ADB

Reviving Lakes and Wetlands

Lessons Learned from the People's Republic of China

WATER for ALL

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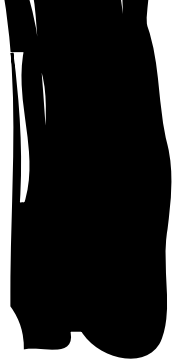


Foreword

Aquatic ecosystems in the People's Republic of China (PRC) are being destroyed by the combined effects of depletion, pollution, and engineering developments. Lakes and wetlands are especially at risk because of their relatively lower ability to absorb sudden change.

Over the last 15 years, the PRC Government has invested substantially in restoring lakes and wetlands, but the efforts have not been as successful as planned. In fact, restoration programs of lakes and wetlands have been especially problematic.

This publication assesses some recent experiences with lake and wetland restoration in the PRC and provides lessons learned. A recent Asian Development Bank (ADB)-financed comprehensive review of the high-profile restoration program of Tai Lake prompted this study.[1] It was also, in part, a result of the inspections of one reasonably successful lake restoration program—the West Lake Restoration Program in Hangzhou, Zhejiang Province. These two cases are compared with ADB's ongoing Sanjiang Plain Project and the Baiyangdian Lake Project.[2]

The lessons learned highlight the need to recognize the connected nature of all activities within a particular catchment, and clearly demonstrate that the problem is ecological rather than an engineering one. Each case has its unique combination of factors, but the analysis highlights four key elements for success: strong and consistent political leadership, integrated planning and analysis, effective management structures, and financial engineering.

This publication will convey the lessons of reviving lakes and wetlands in the PRC. It will contribute to a better understanding of the processes behind aquatic ecosystem deterioration and the restoration approaches to be taken so that integrated planning of water and land resources are reinforced, and the coordination among stakeholders are strengthened. The publication should prove useful to all those concerned with reviving the aquatic ecosystem in the PRC and in other countries.

Klaus Gerhaeusser
Director General
East Asia Department

[1] Asian Development Bank (ADB). 2004. *Technical Assistance to People's Republic of China (PRC) for Evaluation of Environmental Policy and Investment for the Water Pollution Control in the Huai River and Tai Lake Basins*. Manila.

[2] The project was approved by the Board of Directors of ADB on 24 June 2008.

Acknowledgments

This knowledge product highlights general lessons from recent experience with restoring lakes and wetlands in the People's Republic of China (PRC). Its creation was prompted by an urgent problem with algal bloom in Tai Lake in June 2007, which moved the Government to seek advice on how to address the situation. A simultaneous review of Asian Development Bank (ADB)-assisted projects in the Sanjiang Plain wetland and Baiyangdian Lake, and inspection of the West Lake restoration program in Zhejiang Province—one of the few lake restoration programs that can reasonably claim to have had some success—yielded insights that can prove crucial as the PRC's rapid economic development and urban sprawl continue to endanger lakes and wetlands.

By analyzing various lake and wetland recovery efforts in the PRC, this paper confirms that lakes and wetlands deteriorate for many complex and interrelated reasons and that a rehabilitation strategy, to be successful, needs to address all elements of the problem within the framework of the integrated ecosystem. This successful approach takes into account not only water resources but also the land as well, and it takes a greater effort to strengthen coordination both between sectors and jurisdictions.

Qingfeng Zhang (Task Manager), Yoshiaki Kobayashi, and Takafumi Kadono developed this product through initiating the concept, finalizing the report, and consulting with the stakeholders. Consultants Robert Crooks and Zhong Ma prepared the earlier draft and participated in the consultation meetings.

Kunhamboo Kannan provided the inspiration and support for this activity. Several reviewers in ADB offered valuable comments at different stages during the preparation of the report, including Wouter Lincklaen Arriens, KyeongAe Choe, Akmal Siddiq, Sergei Popov, and Zhiming Niu.

The report benefited from the close cooperation with the Ministry of Environmental Protection (then State Environmental Protection Administration), Ministry of Water Resources, Chinese Academy of Environmental Science, and Zhejiang Environmental Protection Bureau. The ADB team is particularly grateful to Xiaozhi Song, Wang Xin, Xie Yongming, Li Ge, Li Yuanyuan, and Zhang Cheng for coordinating the counterpart team from the PRC Government and closely working with the team.

The report also benefited from the multistakeholder consultative workshop conducted to gain feedback on the final draft, held on 23 June 2008 in Harbin, Heilongjiang province. About 90 participants from multilateral and bilateral development partners, government organizations, universities, and international nongovernment organizations attended and gave valuable feedback.

Melissa Alipalo, Ellen Pascua, Ma. Christina Dueñas, Ma. Priscila del Rosario, Josephine Lucero, and Rosario Soriano helped edit, design, and produce this report.

Currency Equivalents

(as of 15 October 2008)

Currency Unit	–	yuan (CNY)
CNY1.00	=	$0.146
$1.00	=	CNY6.83

Weights and Measures

cm	—	centimeter
ha	—	hectare
km	—	kilometer
km^2	—	square kilometer
m	—	meter
m^2	—	square meter
m^3	—	cubic meter
mg/l	—	milligrams per liter
1 mu	—	0.067 ha

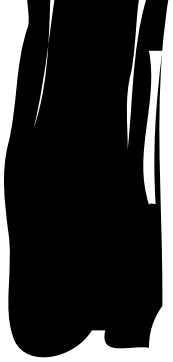
NOTE

In this report, "$" refers to US dollars.

Abbreviations

ADB	—	Asian Development Bank
BOD	—	biological oxygen demand
COD	—	chemical oxygen demand
EPA	—	Environmental Protection Agency
FYP	—	five-year plan
GDP	—	gross domestic product
GEF	—	Global Environment Facility
IRBM	—	integrated river basin management
MOC	—	Ministry of Construction
NH^3-N	—	ammonia nitrogen
NPS	—	nonpoint pollution source
PRC	—	People's Republic of China
SARS	—	severe acute respiratory syndrome
TN	—	total nitrogen
TP	—	total phosphorus
UNEP	—	United Nations Environment Programme
US	—	United States
WWTP	—	wastewater treatment plant

Executive Summary



Lakes and wetlands in the People's Republic of China (PRC), particularly in eastern parts of the country, are in a very poor condition. The Government is aware of the problem and has underwritten and/or encouraged lake and wetland restoration programs over the last 20 years or more. For the most part, these have been unsuccessful. The Government has sought assistance from its development partners, most notably the Asian Development Bank (ADB). ADB, for its part, has already supported one project (Sanjiang Plain Wetland Protection Project), and has prepared a second (Baiyangdian Integrated Ecosystem Management Project); other new projects[1] are now also being prepared.

This knowledge product assesses some recent experiences with restoring lakes and wetlands in the PRC and identifies general lessons. Its preparation was prompted partly by the recent completion of a comprehensive review of one of the country's highest profile lake restoration programs—the Tai Lake program, which was evaluated as part of an ADB-financed technical assistance[2]—and also by inspections of one of the reasonably successful lake restoration programs—the West Lake restoration program in Hangzhou, Zhejiang Province. These two cases are compared with ADB's ongoing Sanjiang Plain Project and the Baiyangdian Lake Project.

The PRC is confronted with a serious water crisis and imminent water shortages; combined with the serious degradation of the quality of available water resources, they are likely to affect economic development significantly and adversely in the coming years. The Government has long been aware of these growing problems. Over the last 10–15 years, it has substantially invested in and taken efforts to reverse these problems in particular areas, such as in some of the larger lakes (Tai and Dianchi Lakes) and rivers (Huai River).

The analysis confirms the widely accepted view among specialists that lakes and wetlands deteriorate for many complex and interrelated reasons and that a rehabilitation strategy, to be successful, needs to address all elements of the problem within the framework of the integrated ecosystem. This approach takes into account not only water resources but the land as well, and considers the greater effort needed to strengthen coordination between sectors and jurisdictions. Each case has its unique combination of factors, but this review suggests

This approach considers both land and water resources and the need to strengthen coordination between sectors and jurisdictions

[1] The Government of the PRC has recently requested ADB to support the Yancheng Wetland Protection Project and Jiaozhou Bay Wetland Protection Project.

[2] ADB. 2004. *Technical Assistance to People's Republic of China for Evaluation of Environmental Policy and Investment for the Water Pollution Control in the Huai River and Tai Lake Basins*. Manila.

that, as a minimum, four key elements need to be present for a successful rehabilitation.

Strong and consistent political leadership. These projects take time and resources for successful implementation and usually require effective cross-sectoral and cross-jurisdictional coordination. These conditions can only be met if political leaders who have the ability to encourage and, if necessary, require the cooperation essential for success are strongly involved. Leadership is particularly important to ensure that effective cooperation is achieved between different sectors, between different divisions of government (e.g., between counties, between counties and provinces, between provinces and the central government), by establishing relevant management structures and, if required, crafting the required laws and regulations.

