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ON REGIONAL DIFFERENTIATION OF RIVER WATER ENVIRONMENT CAPACITY AND STRATEGIES TO CONTROL WATER ENVIRONMENT POLLUTION IN CHINA

Wang Huadong (王华东)　　Wang Shuhua (王淑华)
Bao Quansheng (鲍全盛)　　Qi Zhong (祁忠)
(Institute of Environmental Science, Beijing Normal University, Beijing 100875, *PRC)*

ABSTRACT: China has large population and wide territory, the natural conditions of different regions are complicated, water resources are distributed unbalanced, economic developing states are unequal. For these reasons the variation of concerned water environment capacity has obvious character of regional differentiation. In this paper, from the economic development point of view, the regular pattern of regional differentiation of China's water environment capacity resources is analyzed, the concept of contradictory degree between water environment capacity and economic development is introduced, based on them, rivers in China are divided into three regions, and corresponding strategies to control water pollution are advanced. The aims are to use river water environment capacity resources effectively, to control pollution and to improve environmental quality.

KEY WORDS: water environment capacity, regional differentiation, pollution control, total quantity control

I. WATER RESOURCES AND WATER ENVIRONMENT CAPACITY RESOURCES

Water is a basic element of natural environment and a kind of important natural resources. At present, water resources are defined differently, such as "water resources are the water sources that can be used, have enough quality and quantity, and can fulfill applications in certain places." (defined by UNESCO and WHO)[1]. In China, water resources are defined as "the water that can be used by

mankind under present economic and technological condition, fresh water like shallow underground water, lake water, water in soil, water in air and river water etc."[2]. Water resources have the combined characters of society and nature, the social characters show that water can be used to make products, can fulfill the need of mankind to exist and develop, the final result is economic benefit increasing and social development; and the natural characters show two basic elements of water resources—quantity and quality, because water environment capacity is determined by quantity and quality of water, water environment capacity is also an important attribute of water resources.

Water environment capacity is the load quantity of certain pollutants during certain time, in a certain unit of water environment, under the condition that water can fulfill certain environmental object. Water environment capacity is a natural attribute of water, it has use value, that means it can be used to eliminate and hold (assimilate, keep and transfer) pollutants discharged into water, therefore it is a kind of natural resources. Water environment capacity change with the required function of water in a certain time, besides the character of eliminating pollutants, it also shows the function reachability of water which is the social attribute of water resources. Evidently, water environment capacity can express the social and natural attributes of water resources, it is the foundation and an important condition for water resources exploitation.

Water environment capacity, to the discharged pollutants, is the measurement of abilities that the water has to dilute and assimilate, but to the water receiving pollutants, it is the measurement value and quality of water resources. The more the water environment capacity, the more the potential exploited ability, and the more pollutants it can contain without declination of environmental object function. As for the water which capacity has reached saturation (such as the seriously polluted rivers or lakes), its use value drop as its usability disappears gradually. To regain the value, a great price (economic cost) must be paid. Water environment capacity has a close relation with the quantity and quality of water, to the total quantity of discharged pollutants, the quantity of water resources is the restricting element of water environment capacity.

Water environment capacity, as an expression of the equilibrium relations in water environment system, of the feedback mechanism and of the self-adjustment ability, since the 1980s, has been studied and used widely[3]. To coordinate the relation between economic development and water environment capacity, in this paper, the balance between water environment capacity and economic development

is discussed, the regional differentiation of contradiction between water environment capacity and economic development is brought into light, and theoretical foundation for making water pollution control policies that suit local conditions is provided.

