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Evaluation of Sustainable Utilization of Water Resources and Analysis of Influencing Factors

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Abstract: As the basic resource for human survival and development, the sustainable utilization of water resources is of great significance for maintaining ecological balance and promoting sustainable economic and social development. However, with the acceleration of global population growth, economic development and urbanization, water resources are facing unprecedented pressure, water shortage, water pollution and water ecological degradation are becoming increasingly prominent, seriously threatening the survival and development of human beings. Therefore, it is of great significance to develop scientific and rational water resources management policies and promote sustainable use of water resources to carry out evaluation and analysis of influencing factors. This paper summarizes the concept and basic principles of sustainable utilization of water resources, analyzes the current situation and challenges of water resources in China, and discusses the evaluation methods of sustainable utilization of water resources, including water balance analysis, water quality evaluation, water resources use efficiency evaluation, etc. On this basis, the main factors affecting the sustainable utilization of water resources are analyzed, including natural conditions, economic and social factors, policy and management factors. Through the analysis, it is expected to provide theoretical basis and practical guidance for rational development, efficient utilization and scientific management of water resources.

1. Introduction

Water is the basis of human survival and development, and is also an important part of the ecosystem. However, with the growth of global population, economic development and the acceleration of urbanization, water resources are facing unprecedented pressure. The over-exploitation, pollution and waste of water resources lead to a series of problems such as water shortage and ecological environment deterioration, which seriously threaten the survival and

development of human beings. Therefore, the realization of sustainable use of water resources has become a major issue facing the whole world. This paper aims to discuss the evaluation methods and influencing factors of sustainable utilization of water resources, in order to provide theoretical basis and practical guidance for rational development, efficient utilization and scientific management of water resources.

2. Overview of sustainable use of water resources

2.1 Concept of sustainable use of water resources

The sustainable use of water resources means that the quantity, quality and ecological function of water resources are sustainable while meeting the current and future needs of human survival and development. It emphasizes that during the development and utilization of water resources, the carrying capacity of water resources should be fully considered, the development intensity of water resources should be reasonably controlled, the water ecosystem should be protected and restored, and the optimal allocation and efficient utilization of water resources should be realized[1].

2.2 Basic principles of sustainable use of water resources

The sustainable utilization of water resources should follow the following basic principles: The principle of equity emphasizes that water resources, as the common wealth of mankind, should meet the needs of the present and future generations in a fair way and avoid over-exploitation and waste; The principle of sustainability requires that the development and utilization of water resources should not exceed the carrying capacity of resources to prevent irreversible damage to the ecological environment. The principle of coordination argues that the development and utilization of water resources should be coordinated with economic and social development to promote the harmonious progress of economy, society and environment. The efficiency principle focuses on improving the utilization efficiency of water resources, reducing waste and pollution, and realizing the optimal allocation and efficient utilization of water resources[2-3].

2.3 Current situation and challenges of water resources in China

The total amount of water resources in China is rich, but the per capita water resources are low, and the spatial and temporal distribution is uneven. According to statistics, the total amount of water resources in China is 2.8 trillion cubic meters, ranking sixth in the world, but the per capita water resources occupancy is only a quarter of the world average, ranking 121st in the world[4]. In addition, China's water resources are also facing the problems of uneven distribution of time and space, serious water pollution and low efficiency of water resources utilization.

With the rapid development of economy and the continuous increase of population, water resources in our country are facing unprecedented pressure. On the one hand, the problem of water shortage is becoming increasingly prominent, and serious water crisis has appeared in many regions. On the other hand, the problem of water pollution has become increasingly serious, and many rivers, lakes and groundwater have been polluted to varying degrees, posing a serious threat to human health and ecological environment[5]. Therefore, realizing the sustainable utilization of water resources has become an important task in our country's economic and social development.

3. Evaluation methods for sustainable use of water resources

3.1 Water balance analysis

Water balance analysis calculates the availability and consumption of water resources by analyzing the recharge, consumption and discharge processes of water resources, so as to assess the sustainable utilization of water resources[6]. The main contents of water balance analysis include: (1) Analysis of water resource supply, including natural supply of precipitation, surface water and groundwater, as well as artificial supply of inter-basin water transfer and recycled water utilization[7] (Table 1). (2) Analysis of water resources consumption, including agricultural irrigation, industrial water, domestic water, ecological environment water consumption, etc. (3) Analysis of water resources availability, calculate the availability of water resources according to the amount of water resources replenishment and consumption, and evaluate the carrying capacity and sustainable utilization degree of water resources.

Table 1 Analysis of water resources replenishment

Replenishment type	Replenishment (million m^3)	Influencing factor
Precipitation	Variable	Climate, terrain, vegetation
Surface water	Variable	Precipitation, runoff, evaporation
Underground water	Variable	Geological structure, hydrogeological conditions
Interbasin water transfer	Variable	Water conservancy project, water resources distribution
Reclaimed water utilization	Variable	Wastewater treatment, sewage treatment, reuse technology

3.2 Water quality evaluation

By analyzing physical, chemical and biological indicators of water bodies, water quality assessment assesses the pollution degree and ecological function of water bodies, thus judging the sustainable utilization potential of water resources[8]. The main contents of water quality assessment include: (1) Analysis of water quality indicators, including dissolved oxygen, chemical oxygen demand, ammonia nitrogen, total phosphorus, total nitrogen and other indicators (Table 2). (2) Water pollution degree evaluation: According to the analysis results of water quality indicators, the water pollution degree and pollution type are assessed. (3) Ecological function assessment of water body, through the analysis of biodiversity, ecological structure and other indicators of water body, to assess the ecological function and ecological restoration potential of water body.

