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# Research on Sustainable Management of Water Resources under the Rigid Constraint of Water Resources

## -- A Case Study of Bengbu City, Anhui Province

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## Abstract

**Water is the foundation of existence, the source of civilization, the essence of production and the foundation of ecology. In 2021, the establishment of a large-scale rigid constraint system on water resources will become a key measure to deal with the overall shortage and uneven distribution of water resources in China. This paper plans to take the water resources management of Bengbu City, Anhui Province as an example, through the investigation of the problems encountered in the water resources, water conservation and water management of Bengbu City. Combined with the latest policies of Bengbu City, through analyzing the difficulties of water resources management in Bengbu City, this paper puts forward constructive and innovative suggestions to help Bengbu City realize the efficient utilization of water resources and water circulation.**

## Keywords

**Water Resource; Rigid Constraint; Sustainable.**

## 1. Research Background

At present, the water crisis caused by the serious shortage of water resources has threatened the vast majority of countries in the world, making the economic, social and scientific and technological development of all countries face a severe test.[1] The global water resources are 1.4 billion KM3, and the industrial and agricultural water consumption accounts for 25% and 70% of the world water consumption respectively. Due to the rapid growth of population, the global per capita water resources have decreased by 25% in recent years. China is listed as a country in short supply of water resources by the United Nations and one of the countries with the largest water consumption in the world. We should establish a rigid constraint system on water resources, strictly control the total amount of water used, make overall plans for production, living and ecological water use, and vigorously promote water conservation in agriculture, industry, cities and towns. We should give top priority to the protection of the ecological environment in the water source area, draw a hard line, unswervingly do a good job in all work, and keep this reservoir of clear water.

According to the research of the international hydrological research program, the research on water resources has changed from a single discipline research to a multi-disciplinary integrated research. With the increase of artificial collateral circulation intensity in the process of water cycle, human intervention in water resources is deeper, and the social attribute of water resources is increasing day by day. At the same time, water resources are facing more crises and challenges. Therefore, it is necessary to combine natural and social systems to carry out comprehensive and integrated research. At present, although China has made great achievements in water cycle monitoring, water resources planning and management, water conservancy construction, agricultural water conservation, basic research of water protection

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science and water development and utilization technology, the water resources situation in most regions of northern China has been severe for a long time. The inter basin water transfer project, mainly the South-to-North Water Transfer Project, has effectively improved the uneven spatial and temporal distribution of water resources in China, It has created favorable conditions for the accelerated development of water receiving areas, and also put forward higher standards for water conservation and use. This paper takes Bengbu City in Anhui Province as an example. Bengbu City is located in East China, the west of the Yangtze River Delta, the northeast of Anhui Province, the middle reaches of the Huaihe River, and the Qinling Huaihe River, the geographical dividing line between North and South China. For Bengbu City, Anhui Province, the management of water resources can better adapt to China's real water resources endowment, effectively improve the comprehensive benefits of the project and realize the high-quality development of Bengbu City only by focusing on the long-term, overall situation and establishing a rigid constraint system for water resources.

## 2. Rigid Constraint System of Water Resources and Sustainable Water Resources Management

The purpose of establishing a rigid constraint system on water resources is to limit economic and social activities within the carrying capacity of water resources through strong constraints. Strictly control the total amount of water use through indicators, improve water use efficiency, improve the quality and stability of water ecosystem, and force all regions and all walks of life to save and protect water resources. To establish a rigid constraint system on water resources, there are three main considerations: first, China has more people and less water, and water resources are unevenly distributed in time and space. This is a basic water situation, which is generally faced with the shortage of water resources. Second, in the future, China will be built into a socialist modern country in an all-round way. Whether it is living, production or ecology, it has a relatively large demand for water resources. Therefore, in the process of modernization, it is bound to face the bottleneck restriction of water resources shortage. Third, due to historical reasons, in the past, there were problems of excessive development and utilization of water resources in some places, resulting in some ecological damage and destruction, including river closure, Lake shrinkage and groundwater level decline. These problems exist to some extent, and some are still very prominent. To build ecological civilization and create happy rivers and lakes, it is necessary to solve these outstanding water ecological problems. The requirements for rigid constraints are implemented from three aspects:

First, establish a series of hard indicators. These hard indicators include: ecological flow of rivers and lakes, groundwater level and other indicators for ecological protection; Indicators of total amount control, such as river water distribution scheme, total amount of groundwater intake, and available water volume in various regions; There are also indicators of water use efficiency, such as water consumption per 10000 yuan of GDP, mandatory water use standards and quotas. Through these indicators, we will strictly control the total amount of water use, improve water use efficiency, improve the quality and stability of the water ecosystem, and force all regions and all walks of life to save and protect water resources.

