

Analysis of the Current Situation of Rural Water Environment Pollution and Governance

Na Wang^{1,2,3,4,5}, Nan Lu^{1,2,3,4,5}

¹Institute of Land Engineering and Technology, Shaanxi Provincial Land Engineering Construction Group Co., Ltd., Xi'an 710075, China;

²Shaanxi Provincial Land Engineering Construction Group Co., Ltd., Xi'an 710075, China;

³Key Laboratory of Degraded and Unused Land Consolidation Engineering, the Ministry of Natural Resources, Xi'an 710075, China;

⁴Shaanxi Provincial Land Consolidation Engineering Technology Research Center, Xi'an 710075, China;

⁵Land Engineering Technology Innovation Center, Ministry of Natural Resources. Xi'an 710075, China.

Abstract

With the development of China's economy and the improvement of people's living standards, water pollution has become increasingly serious. Based on the current situation of rural water pollution, this paper analyzes the existing problems and proposes targeted prevention and control measures to promote the sustainable development of the rural ecological environment.

Keywords

Rural Water Pollution, Current Situation, Prevention and Control Measures.

1. Introduction

In recent years, with the rapid economic development, the rational utilization and protection of water resources have been neglected, leading to varying degrees of pollution in both urban and rural areas. Compared to rural areas, urban areas have more comprehensive sewage treatment facilities and capabilities, resulting in a better situation regarding water pollution control [1]. However, the issue of rural water pollution has become increasingly severe. Wastewater from rural living, agriculture, and industrial activities is discharged indiscriminately, causing serious pollution to the water environment. This not only affects the rivers surrounding rural farmland and reduces land fertility but also contaminates drinking water sources, posing a threat to the drinking water safety of local residents [2]. This situation severely hampers agricultural development, poses a serious threat to the health of rural residents, and fundamentally impedes the healthy and sustainable development of the rural economy. Therefore, the governance of rural water pollution has become one of the important tasks of current environmental protection efforts.

Since the 13th Five-Year Plan period, in order to implement the "13th Five-Year Plan Outline for National Economic and Social Development", the "Action Plan for Water Pollution Prevention and Control", and the "13th Five-Year Plan for Ecological and Environmental Protection", among other relevant plans, and effectively improve the rural ecological environment, the Ministry of Ecology and Environment has formulated the goal of "adding 130,000 newly completed integrated environmental improvement villages nationwide by 2020". In the Central Document No. 1 of 2018, it was also emphasized to intensify efforts in

rural environmental governance, improve rural living environment, with the governance of rural water pollution being an important part of it.

2. Rural Water Pollution Sources

2.1. Agricultural Activities

Agricultural activities are one of the significant sources of rural water pollution, with main pollutants including pesticides, fertilizers, wastewater from livestock and poultry farming, as well as field drainage.

2.1.1. Pesticide Pollution

In China, excessive use of chemical fertilizers and pesticides in agricultural production has become one of the primary factors leading to rural water pollution. Farmers typically use large amounts of chemical fertilizers during cultivation, with organic fertilizers being used for extended periods. While this practice can to some extent increase crop yields, it also leads to severe soil pollution, subsequently contaminating surface water. Additionally, in order to control pests and diseases, farmers often use a large amount of pesticides, some of which remain in crops and fields, while the rest mix with rainwater and atmospheric particles, entering surface water through runoff, severely impacting water quality. During the use of pesticides, approximately 20% adhere to crops, while the remaining 80% infiltrate into the soil, causing groundwater pollution. Furthermore, in rural areas, a large amount of untreated sewage is often used for irrigation, leading to pollution of farmland soil and surrounding water sources. Sewage irrigation has become one of the important factors affecting the quality of rural water resources, thus effectively compromising the safety of drinking water in rural areas.

2.1.2. Fertilizer Pollution

The use of fertilizers is also one of the major contributors to rural water pollution. Nutrients such as nitrogen and phosphorus in fertilizers are not fully absorbed and utilized in the soil, and are washed into rivers and lakes with rainfall or irrigation water, leading to water eutrophication. Eutrophication causes excessive growth of algae in water, resulting in the formation of algal blooms, which severely affect water quality and may even trigger harmful phenomena such as red tides.

2.1.3. Wastewater from livestock and poultry farming

Wastewater from livestock and poultry farming is another significant source of water pollution in rural areas. The large quantities of wastewater contain substantial amounts of organic matter such as feces, urine, and feed residues, which are frequently directly discharged into surrounding rivers and lakes, resulting in water contamination. The degradation of these organic substances consumes a considerable amount of oxygen, leading to water oxygen depletion and impacting the survival of aquatic organisms.

2.1.4. Field drainage

Field drainage refers to the water discharged into rivers and lakes during agricultural production processes through irrigation, drainage systems, or natural precipitation. These field drainage waters contain pollutants such as pesticide residues, fertilizer residues, and agricultural wastewater from the soil, often carrying high concentrations of nutrients and organic matter, directly affecting water quality.

