

The Practice and Research of Water Protection of the Fuxian Lake in Yuxi City

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Abstract. This paper introduces the basic situation and strategic position of the Fuxian Lake, the implementation of the protection decision-making deployment of the Fuxian Lake, the control of pollution sources and exploitation quantity according to The Fuxian Lake Basin water environment capacity, the balanced promotion of the coordinate development of economic society and lake protection of the Fuxian Lake basin, and the full deployment of a series of projects such as the repair of the water conservation forest, the shutting down of surrounding phosphate mining enterprises, the reduction of village pollution, the improvement of the river ecology, the purification of less-polluted water, the civilization corridor around the lake, the lakeside zone construction, four withdrawals (of people, houses, fields and ponds) and three returns (of lakes, water, and wetlands), and clear water runoff mechanism like the outflow diversion of the Xingyun Lake and the Fuxian Lake, etc., and ecological restoration system. The main experience includes: to co-ordinate the Fuxian Lake Management Committee; to set up platforms of investment financing and science and technology support; to achieve national system reform and breakthroughs in protection development; the establishment mechanisms of project supervision, linkage law enforcement, ecological compensation and bonus-penalty assessment; to implement projects of the ecological restoration around the lake, the prevention and control of the basin pollution, the control of agricultural non-point source, the regulation of watercourses into the lake, as well as management system and capacity building.

Basic Situation and Strategic Position of the Fuxian Lake

The Fuxian Lake is the only Class I water lake among others on the same latitude. It is an important and rare and poorly cultivated freshwater lake with the best water quality and the largest water storage in China. It has a basin area of 674.7 square kilometers, a water area of 216.6 square kilometers, the largest water depth of 158.9 meters, the average depth of 95.2 meters, the water storage of 20.62 billion cubic meters, the water cycle of over 250 years; the Class I lake water quality, the average water transparency of 5 to 6 meters, up to 12.5 meters at the maximum. The Fuxian Lake is located in the Pearl River source ecosystem, which plays an important role in maintaining ecological security such as biodiversity, water conservation, soil and water conservation and climate regulation in the Pearl River source and the southwest area. It is of great significance to Yuxi, Yunnan and even national economic and social development. Due to frequent global extreme climates and increasing number of extreme droughts and floods around the world and reduced high-quality fresh water resources in China, the Fuxian Lake has become a national strategic backup water source, reserving 15 tons of high quality fresh water resources per person for nearly 1.4 billion Chinese people.

Ecological Environment Problems and Protection and Management Strategies of The Fuxian Lake

Ecological Environment of the Lake

The water quality indicators of the Fuxian Lake were better than the Class I standard before 1990, with the average transparency of 7 meters; the over-oxidation status indexes were respectively 6.82 and 10.91 in 1980 and 1990. In the 1990s, the water quality transparency of the Fuxian Lake was declining and the chemical oxygen demand was slowly increasing. The total nitrogen and total phosphorus showed a continuous increase. The mean of the total nitrogen content was very close to the upper limit of the water quality standard of Class I. The water quality of part of the lake area is reduced from Class I to Class II; from north to south, from the coast to the lake, there is a danger of faster decreases of water quality; the water ecosystem is reduced and the pollution is increased, plus the invasion of alien species.

Ecological Problems in the Lake Basin

The Fuxian Lake is a "sag pond", with steep lake coasts, narrow natural lakeside zone and a fragile ecological environment; the land area in the runoff area is only twice the water area, so the catchment area is small; the theoretical water cycle is long and mountain-surrounding forest cover rate is low, so water conservation is insufficient and rocky desertification and soil erosion are serious; the population density is large and the industrial structure is unreasonable; the agricultural multiple cropping index is close to 400%, the importance ranking of pollution source is human and animal manure > farm runoff > village sewage > pollution of urban sewage > soil and water loss; the 103 into-lake rivers account for 52.37% of the total runoff, most of the river is inferior Class V; natural shore is affected by human activities -- the buffer zone within 100m is occupied by 24% of the population and 4% of farmland, buffer zone within 1km is occupied by 32% population and 43% farmland, so the self-purification function of the lake is destroyed. Now and in the future The into-lake pollution of part of the Fuxian Lake will be increasing periodically, while there is no sign of regional water quality fluctuations.

Protection and Governance Strategy of the Lake

Yuxi City, Yunnan and the national lake protection institutions and academicians have led expert groups to provide support for the ideas, planning, programs and engineering techniques of the protection of the Fuxian Lake. They put forward a systematic control idea of "industrial policy and structural adjustment pollution control - pollution source engineering control - less-polluted water purification and treatment" for the whole river basin pollution source; and put forward the new concept of "water conservation and soil erosion - pollution control and restoration of into-lake rivers - capturing and purification of the lake buffer zone", with the practice of "green river basin protection, clear water runoff mechanism and lake buffer zone construction"; based on the concept of lake ecological security and the theory of system control, and also combine the Fuxian Lake water pollution control and the economy development of social and ecological system construction in the whole basin with human production and life behavior, in order to form a scientific, innovative and sustainable theoretical technology system of Fuxian Lake protection and management, which includes: a comprehensive control of pollution sources within the basin, inferior Class VI into-lake rivers, and lakeside entrance, etc., to ensure that Fuxian Lake pollution into the lake is remain less than the lake water environment carrying capacity; scientific, effective and orderly adjustment of industrial structure in the Fuxian Lake runoff area, followed by a good implementation of ecological restoration, environmental regulation, park construction, institutional reform, diversified investment and so on; continuous monitoring, assessment and early warning of water ecological changes and timely grasp of water quality monitoring, assessment, early warning work, timely grasp of the productivity performance of clean-water species, anti-pollution species, algae content, chlorophyll

