

Managing Rural Water Environments: Pathways to Improvement

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Abstract

The rural water environment constitutes a vital component of rural ecology, with its proper governance serving as a fundamental prerequisite for building beautiful countryside. In recent years, rural water environment issues have emerged as significant factors undermining rural ecological systems and residents' livelihoods. Strengthening rural water environment governance has thus become a crucial measure for improving rural environments. This paper employs a systematic review method to analyze recent literature on rural water environment governance, focusing on four dimensions: current status, governance dilemmas, governance models, and improvement pathways, to analyze the progress of rural water environment management research. Finally, prospects for rural water environment governance in China are proposed.

Keywords

Rural Water Environment Governance, Research Review, Prospects

1. Introduction

The issues of agriculture, rural areas, and farmers constitute the foremost priority in the work of the Communist Party of China and represent a fundamental concern that underpins the nation's economic development and people's well-being. To effectively address these issues, accelerate the modernization of agriculture and rural areas, and foster the development of harmonious and aesthetically pleasing villages, the implementation of the rural revitalization strategy is imperative. Ecological livability, as a pivotal component of the rural revitalization strategy, ranks as the second most critical objective after industrial prosperity, reflecting the Party and the state's profound commitment to improving the ecological environment in rural regions. Within the framework of advancing ecological livability, the rural water environment emerges as both a vital element of rural ecology and a persis-

tent governance challenge. The National Ecological and Environmental Protection Conference has outlined a strategic directive to “enhance urban and rural living environments and build a Beautiful China”. This policy emphasizes the need to elevate rural water environment governance, address deficiencies in rural living conditions, and expedite the construction of beautiful and sustainable villages.

The aquatic environment constitutes one of the fundamental elements of rural ecological systems and serves as a crucial indicator for assessing rural livability. Water environment governance represents a vital aspect of rural living environment improvement initiatives, and more importantly, forms the foundational prerequisite for constructing harmonious and beautiful villages as well as realizing the vision of Beautiful China. Effective governance of rural water environments holds critical significance for enhancing both rural residential conditions and the nationwide water environment. The year 2024 marks a pivotal stage in the continued implementation of the Rural Revitalization Strategy. Achieving rural revitalization necessitates urgent and effective governance of rural water environments.

Simultaneously, research on rural water environment governance has flourished, with numerous scholars investigating diverse aspects, including causal factors, governance approaches, stakeholder roles, and effectiveness evaluation. The disciplinary scope of rural water environment governance studies has also expanded significantly, encompassing sociology, jurisprudence, management science, political science, psychology, and other related fields. This paper systematically reviews recent literature on rural water environment governance, providing comprehensive analysis and synthesis of current governance status, problem attribution, participating stakeholders, governance models, and improvement pathways.

2. Current Status of Rural Water Environment Governance

The rural water environment refers to the collective water bodies in rural areas, including rivers, lakes, canals, groundwater, and other water systems related to agricultural production and daily life. These water resources are closely linked to various rural activities such as crop cultivation, livestock breeding, aquaculture, drinking water supply, and wastewater discharge. Among these, the treatment of rural domestic sewage represents a critical component of rural water environment governance, significantly influencing its overall effectiveness. In recent years, accelerated urbanization and rapid industrial development in some regions have led to improved living standards for rural residents and substantial advancements in production technologies. While these developments have enhanced quality of life and boosted rural economic growth, they have also introduced multiple pollution sources. Consequently, severe water pollution has emerged, progressively deteriorating the rural water environment and adversely affecting the vital interests and health of rural populations (Fan & Tang, 2022).

Based on research conducted in 15 counties across four cities in Shandong Province, the study found several common sources of rural water pollution: In

agricultural production, excessive use of pesticides and fertilizers leaves chemical residues that enter surface water through runoff and drainage channels, while some seep into groundwater, polluting both underground and surface water sources. Plastic waste floating on water surfaces creates white pollution that is difficult to degrade. Livestock farming generates accumulated waste, with poultry manure being poorly collected and treated, leading to contamination of both groundwater and surface water. On the other hand, rural domestic life produces significant amounts of household waste and sewage. Coupled with scattered rural settlements and a lack of centralized wastewater treatment facilities, this severely impacts water quality, making domestic pollution a major contributor to rural water environment degradation. Additionally, as cities strengthen pollution controls, some industries have relocated to towns and rural areas, creating new pollution sources through industrial wastewater and hazardous waste discharge, which significantly harm rural water systems. Overall, rural water pollution is characterized by multiple sources, severe contamination levels, widespread impact, and significant regional variations (Wang, 2020).