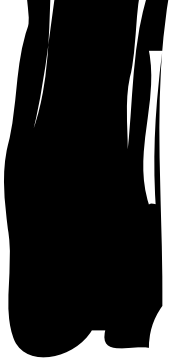
Integrated planning and analysis. Aquatic ecosystems usually collapse because of a complex array of factors operating over extended periods. Successful rehabilitation strategies are almost always grounded in a thorough understanding of all the relevant factors that have contributed to the problems and are designed not only to rectify the problems of the past but also to avoid their reemergence in the future. A truly comprehensive strategy also needs to take into account issues governing land use and management within the catchment as well as maintenance and operation. Successful plans recognize the need for a step-by-step approach that allows for sufficient time to make the fundamental changes necessary for success. Programs driven by 5-year planning constraints and short-term perspectives are rarely successful. Finally, programs that focus too much on "hardware" investments (engineering structures, etc.) at the expense of "software" modifications (changes in planning and management activities, protection and restoration of ecological systems) are also rarely successful.

Effective management structures. Comprehensive plans need a strong and effective management to ensure that implementation of all components of the plan proceeds at the correct time and sequence and, more important, the regulatory and institutional changes that are usually required as part of a comprehensive plan are also carried out. Catchment boundaries are rarely, if ever, the same as jurisdictional boundaries; and effective management structures take into particular account the need to ensure coordination across administrative boundaries.

Effective financial engineering. It is understood that adequate funding delivered timely is an essential element for any successful plan. However, it is even more important to ensure that all elements of the plan are sufficiently funded and, in the PRC context, must consider the revenue-raising capacity of the participating governments. Too many programs have failed because of the inability of lower-level governments to raise counterpart funds, or have been distorted because of the need for local governments to focus spending only on activities that create short- and medium-term revenue-raising possibilities.

Prior to finalizing this report, a multi-stakeholder consultative workshop was held on 23 June 2008 in Harbin, the capital of Heilongjiang Province and home to Sanjiang Plain. The workshop focused on key positive results from several site-specific studies and pilot projects, namely: (i) water charge into Zhalong wetland and water recharge into Baiyangdian Lake; (ii) payment of ecological services in Lashi Lake in Lijiang, Yunnan Province; (iii) alternative livelihood development in Dongting Lake in Hunan and Caohai Lake in Guizhou; and (iv) comanagement of Caohai Lake. Overall, the participants concurred that the four success factors presented in this document are essential to a successful rehabilitation.

Introduction



Aquatic ecosystem restoration is a pressing issue in the People's Republic of China (PRC). The Government is aware of the generally poor and still deteriorating condition of many of the country's aquatic systems and has been devoting substantial amounts of time, money, and effort to reverse the situation. The Government is also looking to its development partners, most notably the Asian Development Bank (ADB), for assistance, and ADB is responding positively.

One of the most intransigent aquatic rehabilitation challenges relates to lakes and wetlands. In contrast to rivers and streams, lakes and wetlands are more closed systems with a tendency to accumulate residues and involve a much closer and more dependent relationship between conditions in the aquatic system and activities within and the condition of the watershed.

Without much success, the PRC Government has supported, among others, three very high-profile lake restoration programs over the last 15 years (Chao Lake, Tai Lake, and Dianchi Lake). ADB is supporting two related projects—Sanjiang Plain Wetland Protection Project, which is under implementation, and Baiyangdian Integrated Ecosystem Management Project, which has been approved recently and, although much smaller in scale, promises to be no less challenging.

In light of the lackluster performance of lake restoration projects over the years, the operational question facing the Government and its development partners today is whether any lessons can be learned from these experiences and applied to current and future efforts. This report intends to address this question.

Three factors prompted the preparation of the report:

(i) Completion of an ADB-financed technical assistance (TA),[3] which has provided a wealth of technical detail on experience with the Tai Lake restoration program.

(ii) ADB's focus on knowledge production and sharing, which has provided a mechanism for producing short, analytical, and timely products that could contribute to the resolution of practical and operational problems associated with restoring lakes and wetlands.

(iii) Identifying one relatively small-scale exercise in lake restoration (West Lake Restoration in Hangzhou, Zhejiang Province) as one of the few programs of its kind in the PRC that has shown

Compared to rivers and streams, lakes and wetlands are more closed, interdependent systems

[3] ADB. 2004. *Technical Assistance to People's Republic of China for Evaluation of Environmental Policy and Investment for the Water Pollution Control in the Huai River and Tai Lake Basins*. Manila.

some encouraging signs of success and was thought to offer some instructive lessons.

The main report has five sections:

(i) Section 1: Introduction.
(ii) Section 2: Background on Issues.
(iii) Section 3: A Promising Case of Lake Rehabilitation in the West Lake, which looks at a case where a focused program of analysis and investment has led to the significant recovery of a seriously polluted lake ecosystem. The discussion identifies four key factors that were considered to account for the results achieved to date.
(iv) Section 4: Comparison with other projects, which compares the achievements of West Lake against three less promising rehabilitation programs in the PRC—Tai Lake, which has been under implementation for more than 10 years; Baiyangdian Lake, which has also been a focus of concern for many years and for which ADB has approved a lending project to support; and Sanjiang Plain, a major wetland protection project already under way with ADB cofinancing. Each project is discussed in light of the key lessons drawn from the West Lake experience.
(v) Section 5: Discussion and Conclusion.

Song Guojun, Renmin University of China

Tai Lake, February 2006

Endnotes and appendices provide further elaboration on the four projects discussed.

Background on Issues

After two decades of rapid economic growth, the PRC is faced with widespread degradation of its aquatic ecosystems. The nation is suffering from critical water shortages and chronic water pollution. Aquatic flora and fauna have been seriously degraded.

The most obvious manifestation of these problems are the water shortages that the PRC have been experiencing for several decades. Total naturally available water flows from all surface and underground sources are about 2,812 billion cubic meters (m^3) per annum, placing the PRC sixth in the world behind Brazil, Russian Federation, Canada, Indonesia, and the United States (US).[4] On a per capita basis, the naturally available water flow (2,206 m^3/person in 2004) is exceedingly low—one of the lowest levels in the world, accounting for 28% of the world average.[5] Therefore, it is inevitable that as population and wealth increase, serious water management problems will be encountered, which has been the case. The PRC's annual per capita water availability has dropped by 23% in the last 20 years, and it is expected to become the most water-stressed country in East and Southeast Asia by 2010.

At present, the PRC is using an average of about 44% of its available water—defined by the International Water Management Institute as "comfortable"[6]—but usage is expected to exceed 60% by 2020, which will place the entire country in the "environmentally overexploited" category. However, the national average disguises considerable variability between different geographical areas. Likewise, many aquatic ecosystems in northern PRC are already "environmentally overexploited." For example, in 2000, the Hai and Huai rivers had water use rates of 95% and 64%, respectively and, thus, were already environmentally overexploited. The Yellow River, with a water use rate of 53%, was approaching it.

Song Guojun, Renmin University of China

Sewage outlet of Li Town in Baiyangdian

[4] Shalizi, Z. 2006. Addressing China's Growing Water Shortages and Associated Social and Environmental Consequences. World Bank Policy Research Working Paper 3895. Washington, DC.

[5] Jiao Yong. 2005. *China Water Policy and Practice. Conference on Water and Sustainable Development: Towards Innovative Solutions*. New Delhi.

[6] The International Water Management Institute uses a four-part scale to classify countries' overall water use: (i) low exploitation (<20%); (ii) comfortable usage (20–59%); (iii) environmentally overexploited (60–100%); and (iv) mining (>100%). "Water use" is defined as the average annual consumption for all human activities plus water needs of aquatic ecosystems as a percentage of all naturally available surface and groundwater flows, excluding stocks and reserves in dams, lakes, and underground aquifers.

The combined effects of overuse, pollution, and water engineering developments are destroying aquatic resources in the PRC, of which lakes and wetlands are most vulnerable

Water shortages have been accompanied by significant increases in the incidence and severity of water pollution. Combined with the declining availability of base flows, rivers, streams, and lakes have seen a progressive increase in the quantity of wastewater discharged into them. The total volume of wastewater discharged in the PRC has been increasing since 1991, with about 54 billion tons in 2006. The water pollution problem has been growing for years, but it has taken a series of major accidents, including a major chemical spill in the Songhua River and persistent algal blooms in Tai Lake, among others, to attract serious attention by national policy makers.

The combined effects of overuse of water, water pollution, and water engineering developments are destroying aquatic ecosystems in the PRC, although, because of a lack of regular and systematic monitoring, it is difficult to quantify the effects. Most vulnerable among these aquatic systems are lakes and wetlands because of their lower assimilative capacity and vulnerability resulting from the adverse effects of sudden change, and it is on these systems that this report mainly focuses.

Given current projections of population and economic growth in the PRC, and without any change in how water resources and the natural systems associated with them are managed, the prospects are that the situation outlined above will worsen significantly in the foreseeable future. This reality is occupying the attention of technical experts and policy makers, and it is becoming clear that a much more comprehensive approach needs to be taken to the whole question of water systems management in the PRC. This more integrated approach would treat water systems as complete ecosystems, taking into account all factors affecting the physical, chemical, and biological characteristics of both the water system and its catchment, with the aim to create a long-term and sustainable balance between the maintenance of a stable and natural ecosystem and meeting human welfare needs. In the PRC context, this requires four types of integration:

(i) Integration of ecological concerns into the water system management to correct existing failures because of excessive focus on water resource management and pollution control;
(ii) Integration of concerned local governments into the management system to encourage coordination of efforts;
(iii) Integration of all concerned sectors and interest groups into the management system and for trans-provincial systems; and
(iv) Integration of the Government into the management system as the only institution capable of mediating disputes between provinces.

