Demand Analysis of Rural Domestic Sewage Treatment Policy under the Background of Rural Revitalization Strategy

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Abstract. The problem of rural water pollution is a typical negative environmental externality problem. The formulation and implementation of relevant policies is a common means for the government to carry out public management, and it is also the starting point and key point for the next step to promote the treatment of rural domestic sewage. Based on the analysis of the current situation and existing problems of rural sewage treatment, this paper summarizes the characteristics of rural sewage source characteristics and sewage treatment in the aspects of system, capital, technology, engineering, operation and maintenance management, and puts forward the policy requirements for promoting rural sewage treatment, in order to provide reference for the formulation and introduction of relevant policies.

1. Introduction
The work report of the 19th National People's Congress of China pointed out that the "agriculture, rural and peasant issues" are fundamental issues concerning the national economy and the people's livelihood. We must always solve the problem of "agriculture, rural areas and farmers" as the top priority of the work of the whole party[1]. The "Three-Year Action Plan for the Rehabilitation of Rural Human Settlements" proposed by the Chinese government in 2018 has identified six key tasks, namely, managing rural domestic garbage, toilet waste, domestic sewage, improving village appearance, improving village planning, Improve the construction and management mechanism. Among them, the rural water pollution problem is a typical environmental negative externality problem. The formulation and implementation of relevant policies is a common means for the government to carry out public management, and it is also the starting point and key point for the next step to promote the treatment of rural domestic sewage[2].

2. Sources, emissions and pollution characteristics of rural sewage in China
The domestic sewage in rural China mainly comes from kitchen sewage, washing sewage and toilet sewage[3]. 1) Kitchen sewage. Kitchen sewage is the main source of organic matter in rural domestic sewage, accounting for 20% of total domestic sewage[3,4]. 2) Washing sewage. The sewage produced by washing accounts for more than 50% of the total domestic sewage. It contains a large amount of ammonia nitrogen, phosphorus and other elements, which is the main reason for the eutrophication of rural water bodies[4,5]. 3) Toilet sewage. Toilet sewage is a major contributor to nitrogen, phosphorus, COD, bacteria and viruses in rural domestic sewage[3-6].
2.1. Rural domestic sewage discharge
The domestic water consumption of rural residents is relatively small, but due to the large number of rural residents, the total amount of domestic sewage is huge[6,7]. In 2016, the total amount of rural domestic water used in China was 13.918 billion cubic meters, of which the eastern region accounted for 64.36%, the central region accounted for 35.93%, and the western region accounted for 38.67%[8]. Consequently, the resulting rural domestic sewage discharge is 5.567 billion to 12.526 billion cubic meters. Correspondingly, the rural domestic sewage discharge in the eastern region is 2.574 billion to 5.792 billion cubic meters, and the rural domestic sewage discharge in the central region is 1.437 billion to 3.234 billion cubic meters. Rural domestic sewage discharge in the western region is 1.547 billion to 3.48 billion cubic meters. Due to the general lack of sewage treatment facilities in the vast rural areas[8], it is difficult to effectively treat domestic sewage, and the phenomenon that farmers are free to dump domestic sewage outside the house is more serious, resulting in environmental pollution.

Table 1. Emissions of rural domestic sewage in different regions in 2016

| Region            | Rural domestic water consumption | Rural domestic sewage discharge |
|-------------------|---------------------------------|--------------------------------|
|                   | Low value | High value | Low value | High value |
| Entire country    | 139.18    | 55.67      | 125.26    |
| East area         | 64.36     | 25.74      | 57.92     |
| Central Region    | 35.93     | 14.37      | 32.34     |
| Western Region    | 38.67     | 15.47      | 34.80     |

Note: The data is from the 2016 China Urban and Rural Construction Statistical Yearbook and does not include Tibet data[8].

2.2. Characteristics of rural domestic sewage
1) Highly dispersed, difficult to collect uniformly. In the vast rural areas of China, the terrain is complex and the degree of economic development is low. The sewage cannot be collected by the municipal pipe network. Most farmers generally discharge the domestic sewage directly into the ditch outside the house or spill it on the ground. 2) The amount of water is small, and the water consumption is greatly affected by the season. Due to the scattered rural areas, there are not many resident populations, and the corresponding domestic sewage is also rare. The daily drinking habits of residents are basically similar. There is one peak of water use in the morning, middle and night, and the water consumption in other times is small. The daily variation coefficient of water consumption is generally 1.9-2.5. The characteristics of the seasonal effects are very obvious, which summer emissions are larger than in winter. 3) The organic matter concentration is high. Rural domestic sewage contains COD, nitrogen, phosphorus and other elements, which is highly biochemical, and the highest concentration of COD can reach 500mg/L. It does not contain harmful substances such as heavy metal elements, which is beneficial to the use of biological treatment. 4) Regional differences in water quality and water volume are large. Due to the different levels of development, topographic climate and residents' habits in various rural areas of China, the amount of water and water quality of rural domestic sewage varies from place to place.