3. Research on the Causes of Rural Water Environment Governance Issues

The issue of rural water environment governance has attracted the attention and emphasis of the academic community. Different disciplines have various research perspectives on the problem of rural water environment governance. Materialism posits that rural areas focus on developing productive forces and value economic development, resulting in a lack of proactive attitudes towards rural water environment governance. Administrative studies focus on governance blind spots, noting the lack of clear governance entities, ineffective interdepartmental coordination, and ambiguous responsibilities and authorities. Institutional economics attributes the problems to the dual governance system, arguing it leads to ineffective policies, incomplete institutional frameworks, and consequently prominent governance challenges. Social action theory emphasizes villagers' subjective perceptions, suggesting their lack of environmental knowledge hinders policy implementation and undermines governance effectiveness. Furthermore, both economics and sociology identify the absence of sound water governance systems as a key cause of rural water environment problems. Sociology and psychology highlight how subjective willingness influences governance behavior, with villagers' level of environmental concern determining their participation.

Although different perspectives offer various interpretations of the rural water environment governance issues, a comprehensive view suggests that the problems can be summarized into three main causes.

3.1. Lack of Participation Motivation among Rural Water Environment Governance Stakeholders

Governance entities are the key factors in rural water environment governance

processes. The lack of participation motivation among rural water environment governance entities has resulted in severe water environment problems. [Zheng & Li \(2012\)](#) believe that the governance of rural water environments requires a collective effort from multiple parties. However, from the current situation, most township governments in China are responsible for operations, lacking the financial funds to establish water environment governance institutions. However, under current circumstances, most township government agencies in China responsible for operations lack special fiscal funds to establish water environment governance institutions, while enterprises, as another governance entity, demonstrate low participation enthusiasm due to both the absence of mandatory mechanisms and lack of incentive mechanisms. As the direct subject, farmers have more opportunities to participate in water environment management. However, due to their weak environmental awareness and lack of incentive compensation mechanisms, farmers lack the motivation for water environment management ([Zheng & Li, 2012](#)). [Fan & Tang \(2022\)](#) believe that the main body of water environment governance also has certain flaws. The government's direct control over water environment governance exhibits behavioral biases, primarily manifested in the lack of sound laws and regulations for rural water environmental protection, inadequate implementation of local water environment policies due to unequal responsibilities and limited fiscal resources for governance. Enterprises in market entities aim for profit and have a weak awareness of environmental protection. They abandon the introduction of water purification equipment and discharge sewage exceeding standards, which exacerbates the dilemma of rural water environment governance. Due to the problem of information asymmetry, social forces find it difficult to participate in water environment governance, making the main body of rural water environment governance lack vitality ([Fan & Tang, 2022](#)).

3.2. Constraints of the Urban-Rural Dual System

The dual urban-rural system is the development characteristic of China at the present stage. It is an important perspective to study rural water environment problems from the dual urban-rural system. On the one hand, the formation of rural water pollution is closely related to the urban-rural differences caused by the urban-rural dual system. Due to the needs of urban development planning and rural economic development, some polluting enterprises have been transferred to rural areas, which has increased the environmental gap between urban and rural areas. According to the perspective of Li Bin, Zhang Xiangshu and other scholars, the policy and institutional differences between urban and rural areas caused by the dual urban-rural system lead to obvious differences in urban and rural environmental governance, resulting in relatively weak measures for rural water environment governance ([Li & Zhang, 2012](#)).

