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# Domestic and Foreign Review Based on Ecological Hydrology

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## Abstract

**Ecohydrology is a science that explores and reveals the hydrological mechanism that forms the ecological pattern and process. Its research and application play an important supporting role in solving the ecological and environmental problems involved in water and the resulting water disasters. It expounds the background and needs of the subject development of ecological hydrology, gives the concept of ecological hydrology and summarizes the research problems of ecological hydrology, puts forward the latest research trends of ecological hydrology at home and abroad, and looks forward to the development and strategy of the subject.**

## Keywords

**Ecological Hydrology; Ecology; Hydrology; Disciplinary Development Strategy.**

## 1. Introduction

After the end of World War II, the world has entered a period of relative peace and economic development. The global population has increased rapidly, science and technology have developed rapidly, and people have intensified the development and utilization of natural resources in pursuit of maximum material civilization [1]. However, after decades of rapid development, it has caused a major environmental crisis that seriously threatens the security of the earth's environment and the sustainability of human beings [2]. The most prominent manifestations are the increasing shortage of freshwater resources, the deterioration of freshwater resources, and the sharp decline in biodiversity. Global environmental issues. It has been found that in terms of the development trend of the discipline itself, although ecology, hydrology and other technical sciences have made great progress in theories and methods, it is difficult to effectively alleviate the above-mentioned global theoretical knowledge and methods if the theoretical knowledge and methods of a certain discipline are used alone. environmental issue. Therefore, the scientific community strives to find new methods [3].

Ecohydrology is a kind of water formed in the practice of seeking an environmentally friendly, economically feasible and effective way of sustainable use of freshwater resources under the background of global environmental problems such as the shortage of freshwater resources, deterioration of water quality and reduction of biodiversity. Cross applied disciplines of literature and ecology. It well integrates the many disciplinary needs of ecological security, environmental security, water security, etc [4]. facing the current sustainable development of human society. It has developed rapidly in recent years and has carried out applied research in a variety of ecological, climatic and landform types.

Ecohydrology is an important hydrological scientific basis for river basin water management, river water governance, and ecological civilization construction. The relationship between water and ecology and the hydrological mechanism that reveals the formation of ecological patterns and processes are important scientific issues in ecological hydrology [5]. The study of ecological hydrology in my country has a good foundation and new developments, especially the completion of the major plan of the Heihe River Basin Eco-hydrological Process Integrated

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Research proposed by the National Funding Committee. Due to the diversity of factors such as climate and rainfall in my country, there is an urgent need to further explore the theoretical methods and disciplinary systems of ecological hydrology under the needs of different problems. The development of the discipline of ecological hydrology needs to strengthen the cross-discipline of hydrology and ecology, strengthen the research and practice of new theories, methods and technologies of ecological hydrology, keep up with the forefront of international development, and at the same time use the development of social hydrology as a supplement to promote my country The construction and development of major national needs such as the construction of ecological civilization.

## 2. Design Research

### 2.1. Problems and Challenges in Ecological Hydrology

As a discipline with a wide range of applications and rich research content, the development of ecological hydrology has a long-term theoretical basis for hydrology and ecology and the needs of human development practice, which has important value and significance. It not only plays an increasingly supportive role in the development of theories and methods of hydrology, ecology, global change and geological disaster prevention and control research, but also contributes to the realization of the strategic goals of my country's ecological civilization construction and the construction of a sustainable development guarantee system. Important scientific influence.

At present, the themes of ecological hydrology research are vegetation, water, water quality, climate change, human activities, remote sensing, models and scales. Many important results have been obtained, but there are still many problems to be further explored and resolved. In the future, eco-hydrological research should pay more attention to the following aspects: multi-scale vegetation-water bidirectional coupling mechanism and simulation research; coupling and correlation between land surface and atmospheric boundary layer; ecological hydrological process; multi-scale observation and land surface characteristic parameters Acquiring capacity; the ecological and hydrological effects of human disturbance and climate change.