This approach is often called integrated river basin management (IRBM) when referring to the management of complete river systems, although the same principles can be applied to the management of water systems at all levels.

There is a broad and growing consensus among water management and environmental experts in the PRC

on the need to adopt a more integrated and comprehensive approach, particularly to the management of river basins. In 2004, the China Council for International Cooperation on the Environment and Development completed an important policy recommendation entitled Promoting Integrated River Basin Management and Restoring China's Living Rivers. Since then, the challenges associated with its adoption have been discussed in a wide variety of forums, including the Second Yangtze Forum in April 2007 and the Third International Yellow River Forum on Sustainable Water Resources Management and Delta Ecosystem Maintenance in October 2007.

A recent comprehensive review of progress in adopting the IRBM approach in the PRC[7] concluded that there has been considerable progress, but there is still a long way to go. The report set out detailed recommendations for medium- and long-term action in five main areas (i.e., legal and organizational reform, policy integration, IRBM master planning, public participation, and science and technology support), making it clear the IRBM strategy offers only limited hope of an immediate solution to the current crisis.

In the interim, and while the Government is acting on the wide-ranging reforms necessary to make IRBM a reality, there will likely be a continuation of the ad hoc or "emergency response" approach that has been a feature of aquatic restoration activities over the past 15 years. With regard to lakes and wetlands, these emergency responses have included programs in the "three lakes" (Chao Lake in Anhui Province, Dianchi Lake in Yunnan Province, Tai Lake in Jiangsu and Zhejiang Provinces) and are continuing with programs that are being planned for Baiyangdian Lake in Hebei Province and Sanjiang Plain Wetlands in Heilongjiang Province. Unfortunately, the great majority of these programs have been failures or, at best, only partial successes.

On the other hand, and as noted in the introduction, there have been some small if rather limited successes. One instructive example is the case of the rehabilitation of West Lake in Hangzhou Municipality, Zhejiang Province, which still offers the potential to learn valuable lessons from even if it is a special case given its relatively small size and its location within a single municipality.

. . . there will likely be a continuation of the ad hoc or "emergency" response approach that has been a feature of aquatic restoration activities over the past 15 years

[7] Y. Wang, L. Li, X. Wang, X. Yu, and Y. Wang. 2007. *Taking Stock of Integrated River Basin Management in China*. Beijing: Science Press.

3

A Promising Case of Lake Rehabilitation:

West Lake

Background

West Lake is located in the Westlake District of Hangzhou City, Zhejiang Province, and is one of the most famous scenic lakes in the PRC. The lake is highly valued as a recreational resource for the people of the city as well as visitors, but as the city grew rapidly during the 1980s and 1990s, the lake became badly polluted.

In recent decades, because of anthropogenic disturbance and climate change, the upstream flow has decreased and West Lake has begun to face water shortages. Since the 1950s, the water in the lake has been turning yellow, dark, and odorous; it has even dried up from time to time. In 2002, the water quality in the West Lake was worse than Class V[8] because of pollution from both point and non-point sources. The former included industrial enterprises and waste discharge from residential and tourist facilities, and the latter included runoff in the basin, fertilizers and pesticides applied in the agricultural areas, and pollution caused by the development of tourist spots. The main pollutants were organic materials plus nitrogen and phosphorous. Eutrophication in the lake was serious, and the water quality situation was exacerbated by water resource shortages (Appendix 1).

Efforts to improve the situation in the lake began as early as the 1950s when a series of major dredging operations were carried out, including the removal of 7 million m^3 of sludge, which deepened the lake from

[8] Overall water quality in the PRC assessed according to the worst indicators, i.e., if only one main indicator exceeds Class V, the overall water quality is classified as worse than Class V.

0.55 meters (m) to 1.8 m.[9] To solve the water shortage problem, Hangzhou City constructed a water diversion project in 1986. The water quality in the lake subsequently improved, although the situation was largely dependent on the quality of water in the supply source, the Qiantang River, which periodically was not good and was diverted untreated. Thus, the water diversion project on its own was insufficient to achieve the water quality and quantity objectives for West Lake. In 2003, two major water pretreatment plants, with a combined capacity of 0.4 million m^3 per day, were constructed to deal with the inflow water quality problem.[10] This significantly improved the situation, but since all the actions taken thus far were only treating the symptoms of the problem and not the underlying causes, the current situation does not pass as sustainable. The final gap in the strategy was filled when a wide range of other actions were taken to deal with the underlying causes, among them, controlling land use in the catchment of the lake; removing significant point sources of pollution (e.g., certain factories and even some households); strengthening compliance with pollution control regulations, reconstructing streams and wetlands, and controlling pollution from tourism developments in the catchment.

The overall principle applied in the restoration program was "protecting first, and prioritizing ecosystem conservation and sustainable development." The combined effect of the program was to improve water clarity in the lake and reduce eutrophication significantly.[11]

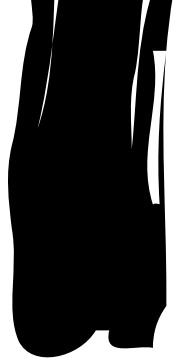
The program is still a work in progress. Not all monitoring locations in the lake have achieved the objective of Class III of National Water Quality Standards, although all monitoring stations are significantly improved over the levels being measured in 2002 before the major elements of the project were implemented (Appendix 1, Table A1.1). The ecological value of the lake has also significantly improved. The number of migratory birds visiting the lake has risen from 1,000 to more than 10,000, including 10 species such as wild duck and cormorant. In 2007, even rare species like swan and mandarin duck were seen in the lake.

[9] A second series of regular dredging occurred between 1976 and 1996, dredging around 0.2 million m^3. A third dredging in late 1999 (completed in 2000) dredged 2.8 million m^3.

[10] These two water pretreatment plants and associated pipelines were the most important components of the 2003 water allocation project for improving lake quality. After treatment began, the deepest water visibility increased to 1.2 m, and water diversion was no longer influenced by the water quality variation in the Qiantang River. Since 2004, the water diversion quantity has reached 120 million m^3 per year, refilling the West Lake monthly.

[11] Ammonia nitrogen (NH_3-N) dropped by 100% and total nitrogen (7N) dropped by 30%.

Some Key Features of Planning and Implementation



As mentioned previously, the example of West Lake has many factors unique to its particular situation, and its success so far is qualified rather than complete. Nevertheless, the experience has several success factors that, even as they set West Lake apart from other river restoration programs, can serve as inspiration and are potentially applicable to other situations.

Recognition from Decision Makers and Creation of an Effective Management Structure

West Lake has long been considered "the root and soul" of Hangzhou, and there was a high level of political interest in improving its quality. In November 2002, the Zhejiang Provincial Party Secretary, Xi Jinping, visited the lake for a briefing on the West Lake Integrated Protection Project. He maintained a high level of interest thereafter, which was backed by a similar level of support from the provincial governor, Lu Zushan. The provincial government and committee appropriated funds totaling CNY90 million to support the project, and the Provincial Development and Reform Committee successfully issued CNY15 million in treasury bonds.

Financial support was backed by a wide range of legislative developments to strengthen management arrangements and institutionalize the development plan. Management was strengthened by creating the Hangzhou West Lake Scenic Area Management Committee[12] in 2000, which was accountable to the municipal government and responsible for comprehensive protection, management, planning, and construction of the West Lake scenic area. Thus, a wholly new institution was created and regarded as a historic breakthrough in the area's resource management system. The committee's legal responsibilities were comprehensive. It was responsible for the following:

(i) making the scenic area's economic and social development plans in accordance with the general plan and the economic

[12] The committee, whose legal status and administrative functions were established in the form of local regulations, was equipped with planning, finance, personnel, environmental protection, construction, land management, and other sectors. The committee will participate in protecting, planning, and constructing the extended protection zones that the local district government will manage. The local ordinance requires the relevant administrative departments or branches of other departments to continue their mandates as usual but to coordinate with the committee to protect the scenic area. The ordinance also called for establishing the scenic area protection and management supervision and inspection system, which is to be organized by the Hangzhou City government.

Ma Zhong, Renmin University of China

West Lake wastewater treatment by artificial wetland

and social development plan of Hangzhou, and to implement them after approval;

(ii) protecting and managing the scenic area's natural environment and resources in terms of laws, regulations, and ordinances for protecting and managing the scenic area;

(iii) planning and managing land, real estate, and construction in the scenic area;

(iv) environmental protection, municipal amenities, sanitation, forestry administration, landscape, heritage, and water resource protection in the scenic area;

(v) finance, statistics, audit, prices, personnel, labor, social security, and financial accounting oversight, and managing government-owned assets and assisting tax collection in the scenic area;

(vi) ensuring cooperation and coordination with the branches of the relevant administrative departments dispatched to the scenic area for working;

(vii) implementing other responsibilities required by the municipal government or the relevant administrative departments; and

(viii) participating in the protection, planning, and construction within the extended protection zones (outside but adjacent to the central planning zone), although these areas would continue to be managed by the relevant local district governments.

The Hangzhou City government also organized relevant departments to inspect the protection and management of the scenic areas regularly and report to the Standing Committee of the Municipal People's Congress.