2.2. Domestic Wastewater Discharge

According to relevant surveys, rural areas generate approximately 8 billion tons of domestic wastewater annually, yet about 96% of rural areas lack proper sewage treatment systems, resulting in no form of sewage treatment [4]. This situation has led to further deterioration of wastewater pollution in rural areas, posing a serious threat to water resources. Meanwhile, in

many rural areas, untreated domestic wastewater is directly discharged into farmland and surrounding rivers, which also partially affects water quality in rural areas. Additionally, the indiscriminate disposal of garbage in rural areas is a serious problem, as these wastes may be washed into rivers by rainwater, thus polluting surface water and local water systems. Therefore, the lack of scientifically effective sewage treatment systems and improper waste disposal both severely impact water quality in rural areas.

3. Rural Water Pollution Hazards

3.1. Hazards to Human Health

Rural sewage contains a large amount of harmful substances such as organic matter, microorganisms, and heavy metals. These harmful substances may include pathogens such as bacteria, viruses, parasites, as well as chemicals such as heavy metals, pesticide residues, and organic compounds. When these harmful substances enter the human body, they can trigger various waterborne diseases such as diarrhea, gastrointestinal infections, and infectious hepatitis. Particularly vulnerable are children and elderly populations in rural areas, who due to weaker immune systems, are more susceptible to the effects of sewage pollution, increasing their risk of illness.

Furthermore, the organic matter and nutrients present in rural sewage can lead to water eutrophication. Eutrophication can cause excessive growth of algae, resulting in algal blooms or red tides, making the water turbid and reducing dissolved oxygen content. This oxygen-depleted environment not only threatens the survival of aquatic organisms but also promotes the proliferation of parasites, bacteria, and other pathogens, further exacerbating the spread of waterborne diseases.

Additionally, chemical substances such as heavy metals and organic compounds in rural sewage also pose potential long-term hazards to human health. Prolonged exposure to these chemicals can lead to chronic poisoning, affecting the function of organs such as the endocrine system, nervous system, liver, and may even lead to serious diseases such as cancer.

Finally, rural sewage pollution may directly threaten drinking water sources. Since drinking water in rural areas typically comes from local groundwater or rivers and lakes, if these water sources are contaminated, it directly affects the drinking water safety of local residents. Long-term consumption of contaminated water sources can lead to chronic health problems such as abnormal liver and kidney function, weakened immunity, severely impacting residents' physical health.

3.2. Hazards to Agricultural and Fisheries Production

Chemicals and microorganisms in rural sewage pose a direct threat to the health of crops and aquatic organisms. Chemicals such as pesticide residues and heavy metals may enter crops and aquatic organisms through soil and water, negatively impacting their growth and reproduction, reducing crop yields and quality, and affecting the productivity of fisheries. Additionally, rural sewage discharge may lead to a reduction in the biodiversity of soil and water, disrupting ecological balance. Harmful substances in water affect the reproduction and survival of aquatic organisms, leading to a decrease in fisheries resources, harming the economic interests of rural residents. Lastly, rural sewage may contaminate crops and aquatic products, reducing their quality and safety. Contaminated crops and aquatic products may contain harmful substances, posing potential threats to human health and affecting the sales and market reputation of agricultural products.

3.3. Prevention and Control Measures for Rural Water Pollution

Preventing and controlling rural water pollution is a complex and long-term process that requires joint efforts from the government, enterprises, and various sectors of society. Below are some potentially effective measures for preventing and controlling rural water pollution:

3.3.1. Construction of Sewage Treatment Facilities

Strengthening the construction and renovation of sewage treatment facilities in rural areas, establishing sound sewage treatment systems, and achieving standard collection, treatment, and discharge of rural sewage. Suitable sewage treatment processes can be adopted, such as constructed wetlands, activated sludge method, etc., selecting appropriate treatment processes based on local conditions.

3.3.2. Promoting Rural Domestic Wastewater Treatment

Supporting rural residents in constructing domestic wastewater treatment facilities, advocating for the collection and treatment of domestic wastewater, and encouraging the use of simple household wastewater treatment devices such as biofilters, anaerobic treatment equipment, etc., to reduce the pollution of the environment by domestic wastewater.

3.3.3. Strengthening Control of Agricultural Non-point Source Pollution

Implementing agricultural water conservancy projects, planning drainage systems reasonably, and reducing the impact of agricultural runoff on the water environment. Adopting scientific agricultural cultivation methods to reduce the use of fertilizers and pesticides, avoiding agricultural non-point source pollution caused by excessive fertilization and improper pesticide use. Yu Chenyang et al. proposed measures to reduce fertilizer usage among farmers, utilizing existing ditches, and constructing pre-treatment reservoirs, artificial wetlands, and other methods for treating non-point sources. The schematic diagram of a grass ditch is shown in Figure 1. Drainage through the grass ditch allows for retention, and through filtration and infiltration, most suspended solids and some dissolved pollutants can be removed, thereby purifying the water body. Pre-treatment reservoirs are cost-effective and highly adaptable, making them an effective measure for controlling non-point sources [5].