### 2.2. Water and Ecological Issues

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Although ecological hydrology has achieved rapid development in the research of wetlands, rivers, lakes, reservoirs, forests, grasslands, farmlands and other ecosystems, most of them also focus on the experimental observation, mechanism exploration, and numerical simulation of a single ecosystem. With the frequent exchanges of materials and energy in the various layers of the earth system, climate change and the intensification of disturbances in human activities, many river basins in the world, especially the key river basins in China (such as the Yellow River, the Yangtze River, the Haihe River, the Huaihe River, and the Liaohe River) are facing ecosystem degradation , Floods, droughts, soil erosion, water pollution and many other problems. For the small-scale eco-hydrological process of a single system, there are still many problems and challenges in exploring the causes of the above problems, identifying their key influencing factors, and formulating countermeasures and suggestions, such as the simultaneous

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observation and integration of multi-eco-hydrological elements, point or field scales. The conversion mechanism of eco-hydrological laws to the basin or global scale, the detection and attribution of multiple effects of climate change and high-intensity human activities on eco-hydrological processes, the two-way coupling of ecological and hydrological process elements at the basin scale, and system simulations. In addition, with the acceleration of global socio-economic and urbanization, traditional ecological hydrological research, while paying attention to physical processes, urgently needs to be integrated into the social economy, human development and other humanistic processes, especially in the field of urban ecological hydrological research. Therefore, with the continuous improvement and development of theories in related fields of earth system science and technological innovations such as observation, information transmission and computing capabilities, it is urgent to strengthen the close connections and interactions between the various ecosystems of the ecological hydrology department and the various processes of ecological hydrology in the future. , To strengthen exploration in the comprehensive observation of multi-element factors of hydrology, multi-process effects of eco-hydrology, environmental changes and human activities, comprehensive simulation and system integration, multi-disciplinary integration, etc., and ultimately improve the basic research framework and theory of eco-hydrology System and technical methods, etc.

my country is a developing country with prominent "population-resources-environment" contradictions and outstanding water and ecological problems. With global climate change and high-intensity human economic development, national water security is facing increasingly severe water and ecological challenges, such as river dry-up, dry lakes, and wetland degradation. Behind the shocking water disasters, whether in cities or in rural areas, are the reasons for changes in the ecological environment. Take Wuhan City as an example. In 2016, the flooding disaster caused 755,000 people in 12 districts of the city to be affected by heavy rains and floods. The direct economic loss reached 2.265 billion yuan. An important reason for Wuhan's “city watching the sea” is the shrinking of lakes and wetlands. According to statistics, in Wuhan, known as the Hundred Lakes, the lake area has decreased by 228.9 square kilometers in the past 30 years and 11.4 square kilometers in the past 10 years. The number of lakes in the urban area has been reduced from 127 in the 1850s to 38 at present. From 1991 to 2010, the water area decreased by 38%. Although Wuhan implemented sponge city construction earlier, it still faces the dilemma of "watching the sea every year" due to the lack of basic ecological hydrological knowledge and strategic support. In addition to urban waterlogging, my country's wetland area is also shrinking. According to statistics released in January 2014, my country's wetland area decreased by 3,396,300 hectares from 2004 to 2014. At the same time, due to the development of rivers and pollution of water bodies, the species of river aquatic organisms in my country are rapidly degrading, such as the extinction of the rare Yangtze baiji dolphins, and the drastic reduction of the eggs and fry of the "four major home fish". Behind such water disasters and degradation of water ecology are water and ecological problems.

Based on the above-mentioned challenges of water and ecology, my country attaches great importance to the construction and healthy development of water and ecology. General Secretary Xi proposed that "green water and green mountains are golden mountains and silver mountains", and ecological problems in our country have risen to strategic issues related to the country's future development. Ecohydrology, as an emerging discipline that explores and reveals the hydrological mechanism that forms the ecological pattern and process, is indispensable for solving water and ecological problems and meeting the needs of my country's ecological construction.