II. ANALYSIS OF RIVER WATER ENVIRONMENT CAPACITY OF CHINA

1. The Concept of Contradictory Degree between Water Environment Capacity and Economic Development

Water environment capacity resources are a kind of limited and renewable resources. It and economic development rely on and condition each other. Rationally exploiting water environment capacity resources can not only effectively protect river environment but also accelerate economic development. On the contrary, over-exploiting water environment capacity resources, will certainly influence the continuous and steady economic development. For this reason, the concept of contradictory degree between water environment capacity and economic development is introduced, which aims at describing the pressure that economic development rivers, and at starting with the regional differentiation law to discuss the potential usability of water environment capacity of China.

The contradictory degree between water environment capacity and economic development is the gross output value of industry and agriculture that specific water environment capacity can bear under current conditions (technology, management and ecosystem). This index can express the contradiction between water environment capacity and economic development, through analyzing the regional distribution of water environment capacity, the macroscopic character of regional differentiation of water environment capacity resources can be explained.

As mentioned above, because the quantity of water environment capacity is determined by the quantity of water resources, there is a close relation between them. To the overall condition of pollutants in a river, the spatial distribution of water resources can reflect the spatial variation tendency of water environment capacity. Based on this, a province is used as the administrative division unit, in this paper, the average quantity of water resources[4] and the gross output value of industry and agriculture[5] are adopted to calculate the contradictory degree between water environment capacity and economic development.

2. The Distribution of Contradictory Degree between Water Environment Capacity and Economic Development

The distribution of water resources in different regions of China are not very proportionate, their general tendency is decreasing progressively from southeast coast to northwest inland, the corresponding water environment capacity resources have similar regulation, their general tendency is also high in the east and low in the west.

The result of calculation shows that the maximum contradictory degree appears in the region from the lower reaches of the Liaohe River to the southwest Huang-Huai-Hai Plain and in the Changjiang (Yangtze) River Delta, the degrees are over 5. 0. The minimum contradictory degree appears in Guangxi, Yunnan, Guizhou, Qinghai provinces and Xinjiang and Xizang autonomous regions, the degrees are all under 0. 5, the degrees of the rest regions are between 0. 5 and 5. 0.

From the state of contradictory degree, the distribution of water environment capacity in China is unbalanced, in general, water environment capacity is high in the west and low in the east. The region from the lower reaches of the Liaohe River to the southwest Huang-Huai-Hai Plain and the Changjiang River Delta is the area where water environment capacity and economic development are seriously contradictory, the rapid economic development has caused serious pollution to rivers, the left capacity is very limited. On the other hand, in Xinjiang Autonomous Region, the Qinghai-Xizang Plateau, Yunnan-Guizhou Plateau and Guangxi Zhuang Autonomous Region, the contradiction between water environment capacity and economic development is small, except the few rivers near big cities, most of the rivers are not polluted, there still left some water environment capacity resources that can be exploited, its potentiality is very great. In the rest regions, there is some contradiction between water environment capacity and economic development, some parts of the rivers are heavily polluted, but there is still some capacity left.

3. The Regional Differentiation of Water Environment Capacity in China

Contradictory degree is the basis of dividing water environment capacity into regions. According to the spatial distribution of contradictory degree, from the east to the west, Chinese water environment capacity can be divided into three regions. The outline is as follows.

Region I—The east region of river water environment capacity: It includes Liaoning, Beijing, Tianjin, Hebei, Shandong, Jiangsu and Shanghai. Its total area is about 627,000km^2, that is only 6.5 percent of the total area of China, but there concentrated 1/4 of the country's population, 23.6 percent of the farmland and about 41 percent of the gross output value of industry and agriculture, it is the most densely populated and best developed region in China. In this region, water resources are very poor, the quantity of water resources is less than 4 percent of the total quantity of China's water resources, but its quantity of wastewater that was discharged into rivers and lakes has reached 11 billion tons, that is almost 31 percent of the total quantity of the China's wastewater, the effluent intensity has reached 65,000 tons/km^2. Economic development has given great pressure to water environment capacity resources, in most of the region, especially places near large and medium-sized cities, water environment capacity is saturated or overloaded, only little water environment capacity is left, the river water environment is seriously polluted. Taking Beijing as an example, 200 million tons of wastewater is discharged every day, except Guanting and Miyun reservoirs and their diversion channels, the rest rivers are all polluted in some degree, water environment capacity is almost used up, only little water environment capacity is left, that is a serious issue of this region.