The second is to take a series of hard measures. Including: strict ecological flow supervision and groundwater level control, strict water resources demonstration and water intake permit management, suspension of new water intake permits in areas with water resources overload, acceleration of water resources overload control, and especially strengthening supervision, inspection and assessment. Through this series of hard measures, we will standardize the development and utilization of water resources in the whole society, restrict and restrain unreasonable water demand, comprehensively curb water waste, improve the water ecological environment, and implement the hard indicators of rigid constraints.[2]

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The third is to form a series of hard constraints. Through the establishment of hard indicators and the adoption of hard measures, we will earnestly implement the principle of determining the city by water, determining the land by water, determining the people by water, and determining the production by water, that is, "how much soup there is, how much bread there is", and promote the formation of a series of hard constraints such as the land spatial pattern, industrial optimization and adjustment, and urban planning and layout.

Through hard indicators, hard measures and hard constraints, we will gradually achieve the balance between China's population, economy and water resources, and provide water security support for the comprehensive construction of a modern socialist country.

Development is the eternal theme of mankind. It is the whole process and result of human life and social activities to meet their own needs. If human activities exceed the life bearing capacity of the earth, it will inevitably lead to the deterioration or even loss of human living conditions. Since the mid-20th century, there have been many major accidents caused by the deterioration of water quality at home and abroad. For example, in 1985, in Wales, England, 2million residents drank polluted water and 44% of the population was poisoned due to the discharge of chemical plants into the di river. In 1999, a large number of paper mills built around the Huaihe River in China discharged a large amount of toxic sewage into Hanoi. The deterioration of water quality in the Huaihe River has led to the lack of water for millions of residents in the lower reaches of the Huaihe River. The development of human society must not be at the cost of excessive consumption of resources and environmental pollution. Because the earth life support system is the fundamental guarantee for human development and survival. However, his support is limited. If it exceeds its limit, nature will retaliate against mankind.

## 3. Current Situation and Existing Problems of Water Resources

### 3.1. Current Situation of Water Resources

According to the comprehensive planning results of water resources in the Huaihe River Basin, the average annual total amount of water resources in the Huaihe River from 1956 to 2000 was 9.1 billion m3, the surface water resources were 67.7 billion m3, and the average annual groundwater resources were 39.7 billion m3. Among them, the average annual total water resources in the Huaihe River Basin are 79.4 billion m3, the surface water resources are 59.5 billion m3, and the average annual groundwater resources are 33.8 billion m3; The average annual total water resources of Shandong Peninsula are 11.7 billion m3, the surface water resources are 8.2 billion m3, and the average annual groundwater resources are 5.9 billion m3. According to the analysis of the average total water resources and water supply of the Huaihe River Basin in the same period from 1980 to 2000, the development and utilization rate of water resources in the Huaihe River Basin is 49%, of which the development and utilization rate of surface water is 51%, and the exploitation rate of shallow groundwater is 48%. The development and utilization degree of surface water varies greatly in different years. The utilization rate of surface water resources in the Huaihe River Basin in dry years above moderate drought is basically above 80%, which has seriously occupied the ecological and environmental water of rivers and lakes, resulting in serious water shortage. Since the 1980s, with the rapid development of the basin economy and the acceleration of urbanization, the water resources problem in the Huaihe River Basin has become increasingly prominent, which does not meet the requirements of sustainable development and has seriously affected the social and economic development of the basin.

### 3.2. Problems

The water resources problems in the Huaihe River Basin mainly include the following aspects:

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The Huaihe River Basin is a water shortage area due to the prominent water shortage problem and the excessive development and utilization of water resources. In the 50 years from 1949 to 1998, drought occurred frequently in the Huaihe River Basin, and there were 12 severe drought years (the frequency of severe drought was once in four years). Drought has become a major natural disaster in the Huaihe River. The per capita water resources in the basin are less than 500 m3, only 1/20 of the world average and 1/5 of the national average; The average water resources per mu is 417m3, only 1/7 of the world average and 1/5 of the national average. At present, there are more than 5700 large and medium-sized reservoirs and more than 5000 sluice gates in the Huaihe River Basin, with a total storage capacity of 30.3 billion m3 and a beneficial storage capacity of 15billion m3, accounting for 51% and 25% of the annual average runoff respectively. The utilization rate of surface water is far higher than that of inland rivers in the world. According to the standards approved by the International Conference on natural resources in 1996, the utilization rate of water resources in the Huaihe River Basin is close to 50%, while the per capita water resources is less than 500m3, belonging to a serious water shortage area. With the development of national economy, the problem of water shortage in the Huaihe River Basin will become more prominent.