Comprehensive Planning

The West Lake Scenic Area Management Committee drafted the original development plan, but it went through a comprehensive review process by relevant agencies, including state-level agencies such as the Ministry of Construction, Ministry of Land and Resources, State Forestry Administration, National Tourism Administration, State Administration of Cultural Heritage, and others. The overall process, culminating in the State Council's approval, took nearly 3 years, yet it ensured that the plan was comprehensive and took into account the technical advice from a wide range of perspectives, including engineering and cultural aspects.

The plan covered not only the measures required to solve the water pollution problem but also aspects of cultural and tourism development. The overall objective of the plan was to achieve a balance among social, environmental, and economic benefits to enhance environmental protection, conform to biodiversity rules, and reduce the need for artificial interventions to maintain environmental quality. The plan was based on a long-term planning horizon: a short term of 2002–2010, a medium term of 2011–2020, and the long term (beyond 2021). The plan defined a wide range of quantitative measures that reached beyond the normal environmental goals (water quality, air quality, etc.). For example, the plan included target capacities for open spaces, visitors, residents (village and city), and buildings.

Finally, the plan did not focus solely on the lake and the associated hydrological system; it addressed the entire ecosystem found to influence the lake, as well as that which will be affected by the lake. This extended area was designated as the "landscape for 10 miles around lake." The plan identified activities to be carried out within this landscape, such as demolishing buildings that have been built illegally or were disfiguring the landscape and had no preservative value, relocating some residents (2,600 households were relocated, reducing the population in the catchment by 7,300), and creating new public green spaces (Appendix 1).

Consulting locals as part of planning

Funding

During the implementation of the 10th Five-Year Plan (FYP), 2001–2005, CNY3.73 billion was invested in the program.[13] More importantly, funding was provided for all key aspects of the plan (Appendix 1, Table A1.2) and the budgeted funds were actually disbursed according to the plan. One of the most interesting financial aspects of the project was the decision to eliminate all entrance fees to the park, associated viewing spots, and scenic areas, which is exactly the opposite of strategies usually adopted by local governments to recover the costs of public works. This was partly

[13] www.hangzhou.com.cn/20070515/ca1312943.htm; www.hznet.gov.cn/hzdpc/0401/6144.htm.

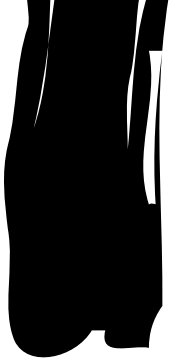
Elimination of all entrance fees to the park and associated viewing spots and scenic areas paid off

caused by the government's strategy of "giving the lake back to the people" but also because the government believed that by eliminating entrance fees, more visitors would be attracted and more willing to spend money and likely a larger amount on shopping, accommodations, and sightseeing, which would increase the government's revenues indirectly.

An economic assessment by the government showed that this strategy of waiving entrance fees paid off. Before this new policy was implemented, ticket sales at parks along West Lake grossed about CNY26 million per annum in revenues. Under the new policy, costs for park security and cleaning increased; and the combined cost of lost ticket revenue plus higher security and cleaning costs amounted to CNY60 million per annum. However, this was offset by increased business opportunities and indirect economic benefits. A greater volume of tourists increased demands for hotels, restaurants, shopping malls, transportation, and other services, all of which support and benefit tourism development of the towns nearby. In 2005, all indicators for Hangzhou tourism reached new records. In comparison with 2001, the number of foreign tourists increased by 85%, reaching 1.5 million; and the number of domestic tourists increased by 27%, reaching 32 million. The tourism income increased by 86% and reached CNY46.5 billion.[14]

[14] *China Youth Daily*. 2006. Economic Significance of the Immense Fishnet in Hangzhou West Lake. 14 February.

Conclusion: Four Success Factors



The success of the West Lake project can be attributed to four important factors:

(i) **Strong and consistent political leadership.** There was a high level of awareness among senior political leaders on the significance of the problems being encountered, which led to support for the comprehensive plan that continued throughout the implementation period.

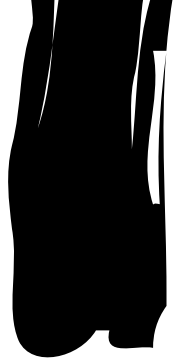
(ii) **Integrated planning and analysis.** Through many years of experience during earlier efforts to clean up the lake and from engineering and scientific analysis, a clear understanding of all the factors contributing to the problem, not only within the water system itself but also in the surrounding catchment, was developed; and all relevant aspects were eventually incorporated into the plan.

(iii) **Effective management structure was adopted.** A strong management structure was created that clarified responsibility for planning and implementation, provided management control over all participating units, and provided a clear accountability framework.

(iv) **Comprehensive investment plan covered all aspects of the problem.** Adequate funding was provided for all aspects of the plan and, perhaps even more importantly, all aspects of the investment program were carried out in accordance with the plan, due in large part to the effective management structure that was created.

Further information about additional administrative measures taken for the West Lake project is available in Appendix 1.

4 Comparison with Other Projects

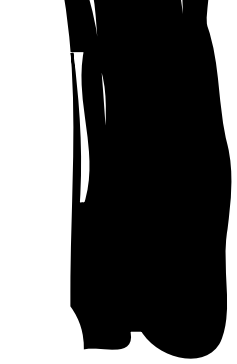


Introduction

When considering the experiences of other aquatic ecosystem restoration programs in the PRC, their past inability to achieve successful results from rehabilitation projects can be associated with a failure to accomplish one or more of the four success factors summarized for the West Lake project. To illustrate this point, this study examined three projects that have undergone failed attempts at rehabilitation and are undergoing new efforts with ADB's help.

First is Tai Lake, which has been one of the highest-profile lake restoration programs undertaken in the PRC. Tai Lake has been the subject of detailed analysis under a recently completed ADB-financed TA study. Second is the Sanjiang Plain Wetland Protection Project, an ADB-cofinanced rehabilitation project that has commenced implementation and already offers some practical lessons learned. Third is the Baiyangdian Lake Environmental Protection Plan, for which ADB recently approved a lending project.[15]

[15] ADB. 2008. *Integrated Ecosystem and Water Resources Management in the Baiyangdian Basin*. June.



Tai Lake

With a surface area of around 2,400 square kilometers (km^2),[16] Tai Lake is the third largest freshwater lake in the PRC. Its catchment is located in three provinces (Jiangsu, Zhejiang, and Anhui) and a provincial level municipality (Shanghai).[17] The catchment is very heavily populated (average population density in 2000 was 1,137 persons/km^2) and very highly developed in economic terms (in the year 2000, the gross domestic product [GDP] generated per unit area of the catchment was CNY29.1 million/km^2).

Tai Lake has suffered various effects of development over the past 50 years, beginning as early as the 1960s (see Appendix 2, Table A2.1 for percentages of samples from Tai Lake in various water quality classes). It has lost many, if not most, of its endemic fish species because of water resource developments, foreshore conversion, and overfishing. This culminated in severely deteriorated water quality during the late 1990s, which led to the implementation of large cleanup programs during the 9th and 10th FYPs and continued into the current planning period. In general, these programs have not achieved their objectives[18] (see Appendix 2, Table A2.3 for a summary of Tai Lake rehabilitation investments proposed under the 10th FYP).

The remainder of this section assesses the characteristics of the Tai Lake program against the four factors leading to the success of the West Lake program.

Political Leadership

Political leadership on restoring Tai Lake has been very high and consistent throughout the planning periods, resulting in significant planned funds—CNY34.95 billion (CNY12.95 billion during the ninth FYP, mainly for industrial and domestic point source water pollution control, pollution control at lakeside facilities, demonstration projects, and management and capacity development. This amount was followed by CNY22.00 billion during the 10th FYP—an increase of nearly 60%).

Whether total funding planned under the 9th and 10th FYPs was adequate to solve the problem is speculative, but undoubtedly, the level of funding was substantial. On the other hand, the application of funds was considerably less than proposed. By the end of the 10th FYP, only 74% of the total (CNY26.00 billion) had actually been disbursed—a substantial gap between the planned expenditures and what was actually spent on the ground (Appendix 2, Table A2.2).

[16] Figures ranging from 2,250 km^2 to 2,400 km^2 are quoted in various sources. The largest lake in the PRC is Poyang Lake followed by Dongting Lake.

[17] Its most notable features from a pollution management point of view are the very large catchment area (36,500 km^2), the large ratio between the area of the catchment and the surface area of the lake (15.21), the lake's shallowness (1.9 m on average with a maximum of only about 2.5 m), the high ratio between the surface area of the catchment and the volume of the lake (564.6 km^2/cubic kilometer [km^3]), and the lake's relatively short residence time (<0.8 years—figures for the Great Lakes on the border of the United States and Canada range from 1.9 years for Lake Superior to 2.6 years for Lake Erie).

[18] A lack of comprehensive control is adversely affecting certain hydraulic measures that have been considered to improve water quality in Tai Lake through the "Coordinated Water Quality and Quantity Operation." This operation would direct Yangtze River water into Tai Lake via the Wangyu River to accelerate water flow into and through Tai Lake, increasing the rate at which water flows through the lake and thus reducing residence time. However, the declining quality of water from the Yangtze River may be affecting the utility of this concept since it is increasing sedimentation in Tai Lake, and its tributaries and pollution discharges into the Wangyu River may be adversely affecting the quality of the flushing water.

