

## Research Article

# Water Resource Accounting Modeling and Analysis Adapting to the Development of Market Economy under the Sustainable Development Strategy of Big Data

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As the world's average population continues to increase, residents' demand for water resources continues to increase. Traditional water resource management models and accounting methods have been unable to adapt to the development of the era of big data. We urgently need to establish a new accounting model to realize the sustainable use of water resources under the sustainable development strategy. Based on the above situation, starting from the development of water resource management and market economy, this paper models and analyzes the water resource accounting of sustainable development strategies in the big data environment. First of all, according to the needs of fine accounting of water resources, we start with the microcontrol principle of accounting. We take the basic principles of the accounting identity and responsibility right generation system as the basic method of water resource accounting. This paper proposes an accounting system framework for water resource accounting accounts and related statements. In the sustainable development strategy, the impact of human wading activities on water resources and ecological environment is discussed. Finally, the application of water basin accounting is analyzed in detail. The results show that under the sustainable development strategy, the water resource accounting model integrated into the market economy development can improve the utilization rate of modern water resources and further improve and realize the concept of sustainable development.

## 1. Introduction

As an important resource in our daily life, water resource is an indispensable material element for social development. Creating sustainable water resource management in the big data environment is the main way to improve water resource utilization [1]. The era of big data and digitization is developing rapidly, and the rapidly consumed water resources are the key content we need to pay attention to. Water resources are not only facing the current situation of shortage but also facing the problem of pollution in social development [2]. The traditional water resource accounting management is no longer applicable to the current big data background, in order to better save and utilize water resources. We need to carry out accounting and modern management of water

resources suitable for the development of market economy under the strategy of sustainable development [3]. At present, people do not pay attention to this kind of content in the optimization of water resource management. The traditional management accounting method has been relatively backward. In order to meet the current development background and improve the utilization rate of water resources, different departments should plan their own responsibilities. We improve the confusion in the accounting management system. With the deepening of urbanization, China's market economy has developed, and the water resource market has become a relatively perfect system [4]. However, the large gap between urban and rural areas and the unbalanced economic development still perplex the market price of water resources in China. The market price system of water

resources has not been improved and established [5]. The price of rural water resources is not equal to that of cities, and even far lower than that of cities. We cannot effectively restrict the use of water resources by rural hukou. This situation has greatly hindered the management of water resource utilization in China [6].

In order to solve the above problems, we not only need to pay attention to ideology but also need to integrate science and technology into water resource allocation and management. In China's economically underdeveloped areas, the amount of investment in water resource accounting and management is small, so it is difficult to achieve an efficient and intelligent management mode. We need to take sustainable development strategy as the core content of improving water resources accounting [7]. In order to ensure the sustainable recycling of water resources, the key research direction is to ensure the sustainable development of water resources. The key factor for effective sustainable recycling and distribution is to promote social development and maintain the natural environment in combination with the development level of market economy [8]. The earth's water resources are limited energy, and the uneven distribution in some regions is easy to cause market chaos. We need effective regulation through the government to realize rational distribution and optimization. We narrow the gap between urban and rural areas and avoid obvious regional differences. We model and analyze water resource accounting from the demand of fine management of water resources and the concept of sustainable development. We apply accounting principles to water resource management and distribution.

This paper is mainly divided into three parts. The first part first analyzes the background and management status of water resources accounting in the sustainable development strategy, briefly describes the main problems faced by water resources accounting, and puts forward the research content of this paper. In the second part, under the sustainable development strategy of big data, integrating the development level of market economy, the water resources are finely divided, and the accounting control mode is studied. This paper puts forward the construction of accounting system architecture such as water resource vouchers and accounting statements. The characteristics of water resources are highlighted, and the current situation of water content and precipitation in water resource basins in China is analyzed. Finally, the water resource accounting is reflected in the form of identity, and the accurate data of water resource output value and accounting statements are studied. The specific application of water resource basin accounting. The third part analyzes the research results of water resource accounting modeling under the big data sustainable development strategy and briefly describes the specific significance of this research content.