2.3. Treatment of domestic sewage in rural China
At present, the characteristics of rural domestic sewage treatment are as follows: First, the overall treatment level of sewage is low. In 2016, the total number of administrative villages in China was 526,200. However, administrative villages that treat domestic sewage only accounted for 20%. Among these villages, the proportion of the eastern, central and western regions is 52.37%, 24.21% and 20.20%
respectively. Second, the regional differences in sewage treatment levels are significant. The calculation results show that among the 195,500 administrative villages in the eastern region, the villages that treat domestic sewage account for 28.19%; among the 172,100 administrative villages in the central region, the villages that treat domestic sewage account for 14.80%; Among the 156,700 administrative villages, the villages that treat domestic sewage account for 13.56%.

| Region          | Administrative village that treats domestic sewage | The proportion of sewage treatment of villages |
|-----------------|---------------------------------------------------|-----------------------------------------------|
|                 | Quantity   | proportion | Quantity   | proportion |
| Entire country  | 52.62      | 10.52      | 20.2       |             |
| East area       | 19.55      | 37.15      | 5.51       | 52.37       | 28.19       |
| Central Region  | 17.21      | 32.71      | 2.55       | 24.21       | 14.8        |
| Western Region  | 15.67      | 29.79      | 2.13       | 20.2        | 13.56       |

Note: The data is from the 2016 China Urban and Rural Construction Statistical Yearbook and does not include Tibet data[8].

3. The main challenges in the treatment of domestic sewage in China
The quality of the rural water environment is related to the life safety of farmers and the sustainable development of agriculture. The remediation and upgrading of rural water environment still faces many challenges.

3.1. Farmers who are the mainstay of rural environmental protection have a slower awareness of environmental protection
China's social and economic development has long been in a dual urban-rural structure. The overall development of the rural areas is inadequate and the economic level is backward. Some farmers believe that environmental problems are not the main problem in rural areas. Farmers are the main body of rural environmental governance. Farmers do not have the awareness of environmental protection, and they lack the motivation and actions to protect the environment. Farmers' environmental awareness is a major challenge for rural sewage treatment.

3.2. Rural sewage treatment and environmental protection lack corresponding overall planning
China has been steadily advancing related work in the construction of laws and regulations related to environmental protection, but the specific laws and regulations or provisions for the rural environment are relatively lacking. Even if it is involved to a certain extent, it only gives a principled requirement, and its content is not targeted enough, and its operation is not strong. For example, the current Environmental Protection Law does not have rigid requirements for the protection of the rural environment. For the treatment of domestic sewage in rural areas, all localities refer to the Law of the People's Republic of China on Water Pollution Prevention and Control according to the actual situation, which causes confusion in implementation. The Law on the Promotion of Rural Revitalization is still under preparation, and it is necessary to further refine the laws and regulations.
3.3. The funding gap for sewage treatment is large, and the source of funds is single
From the perspective of the Chinese government's investment in environmental pollution control in 2010-2014, the annual investment amount accounts for about 1.5% of GDP, which has led to a certain degree of control over environmental pollution. However, compared with the investment in urban environmental governance, the investment in rural environmental remediation is less. For example, the cost of rural environmental protection investment in 2014 was 15.896 billion yuan, only 26.8% of the urban environmental sanitation investment in the same period. For such a vast area of rural areas, its investment is relatively small, leading to a lag in rural environmental governance. Therefore, there is still a large funding gap for the governance of China's rural environment. The government is currently the main investment body of rural environmental governance. However, relying solely on the government's financial input can only be carried out on conditional points, it is difficult to achieve large-scale investment governance, and it is unable to meet the capital demand for comprehensive improvement of the rural environment.

3.4. Lack of institutions, professional and technical personnel and technical standards
There is a big gap between the number of institutions in the environmental protection system and the number of demand. The talent team is also lacking accordingly. At the same time, rural sewage management, from construction, operation, emissions to supervision, lacks a complete technical system. For example, there are no emission standards specifically for rural water pollution control in China. Most of the standards currently implemented in the sewage discharge process are based on the “Emission Standards for Pollutants in Urban Sewage Treatment Plants” (GB18918-2002) and Integrated Wastewater Discharge Standards (GB8978-1996) and "Irrigation Water Quality Standards" (GB 5084-2005). There is a double problem of non-standard sewage discharge and non-uniform use standards.