Integrated Planning and Analysis

The problem of Tai Lake has been the subject of many comprehensive planning studies and investment programs over the years, particularly during the 10th FYP. The studies have considered a wide range of possible factors behind the problem of failed clean-ups. For example, the programs under both the 9th and 10th FYPs included investments in point source pollution control (both industrial and municipal), in-lake ecosystem rehabilitation, dredging to control eutrophication sourced within the lake, nonpoint source control, water resource management, and management and capacity development. The program under the 10th FYP was particularly notable for the breadth of interventions planned (see Appendix 2, Table A2.3 for the summary of Tai Lake rehabilitation investments proposed under the 10th FYP).

Despite the breadth of the investment plan, the restoration plan itself has been deficient in two major respects:

(i) The plan was too static and insufficiently forward looking. It took inadequate account of the deleterious effects of continued economic and population growth. Unlike the West Lake plan, the Tai Lake plan included no measures to contain or restrict economic and urban growth within the catchment during either of the planning periods.

(ii) Similarly, and although the plan included substantial funds for nonpoint source (NPS) pollution control, no measures were included to control the growth of livestock numbers during the planning periods, outweighing some success achieved in restricting the growth of in-lake aquaculture activities (see Appendix 2, Table A.2.6. for estimated quantities of total nitrogen and total phosphorus from NPS pollution in the Tai Lake Basin).

Jin Shuqin, Renmin University of China

Tai Lake, August 2007

Effective Management Structure

A notable obstacle to all progress in reversing water pollution trends in the Tai Lake Basin has been the lack of effective control over land use in the catchment, partly because of the large number of jurisdictions governing the management of different parts of the catchment.[19]

Ineffective control has led to rapid and significant increases in the urban population within the catchment and of urban wastewater flows. The large investment programs under the 9th and 10th FYPs provided a significant increase in municipal wastewater treatment capacity throughout the Tai Lake catchment, but lack of coordinated expenditure resulted in underinvestment in drainage systems, resulting in many treatment plants in

[19] The catchment falls within three different provinces, one provincial level municipality, seven prefecture level cities (four in Jiangsu and three in Zhejiang), and 30 county-level cities.

Unlike the West Lake plan, the Tai Lake plan included no measures to contain the growth within the catchment

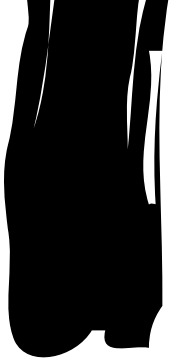
the basin operating significantly below their design capacity (see Appendix 2, Table A.2.4 for municipal wastewater treatment plant ratios).

In the industrial sector, significant advances in wastewater discharge compliance rates are far more variable than they should be, especially because of the critical water pollution in Tai Lake and its national significance. A stronger and more integrated management structure is needed, such as a lake basin management authority. This kind of a body may have provided more steady, effective, sustainable compliance rates if it was structured to gain the concurrence of all relevant levels of government (especially provincial and municipal) and if it was given the right degree of enforcement authority (see Appendix 2, Table A.2.5 for compliance rates on industrial chemical oxygen discharge).

Comprehensive Investment Plan Covering All Aspects of the Problem

During the ninth FYP, the main disbursement problem was the slow construction of the wastewater treatment plants. By the end of the planning period in Zhejiang Province, only three of 28 planned treatment plants had been completed and total expenditure on all components of the plan was only 77% (CNY10 billion) of planned expenditure. The most significant under-expenditures were for activities such as ecosystem rehabilitation, dredging, NPS control, and water resource protection, which are all activities that have no revenue-earning potential for repaying loans and other financial obligations incurred from implementing the planned activities. This highlights a recurring problem that undermines successful implementation of all such plans—too much financial obligation is placed on provincial and lower levels of government, which, under the PRC fiscal system, have very little potential to generate revenues and finance investments, particularly for local government infrastructure that cannot generate cash returns in the short term to repay financial obligations.

Baiyangdian Lake



Baiyangdian Lake in Hebei Province is the largest remaining semi-closed freshwater body in northern PRC. The lake and most of its watershed are located entirely within Baoding Municipality.[20]

The open water and aquatic beds of the lake serve as spawning grounds and feeding habitats for a diverse array of fish and other animal species. The lake is also a globally important resting site for migratory birds on the East Asian—Australasian flyway. Baiyangdian Lake has economic importance, especially for more than 200,000 people living within its wetlands and peripheral zones, as the lake resources provide them with (i) livelihood opportunities (i.e., freshwater fishery, reed production, and tourism-related jobs and businesses); (ii) water for drinking and irrigation; and (iii) major transportation routes. Furthermore, the lake regulates floodwater and moderates the microclimate of the surrounding areas. In the last four decades, the functions and values of the basin and the lake itself have been eroding, with adverse affects on its ecosystem. Construction of large reservoirs upstream of the lake have seriously reduced inflows, with water demands in the Daqing River having risen rapidly and now exceeding supply, resulting in an increase in the incidence of "no" or "low" inflows to the lake.[21] The size of the lake has decreased by almost half because of reduced inflows, more frequent droughts, and increased sedimentation because of increased soil erosion in the catchment. The decreasing inflow of water and the increasing discharge of pollutants over the past 40 years have reduced the lake's water quality from Class III to Class V—and even worse in some areas—resulting in the loss of biodiversity and livelihood (see Appendix 3, Table A3.1 on the present water quality of Baiyangdian Lake).

The Baoding municipal government has recognized these problems and has prepared a comprehensive plan to reverse the situation. Implementation of the plan has not yet commenced. The purpose of the following discussion is to review the planning proposals in light of the West Lake experience in Zhejiang Province and see what lessons can be learned.

Political Leadership

Awareness of the declining water quality situation in Baiyangdian Lake dates as far back as the 1970s. Since then, the Government has repeatedly issued instructions for a thorough solution to be worked out for the problem, although these instructions were not backed up by any decisive action from the central level. Despite the long-standing high level of political awareness, it was not until 2005 that the Hebei provincial government and Baoding municipal government announced that a comprehensive plan to address the problem had been developed.

[20] The Baiyangdian Lake in Hebei Province, with a surface area of 366 km^2, is the largest remaining semi-closed freshwater body in northern PRC. It lies in the middle reaches of the Daqing River basin and ultimately discharges into the Bohai Gulf of the Yellow Sea. Baiyangdian Lake and most of its watershed, totaling 31,500 m^2, are located entirely within Baoding Municipality.

[21] Moreover, rising population, expanded agricultural and industrial activities, limited solid waste and wastewater disposal measures in the watershed and within the lake, plus deforestation of the watershed have transformed the lake into a major depository of wastewater discharges, solid wastes, and sediments.

Dead fish as one of the manifestations of pollution in the lake

Integrated Planning and Analysis

Planning and investments in the lake's problems have often preceded—to their detriment—the many comprehensive studies accomplished about the lake's problems. The early political awareness of the problem eventually led to the commissioning of many studies[22] and official inspections by government leaders at various levels. These could have provided a good basis for developing and implementing a comprehensive solution. In most cases though, they were not accomplished until after many projects had already been attempted, and failed. As early as the 1970s,[23] industrial pollution control and prevention projects were initiated with the support of the Government. However, these only addressed part of the problem and not much was done to deal with (i) other pollution sources, particularly domestic wastewater; (ii) irrational and unsustainable aquatic farming in the lake itself; and (iii) overall socio-economic development in the lake basin and surroundings.

Weak institutions, inadequate capacity of the local government, and poor planning in the use and allocation of the lake's water resources were behind the degradation. This was aggravated by gaps and overlaps in the roles of government agencies at the provincial and municipal levels on water use and allocation driven by single-sector approaches. Also, as economic growth became the primary goal of local governments, environmental protection laws and regulations were not adequately enforced. The provincial and Baoding municipal governments now recognize that a more holistic approach needs to be adopted. An integrated plan to be implemented over a 10-year period has been developed, requiring an investment of CNY8 billion (about $991 million). The plan involves both pollution control activities and an ecosystem rehabilitation component that addresses

[22] Important studies included detailed investigations on environmental pollution in the area conducted in the 1970s by the Shijiazhuang Institute of Geography of Hebei Province and the Institute of Zoology of the Chinese Academy of Sciences, followed by studies in the 1990s by the same two organizations on the structure, function, environmental effects, and prospects for future development of the lake ecosystem.

[23] Starting in the 1970s, the Hebei provincial government, with the support of the central Government, initiated 53 control and prevention projects; at the beginning of 1992, the two biggest paper mills in the catchment were forced to suspend production or change their product line to reduce pollution emissions. At the same time, two industrial wastewater treatment plants with a combined capacity of 8,000 tons per day were constructed or under construction to lay a sound foundation for water pollution control and prevention in Baiyangdian Lake.

environmental degradation of both the lake and its watershed.[24]

Effective Management Structure

The executing agency of the proposed ADB-supported project to implement the new comprehensive plan will be the Baoding Development and Reform Commission, where a central project management office will be established. Project implementation units will also be established in each county government to provide oversight of the projects to be implemented within the county.

This approach may be adequate for managing and coordinating the implementation of the individual project components, but it will not be able to provide the long-term and comprehensive basin management operation necessary to ensure that future growth and development of the lake and its catchment do not lead to problems. A short-term solution might be to establish a leading group of senior officials from all relevant departments, but a better solution would be to establish an agency with a high level of control over future developments in the catchment that would work with relevant departments to define development standards for all activities in the catchment.

