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Sustainable management of water resources in arid areas

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Abstract. Water is an essential resource for human survival, production and socio-economic development, essential for all forms of life, and essential for the maintenance of healthy ecosystems. Due to the continuous change of climate and the continuous growth of population, economy, region and other factors, water resources are becoming more and more scarce. In arid and semi-arid regions, the coupling and interaction between water resources security, energy security, food security and ecological security are becoming more complex, conflicts and contradictions are gradually emerging or intensifying, and uncertainty and risk levels are increasing. Water utilization and management methods are also becoming increasingly serious and complex, which requires new and innovative approaches to conserve and use water wisely. The sustainable management of water resources has always been the focus of research on water resources in the world, and there is much research on water resources management in major forums. This paper uses the method of review to analyze the relevant articles on water resources management, and puts forward more effective methods for sustainable water resources management, and provides suggestions for follow-up research on sustainable water resources management.

Keywords: Water resources, Sustainable management, Arid regions

1. Introduction

In terms of the current state of water resources management, water resources management is currently facing three problems in China and the world. The first is the rapid growth in demand for water. Economic and population growth has led to a significant increase in water demand for industry and agriculture. In addition, the uneven distribution of water resources and environmental pollution also affect the demand for water. Second, there is a lack of comprehensive planning for water resources. Many countries lack comprehensive and unified water resources planning and management mechanisms. Each management department is trying to protect its own interests, thus ignoring the joint action of multiple departments. This has caused mutual influence on groundwater, surface water, water ecology and water environment. Third, water resources management is difficult. Due to economic and other interests, viable water management schemes are not implemented in many areas. Failure to establish an effective testing and management system. In addition, some areas have become difficult to manage due to politics or disasters. These problems make it difficult for many water resources to be effectively used and protected due to pollution and waste. For the ecological importance of water resources management. Water is a non-renewable natural resource and its supply is limited. In addition, the negative impact of

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water use on the environment and ecosystems is also very important. The sustainable utilization and management of water resources is a necessary condition for maintaining social stability and harmonious development. Therefore, the sustainable management of water resources plays a vital role in maintaining regional ecological security and socio-economic development.

2. The challenges faced

Water scarcity affects food security and economic development. Of the freshwater consumed worldwide, 70% is used for irrigation, 20% for industry, and 10% for drinking and residential use. Because the value of water in agriculture is lower than that in industry, driven by economic interests, agricultural water is gradually occupied and transferred to industrial water. At the same time, the contradiction between agricultural water utilization and industrial water use restricts regional economic development.

The lack of water resources brings challenges to the ecological environment. The change in the natural flow of the river and the influence of river damming on the natural water volume of the upstream and downstream rivers and lakes have destroyed the ecological environment of the basin [1]. The impact of cross-domain water transport on species diversity, as well as the overuse of groundwater, has long-term implications for the ecology of the region [2]. The contradiction between water use for industrial and agricultural development and ecological water use is prominent, and the problems of river interruption, lake shrinkage and disappearance, soil salinization, land desertification and vegetation are prominent. A series of problems, such as degradation, make the fragile ecological environment worse.

The lack of water resources has a negative impact on social equity. The social welfare between the water source and the water receiving area is unfair, which is easy to produce social contradictions. In particular, the distribution of water resources in cross-border rivers is prone to political and economic friction between countries.

In short, the lack of water resources has an impact on the sustainable development of society. Sustainable development is defined as development that meets the needs of the present without endangering the needs of future generations. From “World Water Development Report” (2012), By 2030, 47% of the world’s population will live in areas with severe water shortages. Most population growth will occur in developing countries and will be concentrated in areas that are already suffering from water shortages and lack full access to safe drinking water and adequate sanitation. According to the World Water Assessment Program, water resources management affects all aspects of the economy, in particular health, food production and food security, civil water and sanitation, energy, industry and environmental sustainability. With the rapid development of society, the contradictions brought by this influence are becoming more and more prominent.

3. Strategies for sustainable water resources management

Implement water resources assessment. Carrying capacity is a measure of the ability of an environment or area to support human and other life and its activities in a sustainable way [3]. Recurring water-related hazards and environmental problems indicate that exploitation of the environment exceeds the carrying capacity. In China, carrying capacity research was started in western China around 1984 to evaluate the ability of water resources to support economic development in arid areas. During the period 1995-2000, these studies continued in other provinces and in many cities throughout the country. Since 2000, the scope of water resource carrying capacity research in China has expanded, and a single comprehensive evaluation method has been adopted to evaluate surface water and groundwater resources. Water resource carrying capacity is known to be a key factor in controlling land and water use, especially in increasingly densely populated areas. Although the capacity of water resources is relatively sustainable, the patterns of use of these resources may change depending on the socio-economic and cultural-technical level of the user, and water resource carrying capacity should be evaluated regularly to maintain sustainable use of water resources and the environment.