## 2. Related Work

For the rational allocation and management of water resources, the realization of sustainable recycling begins with the accounting audit of water resources. We take social economy, natural resources, and social harmony as the basis

of a virtuous circle [9]. To realize the sustainable development of water resources, we need to integrate the water resources of each region of the basin and make common distribution and utilization from the concept of science and technology. We observe the change of water resource basin and explore the accounting content of water resources from the overall regional structure. How to establish an accurate accounting mechanism is our main problem. Relevant departments need to strictly control the total amount of water resources in various regions and add the water resource quota and basic units to the accounting in providing accurate data [10]. The government also needs to regulate the conditions of water intake and use and strictly control the water intake and consumption of water resources. We help residents form standardized water use behavior and do a good job in social registration and coordination. The establishment of the accounting mechanism should first start from the level and development of market economy. The economic level of each region is different, and the share of water resources is also different. The price of water resources in economically underdeveloped areas is far from that in developed areas [11]. We need to fully grasp the change law of water consumption and water intake coefficient from the actual situation of local water resource distribution and market economy.

The spatial distribution of water resources in China is very unbalanced, and the areas that can recycle water resources are distributed in the South [12]. With the acceleration of industrial process and urban development, the use and waste of water resources are very serious. Since China proposed to take energy consumption, environmental protection, and ecological benefits as the comprehensive evaluation system of economic development in 2015, regional governments have begun to attach great importance to natural resource protection from the concept of sustainable cycle [13]. The accounting of natural resources is becoming more and more strict and standardized, and the accounting of water resources is the main concern of government agencies. At present, our research on water resource accounting is in the primary stage, and the scientific accounting method is not perfect. We need to realize research and application on the basis of accounting theory. As early as the 1970s, the contradiction between the demand for water resources in different countries and regions began to become the main social problem, and the accounting of water resources also came from people's cognition of the value of natural resources [14]. This contradiction has brought a new impact on water resource management. The United Nations and other accounting systems accounted for the total social value in 2008 and calculated the value in the balance sheet by measurement. Among them, the value of water resources as nonfinancial and nonproductive is presented in the balance sheet. This also means that natural resources are debt free. They did not consider the concept of environmental protection. At this stage, many western countries tried to add water resource accounting. The environmental protection department of the United States first investigated the output value and treatment cost of water resources and provided help for their country's water resource allocation

in the research data [15]. The UK allocates the expected income from the ownership of water resources meeting the conditions, treats the resources in the income part as assets, and brings them into the scope of environmental accounting table. Japan and other countries have also successively incorporated water resources into the natural resource accounting table and established corresponding physical quantity supply and demand balance accounts. According to the development status of water resource accounting in various countries, China also puts forward the accounting model to model and analyze water resources. This paper studies the modeling of water resource accounting to meet the development of market economy under the strategy of sustainable development.

### 3. Methodology

*3.1. Research on Accounting Principle and Modeling of Water Resources Based on Big Data Sustainable Development Strategy.* Clarifying the relationship between water resources and water resources assets is an important prerequisite for the preparation of water resource balance sheet, and clarifying water resources assets and their measurement methods is the theoretical basis for the preparation of water resources balance sheet. If you want to prepare a reasonable and accurate water resource balance sheet, you must clarify the relationship between water resource assets and water resources. To implement the key projects of regional reclaimed water recycling and establish a sustainable mode of regional reclaimed water recycling, the government needs to strengthen the supply of investment and financing policies and systems, innovate the project implementation mode and market-oriented investment and financing mode, and guide social capital investment.

Water resource is the basic material of natural resources and plays a major role in social and economic development. All life and environment cannot operate without the support of water resources. In order to realize the social development model of sustainable concept, we need to realize sustainable development in the division and protection of water resource management. With the increasingly serious problem of water resource pollution and shortage, in order to better manage and utilize water resources, we need to combine the concept of sustainable development with the development form of market economy and integrate it into the process of water resource management and governance. With the continuous emergence of research results on the relationship between man and nature and nature and water resources, researchers have paid great attention to the utilization and distribution of water resources. In order to alleviate the increasingly severe shortage and unequal distribution of water resources, a new direction for the sustainable development of water resources is pointed out. It is necessary to establish an authoritative accounting mechanism in the relationship between man, nature, and water resources. The accounting data is applied to the division of modern water resources.