Region II—The middle region of river water environment capacity: It includes Heilongjiang, Jilin, Gansu, Shaanxi, Shanxi, Henan, Hubei, Hunan, Guangdong, Hainan, Anhui, Jiangxi, Zhejiang, Sichuan and Fujian provinces and Inner Mongolia and Ningxia Hui autonomous regions. Its total area is about 4,585,000 km^2, that is 47.7 percent of the total area of China. In general, it is a comparative populated and developed region, its population is 62.3 percent of China, but its population density is lower than Region I, only 150 men/km^2, it is 1/3 of that in Region I. Its cultivated land per unit is 201.1 mu/km^2 (1 mu=1/15 ha), its per unit output value of industry and agriculture is 328, 900 yuan/km^2, respectively is 37.2 percent and 17.7 percent of that in Region I. Its water resources are richer, its total quantity of water resources is more than half of that in China, but its distribution among the region is not balanced, generally, from south to north from the east to west, its water resources decline gradually, its water environment capacity has the similar regular pattern. Although its discharged wastewater quantity is 60 percent of that in China, the intensity is smaller, only 6,800 tons/km^2, it is 10 percent of that in Region I, therefore, rivers in this region is lightly polluted, only the rivers that pass through large and

medium-sized cities are seriously polluted. The pressure that economic development gives water environment capacity is lighter, there is still some water environment capacity that can be exploited. Taking Ma'anshan City of Anhui Province as an example, the river that passes through Ma'anshan City is seriously polluted because of the wastewater discharged from Ma'anshan City and Ma'anshan Steel Co. Lmt., but because it is near the Changjiang River, there is still some environment capacity from the upper reaches of the Changjiang River that can be exploited.

Region III—The west region of river water environment capacity: It includes Guizhou, Yunnan, Qinghai provinces and Guangxi, Xinjiang and Xizang autonomous regions etc., its total area is 4,384,000km^2, it is about 45.8 percent of that in China. It is a large area with little population, its population is only about 11.8 percent of that in China, its population density is only 30 men/km^2. It is also an under-developed region, its gross output value of industry and agriculture is only 6.1 percent of that in China, its per unit output value is only 39,000 yuan/km^2, respectively 2.1 and 11.8 percent of that in Region I and Region II, its per unit cultivated land is only 2.53 ha/km^2, much less than that in Region I and Region II. Water resources in this region are very rich, it is about 41 percent of total quantity of water resources in China, it is also not very balanced, from the southeast to the northwest, it declines gradually, its water environment capacity has the similar tendency. But the quantity of discharged wastewater is only about 2.8 billion tons, it is less than 8 percent of that in China, especially its intensity is very low, only 640 tons/km^2. Thus the rivers in this region, except few that near large city, are not polluted, their water quality is good, the pressure that economic development exerts water environment capacity is very light, or almost no pressure exists, there is great exploiting potentiality.

III. STRATEGIES TO CONTROL WATER ENVIRONMENT POLLUTION

1. Overall Plan, Rational Distribution of Industry and Agriculture

Whether the structure and distribution of regional production is rational or not, they have great impact on the productivity and environmental quality. At present, in some places of China, environmental problem is very serious, there is a close relation with the structure of industry and agriculture. Therefore, in order to control pollution effectively and comprehensively, we should strengthen the control and management of pollution sources, readjust the irrational arrangement and

strictly check new projects as well, so as to accomplish economic development without environmental pollution, and to improve environmental quality step by step.

