{nQ_1 \times K_1 \times L}{K_2 \times 1000} \]  \hspace{1cm} (1)

where \( Q \) is the average daily total sewage, \( n \) is the number of people, \( Q_1 \) is the highest daily domestic water quota for stockholders, \( K_1 \) is the domestic sewage discharge coefficient, \( L \) is the permeability coefficient, and \( K_2 \) is the daily variation coefficient of water supply.

The formula for the compliance rate of pollution source treatment is as follows:

\[ R = \frac{H_1}{H_2} \times 100\% \]  \hspace{1cm} (2)

where \( R \) is the pollution source treatment compliance rate, \( H_1 \) is the number of pollution sources that meet the standard after treatment, and \( H_2 \) is the total number of pollution sources.

3.2. Sewage Treatment Design. The indicators of sewage water quality are shown in Table 2.

Analysis of sewage water quality characteristics is as follows:

The biological treatment method used in sewage, particularly the nitrogen and phosphorus removal procedures, has stricter criteria for the amount and balance of contaminants in the influent than other treatment processes used in wastewater. Table 3 contains an index list of the influent water quality ratios based on the water quality.
(1) BOD$_5$/COD$_cr$

This indicator is used to determine whether or not sewage is biodegradable. This indicator has a value of 0.61 in this region, and it may be purified by biological treatment. The biological treatment method used in this study will be used for sewage treatment.

(2) BOD$_5$/TN

Most of the time, this indicator is used to determine the biological denitrification performance of waterbodies. The greater the value of this finding, the greater the rate of denitrification. According to the index in this region, the nitrogen removal rate may be assured, showing that it fits the standards for biological nitrogen removal.

(3) BOD$_5$/TP

This indicator is primarily used to assess the efficacy of water bodies in removing phosphorus. The biological phosphorus removal procedure may be used in this project, depending on the quality of the wastewater determined by the analysis.

4. Project Construction Results

Following the project’s successful completion, the water quality of the area’s influent and effluent was tested. The results revealed that the COD, ammonia nitrogen, total nitrogen, total phosphorus, and suspended solids of the effluent in the area had all decreased significantly over the previous year. Figure 3 depicts a particular instance in which this is the case.

Figure 3 shows that the COD, BOD, and total nitrogen levels all fall significantly, and the effluent meets the required standards. Figure 3 shows that the gel layer of the treatment facility takes around 20 days to create and that the effluent quality starts to stabilize once the gel layer has been established. The removal rate of COD may be increased to 90% by using anoxic tank degradation in conjunction with membrane tank filtration. As seen in Figure 4, the clearance rate of COD and BOD is calculated.

From Figure 4, it can be seen that the BOD removal rate is around 90% and that the removal method is much the same as the COD removal process. As a result of the
operation of the anoxic pool, COD will first convert BOD before being evacuated. The MBR technique is effective in removing ammonia and nitrogen from water sources. The operation of the filler biofilm in the anoxic tank results in the removal of about 80% of the total nitrogen produced.

5. Conclusions
As the role of government auditing in environmental oversight continues to expand, an increasing number of audit practices will conduct water resources environmental audits and encourage the system’s improvement. Environmental degradation and contamination of water resources have become more prominent, necessitating the inclusion of environmental performance audits in audit work. In this paper, we propose an approach for water resource audits, summarize the sustainable development technology of water resources, and finally carry out case implementation. The practice has shown that the project can minimize the damage to the original ecological water environment in the process of rural economic development, improve the ground penetration rate of rainwater and the accumulation of rainwater resources, purify the rural green space, and also be a source of water for rural production and living [18].

Data Availability
The data underlying the results presented in the study are available within the manuscript.

Conflicts of Interest
There are no potential conflicts of interest in our paper, and all authors have seen the manuscript and approved to submit to the journal. The authors confirm that the content of the manuscript has not been published or submitted for publication elsewhere.

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