

South Yunnan Lakes Integrated Environmental Master Planning

assignment

The South Yunnan Lakes Integrated Environmental Master Planning Project aims to develop integrated packages of measures for lake protection and rehabilitation. Four lakes are covered by the project, namely Fuxian, Xingyun, Qilu and Yilong Lake. These four lakes are among the nine plateau lakes in Yunnan Province, being the main focus of the Province's environmental protection.

client

The Yunnan Provincial Environmental Protection Bureau (EPB), Yuxi Municipal EPB, Honghe Prefectural EPB and four County EPBs from Chinese side and DHV Consultants BV and WL | Delft Hydraulics from Dutch side have implemented this project. The Dutch government supported the technical assistance under the MILIEV programme. Yunnan Provincial government supported the relative counterpart contribution.

period

January 1998 - December 1999.



Fishing boats on Fuxian Lake

keywords:
decision support
systems
reservoirs and lakes
technology transfer
water quality



introduction

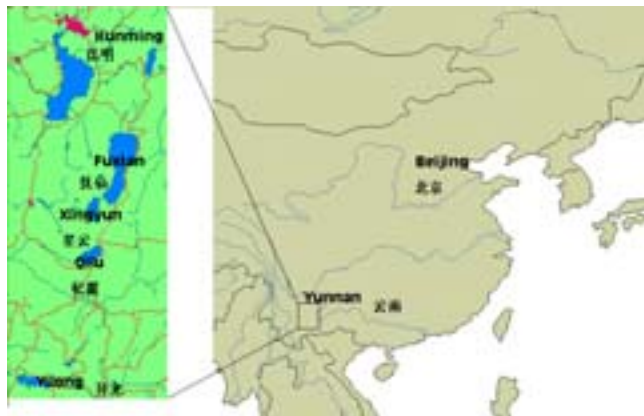
The South Yunnan Lakes, situated in the upper watershed of the Pearl River, are threatened by water pollution and by decrease of storage volume resulting in an increased risk of flooding and drought. The water pollution is caused by waste water discharged by industrial, urban and agricultural sectors. This leads to eutrophication of the lakes, seen in the high nutrient level and high productivity of water plants and algae.

Xingyun, Qilu and Yilong Lakes suffer from high concentrations of nitrogen and phosphorus, mainly caused by the lack of treatment of domestic waste water as well as intensive agriculture using high amounts of fertiliser. The eutrophication of these lakes has resulted in high levels of organic matter (Biological Oxygen Demand).

Fuxian Lake has a phosphorous problem in particular due to the phosphorus industry and agriculture.

The decrease in storage capacity of the lakes is caused by the accumulation of organic material resulting from eutrophication, siltation of eroded soil material and the reclamation of land for agricultural production. The erosion in the lake basins is a result of the collection of fuel wood and overgrazing by livestock.

The South Yunnan Lakes Integrated Environmental Master Planning Project aims to reverse this trend and improve the quality of life in the lake basins, setting an example for other lakes in the region.



Map showing the location of the project area

The water quality of Qilu and Yilong Lakes is currently worse than grade 5. Xingyun Lake water quality is grade 4. The water quality of these lakes is primarily determined by the concentration of organic compounds (BOD), nitrogen and phosphate. If no measures are taken, the water quality will continue to deteriorate. The objective of the present lake rehabilitation study is to guarantee grade 3 water quality for the year 2020 in these three lakes, ensuring the multiple purpose use of the three lakes.

The water quality of Fuxian Lake is currently very good and is generally grade 1. If no measures are taken, the water quality will have deteriorated to grade 3 in 2020, mainly because of the total phosphorus load from point- and non-point sources. For Fuxian Lake the primary objective is to protect the water quality and to assure the sustainable use of the water for future generations.

For the four lakes a number of strategies have been formulated to reach these objectives:

- Reduction of point- and non-point pollution, to protect and improve the current water quality.
- Flood protection.
- Reduction of water shortages and the improvement of irrigation management and infrastructure.
- Erosion prevention.
- Reduction of health impacts from pesticides, hazardous waste and bacteriological pollution.
- Institutional strengthening and awareness raising leading to an integrated approach for the management of the lakes.



Children bathing among water hyacinths

selection of measures

A list of potential measures has been made, based on discussions with the relevant authorities and experts. An evaluation process has been applied to select only the most effective measures.