Develop basin wide water management plans [4]. Let all departments and units of water use, including agricultural departments, industrial departments and ecological departments, participate in the formulation of water resource management plans, and regulate the total amount to ensure the balance of

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ecological water use and social water use. Based on a large number of scientific research achievements of water resources allocation and ecological environment management in Northwest China by the Chinese Academy of Engineering, the change pattern and trend of inland river water cycle in Xinjiang under the influence of socio-economic water cycle, as well as the challenges facing in the future were studied [5]. The appropriate threshold value of water resource utilization at home and abroad is studied. This paper puts forward the water resources management regulation mode from two aspects. Water consumption of the ecological environment and socio-economic water consumption are divided into 50% to 50%. 30% of the runoff in the river should be retained to maintain the basic natural water cycle. The maximum drainage of a river does not exceed 70% of its runoff. This pattern provides a reference for the innovation of water resources management and the coordinated development of water, economy and ecology in the arid region of Northwest China.

Increase unconventional water resources development and utilization. Unconventional water resources (UWS) can be used as an alternative water source to overcome water scarcity [6]. The use of UWS as a new opportunity to address water constraints is growing and is particularly useful in arid and semi-arid regions. Many countries have begun research on unconventional water resources, and vigorously develop and utilize unconventional water resources. There is a lot of literature on the use of very unconventional water resources. Rainwater collection and utilization, is low cost, low technical requirements, and does not require energy. Fog water, dew collection and utilization, low cost, low technical requirements, no need for energy. Due to the relatively small amount, it is neglected in wet areas, but can play a larger role in arid areas, especially mountains and coastal areas. Desalination is costly and relies on technology and energy. Cloud seeding water with high cost, depends on high technology. Groundwater, good water quality, great ecological impact. Industrial and commercial Greywater reuse requires disposal and depends on technology and energy. Domestic wastewater reuse requires disposal, and relies on technology and energy. Agricultural water discharge, collection and disposal difficulties, have a great impact on the ecology. Chemical fertilizers and pesticides are used extensively in agricultural areas, and the discharge water from agricultural areas has a great negative impact on the ecology of the basin. Due to spatial and temporal differences such as geography and climate, the quantity and quality of unconventional resources in different regions are very different, as well as the differences in the management level, knowledge application and social development level of each region, each region should develop unconventional water resources according to local conditions. In northwest China, for example, electricity is plentiful and cheap. So unconventional water management measures that consume energy can be adopted.

Implement a virtual water strategy [7]. Dry areas grow crops that absorb low water demand, import products with high water consumption, and carry out virtual water international trade, and areas with excess water resources meet the needs of water-scarce areas through water-intensive commodity trade. In the 1990s, Allan proposed the concept of Virtual Water, which refers to the water consumed by a region in the process of production and service [8]. Virtual water flows between different regions when products and services are traded, and its flow form overcomes the difficulties of water resources in long-distance space transportation. There are significant differences in the water requirements for planting the same crop among countries along the Belt and Road. With reference to the superimposed analysis results of "export volume - water requirement", countries should focus on reducing the export proportion of "high water consumption - high mouth type" crops, expand the export trade of "low water consumption - high mouth type" crops, and adjust the crop trade structure accordingly [9]. Reduce the loss of renewable freshwater resources along the Belt and Road from the perspective of saving water resources. The virtual water strategy brings new directions to the system of water resources management and economic development in the region. The development of a virtual water strategy is becoming more and more urgent.

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4. Future research recommendations

Adopt mathematical modeling to improve the ability of water resources evaluation, so that the supply of water resources can more accurately match the needs of economic development and ecological protection.

Take advantage of big data to improve process monitoring and analysis of sustainable water resources management, and constantly improve process control methods.

Take good use of new technologies to improve the utilization rate and reuse rate of water, improve the efficiency of water and economic return per unit.

Comprehensively implement virtual water strategies to reduce water dependence in arid areas.

Strengthen cooperation between regions and countries to share new technology and management mechanisms for water resources management.

5. Conclusion

This paper briefly describes the challenges and strategies for the sustainable management of water resources in arid areas. The sustainable management of water resources is a huge project that concerns generations and has a vital impact on human survival and life on Earth. Knowledge about unconventional water use remains to be developed, and the impact of some water management on the ecological future of the environment is not well understood. The level of water management varies greatly between regions. The interdependence of life on Earth determines that the sustainable management of water resources is not a matter for a region or a country, but for the whole planet. Building on regional water management to develop sustainable management of the world's overall water cycle. The sustainable management of water resources for one planet will solve the current crisis of water resources for the development of all mankind in a more systematic and comprehensive way. Similarly, the development of science and technology will bring indelible contributions to the sustainable management of water resources.

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