and so on and take targeted measures; continuous monitoring, assessment and early warning of the water quality, timely grasp of the downward trend of the water quality from Class I to class II and take targeted measures.

Practice of the Fuxian Lake Water Protection

The work to ensure the stability of the Fuxian Lake to maintain the Class I water quality is summarized as "12345", namely: coordinating comprehensive test area management committee for the Fuxian –Xingyun Lake ecological construction and tourism reform and development; building two platforms of investment financing, science and technology support; achieving three major breakthroughs in the national level, system reform, protection and development; establishing four mechanisms of project supervision, linkage law enforcement, ecological compensation and bonus-penalty assessment; implementation of five projects including ecological restoration, water basin pollution control, agricultural non-point source pollution prevention, regulation of watercourses into the lake, management system and capacity building.

Coordinating an Institution

In 2013, the municipal party committee and the municipal government co-ordinate the projects of Fuxian Lake protection and management and tourism development planning. In 2008, Yunnan Fuxian - Xingyun Lake ecological construction and tourism reform and development comprehensive test area management committee was set up, with the municipal party committee secretary as director, the major and the relevant municipal leadership as deputy directors, and the main leaders of the relevant departments of the city and three-county district committee as members. The administrative committee of the test area is located in the city management bureau, with the deputy mayor in charge as director.

Building Two Platforms

First, build an investment and financing platform including the establishment of Fuxian Lake Protection and Development Investment Co., Ltd. and its wholly-owned subsidiary; providing the Fuxian Lake ecological and environmental protection project funds by comprehensive means of BT, EPC, project loans and equity trust financing, promoting the building of ecological protection of water resources allocation emergency project and resettlement housing project, etc..

Second, build a technology support platform, including the establishment of the Fuxian Lake ecological and environmental protection project management center, continuous strengthening of the lake monitoring, investigation and research, implementing of the dynamic monitoring, evaluation and maintenance of the effect of lake protection strategy measure; strengthening of communication and cooperation with national research institutes for the support of China Academy of Sciences and Central Academy of Sciences, regular organizing consultations of lake governance academicians and experts on major planning, projects and issues.

Achieving Three Breakthroughs

First, there is a breakthrough at the national level. Wen Jiabao, Li Keqiang and other national leaders have made important instructions on the protection and management of the Fuxian Lake, and the Ministry of Finance, the Ministry of Environmental Protection and other relevant departments have been to the Fuxian Lake for research for many times; Chinese Academy of Engineering included the Fuxian Lake in China's key lake over oxidation control and the strategic research projects for economic coordination and development in the lake basin; In 2011, the Ministry of Finance and the Ministry of Environmental Protection listed the Fuxian Lake as one of the eight good quality lake eco-environmental protection pilot projects; In 2013, it became a national key support lake; In 2013, it received support from provincial special funds.

Second, there is a breakthrough in institutional reform. The city and the county cadre team building of the Fuxian Lake authorities has been strengthened, due to the establishment of the city Fuxian Lake comprehensive law enforcement detachment. The comprehensive reform of Fuxian Lake environmental resources protection management system was included in the central preparation reform pilot. Since January of 2016, the Fuxian Lake runoff area has been managed as a whole by Chengjiang County, to achieve "unified planning, unified management, unified protection, unified development and unified law enforcement".

Third, there is a breakthrough in protection and development. The management committee of the test area always adheres to the priority of protection, green development, sets up scientific and rational layout and regulate the production space, living space and ecological space in the Fuxian Lake runoff area, forms a set of ecological protection red line and build control measures for project red line.

Establishing Four Mechanisms

First, establish project supervision mechanism. Both the city and the county set up and carry out action plans of the 12th Five-Year project for the comprehensive prevention and control of water pollution in the Fuxian Lake basin, organize supervision groups directed by the mayor for the Fuxian Lake project construction, command the leadership of all levels to sign the project responsibility letter and implement the responsibility of the lake pollution prevention one by one, promote the implementation of the project, in accordance with the requirements of "one project, one team, one system and one control".

Second, establish the linkage mechanism for law enforcement team. The joint meeting system of the secretary and the chief of Lake County and the joint law enforcement mechanism of Municipal Authority, the Municipal Public Security Bureau are established, with joint law enforcement, weekly consultation, information exchange and severe blows on illegal acts, grasping the key and overcoming the difficulties, in order to maintain the ecological safety of The Fuxian Lake; jointly implementing special regulation to solve a series of uncivilized behavior such as large drift net, light trapping, beach washing, scaffolding camping, etc., in law enforcement process; Construction and orderly development, The Fuxian Lake water and fishery, tourism, construction order in general good.