The core content of accounting is to show the main fund activities and realize the microcontrol of fund activities by setting relevant items, bookkeeping methods, filling in

forms, reviewing vouchers, registering records, filling in reports, etc. Firstly, the voucher is used as the basis for authenticity guarantee, and the three steps of accounting are used as technical support. Finally, it is presented in the form of accounting statements to evaluate and manage the quality of the data results. The basic principle of accounting is shown in Figure 1.

As can be seen from Figure 1, this microcontrol mode is related to fine division management, and many steps and contents can be overlapped. The flow and distribution of resources can be reflected from the details, calculation process, and specific implementation to the final effect. From the direction of fine management of water resource division, the main body and regional resources of water resources are accounted by using accounting identity and bookkeeping as calculation principles. We build project tables and ledgers including resource vouchers. This modeling method not only meets the table requirements and audit purposes but also highlights the characteristics of water resource accounting. The basic framework of water resource accounting is shown in Figure 2.

It can be seen from Figure 2 that in water resource accounting, accounting subjects can reflect the transaction process of things and are the main means of supervision. The primary steps and specific vouchers can be set to account for entities that meet the calculation principles. The accounting content shall be comprehensive and universal, and the accounting content shall be combined with specific indicators. The basic principles of water resource accounting mainly include several elements: assets, liabilities, and equity. Such as surface water content, bottom water content, other water content, utilization rate and water consumption are needed. In the framework of sustainable circulating water flow relationship, we can know the regional relationship of water resource sources from the perspective of accounting. It also includes water sources that can be used directly without processing. The processing process also includes water intake content, available water content, and consumed water content. In the process of relationship inference, we assume that the main body will use all water intake, and the calculation formula is as follows:

$$Wg_t = Kf + Sh_1 = GS + Sh_2 + Sh_1, \quad (1)$$

where  $Wg_t$  represents the water intake content,  $Kf$  represents the available water volume, and  $Sh_1$  represents the water consumption. We judge the sustainable circulating water consumption according to the obtained water content as follows:

$$\begin{aligned} \text{loop}_{Wg} &= SH + Sh_1 + Sh_2, \\ Wg_t &= \text{loop}_{Wg} + PWg_t + \sum SH_t, \end{aligned} \quad (2)$$

where the variable  $\text{loop}_{Wg}$  represents the water content that can be recycled sustainably. When the regional inventory volume is changed, our accounting equation will change as follows:

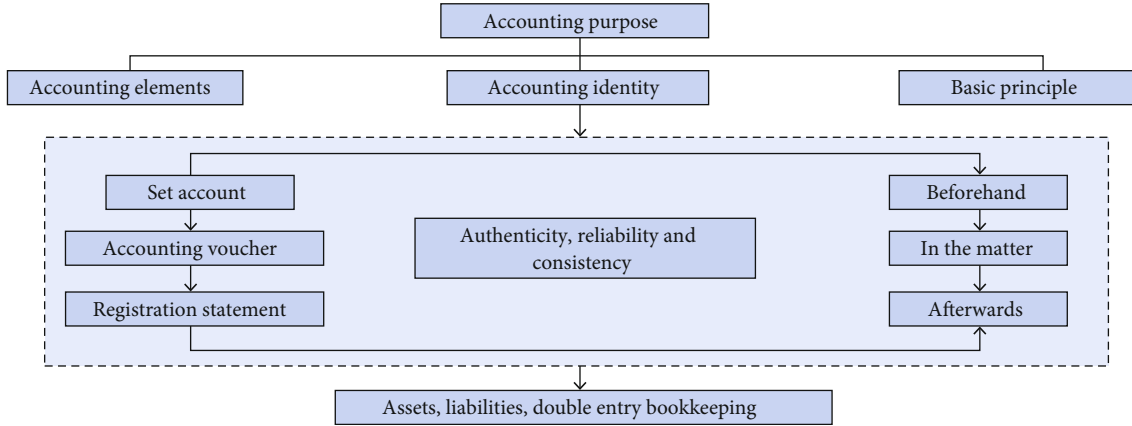


FIGURE 1: Basic principle diagram of accounting.