Because of historical reasons, in the east part of China, many water consuming and heavily polluting industries were concentrated, aggravated the contradiction between supply and command of water resources, water environment pollution has become an outstanding issue. Hence in the arrangement of industry and agriculture, the heavy water consuming and polluting projects must be placed restrictions on, at the same time, encourage the industries to adopt water-saving measure and control pollution, and rearrange industry and agriculture of the region, move some industries out or make new project select elsewhere, so as to improve the water environment quality and increase the benefit of industry.

In the middle part of China, although the type of new projects need not be restricted, those water consuming and heavy polluting industries must avoid large cities where pollution is serious and has little water environment capacity left, so as to use water resources and water environment capacity resources rationally and to increase economic benefit.

In the west region of China, we should import more technology in condition permitting places, distribute more industry, and bring the advantage of water environment capacity resources into full play, so as to accelerate the development of regional economy.

2. **Suit Measures of Pollution Control to Local Conditions**

Carrying out total quantity control of discharged pollutants and pollutant discharging licence system are effective measures that were adopted in water environment management in recent years in China. They have overcome the disadvantages of concentration control, and they are practical ways to control water environment pollution and to improve environmental quality. But because the water environment capacity resources have obvious regional differentiation character, the water environment capacity resources and the state of economic development of different places are greatly different from each other. Therefore, the measures to control water environment pollution must suit local conditions, different regions choose different measures such as total quantity control of discharged pollutants, pollutant discharging licence and concentration control, so as to increase the economic benefit and environmental benefit at the same time.

In the east part of China, water environment capacity has reached saturation or is overloaded in recent years, although the total quantity control and pollutant discharging licence system are being carried out, that is still not enough to change the case[6]. The system of trading pollutants discharging rights should be also made experiments, in some condition permitting places, this system should be carried out first, so as to control pollution as effective as possible, and to turn around the situation of serious water environment pollution.

The middle part of China is a comparatively developed region, except the places near large and medium-sized cities and few industrial towns where water pollution exists and no much water environment capacity is left, in the rest regions there is still some water environment capacity resources that can be exploited, therefore, when controlling river water environment pollution, from the practical point of view, we should use both total quantity control and concentration control, make a distinction between heavily polluted rivers and lightly polluted rivers, in order to exploit the water environment capacity resources to completely improve water environment quality and to accelerate economic development.

The west part of China is an unexploited region, its economic foundation is poor, the majority of river water environment capacity resources are not exploited, except few places near large cities, river environment is almost unpolluted, therefore, when controlling water environment pollution, it is not so perfect to use the strict total quantity control, it is better to use concentration control system only in some polluted area, so as to bring the potential of water environment capacity resources into fullest play, to reduce the cost of products, to increase the competition of products, and to encourage the economic development.

3. Set up Cost Accounts of Water Environment Capacity Resources and Carry forward the System of Using Capacity upon Consideration

River water environment capacity is a kind of limited and renewable natural resources. In the state of social market economy, to prevent damage and exhausting of water environment capacity, we should seek the help of law and technology, set up cost account of water environment capacity resources, add its cost into the cost of products, and advocate the system of using capacity upon consideration, so as to restrain the shortsighted behavior of industries and to reach the aim of using water environment capacity resources forever.

IV. CONCLUSION

1) Water environment capacity resources in China are limited, especially in the east where few water environmental capacity is left, we should use strong measures to protect the water environment, and increase using efficiency.

2) The distribution of water environment capacity resources in China is not balanced, for this reason, when controlling water environment pollution, we should suit the measures to local conditions, in order to fully exploit the potential resources of different regions, and to make the economic benefit and environment develop simultaneously.

3) The state of the non-point source pollution in the total pollution is still not clear, further research work to distribute the total quantity control should be carried out.

4) Water environment capacity is a kind of limited and renewable resources, in the state of social market economy, the cost account of water environment capacity resources should be set up, its cost should be added into the cost of products, water environment capacity resources should be used upon consideration, so as to exploit the water environment capacity completely, rationally and continuously.

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