Comprehensive Investment Plan Covering All Aspects of the Problem

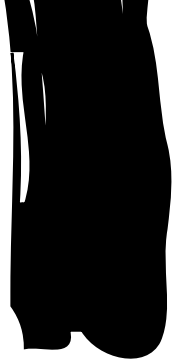
The comprehensive plan calls for 27 new wastewater treatment plants in the watershed to treat all urban sewage in Baoding City and about 60% in the 22 counties by 2010 (see Appendix 3, Table A3.2 for a summary of the investment plan's capital outlay). The plan also calls for a comprehensive range of other actions, including rehabilitating the Baiyangdian Lake Wetland Reserve, improving the disposal of fly ash from thermal power plants in the catchment, promoting clean energy by developing geothermal resources, reducing the number of people without access to safe drinking water, and reversing the environmental degradation of Baiyangdian Lake and its watershed.

Despite the comprehensive range of activities proposed, some gaps remain—most notable is the lack of plan to deal with the problem of "in-lake" pollution, such as the domestic wastewater emissions from about 100,000 people whose houses are located in the lake or right on the waterfront.

Finally, some components of the plan—most notably a proposal to supplement inflows to Baiyangdian Lake by constructing a water transfer system—may not be the optimum solution. The feasibility of other options has not been considered adequately, such as changing water release rules for dams in the upper parts of the catchment or introducing water savings programs for industrial and irrigation water.[25]

[24] The comprehensive plan has two parts. The first part requires constructing 27 wastewater treatment plants in the watershed to treat all urban sewage in Baoding City and about 60% in the 22 counties by 2010 along with a comprehensive range of other actions. Such other actions include (i) rehabilitating the Baiyangdian Lake Wetland Reserve; (ii) improving disposal of fly ash from thermal power plants in the catchment; (iii) promoting clean energy by developing geothermal resources, and (iv) reducing the number of people without access to safe drinking water. The second part of the plan is intended to reduce by 8% the chemical oxygen demand from the 2000 level and improve lake water quality to Class III. The associated Baiyangdian Ecosystem Rehabilitation Master Plan (2005–2015) specifically addresses environmental degradation and calls for an integrated approach with a planned investment of over $1.0 billion. It comprises 17 projects in Phase 1 (2005–2009) and 7 projects in Phase 2 (2010–2015).

[25] The 5-Year Environmental Protection Plan and Baiyangdian Ecosystem Rehabilitation Master Plan (BERMP) are just getting started. Whether the required financing will be secured remains to be seen, although early indications show the program is underfinanced and that there will be either delays or certain components will not be implemented at all. Securing the financing has been problematic because (i) BERMP has not been endorsed and approved by the National Development and Reform Commission, and thus, is being approached on a project rather than on a program basis; and (ii) some participating counties are having difficulty providing the counterpart funds.



Sanjiang Plain

The Sanjiang Plain contains the largest area of wetlands in the PRC, yet the wetlands have receded by more than 80% in 50 years (see Appendix 4, Table A4.1 for estimates on the decline in wetland area since the founding of the PRC). The Sanjiang Plain is located in the northeastern corner of the PRC with a total area of 108,900 km. The wetlands are considered globally important and represent one of the most important breeding sites and migratory routes for water fowl in northeastern Asia. They are significant for the number and variety of globally threatened waterfowl species. Since the 1950s, the Sanjiang Plain has been a major area for extensive agricultural development, which has resulted in a considerable loss of wetlands. In 1950, wetlands covered 5.34 million hectares (ha), or nearly half of the Sanjiang Plain. By 2000, the area had been reduced to only 0.89 million ha, or only about 8% of the Sanjiang Plain.

To protect the wetlands, the Sanjiang Plain Wetlands Protection Project (SPWPP), cosponsored by the Heilongjiang provincial government, ADB, and Global Environment Facility (GEF), started in March 2007. This 5-year project is expected to cost $55 million. The project aims to (i) protect the natural resources of the Sanjiang plain wetlands and the watersheds from continued threats, (ii) promote the sustainable use of natural resources through integrated conservation planning, and (iii) improve the well-being of inhabitants in local communities.

As is the case with the Baiyangdian Lake project, the Sanjiang project is still at an early stage and it is too soon to determine whether the plan would be successful. But valuable experience has already been gained and it is possible to draw some lessons regarding its overall contributions toward improving the management of wetlands. (see Appendix 4 for a brief discussion of preliminary discussions).

Political Leadership

There has been a high level of political involvement and leadership on issues facing the Sanjiang Plain over a long period:

(i) 1992 – The PRC ratified the Ramsar Convention.[26]

(ii) 1992 – The PRC's Agenda 21 identified the wetlands as a special land resource and habitat, and put forward objectives and requirements for wetland conservation and rational use.

(iii) 1994 – The PRC's Biodiversity Action Plan identified biodiversity conservation in the Sanjiang wetlands as the highest priority by ranking Honghe National Nature Reserve in the Sanjiang Plain as a Category A-I (international importance or significance, Grade 1).

(iv) 1995 – The Committee of Environmental and Resources Protection of the National People's Congress released an official document requiring the central and local governments to protect the wetlands in Sanjiang Plain.

(v) 1996 – In a report to the State Council, the Ministry of Agriculture stressed the importance of coordinating wetland conservation and agricultural development in the Sanjiang Plain.

(vi) 1998 – Heilongjiang provincial government issued a decision

[26] By 2005, 26 natural reserves were established in the Sanjiang Plain with a total area of over 1 million ha, of which three are listed under the Ramsar Convention as globally important wetlands.

ADB Photo Library

Sanjiang Plain

to suspend any kind of wetland development in the province.

(vii) 2000 – The State Council approved Heilongjiang Province as the Demonstrative Ecological Province.

(viii) 2006 – The national 11th FYP specified the Sanjiang Plain as the national wetlands ecological zone and limited agricultural and urban development in this area.

Despite this high level of political interest, degradation of the wetland ecosystem in the Sanjiang Plain has continued. During the initial implementation period, the SPWPP has identified various threats unknown previously. Further, it noted that some contradictory policies relevant to wetland management make the SPWPP difficult to generate conducive outputs (Appendix 4).

Integrated Planning and Analysis

A considerable number of background researches—supported both by the Government and international organization[27]—on sustainable land use strategies for the Sanjiang Plain had been carried out, but very few dealt with all aspects affecting the wetlands in a comprehensive manner. Subsequently, two key issues have been emerging at this stage of the SPWPP, i.e., conflicting uses of water resources[28] and water pollution. Field monitoring activities included in the SPWPP have revealed that the water quality is quite poor in Qixinghe National Nature Reserve—one of the most well-preserved wetlands in the Sanjiang Plain (frequently class II, IV, V, and even V+ for certain parameters). This result has been quite surprising because the national standard prescribes class I for national level nature reserves. The main sources of the problems are from upstream activities, such as coal mines, gold mines, and NPS in the surrounding area, while the main concern at the downstream wetlands were for restoring adequate level of water quantity for ecosystem. Integrated and comprehensive perspectives are

[27] These include (i) the Sustainable Land Use and Allocation Program for the Ussuri/Wusuli River Watershed Project (1995, funded by the United States (US) Agency for International Development and the US National Committee on US–PRC Relations); (ii) a $12 million United Nations Development Programme/Global Environment Facility (GEF) Project (2001–2006), which produced a review of Sanjiang Plain biodiversity and the protected areas system; (iii) the United Nations Environment Programme (UNEP)/GEF Amur River Basin Trans-boundary Cooperation Project, which is focusing on pollution along the Amur–Heilong River; and (iv) the UNEP/GEF Siberian Crane Project.

[28] These conflicts include (i) water use in the Sanjiang plain is determined largely by agricultural development; (ii) the water flow in Sanjiang plain has been more and more controlled by engineering works, including reservoirs, drainage, and diversions; (iii) a proposal of diverting large-scale water from Sanjiang plain to support the State Council's Promotion Plan of Northeast Industrial Base accepted contrary to conservation plans (Appendix 4).

needed in planning and analyzing wetlands management issues.

Effective Management Structure

The SPWPP was designed to promote institutional coordination, and has identified three underlying bottlenecks which may prevent truly sustainable management of the wetlands:

(i) The boundaries of natural reserves are usually determined by jurisdictional borders instead of watershed boundaries. This often results in conflicts instead of cooperation. One typical case is the upstream water users' dam construction, aiming for irrigation without considering the effects on the water supply to the downstream nature reserves. The extent and scope of water balance in a watershed area should be taken into account for wetlands management.

(ii) Water use, water pollution control, nature reserve management, and water ecosystem conservation are run by different agencies. Coordination among and across multi-sectoral stakeholders needs to be significantly strengthened for wetlands management.

(iii) Regional economic development planning should incorporate wetlands management issues as integral part of its planning factors, and should take into account the potential impacts of social, economic, and emerging urban development on wetlands habitat in the watershed areas.