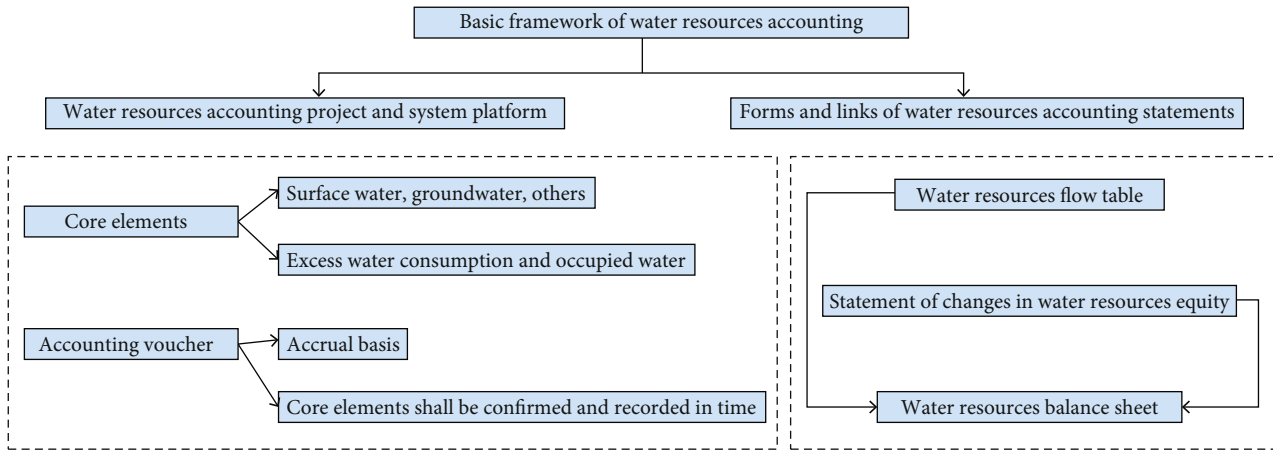


FIGURE 2: Basic framework of water resource accounting.

$$Wg_t - \text{Time}_{Wg} = \text{loop}_{Wg} + PWg_t + \sum SH_t. \quad (3)$$

The above formula represents the difference between the water consumption and the inventory at this stage. In accounting, we need to calculate the cost of water intake, power supply cost, and processing cost. The calculation equation is as follows:

$$\begin{aligned} \varepsilon_{tr} &= \frac{(Y_1 + Y_2) - (Y_3 + Y_1)}{2(Y_3 - Y_1)}, \\ TVW_s &= B_s \times \varepsilon_{w,s} + F_{w,s}, \\ f_{w,s} &= f^w = \frac{F_w}{Q_w} = F \times \frac{\varepsilon_w}{Q_w}, \end{aligned} \quad (4)$$

where  $\varepsilon_{tr}$  represents the water intake cost and  $Y_1$  represents the variable of water intake times.  $f_{w,s}$  represents the consumption of processing cost. From the perspective of macroaccounting, water resource accounting is a way to realize economic and social, environmental protection and resource utilization. It can maintain the harmonious survival between man and nature and adapt to the changes of natural

resources. The microcontrol can reflect the information of water resource allocation, water intake process, water use, and so on.

3.2. Research on Application of Water Resource Basin Accounting Based on Big Data Sustainable Development Strategy. Several major water systems in Haihe River Basin are rich in water resources, among which Beihai River, Daqing River, and other tributaries originate from Inner Mongolia and the Loess Plateau, respectively. The annual precipitation in Hebei Plain is less, and the main flood season begins in June every year. July and August account for more than half of the annual precipitation. We analyze the precipitation trend of water resources in the basin over the years, as shown in Figure 3.