Yu Fangwen believes that in the process of urbanization, the government's insufficient supply of public goods is the fundamental reason for the rural environment to change from hidden to visible ([Yu, 2017](#)). According to the 2019 Urban

and Rural Construction Statistical Yearbook released by the Ministry of Housing and Urban-Rural Development, in 2019, the investment in urban sewage treatment was 52.801 billion yuan higher than that in rural areas, and the total number of urban sewage treatment plants was 641 more than that in rural areas, and the urban sewage treatment rate was 5.3 times that of rural areas. From this point of view, the investment in pollution control funds is unfair in urban and rural governance, and the dual structure of urban and rural areas leads to the differences in government water environment management policies and policy resources. Compared with cities, there are large gaps in preferential policies, water environment management funds and technologies for rural water environment management, which increases the difficulty of rural water environment management.

At the same time, there is also a view that the inequality caused by the dual urban-rural structure is a significant reason for rural water environment issues. Yu Fawen believes that the pursuit of political achievements and eco-cities can lead to perfunctory governance of rural ecological environments, even introducing urban polluting enterprises into rural areas, marginalizing rural environmental governance. Cao Haijing & Du Juan also argue that farmers not only bear pollution caused by themselves but also face governance pressures transferred from cities, leading to unfair governance responsibilities in rural areas (Cao & Du, 2020). Wang Xiaoyi points out that urbanization exerts a suction effect, drawing various resources such as materials, finances, and labor from rural areas into cities, turning rural areas into appendages of cities, which can exacerbate the deterioration of the rural environment (Wang, 2010).

3.3. The Relationship between Changing Lifestyles and Rural Water Environments

With the improvement of farmers "living standards, the change of farmers" lifestyle has gradually become an important cause of rural water pollution. In recent years, China's farmers' income has maintained a rapid growth. Since 2009, the growth rate of farmers' per capita income has begun to be higher than that of urban per capita income, and the lifestyle of rural residents has gradually changed.

Wang Pengfei, Zhang Xiang & Xu Wei believe that due to the change of lifestyle, the chemical elements in the discharged wastewater are high. The domestic sewage used as fertilizer has been transformed into a new nature, so it is difficult to continue to be used as fertilizer, and no discharge will cause water pollution (Wang, Zhang, & Xu, 2010). Bai Zhigang, Hu Tiesong, & Liu Jingjing believe that the change of production and life style leads to excessive use and loss of pesticides and fertilizers in the production process, resulting in the production of toxins and eutrophication of water bodies, which greatly increases the difficulty of water environment management (Bai & Hu, & Liu, 2009). Zi & Zhu (2019) believe that the rapid development of agriculture and animal husbandry in rural areas has driven economic growth while causing severe water pollution. In terms of rural living, changes in lifestyle have generated large amounts of domestic wastewater.

Wastewater from washing, laundry, and toilet flushing is discharged directly without professional treatment equipment, seeping into the ground and flowing into rivers, placing a heavy burden on the rural water environment. At the same time, decentralized discharges have expanded polluted areas, increased pollution sources, and made governance more challenging (Ye & Zhu, 2019).

4. Study on Rural Water Environment Management Model

As a part of grassroots governance, rural water environment management has been led by the government from the very beginning. The government plays a leading role in the process of rural water environment management. This is related to the characteristics of the grassroots governance model, which has a strong government and weak society in China's political system, as well as the long-term governance habits of the society. The academic circles can roughly divide the ways of rural water environment governance into the following categories: government-led, villagers' willingness, and network.

4.1. Research on the Government's Leading Role in Rural Water Environment Governance Practice

Although rural water environment governance features multiple stakeholders, practical governance experience demonstrates that the government plays a dominant and driving role. There have been studies on the functions of the government in rural water environment management, which mainly include three aspects:

First, the institutional level. The formation of both central policies and local laws and regulations requires the planning, promotion and implementation of the government. Because the rural environmental protection institutions and organizations are not yet perfect, the government is responsible for the institutional design of rural water environment management. Kong Fanbin, et al. believe that modern laws and regulations are of great significance to rural water environment management, and the institutional design of water environment management should be strengthened (Kong et al., 2022).