4. Policy Needs for Rural Domestic Sewage Treatment in China
Due to historical reasons, there are many gaps in policies and regulations, technical standards, financial support, and operation and maintenance management systems for rural sewage treatment. After the Chinese government proposed the "Village Revitalization Strategy" in 2018, the Chinese government paid more and more attention to the governance of the rural environment. The formulation and implementation of relevant policies is the starting point and key point for the next step to promote the treatment of rural domestic sewage.

4.1. Formulate and improve relevant laws and regulations on rural domestic sewage control as soon as possible
In the 2017 Central Rural Conference and the Document No. 1 of the Central Committee of the Communist Party of China in 2018, it was clearly stated that the Law on Rural Revitalization should be enacted. The name of this law was finally defined as the Law on Promotion of Rural Revitalization. Incorporating agriculture-related work into the rule of law, it just fills in a short board of "consistent with the rule of law, the rule of law, and the rule of law." This is also an important manifestation of the expansion of the development dividend from the city to the countryside. By increasing the supply of law, it provides the most fundamental and basic compliance for the treatment of rural domestic sewage, thus protecting the rights and interests of farmers.

4.2. Develop relevant technical standards and related support policies
It is recommended to establish a technical standardization system covering the whole process from planning to construction, operation and supervision through research, scientific research and international experience as soon as possible, and establish a complete village sewage treatment and management model system with different regional characteristics. According to the characteristics of the village sewage and the direction of drainage, scientific and reasonable rural sewage discharge standards are formulated.
After categorizing the 119 engineering cases of rural domestic sewage, the current rural domestic sewage can be classified into three technical modes: biological treatment, ecological treatment and combined treatment. The proportion of these three technologies is 5.88%, 14.29% and 79.83%. Therefore, some water treatment technologies with good treatment effects can be promoted nationwide, and it is recommended to develop more suitable water treatment technology methods as soon as possible. It is recommended to introduce relevant policies to support research institutions, universities, and enterprises to carry out research and marketing of related technologies.

4.3. Further improve the support of financial policies for rural sewage treatment
At present, the source of funds for rural sewage treatment in China is mainly government investment, but in terms of cost and efficiency, it requires the participation and supplement of social forces. There is an urgent need to develop relevant policies to open up channels for social participation and to establish appropriate modes of participation. The following financial support models can be considered. One is to use the PPP model to innovate rural water pollution control. Encourage the use of PPP mode to participate in the construction of agricultural public infrastructure, and establish a multi-funded rural sewage treatment project operation mechanism that is compatible with the market economy. The second is to comprehensively use fiscal transfer payments to manage rural water pollution. It is recommended to establish a special financial fund for water pollution control to help local governments use high technology to control water pollution. The third is to increase the local government's share of environmental protection taxation and fully mobilize local enthusiasm to control rural water pollution. In January 2018, China began to implement the Environmental Protection Tax Law to correct the external effects brought about by pollution through taxation. It is recommended to clarify the local government's tax and tax rates for environmental taxes, match local powers and expenditures, and increase local environmental tax sharing, which is conducive to the joint efforts of local governments and the central government to jointly control pollution.

4.4. Establish a sound villager autonomy policy system
The peasant masses are the makers of environmental pollution in rural areas and the victims of environmental pollution. The subjective attitudes and behaviors of farmers directly affect the effectiveness of rural environmental pollution control. Rural sewage treatment requires a broader system of mass participation. It is suggested to further improve the villager autonomy system. The rural sewage autonomy system should include: village regulations on water resources protection, sewage treatment promotion committees set up in the village, water resources protection publicity column, complete sewage self-government plan, and sewage treatment special cooperatives. Through environmental investigation and publicity, the government has made the peasants understand the importance of sewage treatment, conduct expert consultation and lectures, post environmental protection publicity charts, and distribute brochures, leaflets, environmental protection training to farmers, and carry out environmental protection in rural areas. Through the extensive awareness of environmental awareness and knowledge in rural areas, the enthusiasm of villagers to control sewage is mobilized. It is recommended that laws, regulations or policies be issued as soon as possible to clarify the main responsibilities of villagers in preventing and controlling water pollution and to establish mechanisms and channels for villagers to participate.

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