Investigation and Control Mode of Domestic Pollution in Rural Areas of Guangxi Province

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Abstract. Due to the unbalanced economic development and scattered residence in rural areas, it was difficult to adopt a centralized approach in rural environmental governance. Based on the survey results of the present situation of rural environment in Guangxi and the analysis of the pollution characteristics in rural areas, the control mode of domestic pollution suitable for rural areas was obtained. Based on this research, a demonstration project of Guangxi's administrative village was selected.

1. Introduction
On account of domestic pollution in rural areas was one of the important non-point source pollution in recent years, rural environmental issues had received more attention than before. Due to the lack of appropriate technologies for pollution control in villages and towns, various problems had arisen in the treatment of villages and towns, or they had invested too much in the centralized treatment of cities, or they had left pollution emissions causing more serious environmental hazards. In view of the problem of environmental pollution in rural areas of Guangxi, we carried out investigations and studies in Domestic Pollution. We implemented the demonstration project of ecological sanitation system in a certain village in Guangxi and carried out research work on demonstration projects of environmental pollution control in villages and towns.

2. Sampling Survey on Domestic Pollution in Guangxi Villages and Towns
In November 2016, a sample survey on the Domestic pollution of villages and towns in Guangxi was carried out and the survey was conducted on selected villages and towns. A total of 99 samples were surveyed, with a valid number of 96, including 18 in the eastern part of Guangxi, 22 in the northern part, 19 in the western part, 17 in the southern part and 11 in the central part. The main survey of environmental pollution and pollution control in rural areas. Method of investigation is to complete the questionnaire and inquiries and "Questionnaire on Environmental Pollution Sources of Towns and Townships and Citizens' Environmental Consciousness". The investigation covered the basic situation of sanitation, garbage, water supply and drainage and energy facilities.

2.1. The basic situation of villages and towns
Residents living in villages and towns were dispersed (70%) with separate decentralized water supply and large courtyard area for planting vegetables, local ornamental plants or fruit trees. The economy was dominated by agriculture with an average of 144.7 hm² of farmland and more than 90% were...
stockpiles of livestock and poultry. Large-scale enterprises and concentrated breeding farms existed in individual villages. Per capita income of villages and towns was ¥ 1000 ~ 10000 a year.

2.2. The Pollution Status of Domestic Waste Water

① The status quo survey of toilets showed that there were mainly three types of toilets used by residents in the study area: The first category was outdoor aqua privy, and the whole village with aqua privies accounted for 84%. According to the questionnaire survey, most of the aqua privy excrement was used as agricultural fertilizer into the fields, accounting for 93.8%. The second category was indoor flush toilets (accounting for 16%), of which 35% to 85% were flushing toilets with reclaimed water. Water flush toilets were generally self-built simple septic tanks. The manure and sewage flowed into the septic tank and pumped out for agricultural using was accounting for about 89%, and most of the supernatant flowed into ditches or rivers. The third category was public toilets. The most public toilets in the village were dry toilets, even some villages were without public toilets.

② Domestic waste water characteristics. The quality of rural domestic sewage was shown in Table 1. Most domestic sewage was freely discharged, and some villages had natural soil drains or drains. The final location of the discharge was river, pond or infiltration into the soil. According to the survey, 40.2% were discharged into the nearby rivers and ponds, 38.6% were infiltrated into the soil, 14.4% were discharged randomly, 4.3% were discharged into the farmland, and the rest was 2.5%.

| Water Quality Index | Grey Water | Domestic Waste Water | Black Water |
|---------------------|------------|----------------------|-------------|
| COD (mg L⁻¹)        | 100-200    | 300                  | 300-600     |
| TN (mg L⁻¹)         | 10-20      | 20-40                | 100-300     |
| Ammonia-Nitrogen (mg L⁻¹) | 5-15      | 15-25                | >25         |
| TP (mg L⁻¹)         | ≤1.5       | 3.0                  | >3.5        |

③ Status of Domestic Waste. The content of organic waste in rural domestic garbage was very high, accounting for more than 50%; construction waste of limestone were accounts for 20%; plastic, glass, metal and other garbage were account for about 28%. Rubbish was mainly collected in a mixed manner. The collection rate was not high, and dumping on the spot seriously.