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## 3. Conclusion

After decades of development, the Department of Ecohydrology has carried out in-depth research in the fields of forest ecology, grassland ecology, river, lake and reservoir ecology, wetland ecology, agricultural ecology, urban ecology, etc. from basic theories, technical methods, and application practices. And has made considerable progress, providing broad application prospects for ecological hydrology. Especially in the context of the construction of China's ecological civilization, ecological hydrology will also be widely used in the restoration and protection of communities such as mountains, rivers, forests, fields, lakes and grasses, and cities. In the field of forest and grassland ecology, vegetation ecological restoration, returning farmland to forests and grasslands, and soil erosion control are important decision-making and technical means in China's "13th Five-Year Plan" and the construction of ecological civilization. In terms of vegetation ecological restoration, it is necessary to carry out research on vegetation physiology and ecological water consumption laws under different conditions such as different regions, vegetation types, water supply conditions, etc., to explore the response relationship of vegetation to hydrological cycles, and to estimate the ecological water demand in accordance with the physiological and ecological laws of vegetation Etc., so as to improve the effective utilization of vegetation water.

In terms of returning farmland to forest and grassland, focus on the study of vegetation types, functions, structures and spatial distribution patterns, revealing its changing hydrological effects, etc., to provide technical support and decision-making basis for returning farmland to forestry and grassland. In terms of soil erosion control, it is necessary to explore the influence mechanism of different soil and water conservation measures on the ecological hydrological process, realize the expansion of the temporal and spatial coupling simulation of small watershed erosion to large and medium-scale watersheds, and provide theoretical foundation and technical support for soil erosion control in China. In the field of river, lake, reservoir and wetland ecology, ecological water conservancy projects, river and lake ecological restoration, and wetland restoration and reconstruction aimed at maintaining river health will have more extensive and in-depth applications in the protection and management of ecological hydrological systems.

In the design and construction of ecological water conservancy projects, it is necessary to explore the impact characteristics of water conservancy projects on the habitats of key protected species, hydraulic elements, runoff regimes, and species populations, so as to promote the transformation of water conservancy projects from traditional flood control and beneficial operation to ecological operation. In terms of ecological restoration of rivers and lakes, carry out investigations of the status quo of the ecosystem, formulate restoration goals and measures; explore the mechanism of the impact of aquatic organisms on river habitat changes in the process of ecological restoration, and improve the effect evaluation system of ecological restoration. In the aspect of wetland ecological restoration and reconstruction, the wetland ecological water demand estimation of large river basins and the comprehensive management and control research of the "hydrology-ecology-society" system should be carried out; the water system connection theory and key technologies for wetland ecological protection and restoration should be explored. In the field of agricultural ecology, we will focus on exploring methods for detecting and estimating crop water requirements at different scales, and the response and adaptation mechanisms of crop water requirements to changing environments; focusing on theoretically and technically improving crop water resource utilization, reducing ineffective evaporation in the field, and further Promote agricultural water conservation.

In the field of urban ecological hydrology, we will focus on the ecological hydrological effects of urbanization and the construction of sponge cities, including exploring the mitigation

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mechanism of forest vegetation evapotranspiration, green infrastructure, etc. on urban heat rain islands and runoff effects; through canal system improvement, Black and smelly water management and river and lake ecological restoration, improve the water environmental quality of urban rivers and lakes, and restore water ecological functions.

Through a comprehensive review of the development history of ecological hydrology, this paper clarifies the current status and challenges of the subject development; based on the research hotspots of ecological hydrology and national needs, the main development trend of ecological hydrology in China is put forward, that is, the importance On the basis of research on the mechanism of action, develop a large-scale multi-process eco-hydrological model to promote the development of eco-hydrology under the integration of multiple disciplines. In addition, the future development direction of ecological hydrology is further clarified, namely, the construction of a comprehensive monitoring network of multi-source information fusion, clarification of the temporal and spatial patterns and evolution characteristics of key elements of ecological hydrology, the development of a land-aquatic multi-scale and multi-element integrated model, and Multidisciplinary researches such as ecology-society, etc., provide theoretical support for the smooth implementation of China's ecological civilization construction and the protection of "mountains, forests, fields and lakes".

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