Table 2 Analysis of water quality index

Water quality index	Value or range	Influencing factor
Dissolved oxygen	≥2mg/L(General)	Self-purification ability of water body and living conditions of organisms
Chemical oxygen demand	≤20mg/L(General)	Organic pollution degree
Ammonia nitrogen	≤0.5mg/L(General)	Nitrogen pollution degree, eutrophication of water body

Total phosphorus	⩽0.05mg/L(General)	The degree of phosphorus pollution and eutrophication of water body
Total nitrogen	⩽1.0mg/L(General)	Total nitrogen, water pollution degree and ecological function

3.3 Evaluation of water resources utilization efficiency

Water resources utilization efficiency evaluation evaluates the sustainable utilization level of water resources by analyzing the utilization efficiency of water resources, the implementation of water-saving technology and water-saving measures. The main contents of water resources use efficiency evaluation include: (1) Water resources use efficiency analysis, including agricultural irrigation water utilization coefficient, industrial water reuse rate, domestic water saving rate and other indicators. (2) Evaluation of water-saving technologies and measures, analysis of implementation effects of water-saving technologies and measures, and evaluation of their role in improving water resource utilization efficiency[9]. (3) Potential analysis of water resources utilization efficiency, through analyzing the potential and constraints of water resources utilization efficiency, suggestions and measures to improve water resources utilization efficiency are put forward.

4. Analysis of influencing factors of sustainable utilization of water resources

4.1 Natural conditions

Natural conditions are one of the important factors affecting the sustainable utilization of water resources. It includes landform, climate characteristics, hydrogeological conditions and so on. Topography has an important impact on the distribution and flow direction of water resources[10]. Mountains, hills and other landforms are easy to form rivers, lakes and other water bodies, which provide favorable conditions for the development and utilization of water resources. However, plains, basins and other landforms are easy to form internal flow areas, water resources are relatively scarce, and it is difficult to develop and use. Climatic characteristics have an important effect on the recharge and consumption of water resources. Precipitation is one of the main replenishment sources of water resources, the amount and distribution of precipitation directly affect the quantity and distribution of water resources. At the same time, climate factors such as evaporation and transpiration also affect the consumption and utilization of water resources. Hydrogeological conditions have an important effect on the storage and exploitation of groundwater. Groundwater is one of the important water resources, its storage and exploitation conditions are restricted by hydrogeological conditions. Different hydrogeological conditions have different effects on the storage and exploitation of groundwater.

4.2 Economic and social factors

Economic and social factors are one of the important factors affecting the sustainable utilization of water resources. It includes population growth, economic development, urbanization and so on. Population growth increases the demand for water resources. With the continuous growth of population, the demand for domestic water, agricultural irrigation water and industrial water is increasing, resulting in the shortage of water resources. Economic development has changed the demand structure and utilization mode of water resources. With the rapid development of economy,

the industrial structure has been continuously adjusted and optimized, and the proportion of agricultural irrigation water has gradually decreased, while the proportion of industrial and domestic water has gradually increased. At the same time, economic development also promotes the application and popularization of water-saving technologies and measures, and improves the utilization efficiency of water resources. The urbanization process aggravates the water shortage and water pollution. With the acceleration of the urbanization process, the urban water consumption is increasing, and the urban water pollution is becoming more and more serious. Urbanization has also exacerbated the uneven distribution of water resources in time and space, leading to serious water crisis in some regions.

4.3 Policy and management factors

Policy and management factors are one of the important factors affecting the sustainable utilization of water resources. It includes water resources management policy, laws and regulations, management system and so on. Through the formulation and implementation of water resources management policies, the government guides the rational development and efficient use of water resources, and promotes the protection and restoration of water resources. Through the formulation and implementation of relevant laws and regulations, regulate the development, utilization, protection and management of water resources, safeguard the legitimate rights and interests of water resources and ecological environment safety. Reasonable management system can ensure the effective management and rational utilization of water resources and improve the utilization efficiency and management level of water resources. However, there are still some problems in the current water resources management system in China, such as multiple management and unclear rights and responsibilities, which affect the sustainable utilization of water resources.

5. Conclusion

Through the in-depth analysis of the evaluation and influencing factors of sustainable utilization of water resources, this paper reveals the severe situation of water resources in the current global background, especially in China, although the total amount of water resources is rich but the per capita occupancy is low, the distribution of time and space is uneven, the pollution is serious and the utilization efficiency is low. In order to realize the sustainable utilization of water resources, this paper discusses a variety of evaluation methods, such as water balance analysis, water quality evaluation and water resources use efficiency evaluation, which provide scientific basis for the comprehensive evaluation of the sustainable utilization of water resources. At the same time, the influences of natural conditions, economic society and policy and management factors on the sustainable use of water resources are deeply analyzed. These factors interweave and work together to form the complex background of the sustainable use of water resources. The research of this paper not only provides theoretical basis and practical guidance for the rational development, efficient utilization and scientific management of water resources, but also provides an important reference for the formulation of scientific and reasonable water resources management policies. In the future, we should further strengthen the research on the evaluation of sustainable use of water resources and the analysis of influencing factors, and constantly improve the policy system of water resources management to promote the sustainable use of water resources, so as to maintain ecological balance and promote the sustainable development of economic society.

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