2.3. The main problems of rural environment

According to the survey and analysis, the following problems existed in the environmental conditions in rural areas: First, existing health systems posed a greater health risk. Whether flush toilets or traditional aqua privies, most of the pathogens which were still present due to the non-decomposing of the faeces used in the farmland, would get into the food recycle chain through the water cycle and the crops possibly. Second, dry toilets were instead by flushing toilets would increase the use of flushing water. With the increase of rural centralized water supply, the number of flush toilets had also increased. Inquiring about the survey, some of the tenants had the intention to build a new flushing toilet. Sewage treatment methods were discharging straightly stream after a simple septic tank. The effluent quality was not compliance which caused pollution in surface water or groundwater. Third, water pollution caused by organic waste. Organic waste included septic tank waste, kitchen waste and other paper waste. Organic waste dumping, pollutants run into groundwater or surface water with surface runoff, was an important source of eutrophication of water. Fourth, the relevant laws and regulations were not sound and the management system is not perfect.
3. Methods of Domestic pollution control

3.1. Manure and sewage treatment
The characteristics of villages and towns determined the pollution treatment, which could not follow the city's sewage treatment model. Domestic and foreign research institutions had put forward a variety of treatment modes one after another, such as: decentralized sewage treatment mode, of which the main promotion of wetland treatment technology, land treatment technology, small sewage treatment technology, biogas digesters and biogas purification pond treatment technology. These treatment modes were with the technical features, which were based on low-energy biological treatment and natural treatment, but there were still some shortcomings as follows:

First, investment was still high and some equipment operation and management problems still existed. Small sewage treatment plants, wetlands were in higher operating costs (see Table 2), and need full-time technical staff for supporting.

| Technology                      | Investment (¥·m⁻³) | Operational Cost (¥·m⁻³) | Pipe Net Cost (¥·m⁻³) |
|---------------------------------|--------------------|--------------------------|-----------------------|
| Anaerobic Reactor              | 550                | 0.006                    |                       |
| Small Sewage Treatment Equipment| 300-5500           | 0.2-0.4                  | 100-350               |
| Constructed Wetlands           | 400                | 0.09                     |                       |

Second, the starting point was still the end treatment. The use of the end of the collection-based reprocessing were need a large number of sewage and storm water pipe network to support.

Third, anaerobic technology had defects when dealt with low temperature, low concentrations of sewage had become the technical limitations. The larger footprint of natural treatment systems, such as wetlands, was difficult to accommodate in an increasingly densely populated area of human settlements. The development of miniaturized traditional biotechnology had brought about high energy consumption and secondary pollution, and had also hindered the application of miniaturized devices in rural areas.

Fourthly, at present, all departments separately invested in construction facilities and did not consider environmental governance as a whole. Functional departments were in charge of different areas, such as the health sector were to consider disease and sanitation control, to solve the human body waste pollution, but less concerned about other sewage treatment; Environmental protection department was easy to ignore the problem of garbage disposal in the sewage problem, because garbage disposal was belonged to the municipal. As a result, environmental pollution still could not be effectively solved.

Fifth, the requirements of sewage discharge standards in villages and towns were relatively low. Generally, only required the secondary standard of urban sewage discharge standards, or even the third-grade standards, so it was difficult to achieve the effect of reducing eutrophication of water.

3.2. Domestic waste treatment
At present, the treatment of rural garbage was adopted in our country in three ways mainly: temporary storage, incineration and dumping. In rural areas, dumping and burial were carried out directly to existing sandpits or low-lying land. In fact, the surrounding countryside could be incorporated into the municipal waste disposal system and generally went to the municipal waste disposal plant. At present, the state and local governments advocated “village collection - town transport - county (city) handling” mode.