It can be seen from Figure 3 that the precipitation in each region has increased and decreased significantly. In addition to precipitation, water resource reserves also come from surface water and groundwater. Groundwater is an important source of water resource reserves, which can help industry, agriculture, and domestic water. To a certain extent, it provides guarantee for a sustainable development strategy. In practical application, we use the unit hierarchy

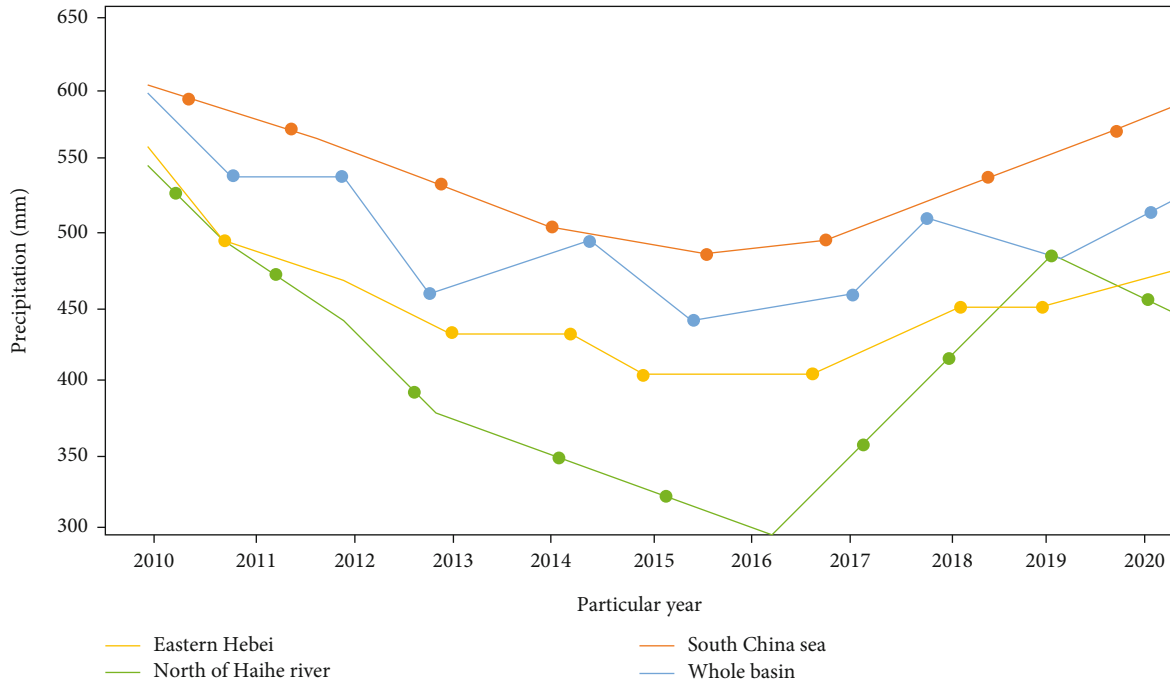


FIGURE 3: Trend of water resource precipitation over the years.

method to calculate the physical quantity of water resources. Mainly for the usable part of surface water resources, the accounting method is used for statistics:

$$V = \sum_{n=1}^i W_n. \quad (5)$$

In the formula,  $V$  is the physical quantity of water resources output value and  $W$  is the physical quantity per unit. The price change of water resources is the result of the balance between supply price and demand price. The shortage of water resources is a developing problem of dynamic balance between supply and demand. To achieve the strategic goal of sustainable utilization of water resources, we must meet the conditions of the water resource system, including the movement law of water quality and quantity in natural circulation. We study and solve various types of problems related to the balance of supply and demand and take effective measures to achieve the purpose of permanent and sustainable dynamic balance of supply and demand of water resources. This final equilibrium system can be used to objectively evaluate the price trend of water resources. In the practical application of water resource accounting, the average flow and ecological demand of each watershed area are calculated, and the formula is

$$W_r = \frac{1}{n} \left( \sum_{i=1}^n W_i \times K \right). \quad (6)$$

In the formula,  $W_r$  is the environmental water demand of the basin and  $n$  is the quantity in the statistical year. We calculate the annual environmental demand according to the average water volume in the minimum month:

$$W_r = 12 \times \text{Min}(W_{ij}). \quad (7)$$

In the formula,  $W_r$  is the minimum demand of the basin and  $\text{Min}(W_{ij})$  is the minimum water consumption of each month. In accounting, it is also necessary to analyze the availability of other water resources and recycle the treated recyclable water. The main calculation formula that can be included is as follows:

