

PROBLEMS OF THE AQUATIC ENVIRONMENT AND COUNTERMEASURES IN THE RAPID ECONOMIC DEVELOPMENT IN THE ZHUJIANG RIVER DELTA

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ABSTRACT: The Zhujiang (Pearl) River Delta is the rapid economic development region in China since the opening and reform door policy was carried out in 1978. Being the rapid development of industry and city, the impact on the aquatic environmental quality was significant. The pollution caused the water quality descended and the ecological system degraded, and also impeded the economic development. The characteristics and problems of the aquatic environment are: the capacity of aquatic environment is large but hasn't been utilized rationally, the water quality is influenced by saline sea water and tide current, the main pollutants are organic matter and the pollution is going heavier, the concentration of pollutants change seasonally. The countermeasures of aquatic environmental protection are: carrying out the environmental functional regionalization and controlling the total amount of pollutant discharge, revising the industrial structure and making a rational industrial arrangement, raising the rate of waste water treatment and making a full assessment of the water conservancy project.

KEY WORDS: economic development, Zhujiang River Delta, water pollution, water environment, countermeasures

I. INTRODUCTION

The Zhujiang River Delta, the largest south subtropical plain in China, is in the middle-south of Guangdong Province and faces the South China Sea. There are 29 cities and counties in this region, including Guangzhou, Shenzhen, Zhuhai and Fushan. There is 39.2 thousand km² of the area that is 22% of the area of Guangdong Province, and 0.4% of China^[1]. The population in this region was 21 million in 1992. It made up 32% of Guangdong's population and 1.7% of China's. Since the policy of opening and reform was

carried out in China, the rate of the economic development in this region is the fastest and became the one of the most important economic regions in this country. In 1992, the gross value of output of industry and agriculture was 278 billion yuan (RMB) that is 523% of 1985's, it made up 69% and 6.0% of the gross value of output of industry and agriculture of Guangdong Province and China respectively. The gross value of output of industry was 252 billion yuan, that is 594% of that in 1985's, it was 75% and 7% of Guangdong Province and China respectively. The urbanization was developed rapidly and the population in the cities and towns also increased very fast during this period. The urban population was about 60% of the total population in 1992, increased 20% compare with in 1986 (40%), and there was also more than 5 million temporary in the cities and towns of this region. The impact of industry, city and population on aquatic environment is significant because the project of wastewater treatment couldn't follow the step of the social and economic development in the Zhujiang River Delta.

II. THE CHARACTERISTICS AND PROBLEMS OF THE AQUATIC ENVIRONMENT IN THE ZHUJIANG RIVER DELTA

1. The Large Capacity of Aquatic Environment but Irrational Utilization

The Zhujiang River Delta is a multi-delta made up by its three main tributaries: Xijiang, Beijiang and Dongjiang. The total annual average discharge is 341.2 billion m^3 ^[2], therefore the capacity of aquatic environment is large. According to the study on the capacity of aquatic environment, the utilized ratio is only 60% until the year 2000 if the speed of economic development and the pollutants discharge increase are the same as that in recent years^[3]. Owing to the distribution of the cities, industry and population are not coordinate with the aquatic environment capacity, the capacity of most of the courses are not utilized effectively but some courses accepted the overloaded discharge of pollutants and caused the water quality to descend obviously such as the courses pass by Guangzhou, Fushan, Shenzhun, Zhongshan and Jiangmen.

2. Influenced by Saline Sea Water

The courses network of the Zhujiang River Delta are made up by several dozen of courses and eight courses entering the sea. The water in many courses influenced by sea water and the salinity go up when the flood tide into the courses, especially in the dry season. The courses pass by Guangzhou, Fushan, Donggan, Zhongshan are influenced by sea water and the salinity may rise to 1%–5‰ in the dry season. At that time, the fresh water is shortage for the uses of drinking, agriculture and industry in these area.

3. The Tide Current Impeding the Pollutants Discharge

Because the most of the courses in the Zhujiang River Delta are influenced by the tide Current, the pollutants will stop or move to the upper reaches by the adverse current when the flood tide enters into the reaches. This phenomenon causes the waste discharge to impede and even causes the waste discharged by the towns in the lower reaches reverse to flow into the towns in the upper reaches. Furthermore, being the river courses making up a network in this region, the flow of the near courses may influence each other and cause the pollutants move to the adjacent courses. These features are special obvious in the dry season.

Many dams were built for the protection from flood and saline tide current or for reclamation and other non-agricultural land use in several decades in the Zhujiang River Delta. These dams also often impede the waste discharge and cause the water quality descent.

4. The Main Pollutants Are Organic Matter and the Concentration of Pollutants Tend to Rise

Because some rivers that pass the cities and towns accept untreated municipal and industrial waste water in large amount, the main pollutants in the rivers are organic pollutants, such as ammonium nitrogen, chemical oxygen demand (COD) and phenol, and also mercury.