Secondly, at the action level. Water environment governance cannot do without strong government regulation; government control is the restraining force in rural water environment management. Yang Hongshan believes that market approaches, self-governance approaches, and regulatory approaches are three perspectives for water environment governance. In the process of water environment governance, a purely market approach is inefficient due to high costs of property rights definition and difficulties in reaching consensus among stakeholders. Autonomous approaches struggle to form public consensus and organize collective action due to the issue of some stakeholders free-riding. Yang Hongshan emphasizes that both market-driven and autonomous approaches have externalities (Yang, 2012). Water environment governance requires strengthened government regulation, while maintaining government leadership, it is also necessary to leverage market mechanisms, self-governance, and public participation. Du Chunlin and Tu Anna em-

phasize that the multiple stakeholders in water environment governance are constrained by their respective fields. The management of rural water environments is a long-term systematic project that requires the government, market, and society to work together to promote the stable and sustainable development of regulatory mechanisms (Du & Tu, 2024).

Thirdly, at the organizational level, grassroots party organizations and local governments have played a significant role in rural water environment governance. Yu Fawen stresses the need to strengthen the core position of grassroots party organizations, leverage their leading role in rural ecological environment governance, improve village rules and regulations, promote environmental knowledge, and take the lead (Yu, 2021).

Dianchi Lake is located in Kunming City, Yunnan Province. It is a famous highland freshwater lake in China. In the 1980s, due to the rapid development of industry, a large amount of waste water was discharged into Dianchi Lake, resulting in serious pollution of water quality and becoming one of the most polluted lakes in China. Since the 1990s, the government has innovated the governance mechanism of Dianchi Lake, establishing a government-led comprehensive management system and strengthening iron-fisted water management and environmental accountability. By setting up comprehensive management institutions, implementing the river chief system, and enforcing environmental accountability, the government has reinforced its leading and supervisory role, thus forming a synergy and ushering in a new chapter in the governance of Dianchi Lake. After comprehensive management, the water quality of Dianchi Lake has been upgraded from category III to category V, and the effect of pollutant reduction is obvious and the water quality of the river into the lake has been significantly improved. The water environment management of Dianchi Lake has given full play to the leading role of the government, showing the necessity of the government steering the boat.

4.2. Public Participation Models in the Practice of Rural Water Environment Management

On the necessity and importance of villagers' participation in environmental governance, Shen Feiwei believes that villagers' participation in managing rural environments is conducive to fostering farmers' subjectivity, providing a public foundation for creating an ecological service-oriented government, and promoting the formation of a virtuous cycle of rural environmental governance involving positive interactions between government and citizens (Shen, 2019). Wang Xinxiao points out, based on villagers' ideal positioning and actual roles, that widespread villager participation is an effective ecological governance strategy, and the collective strength of villagers can transform the negative externalities of environmental damage into conscious behavior (Wang, 2019). The empirical research by Lu Hongyou and Qi Yu also indicates that shaping villagers' conscious participation and improving the feedback mechanism for villagers' interest demands are action

strategies to enhance the effectiveness of rural environmental governance (Lu & Qi, 2013).

Xu Lang believe that farmers should be encouraged to participate in and manage the entire process of rural water pollution control, thereby increasing farmers' attention to water pollution control (Xu et al., 2021). Su Shuyi, Zhou Yuxi based on survey data from 160 villages in 16 cities in Shandong Province, used a binary logic model to analyze farmers' willingness to participate and influencing factors in rural domestic sewage treatment, and found that farmers' cognition has an important impact on farmers' sewage treatment behavior (Su & Zhou, 2020). Therefore, they propose to improve the overall quality of villagers, strengthen environmental awareness education for farmers, and leverage the power of the public in the process of sewage treatment. Xu Ying, Tan Xin believe that villagers' autonomous governance can enhance the organization and orderliness of villagers' participation, effectively mobilize villagers to participate in water environment governance, and stimulate participation vitality (Xu & Tan, 2024).

Chengtuan Town is under the jurisdiction of Liuzhou City, Liuzhou District, Guangxi Zhuang Autonomous Region. Due to the large areas of farmland protection zones in each village of Chengtuan Town and their proximity to grain production bases, the water resources (ditches) around the farmland are connected to upstream reservoirs, allowing for direct irrigation. Therefore, the water environment is inevitably affected when pesticides or fertilizers are used for pest control in the rice fields. Based on this, the village committee frequently organizes water environment improvement activities, using methods such as points and material rewards to encourage villagers to maintain the water environment voluntarily. For example, they clear rivers and canals, clean up water bodies within their own areas, and reduce sewage discharge. Chengtuan Town has successively completed 34 various water conservancy projects, with a river cleaning length of about 400 km, fully promoting the River Chief System, and achieving tangible results in water environment governance.