3.3. Analysis of mode selection
Due to the dispersion of sewage in rural areas, it was necessary to give consideration to other domestic sewage treatment while solving the problem of excrement pollution. At the same time, the garbage in rural areas was mainly piled open-air and directly enters the water bodies through runoff. Therefore, it
must meet the systematic requirements of solving the rural water pollution. According to the characteristics of rural sewage, the proportion of faces. COD, N and P contained in sewage effluents was the largest, and the pollutants would greatly reduce the concentration of pollutants in water by intercepting faces. The COD, N and P concentrations of other domestic sewage (also called gravy water) Low, which could adapt to the low load of natural processing technology requirements, could reduce the footprint of processing facilities, and to meet the requirements of decentralized processing system.

At present, the amount of domestic garbage in villages and towns was large, and the collection and treatment rate was extremely low. Though the relevant departments promote the collection and landfill for the rural rubbish, due to the high investment cost and the increase of the recovery cost of waste such as plastic, paper and metal, as well as the increase of landfill volume and subsequent treatment of leachate, making it difficult to implement in the scattered areas such as villages and towns. At present, the treatment methods for domestic waste suitable for rural areas were mainly trans-shipment + landfill [1]. Second, the realization of garbage collection and recycling was an inevitable waste disposal measures, while garbage collection and classification should be combined. Complicated classification and a single approach would both reduce the classification effect. Therefore, for the classification of domestic garbage in villages and towns, it was advisable to use dichotomy method of organic matter and residual inorganic mixture, and then to combine transport and landfill for treatment.

4. demonstration project of domestic waste controlling

In view of the above investigation and existing problems, we selected an administrative village in the central part of Guangxi Province as a demonstration project to carry out research on pollution control in rural areas. The technical route was shown in Figure 1. The control project adopted the concept of the latest eosin system in the world, with the key technology that the ecological toilet with urine and excreta separating and the micro-wetland gray water treatment which was suitable for rural conditions and the aerobic waste, excrement and waste composting process. The ecological toilets, which excrement and urine separately, combined with composting technology, enable the excrement to be treated innocuously, which can be directly used as agricultural to avoid the problem of wastewater discharge, transportation and disposal caused by flushing toilets. At the same time, the domestic sewage was changed into low-density and easily degradable gray water, which had good effluent quality, due to the use of eco-toilet technology, making a low investment and low energy consumption.

![Figure 1. Flow Chart of Ecological Sanitation System Process](image)

The testing apparatus of Sketch map of micro-wetland was shown in Figure 2, the Effect of micro-wetland treatment was shown in Table 3.
Figure 2. Sketch map of micro-wetland

Table 3. Effect of micro-wetland treatment

| Index             | Inflow Water (mg L⁻¹) | Outlet Water (mg L⁻¹) | Removal Rate % |
|-------------------|------------------------|-----------------------|----------------|
| COD               | 130-180                | 30-45                 | 79             |
| SS                | 25-35                  | 5-8                   | 58             |
| Ammonia-Nitrogen  | 10-30                  | 0.4-0.9               | 42             |
| TN                | 10-50                  | 0.5-1.1               | 97             |
| TP                | 1-6                    | 0.1-0.35              | 85             |

We set up two types of trash bins at each street in the village to collect organic waste (food waste) and inorganic waste (construction waste, dust, metal products, waste plastic bags and glass products) respectively. Organic waste was manure after composting together with and domestic waste. The volume of the remaining waste was drastically reduced. After the recyclables were sorted out, they were sent to the landfill, which reducing transportation costs and landfill costs. In order to ensure the effective operation of the project, many training and publicity and education programs were organized during the implementation of the project, and the institutionalization of village environmental pollution remediation was perfected.

5. Summarize
In rural areas, with the characteristics of large area and scattered living, poor public infrastructure and low economic level, pollution control should abandon the thinking mode of end-processing and be based on sustainable development, circular economy, source reduction and overall process control. Demonstration projects reduced the difficulty of sewage treatment by the ecological sanitation toilet water and reducing faecal pollution to ensure the low-cost sewage economy of small wetlands. The use of waste collection reduced waste volume and transportation costs. The investment of the overall project was low, the operating cost less, and the environmental benefit obviously made it worth promoting in rural areas.

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