PRC Loan 2157

Mission for Sanjiang Plain Wetlands Protection Project

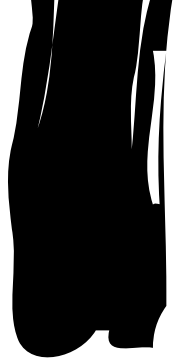
Comprehensive Investment Plan Covering All Aspects of the Problem

Monitoring activities are uncovering water pollution as critical threats to wetlands habitat. However, the current SPWPP fund is limited to deal with restoring nature reserve in the wetland largely, but not for dealing with water pollution sources from the upstream, beyond the current project area. The proposed investment program (equivalent to $55 million over 5 years) will obviously not be sufficient to meet all the protection needs of the Sanjiang Plain wetlands, given over 50 years of accumulated problems and huge geographical coverage. Regional economic development plan should integrate planning and management of the Sanjiang Plain, including the nature reserves, as a complete ecological system. Subsequently, a regional economic and investment plan requires attention to cover multi-sectoral coordination, with a longer time horizon to restore natural habitat. The long-term security of the remaining wetland areas is vulnerable, until these requirements are met.

Sanjiang Plain at dusk

ADB Photo Library

5 Discussion and Conclusion



Discussion and Conclusion

The country is facing a serious water crisis and imminent water shortages combined with serious degradation of the quality of available water will likely affect the cost of economic development significantly and adversely in the coming years. The Government has long been aware of these growing problems and, over the last 10 or 15 years, has invested substantially to reverse these problems in particular areas, such as some of the larger lakes and rivers (Tai and Dianchi Lakes and the Huai River).

Overall, these efforts have not been as successful as planned, and programs for restoring lakes and wetlands have been particularly problematic. Nevertheless, there have also been a small number of encouraging successes, such as the West Lake in Hangzhou Municipality, Zhejiang Province. The West Lake experience—although it has certain unique characteristics—shows clearly that aquatic ecosystems deteriorate for many complex and interrelated reasons and that a rehabilitation strategy, to be successful, needs to address all elements of the problem within the framework of the total ecosystem. The successful approach takes into account not only the water resource and uses but the land as well, and makes greater efforts to strengthen coordination between sectors and between jurisdictions. The comprehensive approach includes a combination of (i) preventive measures (planning and development restrictions, much better environmental impact assessment); (ii) regulatory measures (control of pollution sources); and (iii) rehabilitation measures (ecosystem restoration, etc.).

Other cases, particularly Tai Lake, show that the Government is capable of mobilizing all the necessary resources to tackle complex problems, but success is frequently compromised by the failure to apply a comprehensive, integrative framework.

A close study of the West Lake experience shows that four key elements are required if success is to be realized in aquatic ecosystem rehabilitation programs.

(i) **Strong and consistent political leadership.** To create the conditions for successful aquatic rehabilitation, projects need the commitment of political leaders who understand the seriousness of the problems and have the ability to encourage and, if necessary, require cooperation for cross-sectoral and cross-jurisdictional coordination (e.g., between counties, between counties and provinces, between provinces and the central government). This level of coordination often requires new management structures and, sometimes, new laws and regulations.

(ii) **Integrated planning and analysis.** Aquatic ecosystems usually collapse gradually from multiple factors—all of which need to be addressed in project designs to prevent the reemergence of the same issues that led to the ecosystem's crisis in the first place. Successful strategies also recognize that investment and construction are only part of the solution. A truly comprehensive strategy also needs to take into account issues governing land use and management within the catchment as well as maintenance and operation. Programs that focus too much on one part of the solution rarely succeed. Specific account also needs to be taken of ecological measures of success, and relevant indicators

need to be included in the plan. Finally, successful plans recognize the need for a step-by-step approach that allows for sufficient time to make the fundamental changes necessary for success. Programs driven by FYPs and short-term perspectives are rarely successful.

(iii) **Effective management structures.** Most important, implementing regulatory and institutional changes that are almost always required as part of a comprehensive plan needs strong management. This can be complicated by the fact that catchment boundaries are rarely, if ever, the same as jurisdictional boundaries. Effective management structures ensure coordination across administrative boundaries—this has been the most consistent failure of large-scale rehabilitation programs in recent years. Problems with interprovincial coordination have been particularly notable, and the State Council needs to take a much more active role in encouraging cooperation. At the project level, comprehensive plans need strong and effective management structures to ensure the proper timing and sequence of component implementation.

(iv) **Effective financial engineering.** Assuming that funding in general is adequate and timely, all the specific elements of the plan must be adequately funded and, in the PRC context, adequate account must be taken of the revenue-raising capacity of participating governments, particularly the lower-level governments of counties and townships. Too many programs have failed because of the inability of lower-level governments to raise counterpart funds or have been distorted because local governments focus their spending on activities that generate short- and medium-term revenue. In general, and given the major externalities associated with aquatic ecosystem rehabilitation programs, the Government needs to take on more of the financial burden.

These factors need to be considered in preparing any aquatic restoration project in the PRC.

The PRC is unique because of its extraordinary economic growth and the unique environmental and social conditions surrounding this growth. The picture is further complicated by the imbalance of power and authority between government levels, the inadequacies of the fiscal system, and the top–down nature of government activities that exclude meaningful public participation. Nevertheless, there are some instructive lessons from foreign experience, particularly from the US, where water resource development during the early and mid-20th century shares close parallels with the PRC experience.

By the end of the 20th century, the US had built over 80,000 dams and reservoirs, installed nearly 90,000 megawatts of hydroelectric capacity, and built more than 15,000 municipal wastewater treatment plants. In the course of constructing this vast infrastructure, the US destroyed more than 60% of its inland wetlands. It has since realized the damage that was being done and has devoted enormous financial and management resources to reverse the trends. The situation has since improved significantly, although it has by no means been completely reversed. The scale of lake and wetland rehabilitation and management activities undertaken in the US ranges from the incomparably large (i.e., the Great Lakes National Program, a bi-national program intended to address environmental management challenges in the greatest freshwater lakes system on earth) to the very small (a vast number of small-scale local lake cleanup programs, frequently initiated by local community groups, run collaboratively with local agencies with a public–private funding mix). Each activity has had its own characteristics; yet no matter the project size, they share the four basic criteria behind the comparative

Blue green algal blooms in Tai Lake, August 2007

Jin Shuqin, Renmin Univesity of China

success of the West Lake experience in Hangzhou. Table 1 provides two illustrations: (i) the Lake Erie Rehabilitation Program being implemented as part of a national program by a Government agency, and (ii) a statewide lake cleanup program in Iowa. Many other examples could be used, but the four basic criteria are fairly consistently applied.

These comparative case studies suggest that the PRC needs to take a far more comprehensive approach to the management of aquatic systems. Such an approach recognizes the connected nature of all activities within a particular catchment and that it is an ecological problem rather than an engineering problem to be solved.

If there is no change in the approach taken in the PRC to the management and development of lakes and wetlands, the problems being experienced in the eastern areas—where development pressure has been highest and most concentrated—will be repeated in the central and western regions. The PRC cannot afford this environmental approach, which undermines economic progress.

Table 1: Some Characteristics of Two US Lake Cleanup Programs

Program Characteristic	Lake Erie	Iowa Lake Restoration
Strong and consistent political leadership	The lake was declared biologically dead in 1970, an important driving factor behind the passage of the Federal Clean Waters Act in 1972. The Clean Waters Act not only provided a strong regulatory basis but also a funding mechanism to support waterway cleanups throughout the US. Programs for cleaning up Lake Erie have had strong political support, led by the state governor (the PRC equivalent is the provincial governor), before the completion of the first state of the lake report in 1992.	Driven by a high level of public interest in the quality of lakes in Iowa (60% of Iowans use the state's lakes each year; and each user, on average, visits a lake eight times a year), the legislature and the governor agreed to coordinate and identify all lakes in the state classified as, or in danger of being classified as, having "impaired water quality." The process began with a "Water Summit" to identify a plan by focusing on three criteria: (i) comprehensive, locally led watershed planning action approach to water quality improvement, (ii) target scarce available financial resources for best results, and (iii) ability to demonstrate success.
Integrated planning and analysis	The Lake Erie Commission follows the Lake Erie Protection and Restoration Plan, which was developed based on extensive technical studies by relevant state departments and the results of 16 discussion groups convened by the commission and involving stakeholder experts, representatives from numerous environmental organizations, local government, universities, and think tanks (research and policy organizations). The plan includes 84 recommendations on specific strategic actions to improve the environment, recreational opportunities, and economy of the lake and its watershed. The plan also set out a series of "guiding principles" intended to change how basic development decisions on issues (such as land use, energy use, and industrial structure) are made within the watershed.	

continued on next page

Table 1 continued: Some Characteristics of Two US Lake Cleanup Programs

Program Characteristic	Lake Erie	Iowa Lake Restoration
Effective management structures	The State of Ohio created the Lake Erie Commission to preserve the lake's natural resources, protect the quality of the waters and ecosystem, and promote economic development. Commission members include the directors of the main relevant state agencies (Department of Natural Resources, EPA, and Departments of Agriculture, Development, Health, and Transportation). The commission has its own staff, administers its own business, and executes many of its own programs (e.g., the Lake Erie Protection Fund, "coast weeks," Lake Erie License Plate Sales, and the Lake Erie Quality Index). The commission's quarterly meetings are open to the public.	Primary responsibility for implementation is assigned to the State Department of Natural Resources, whose secretary reports directly to the state governor. Concerned communities surrounding the lake are involved and expected to lead planning and implementation. Strenuous efforts are made to involve and coordinate the work of all relevant agencies and levels of government including municipal and county governments, local nongovernment organizations, and relevant state agencies, particularly the Department of Agriculture and Land Stewardship. Regular public meetings are held to keep affected communities informed and to generate support.
Effective financial engineering	The work of the Lake Erie Commission is effectively a subset of the Great Lakes National Program, covering the entire Great Lakes region. It was established by the Clean Waters Act to support investments consistent with the US–Canada Great Lakes Water Quality Agreement, which aims to restore and protect the chemical, physical, and biological integrity of the Great Lakes. Activities are governed by a series of rolling FYPs prepared under the direction of the US EPA, beginning in 1997. Specific management plans are prepared for each of the five lakes by the relevant states.	The managers used innovative analysis to tap into funds allocated for related purposes. For example, background research established just how important lakes were to the tourism industry in Iowa, which provided justification for tapping into ongoing tourism development grants programs. The Department of Natural Resources also contracted with Iowa State University to develop a classification of Iowa's Lakes for Restoration, which provided a basis for tapping national lake restoration funding programs managed by the US EPA under the Clean Waters Act. The level of federal funding varied but was usually about half of total expenditures. Cost-benefit analysis is applied to all planned investments to ensure maximum efficiency of funds use.