4.3. The Gridded Governance Model in the Practice of Rural Water Environment Management

The governance of rural water environments is a complex systems engineering task that requires the rational coordination and utilization of existing resources. The networked governance model refers to a process where government departments and non-governmental entities (such as private sectors, third sectors, or individual citizens) cooperate as numerous public action agents to share public power in an interdependent environment for the purpose of realizing and enhancing public interests. It is characterized by a polycentric governance body, a networked governance structure, and clear governance objectives. The rural water environment network governance model is led by the government, coordinating various resources and strengths to construct a framework for the governance of rural water environments.

Liu Yonghong and Li Fengwei believe that the traditional governance model dominated by a single government struggles to improve rural water environments (Liu & Li, 2022). The networked governance model can leverage the advantages of multi-stakeholder co-governance, bringing together the strengths of government, market, and society to form a networked governance model led by the government but with participation from multiple parties. This promotes multi-party collaboration and participation, enhancing the level of water environment governance. Fan Canghai and Zhang Han applied the theory of networked governance to deconstruct the predicament of rural environmental pollution. They analyzed the rationality and applicability of networked governance from aspects such as governance concepts, multiple stakeholders, network governance structures, and operational mechanisms (Fan & Zhang, 2021). Xie Baojian and Zhang Xuan based on the theory of networked governance, analyzed the governance practices in Changting County, Fujian Province. Their research identified a networked governance mechanism characterized by government establishing preferential policies, enterprises bearing financial investment, science and technology departments providing technical support, and functional departments offering public services (Xie & Zhang, 2018). This mechanism facilitates collaboration among multiple stakeholders and fully integrates the resources and technological advantages of various social organizations and actors.

5. Pathways for Improving Rural Water Environment Governance

Rural water environment management is a crucial component of rural living environment improvement, an important manifestation of rural ecological construction, and a key link in the rural revitalization strategy. Researchers have conducted a series of studies from various perspectives, including the current status, measures, significance, participants, and governance models of rural water environment management, providing theoretical support for practical efforts in this area. Based on the current research, the main approaches to improving rural water environment management are as follows.

5.1. Transforming Governance Concepts and Clarifying Objectives

Local governments should transform their governance philosophy, breaking away from the notion of prioritizing economic development over environmental protection, and focusing on the simultaneous enhancement of ecological and economic benefits. They must clarify their primary roles as leaders and supervisors in rural water pollution control, which include formulating policies for water environment pollution prevention and control, establishing legal frameworks, and ensuring the effective implementation of supervisory rules. Secondly, local governments should actively guide enterprises and villagers to participate in the process of rural water environment governance, stimulating the vitality of multiple stakeholders and promoting synergy among them in water environment management. On the one hand,

the government should play a leading role by guiding enterprises and villagers to embrace green development concepts and environmental awareness through policy tools and guidance. On the other hand, it should strengthen the promotion of policies and knowledge about rural environmental protection through educational means such as television, radio, and slogans, emphasizing the urgency of water pollution and the advantages of using environmentally friendly production technologies. This will help farmers shift from traditional agricultural practices, enhance their sense of responsibility for environmental protection, and reinforce the concept of protecting the rural water environment.

5.2. Integrating Stakeholder Relationships and Clarifying Governance Responsibilities

In the process of rural water environment governance, various entities have different interest relationships, which in turn form distinct rights and responsibilities. It is essential to clarify these relationships among the entities involved in water environment governance, so that each party can fulfill their responsibilities and reduce pollution at its source. Emphasize the role of enterprises as primary polluters. Township enterprises are both creators and practitioners of rural water environmental pollution. Emphasize the primary role of enterprises in pollution control. Township and village enterprises are both creators and perpetrators of rural water pollution, and they should also be practitioners of water environmental governance. These enterprises should proactively assume social responsibilities for environmental protection and restoration, fostering a green production mindset. They should actively transform and upgrade their operations, change production methods, and strengthen pollution control infrastructure to reduce wastewater generation at the source. Enhance farmers' environmental awareness. Households should deepen their understanding and take action to minimize adverse impacts on the water environment in both production and daily life. In the process of production, we should pay attention to green production, rationally use chemical fertilizers and pesticides, develop ecological agriculture, and improve the technical level of agricultural production under the guidance of relevant policies. At the same time, we should pay attention to reducing the random discharge of domestic sewage and improve the rational treatment of household garbage.