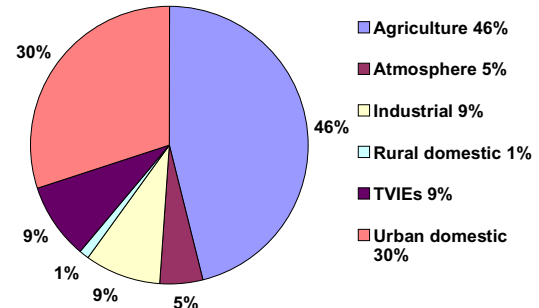
This evaluation has been done with the South Yunnan Lakes Decision Support System (DSS), and by ranking the measures in a Multiple Criteria Analysis (MCA).

The DSS comprises the application of sophisticated computer software to the specific situation of each lake. The aim of the DSS is to analyse the present situation with regard to the water balance, the waste loads and the water quality and to make projections for the future situation under different water management strategies. The impact of each individual measure on the lake water quality has been evaluated with the DSS.



Water is pumped from Yilong Lake for irrigation

The Multiple Criteria Analysis is the ranking of the impact of different measures to various criteria of sustainable development. These criteria are the lake water quality, flood protection, reduction of water shortages, erosion prevention, bio-diversity, public health, macro economic development and poverty alleviation. The criteria have been weighted in line with their relative importance to the development of the lake basins. The determination of the weighting factors is a political rather than technical question which has been answered for each lake separately during sessions held with the representatives of all involved Bureaux at the County level.



Breakdown of the phosphorous pollution by contributing sector in Qilu lake in 1996

The minimum package of measures needed to reach the water quality targets has been established by the application of the DSS. This was followed by the selection of a wider package of measures to satisfy the other criteria, based on the Multiple Criteria Analysis.

Basic design reports have been prepared for each of the selected measures, including the assessment of their technical, financial, economic and social feasibility and their environmental impact.

Pollution reduction should be implemented as much as possible at the source. Therefore it is necessary to increase general environmental awareness, specifically of the farmers to reduce the use of fertiliser and pesticides and of the consumers to reduce the use of phosphate containing detergents. Training of policy makers and Bureau staff will enhance their capacity and raise their environmental awareness.



Workshop with local decision makers about the weighting factors for the multiple criteria analysis

Lotus flowers on Yilong Lake



For all lakes, the construction of wastewater treatment plants and sewage systems for the urban areas is important, not only to improve the water quality, but also to reduce the risks to the public health. For the two most polluted lakes, Qilu and Yilong, the rural runoff should be treated in wetlands. The wetlands will be built in the lakes using material dredged from the lakes in order not to decrease their storage capacity.

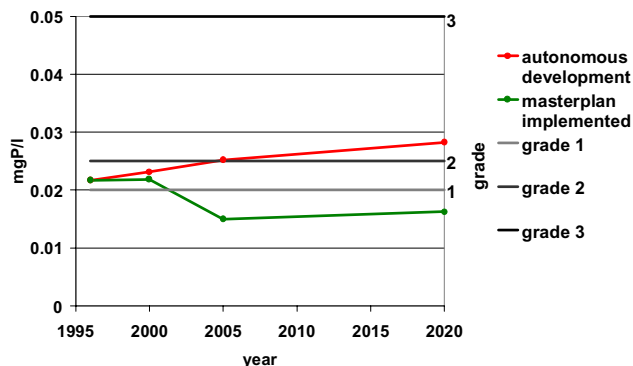
Erosion should be prevented in all lake basins by increasing the amount of dense forest, reducing grazing and improving agricultural practices.

For Qilu Lake the outlet capacity should be increased to prevent future flooding.

Three levels of project organisation are proposed to secure the proper implementation of the masterplans and their individual measures, being a Leading Group, Expert Groups and Project Implementation Units.

It is recommended that the overall implementation of the masterplan be coordinated and supervised by a Leading Group, which should be established at municipal (Fuxian Lake) or county level (other lakes). Its main functions would include the development of lake management policies (and legislation), the final review and approval of the masterplan and its individual measures and the overall monitoring of its implementation. The Expert Groups will take decisions on key project issues and give overall guidance on project implementation. The Project Implementation Units will be responsible for the day-to-day management of the project implementation and should be established in the office of the project owners.

The South Yunnan Lakes Integrated Environmental Master Planning Project will only be successful if the implementation of the proposed measures is started not later than the year 2001. The Yunnan Provincial Government is willing to allocate part of the funds needed for its implementation from its budget. In addition, assistance will be sought from bilateral, multilateral and commercial financing institutions to supplement the required funding. Availability of such external funding, together with the commitment of the Yunnan Provincial Government would be a good basis for the improvement of the environmental conditions in and around the South Yunnan Lakes.



Prediction of total phosphorus concentration (mgP/l) in Fuxian lake without (autonomous development) and with the master plan implemented.

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