$$W_Q = W_L + W_H + W_X + W_k. \quad (8)$$

The formula represents the amount of other water resources that can be utilized and the amount of reclaimed water, Haihe River water, salt water, and fresh water. According to the calculation of the formula, the data of water resource statements of various provinces and cities can be statistically determined. In view of the shortage of water resources, water intake management is not only the best way to plan the allocation and dispatching of water resources but also one of the important means to realize recyclable and sustainable utilization. Water intake permit is the main embodiment of water resource power. One of the important responsibilities entrusted by the state to various departments and management institutions is the water intake certificate. During the accounting period, we should calculate the current water right for the undistributed and transmitted water resources. When the physical quantity and unit value



of water resources are determined, the value output can be expressed by the following formula:

$$V_{\text{ass}} = A \times v. \quad (9)$$

In the formula,  $V_{\text{ass}}$  represents the value of water resources and  $A$  represents the physical quantity of assets. In practical application, the accounting of the physical quantity of water resources is mainly analyzed from the water consumption and quality degradation in each region. The characterization of water resource liabilities in different watersheds needs to be judged from the formal organization and finally accounted in a quantitative way. In the concept of water resource consumption, the water resource system of the whole region is taken as the object, and the total consumption is the difference between water use and available water. It is objective to calculate the quantity of surface water, shallow groundwater, and deep groundwater, respectively. The calculation formula is as follows:

$$\begin{aligned} D &= D_s + D_{\text{sg}} + D_{\text{dg}}, \\ D_s &= (C_{\text{in}} + C_{\text{lus}} + C_{\text{out}}) - W_{\text{sv}}. \end{aligned} \quad (10)$$

$D_s$  in the formula represents the surface water consumption. This data should be analyzed from whether the surface water consumption exceeds the available. The transferred water resources are not included in the accounting scope, so the total physical liabilities of water resources are

$$D_{\text{sg}} = E_{\text{sg}} - R_g = L_p + D. \quad (11)$$

According to the accounting method of water resources, we calculate the output value, physical quantity, and value of water resources in the basin with the region as the unit. Finally, a water resource balance sheet is formed.

## 4. Result Analysis and Discussion

*4.1. Analysis on Research Results of Water Resource Accounting Principle and Modeling Based on Big Data Sustainable Development Strategy.* From the perspective of sustainable development of big data, we should first start from the accounting model adapted to the development of market economy, focusing on physical measurement and supplemented by value. When establishing the balance sheet of water resources, it is necessary to take the change item, time, and unit as the measurement range. The cost value and fair value in historical data are used for calculation. This paper mainly uses the balance sheet in the accounting process. Taking the natural energy of water resources as the main object, report statistics are carried out from the quantity of resources and environmental impact. The method based on the accrual basis takes the entity as the calculation content and follows the water asset calculation identity. The income and expenditure of different water right entities form a creditor's right relationship. In the accounting identity, we calculate the difference between the physical quantity of the net output value of water resources and the physical quantity

of liabilities and finally obtain the physical quantity value of the net output value of water resources in each region, as shown in Figure 4.

As can be seen from Figure 4, we take Eastern Hebei, northern Haihe, and southern Haihe river basins as examples. We explore the changes of net aquatic products in the three regions with the growth of years. Finally, the change of physical quantity is filled in according to the setting principle of the balance sheet, and the results of water resource output value and purified water physical quantity are obtained. The core content of water resource accounting is to express the use of water resources activities of water-related subjects with water output and value as the main scale. The entity of water resource accounting can conduct post accounting for activities generated or completed. The main method is also used to supervise the accounting entity. Starting from the diversity and unity of subjects, we optimize the traditional single way. We adopt systematic methods and systems, establish water resources accounting identities, and determine the main factors affecting accounting. We set up calculation items and liability distribution table. Finally, the water resource accounting process is evaluated to form a complete and smooth accounting model.