Figure 1 Schematic Diagram of Grass Ditch

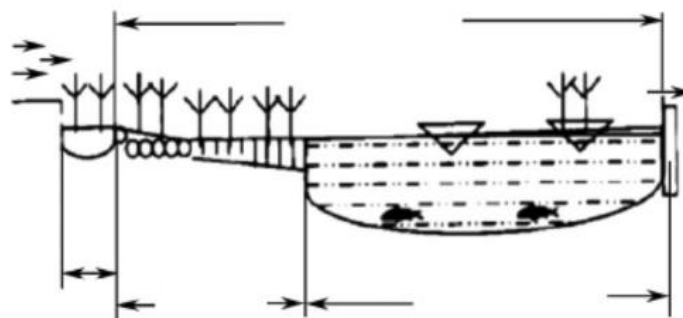


Figure 2 Schematic Diagram of Pre-treatment Reservoir**3.3.4. Strengthening Livestock Wastewater Treatment**

Implement treatment of wastewater from rural livestock farms using technologies such as biofilters, constructed wetlands, etc., to reduce the pollution of water bodies from livestock wastewater and protect the living environment of aquatic organisms.

3.3.5. Strengthening Environmental Monitoring and Law Enforcement

Establish a sound environmental monitoring system to enhance monitoring and assessment of rural water environments, promptly identify and address water pollution issues. Strengthen environmental law enforcement, crack down severely on illegal discharges, enhance penalties for offenders, increase the cost of violations, and create a strong deterrent against environmental pollution

3.3.6. Strengthening Publicity, Education, and Technical Training

Enhance environmental awareness among rural residents, conduct environmental protection publicity and education activities, and increase the attention of rural residents to the prevention and control of water pollution. Provide technical training to improve the environmental protection skills of rural residents, promote the dissemination of environmental protection technologies, and guide rural residents to adopt environmentally friendly measures.

3.3.7. Promoting Industrial Structure Adjustment

The government can promote rural industrial structure adjustment through policy guidance and financial support, optimize resource allocation, reduce overexploitation and pollution of water resources, and promote the green development of the rural economy.

4. Rural Water Pollution Control Issues**4.1. Insufficient Funding Allocation**

Water pollution control requires substantial financial investment, including infrastructure construction, equipment procurement and maintenance, personnel management expenses, and more. However, funding sources for water pollution control are relatively limited, with insufficient financial resources at the local level. This lack of available funds constrains the progress of water pollution control efforts, as it undermines the solid economic foundation necessary for effective implementation.

4.2. Inadequate Infrastructure

The low level of economic development in rural areas, coupled with insufficient funding, results in inadequate provision of water environmental governance infrastructure, thereby hindering rural water pollution control to a certain extent. For example, to save on equipment expenses, some rural areas opt for low-efficiency water purification equipment, leading to ineffective purification of rural domestic wastewater.

4.3. Lack of Awareness

There is a significant disparity in environmental awareness between economically developed and underdeveloped regions in China. Urban residents and rural dwellers in economically developed areas tend to have a strong environmental awareness, whereas those in economically underdeveloped areas show a noticeable gap in environmental consciousness. This is primarily due to limited economic conditions, where people prioritize ensuring basic material living conditions and often overlook higher-level environmental issues. Consequently, rural residents in such areas may not sufficiently prioritize water pollution issues. Additionally, the lack of corresponding environmental education or inadequate publicity efforts contributes

to the weak environmental awareness among villagers, leading to unconscious waste and degradation of water resources in their daily lives.

4.4. Inadequate Legislative Safeguards

Despite the enactment of a series of environmental protection laws in China addressing water pollution issues, there is a lack of specific legislation dedicated to rural water pollution problems. In practice, this absence of specific legislation leaves authorities without clear guidelines to effectively address rural water pollution issues. Furthermore, in the process of policy implementation, the macroscopic nature of legislation makes it difficult for local governments to effectively carry out relevant work, resulting in less than satisfactory outcomes in water pollution control.

5. Outlook

The construction of a beautiful China and the pursuit of green development in rural areas underscore the urgent need for rural water environment protection. Currently, controlling and managing rural water environment pollution requires a pragmatic approach, ensuring that the infrastructure constructed is effectively utilized. There is a pressing need to actively explore sewage collection and treatment systems that are more suitable for rural areas.

In China's rural areas, water pollution is a serious issue. Therefore, local government departments must serve as strong support for water pollution control, adopting effective solutions tailored to local conditions to prevent the occurrence of water environment pollution effectively. Simultaneously, local managers need to learn from the lessons of water pollution control processes and utilize advanced treatment technologies to enhance sewage treatment efficiency.

For less developed rural areas, particular attention must be paid to water pollution issues. Only through vigorous protection of local water resources can economic development occur in a healthy environment. This approach ensures the integration of ecological, economic, and social benefits.

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