Third, establish ecological compensation mechanism. Lake County successfully incorporated into the transfer payment scope of national key ecological function area; *The Management Approach of the Fuxian Lake Resources Protection Fee Collection in Yuxi* and *The Decision to Set up Test Area Project Deposit and Fuxian Lake Protection and Management Special Funds* are introduced to receive funds as the special funds for Fuxian Lake protection and management. On the basis of summing up the experience of multi-channel fund raising, according to the principle of "those who benefits compensates", the ecological compensation mechanism of the Fuxian Lake was put forward for the first time in the newly revised *Regulations on the Protection of the Fuxian Lake in Yunnan Province*, claiming: "Developers should offer ecological compensation to the approved development projects, specific approaches of which will be reported by the Yuxi Municipal People's Government to the provincial people's government for approval according to the procedures".

Fourth, establish assessment accountability mechanism. Develop the assessment methods of the responsibility letter of Fuxian Lake protection and management objectives, assessment methods of ecological construction objectives and tasks and accountability measures; introduce *View on Strengthening and Improving the Municipal Management Leading Groups and Comprehensive Assessment of Leading Cadres*, constantly improving the municipal leadership and the comprehensive evaluation system of the leading cadres, greatly reducing the GDP assessment weight in Lake County, highlighting the assessment weight of indicators of river pollution control, urban sewage treatment, ecological restoration, water pollution control and so on. Aspects of the lake water quality objectives, lake planning responsibility book, agricultural non-point source pollution control, forestry ecology, environmental quality, two pollution control, pollution abatement, supervision and

management are assessed to accurately evaluate the leading groups and the performance of leading cadres.

Implementation of Five Major Projects

First, make efforts to promote the ecological restoration project of the Fuxian Lake. The first period of the project of "four withdrawals and three returns" in the lakeside buffer zone removed first-class protective temporary construction of 360,000 square meters in the Fuxian Lake, returned 8000 mu of farmland, complete the net packer of 35 km, planted 500,000 trees, completed the relocation of 6700 people, repaired the relocation land of 103 mu, implemented of forestation of 81 thousand mu and closed forest of 40 thousand mu, the national public welfare forest management and protection of 250 thousand mu, control soil erosion area of 180 square kilometers.

Second, make efforts to implement interception pollution control projects. The implementation of the projects including the sewage treatment plant expansion in North Bank area, sewage pipe network expansion on west bank of the Fuxian Lake, the sewage treatment plant renovation and expansion in Luchong tourist area, the garbage disposal in North Bank area and the facilities construction of garbage collection and transportation in the Fuxian Lake basin, the market operation of the wetlands and around-lake environment hygiene, will reduce about 36,000 tons of garbage per year into the lake, effectively reducing the garbage pollution.

Third, pay close attention to the regulation of main into-river watercourses. Establish a responsibility system of municipal leaders in charge of the river (segment). Starting from less-polluted water purification, river bed dredging, ecological restoration, cross-strait prohibition, the total investment of 1.021 billion yuan will complete the 16 major rivers into the river water environment management. Carry out four major projects including the water source area of water and water conservation forest restoration, the upper reaches of the reservoir protection and ecological restoration, pollution control and purification area recovery and lake area ecological restoration, so that the water quality of Fu Cheng River, Jianshan River, East River, Liang Wang River meets the requirements of Class IV and Class III.

Fourth, speed up the agricultural non-point source pollution control. Implement demonstration projects of industrial structure adjustment and green agriculture in the Fuxian Lake basin dam area. Establish support funds to support the leading enterprises to promote farmers to plant blueberries, seedlings, lotus root and other low-pollutant emissions of economic crops, with the completion of agricultural planting structure adjustment of 18,500 mu, banning planting 4827 mu of greenhouses, built more than 600 mu of landscape seedlings base; mining geological environment to restore governance 40.1hm². Promote the livestock and poultry breeding pollution control work and move all of livestock and poultry scale farming in the runoff area to the outside area for intensive livestock and poultry breeding. Through the implementation of the project, the natural shoreline rate of the lake is increased to 82%, the forest coverage rate is increased to 31.68%, the ecological restoration rate of phosphate rock mining site is 30%, and the control rate of soil and water loss in the basin is 56%.

Fifth, strengthen the lake monitoring management system and capacity building. Speed up the project construction of the Fuxian Lake ecological environment monitoring system and the plateau lakes research center. Strengthen the Fuxian Lake water quality monitoring and early warning key technology research and application demonstration project construction. Gradually build an all-round, all-weather monitoring network of into-lake water volume, water quality, ecology and so on in the Fuxian Lake. Put forward the feasible strategies and measures for the protection of the Fuxian Lake in the near future. Provide data including the water level, storage capacity, water temperature, rainfall, evaporation and other hydrological of the Fuxian Lake in accordance with the City Hydrological Bureau and other water regime registration.

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