*4.2. Analysis of Research Results on Application of Water Resource Basin Accounting Based on Big Data Sustainable Development Strategy.* Sustainable development strategy in the big data environment is the core content of our social development. Water resources in natural resources are characterized by their own randomness, fluidity, and uncertainty. Uneven distribution in some regions is easy to cause market chaos. We need effective supervision by the government to achieve reasonable layout and optimization. We narrow the gap between urban and rural areas and avoid obvious regional differences. Starting from the requirements of fine management of water resources and the concept of sustainable development, this paper models and analyzes water resource accounting. In the accounting statements of water resources, it is necessary to consider the impact of recycling characteristics and changes in assets and liabilities on regional price fluctuations. A set of reporting principles specific to changes in water resources should be formulated to highlight the characteristics of water resource assets. According to different accounting entities, the accounting results are also different. Each individual water right, as the accounting subject, such as water plants, reservoirs, and other wading areas, provides them with correct water use strategies. In wading activities, we should carry out macrocontrol of the total amount of water resources in different forms from the regional differences. We evaluate the main nature of wading activities and wading quality. We comprehensively analyze the water resource accounting cases of different subjects and study the demand for fine division of water resources in combination with the concept accounting system and relevant data. We strictly formulate the water resource management system, water right system, flow management system, value evaluation system, etc. and connect the relevant systems with water resource accounting statistics and apply the content of water resource accounting to the actual management in a quantitative and qualitative way.

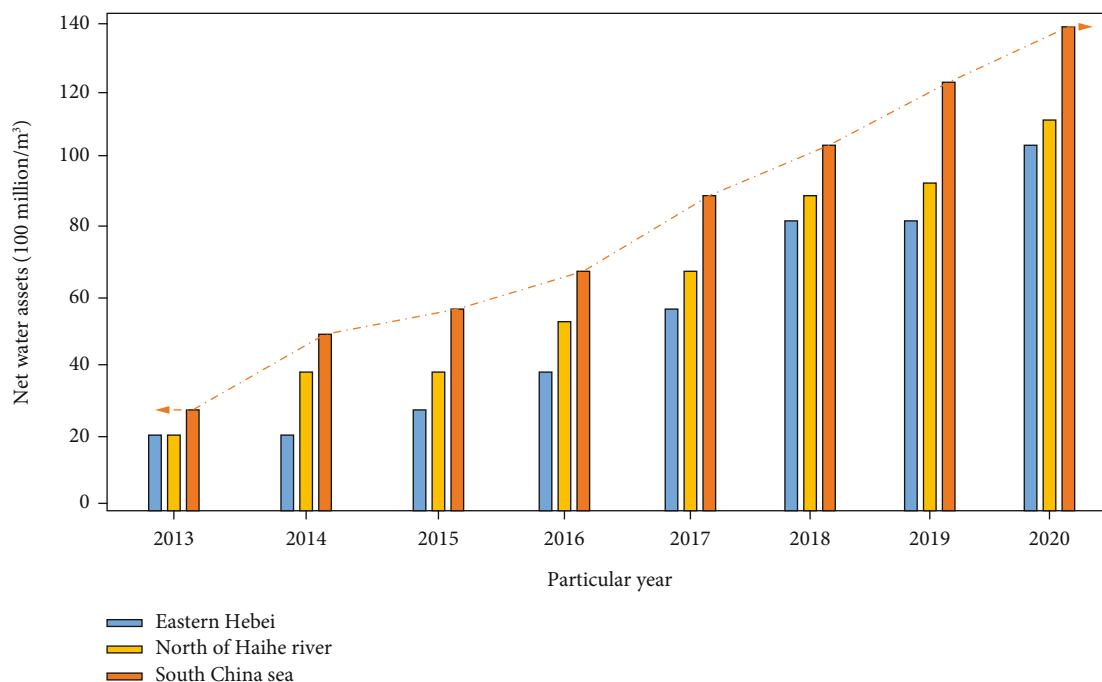


FIGURE 4: Net output value of water resources in each region.