The spatial and temporal distribution of water resources is uneven, which does not match the distribution of regional productivity. The Huaihe River Basin is located in the transitional zone of North-South climate in China, with uneven distribution of water resources within a year and sharp interannual changes. 70% of the runoff in the whole basin is concentrated in the flood season from June to September, and the maximum annual runoff is 6 times of the minimum annual runoff. The uneven spatial and temporal distribution and drastic changes of water resources aggravate the difficulty of the development and utilization of water resources in the basin, and make the situation of water resources shortage more prominent. In addition, the spatial distribution of water resources does not match the layout of regional productivity. The area south of the Huaihe River is relatively rich in water resources, but its economy is relatively backward and its total economic output is small. In 2010, the GDP of the region accounted for only 12.6% of the GDP of the whole basin, while the total water resources accounted for 27.2% of the whole basin. The area north of the Huaihe River (especially Shandong Province) is poor in water resources, but its economy is relatively developed and its total economic output is large.

Serious water pollution

Up to now, there have been nearly 200 major water pollution accidents in the whole basin, and the accumulated direct economic losses have reached several billion yuan. The major pollution accidents occurred in 1989, 1991, 1992, 1994, 2001, 2002 and 2004. Water pollution directly leads to the deterioration of water quality, which brings great risks to water users along the Huaihe River.

## 4. Water Resources Management Countermeasures

Realize the great change of ideas or thinking mode

Ideas and ideas determine the development direction and outlet of things, and also directly affect the results. In the new period of Huaihe River governance, the situation of the basin will be more complex. It is necessary to firmly grasp the general idea of water governance in the new period and establish a new concept, idea and value system on the basis of summarizing and absorbing the advanced experience and Enlightenment of foreign water resources basin management. The sustainable management of river basin water resources needs to focus on the transformation from project construction management to comprehensive management of river basin water resources, from end-of-life treatment of water environment and passive response to active guidance and planning. At the same time, we should deeply understand the

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relationship between river basin management and administrative regional management, make psychological preparations for "protracted war and tough battle", and firmly establish a "comprehensive, coordinated and balanced" thinking mode, Water resources management should be carried out from the perspective of sustainable development of the whole basin.

Constructing a scientific objective system of watershed management

The Huaihe River control work has entered a new historical period, and the watershed characteristics have changed significantly, which will inevitably lead to more diversified water resources management objectives and higher requirements. On the basis of a deep understanding of the ultimate goal of water resources management, it is necessary to establish a fully coordinated, hierarchical and dynamic goal system between the basin and the four provinces, so as to ensure the common development of social, economic, technological and ecological indicators in the basin and replace the new goal system of water resources management at the engineering technical level.

Introducing public management theory to strengthen public management of water resources

At present, the main characteristics of the traditional mode of river basin water resources supervision and management are over reliance on local administrative management, lack of supervision and management of water intake license, lack of unified management of water quality and quantity, and unscientific management of total amount control of water intake license. The role of government is realized through the operation of policy system, and its essence is the process of interaction between policy subject, object and environment. The policy process and its various functional activities are jointly completed by subsystems such as information, consulting, decision-making, implementation and monitoring. These subsystems have their own division of labor, are independent of each other, and are closely coordinated and coordinated to ensure the smooth operation of the policy system. The traditional mode of water resources administration has not met the practical requirements of contemporary water resources management. Therefore, the public management theory should be actively introduced to establish and improve the public decision-making system of water resources management.

Strengthen the construction of river basin water resources monitoring and management system

One of the important reasons for the lag of watershed water resources management is the backwardness of water resources monitoring and management. At present, there is no comprehensive, coordinated and unified water resources monitoring system in the basin, and the water resources monitoring capacity is incompatible with the responsibilities entrusted by the water law. The goal of integrated watershed management requires integrated watershed water resources management. Integrated management urgently needs a comprehensive management, service platform and tool - watershed water resources management system. Therefore, it is necessary to strengthen the planning and construction of water resources monitoring network and the construction of river basin water resources management system in close combination with the technical requirements of the construction of national water resources management system under the condition of clear thinking and clear management objectives, so as to achieve a great leap in management means.[3]

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