According to the monitoring data in the Zhujiang River Delta in 1985–1989, COD in 4 of 29 rivers decreased, unchanged in 17 rivers and increased in 8 rivers. Ammonium nitrogen in 1 of 28 rivers decreased, unchanged in 16 rivers and increased in 11 river. Phenol in 11 of 30 rivers decreased, unchanged in 12 and increased in 7. Mercury in 14 of 24 rivers decreased, unchanged in 5 rivers and increased in 5 rivers too. According to the quality standard for drinking water in China, 30% of the courses are not suitable for public water supply in the Zhujiang River Delta.

5. The Concentration of Pollutants Change Seasonally

Being the influence of monsoon, seasonal change of the discharge of the rivers in the Zhujiang River Delta is significant. About 75%–80% of the total discharge concentrated in April to September. This causes the ability of dilution and degradation of pollutants to change seasonally and causes the pollutants's concentration to change seasonally. The concentration of most of the pollutants' in dry season is higher than that in flood season. The change pattern of COD concentration, however, is dependent upon the degree of pollution. The concentration of COD in dry season is higher than that in the flood season under the condition of heavy pollution, but it is converse in the light pollution rivers. The main source

of COD in the light polluted rivers is not the municipal and industrial waste but the countryside. The surface runoff bring the organic pollutants into the river in the flood season.

Being the water pollution, the influence of water quality descent on the social-economic-ecological system is obvious in the Zhujiang River Delta. The water source pollution imperils potentially the citizen's health in some towns so that the water works were forced to move sites. According to the investigation in 1987, the phenol content of fishes exceeded the normal level by 1.7 time and the contents of As, Cr and Hg of fishes in some courses also exceeded the normal level in the Zhujiang River Delta. The water pollution also caused the fishery resources failing and caused the agricultural production decline. It was evaluated that the loss was 730 million yuan account for the water pollution in the Zhujiang River Delta in 1985.

III. THE COUNTERMEASURES OF THE AQUATIC ENVIRONMENTAL PROTECTION IN THE ZHUJIANG RIVER DELTA

According to the characteristics and problems of aquatic environment in the Zhujiang River Delta, and for protecting the aquatic environment and ensuring the continued and health development of economy, the countermeasures are suggested as follows:

1. Carrying Out the Environmental Functional Regionalization and Controlling the Total Amount of the Pollutant Discharge

On the basis of the situation of economic development and the needs for the protection of aquatic environment, and give priority to the protection of the sources of drinking water and the water uses of agriculture and industry, and take account of the benefits to the upper and lower reaches, carry out the further research of aquatic environmental capacity and control the total amount of the waste discharge of each river basin.

2. Revising the Industrial Structure, Rational Industrial Arrangement

For decreasing the load of the pollutants of the reaches which pass the cities, the industrial structure should be revised in the cities which the industry concentrated, move the heavy aquatic polluted industrial plants and also arrange the new aquatic polluted projects to the places which still have large aquatic environmental capacity so that aquatic environmental capacity can be use properly. In the cities that the aquatic environment pollution is serious should develop the industries of high productive value and service enterprise. This plan is began to carry out in Guangzhou, Shenzhen and Fushan etc.

3. Strengthening the Project of the Waste Water Treatment

Up to date, there is still a lot of industrial and municipal waste water was untreated and straight discharge to the courses in the Zhujiang River Delta, specially in the towns and countryside. The key to protecting the aquatic environment in this region is raising the technique of the water treatment and strengthening the project of water treatment plants in the after years. The cities in this region, such as Guangzhou, Shenzhen, Fushan, are carrying out the plan to build more plants of waste water treatment so that the aquatic environment can be protected as the economy develop in high rate. The plan to build the facilities for discharging the waste water to the sea also be through out for reasonable use of the sea environmental capacity in the coast area. In the meantime, it is necessary to treat the solid waste in the appropriate ways in order to prevent the water pollution.

4. Making a Full Assessment of the Water Conservancy Project

Building the water conservancy project is the important effective factor for the aquatic environment, such as the projects of protecting saline sea water and tide current, reclamation, reservoir and canal etc. These project should be full assessed on the environmental effect so that the harmful influence can be avoided in the pearl River Delta.

IV. CONCLUSION

The quality of aquatic environment in the Zhujiang River Delta was descending with the economy developed rapidly since 1978, and also influenced by saline sea water and tide current. The main pollutants are organic matter and the pollutant concentration changed seasonally. The capacity of aquatic environment in this region is large but didn't utilize rationally. Carry out the environmental functional regionalization and control the total amount of waste discharge, revising the industrial structure and making a rational industrial arrangement, raising the rate of waste water treatment and make a full assessment of water conservancy project are the countermeasures for protecting the aquatic environment and guarantee to the continuous economy development in the Zhujiang River Delta.

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