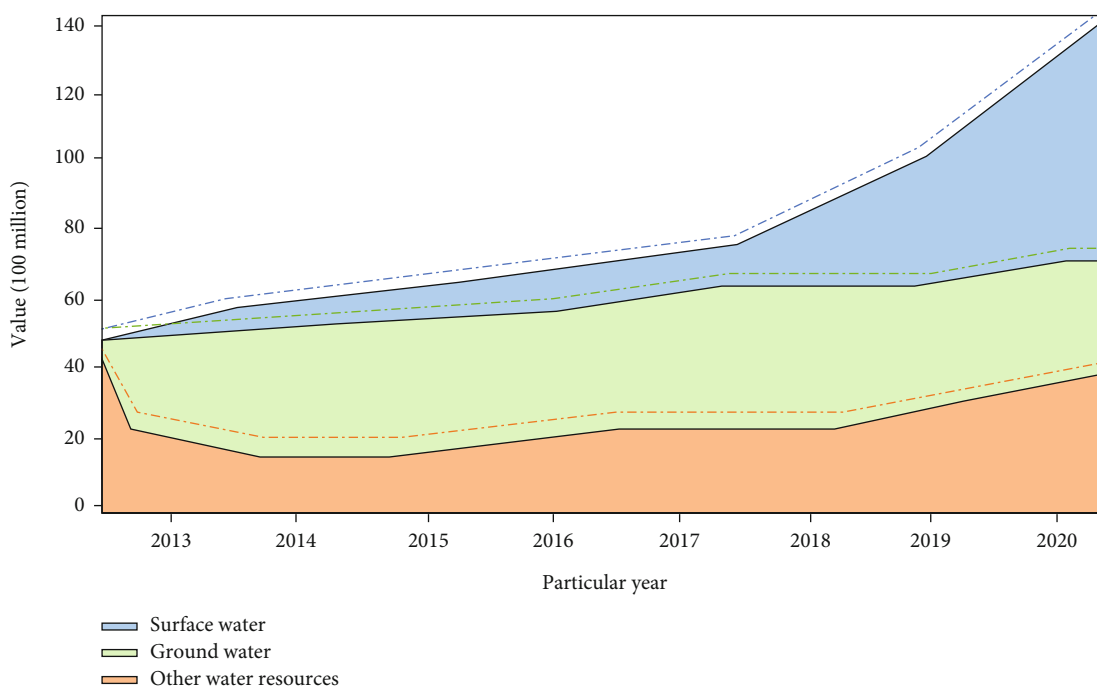


FIGURE 5: Analysis of available value of water resources.

According to the established the water resource accounting method and liability accounting method. Taking the water resource basin as a regional case, we take each region as the basic unit for value accounting and analysis. Finally, the available value of water resource sources is evaluated according to the accounting results. In the accounting price model, we analyze the price of natural water resources from the available quantity. We calculate the available value of

surface water, underground water, and other water resources, as shown in Figure 5.

It can be seen from Figure 5 that in the total value, the available value of surface water is the highest and that of other water resources is the lowest. According to the above research results, under the theme of sustainable development strategy, we should start from the changes of market economy in different regions and uniformly allocate the divided quantity of

water resources in combination with the availability. The process of accounting includes control decision-making and demand management. This bookkeeping method and vouchers are used as the basis, and the liability statement is used as the output embodiment. We ensure the accuracy and authenticity of accounting. The research reflects the integrity and continuity of accounting. As the main branch of environmental analysis, water resource accounting provides effective help for resource scientific planning. It is of great significance to the conservation and utilization of water resources. If conditions permit, we can also take data research from the water resource accounting information of listed companies to explore the relationship between accounting and industrial behavior and income. Finally, combined with the concept of sustainable cycle, a new accounting model is formed.

## 5. Conclusion

This paper applies the content of accounting to the analysis of the availability of water resources in the basin and discusses the impact of different water sources on the availability. The results show that the accounting model is helpful to optimize and improve the water resources management system and provide an effective basis for the development, utilization, protection, and conservation of water resources. According to the research results of this paper, under the theme of sustainable development strategy, we should carry out unified distribution of water resources from the changes of market economy in different regions and combined with the availability of water resources. The accounting process includes control decision-making and demand management. Based on this bookkeeping method and vouchers, the balance sheet is the output embodiment. We ensure the accuracy and authenticity of accounting. This study reflects the integrity and continuity of accounting. As the main branch of environmental analysis, water resource accounting provides effective help for resource scientific planning. This is of great significance to the protection and utilization of water resources. However, this paper does not study the data in the water resource accounting information of listed companies to explore the relationship between accounting and industry behavior and income. This needs further analysis and development in future research.

## Data Availability

The experimental data used to support the findings of this study are available from the corresponding author upon request.

## Conflicts of Interest

The author declared that they have no conflicts of interest regarding this work.

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