5.3. Improving Governance Mechanisms and Harnessing Multi-Stakeholder Synergies

Rural water environment governance requires a sound and complete management mechanism. It should be advanced through strengthening collaboration, improving safeguard mechanisms, and establishing responsibility systems. In water environment governance, first, it is necessary to establish a consultation platform to promote information sharing, mutual trust in interests, and alignment of rights and responsibilities among stakeholders, thereby achieving clear benefits for stakeholders and well-defined responsibilities. Secondly, strengthen the collabo-

rative mechanism. Rural water environment governance involves multiple stakeholders including government, enterprises, markets, and society. Each party has specific responsibilities and capabilities, so it is necessary to foster collaboration among these entities to leverage collective strength and enhance the effectiveness of water environment management. On the one hand, vertical coordination within government departments should be strengthened, with enhanced communication and cooperation between government offices, water conservancy departments, environmental protection departments, and other relevant agencies. This will ensure clear delineation of responsibilities and duties, facilitating coordination and collaboration. On the other hand, it is also necessary to strengthen the horizontal coordination among enterprises, villagers and society. Through consultation, supervision and incentive mechanisms, information communication and interest integration among subjects should be strengthened to improve the efficiency of water environment governance.

6. Conclusion

Rural water environment governance is an important part of rural living environment governance, a significant manifestation of rural ecological construction, and a crucial aspect of the rural revitalization strategy. Researchers have conducted a series of studies from various perspectives, such as the current situation, measures, significance, participating entities, and governance models of rural water environment governance, providing theoretical support for the practice of rural water environment governance. After a comprehensive review of the current research status, the following conclusions can be drawn:

It is necessary to promote the behavioral and goal synergy in rural water environment governance. In practice, neither a single government entity, a single market entity, nor the villagers can properly address rural water environment issues. Rural water environment governance requires the leading role of the government, combined with the power of the villagers and social organizations, to leverage synergistic efforts, thereby improving the efficiency of rural water environment governance. Efforts should be made to strengthen the study of behavioral synergy mechanisms and internal logic in rural water environment governance. At the same time, while improving the rural water environment, the sustainable development of rural areas should be taken into account during the process of rural water environment governance. Future research should be linked to the context of the times, focusing on the integration of rural water environments with industry, culture, and ecology.

7. Prospect

With the continuous advancement of the rural revitalization strategy, the governance of rural water environment will exist as a long-term issue. It requires not only the sustained efforts of the government, villagers, and social organizations, but also the continuous attention of the academic community. The future research

focus on rural water environment governance can be roughly divided into the following aspects:

Firstly, it is necessary to promote research and innovation in the governance system for rural water environments. A sound management system can leverage the combined efforts of all governance entities to address issues related to rural water environments effectively. Currently, research on how to establish and improve the mechanisms and supportive policies in this field is insufficient. Policies related to financial support, participation of entities, and governance supervision for rural water environments need further improvement and study. The deep-seated factors affecting the role of farmers as main entities also need to be explored. In future research, it should be based on actual needs and conditions to advance the improvement and innovation of the rural water environment governance system.

Secondly, it is necessary to strengthen the summary and evaluation research on the governance models of rural water environments. China's rural areas are widespread and unevenly developed, leading to differences in the models and outcomes of rural water environment governance. In the course of governance practices, distinctive governance models have emerged due to local differences, which contain rich governance experiences. Currently, the academic community lacks a summary and evaluation of this universal governance experience, as well as a promotion of adaptive and universal governance models. It is essential to actively carry out research on the evaluation of rural water environment governance outcomes and the indicator system, to more scientifically assess the effectiveness of rural water environment governance, and to promote the dissemination and popularization of scientific and reasonable governance models and governance experiences.

Conflicts of Interest

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