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Table 1 continued: Some Characteristics of Two US Lake Cleanup Programs

Program Characteristic	Lake Erie	Iowa Lake Restoration
	Lake Erie has improved remarkably over the past 25 years. Water quality has improved considerably, largely from steep reductions in phosphorus as a result of upgrading sewage treatment plants, adopting pollution prevention technologies, and improving industrial wastewater treatment. Water clarity has increased eightfold, resulting in significant increases in tourism. Nevertheless, many goals remain unmet. For example, only two of the lake's 12 major tributaries are considered in "good" condition, four are rated only "fair," while six are still rated as "poor." Sediment inflows are not yet fully under control; the current inflow of 1.5 million tons per annum is thrice the acceptable level. Swimming beaches are still classified as unsuitable for 20% of the summer which—although a significant improvement—is still below the planning objective. The quality of near-shore biological communities, although much improved, is still below planning objectives, with none of the 21 areas assessed by the Index of Biotic Integrity being rated as "excellent", two as "good", 14 as "fair", and five as "poor".	Three lakes have implemented and completed cleanup programs. They are no longer classified as "impaired." Implementation has begun on three more programs, and watershed control activities in preparation for lake restoration activities are being completed on 11 lakes.

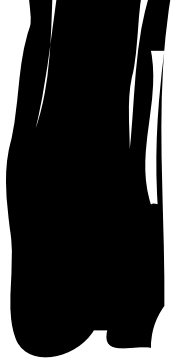
PRC = People's Republic of China, US EPA = United States Environmental Protection Agency, US = United States.

Source: Compiled from literature review.

Appendix 1

A Promising Example of Lake Rehabilitation:

West Lake Hangzhou City



Basic Conditions

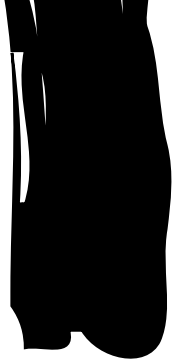
The lake is 3.3 kilometers (km) long, 2.8 km wide, 15 km in perimeter, covers a water area of 6.03 square kilometers (km^2) and has a catchment area of 27.25 km^2. The average depth of the lake is about 1.55 meters (m), with the deepest part being 2.80 m. The usual water control line is around 7.15 m, at which level the lake has a volume of 9.23 million m^3. The West Lake scenic area is a part of the West Lake National Ecological Landscape Conservation Function Zone, which covers an area of 195 km.

In 2005, Hangzhou's gross domestic product (GDP) climbed to yuan (CNY) 294.26 billion, an increase of 13.1% at constant prices compared to the previous year.[1] Hangzhou's GDP per capita in 2005 was CNY44,853. Tourism income was about CNY46.51 billion, including $0.76 billion of foreign income.[2] Westlake District's GDP was CNY5.88 billion in 2005, an increase of 17.8% for the year. Fiscal revenues of the district government were CNY3.14 billion, up by 16.6%, and local revenue went up to CNY1.766 billion, a 19.8% increase over the previous year. The average income of downtown employees in the district in 2005 was CNY29,850, an increase of 16.5% over the previous year, while the farmers' income was CNY9,108, an increase of 12.5%.[3]

[1] http://zj.xinhuanet.com/newscenter/2006-12/08/content_8730307.htm.

[2] *Hangzhou Statistical Yearbook 2006*: www.hzstats.gov.cn/webapp/tjnj/nj2006/8/nj.htm.

[3] www.hangzhou.gov.cn/main/zjhz/hzlj/2006/qxs/T159949.shtml.



Water Pollution Problems

Before 2002, the monitoring data for the Changqiao Stream, Longhong Stream, Jinsha Stream, and the Lake Area showed the following features compared to the National Standards of Surface Water Environmental Quality (GHZB1-1999) and standards for eutrophication.

(i) **Organic pollution evident.** The monitored concentrations of chemical oxygen demand $(COD)_{Mn}$, biological oxygen demand $(BOD)_5$, total nitrogen (TN), and total phosphorus (TP) in the streams exceeded standards. The highest CODMn concentrations in the streams occurred in the summer. While CODMn concentrations were stabilized between Classes III and IV in the Lake Area, TN concentrations were worse than Class V.

(ii) **Pollution levels high.** Changqiao Stream was the most polluted, followed by Longhong Stream and Jinsha Stream. Changqiao Stream had concentrations of BOD_5, TP, and TN one to two times higher than other monitoring sections. There were many rural residents and enterprises upstream of Changqiao Stream, resulting in substantial quantities of domestic wastewater and agricultural pollutants flowing into the lake.[4] According to statistical data, the average monthly wastewater discharge from Changqiao Stream reached 25,182 tons, and the water quality was worse than Class V all year round.

(iii) **Serious eutrophication.** The *Hangzhou Environmental Status Bulletin 2002* noted:

> The water quality of the Lake Area of the West Lake was mainly stable. Indicators including COD_{Mn} and TP reached Class IV, but TN and chlorophyll-a exceeded the standard and the lake was still in eutrophication status. The water quality in the four streams that run into the West Lake was worse than Class V, with fluctuation of different indicators. TN and fecal coliforms substantially exceeded the standard. Through a series of comprehensive rehabilitation measures including dredging, intersecting discharges, diverting, and allocating water from the Qiantang River, the eutrophication process has been slowed down, however, the water quality has not shown remarkable improvement.[5]

After comprehensive treatment, the water quality still has not reached the requirements for planned functions. The water environmental status of the West Lake is shown in Table A1.1.

[4] Ecological and Environmental Research Group of the West Lake Basin. 2002. Pollution Control Measures in the West Lake Basin. March.

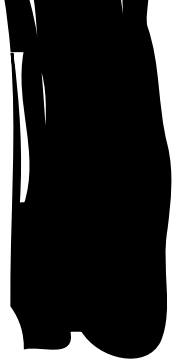
[5] *The Hangzhou Environmental Status Bulletin 2002*: http://sixx.cn/hb/Article.asp?ID=146.

Table A1.1. Water Environmental Status of the West Lake

Section	2004			2005			2006		
	Water Quality Class	Nutrients	Indicators Exceeding Standards	Water Quality Class	Nutrients	Indicators Exceeding Standards	Water Quality Class	Nutrients	Indicators Exceeding Standards
Central Lake	V	Heavy eutrophication	COD_{Mn}, BOD_5, Oils, TN, TP	V	Light eutrophication	TP, TN	V	Light eutrophication	Oils, TN, TP
Children's Palace	V	Heavy eutrophication	COD_{Mn}, BOD_5, Oils, TN, TP	Worse V	Light eutrophication	TP, TN	V	Light eutrophication	Oils, TN, TP
North Xilihu	Worse V	Heavy eutrophication	Oils, TN, TP	Worse V	Light eutrophication	TP, TN	Worse V	Light eutrophication	Oils, TN
Average	V	Heavy eutrophication	BOD_5, Oils, TN, TP	Worse V	Light eutrophication	TP, TN	Worse V	Light eutrophication	Oils, TN, TP

BOD = biological oxygen demand, COD = chemical oxygen demand, TN = total nitrogen, TP = total phosphorus, V = Class V.

Source: China Academy of Environmental Planning. 2007. *Water Protection and Management Policy for Main Lakes and Reservoirs in China. Study Report*. March.



Planning

As it is a national key scenic area, West Lake needed a comprehensive restoration plan prepared for national review and approval. It had taken 3 years to obtain national approval, but this process proved valuable in terms of taking into account all aspects of rehabilitating an ecosystem.

The Hangzhou West Lake Scenic Area Management Committee (the committee) submitted the master plan to the municipal government in December 2002. It took 6 months for the committee to get the municipality's approval and incorporate the municipality reviewers' comments. In June 2003, the plan was discussed in the provincial government executive meeting. After obtaining provincial approval, the plan was submitted to the State Council for review in September 2003.

In February 2004, the ministries concerned, including the Ministry of Construction (MOC), Ministry of Land and Resources, State Forestry Administration, National Tourism Administration, and State Administration of Cultural Heritage, met in Hangzhou to review and discuss the plan. A comprehensive note (No. 25, 2004, MOC) about the further revision of the plan was generated from this meeting. The notes—the Guidance on Review and Approval of National Key Scenic Areas' Management Plan (No. 83, 2001, MOC) and the Requirements for Preparing and Approving National Key Scenic Areas' Plans (No. 126, 2003, MOC)—provided a good basis for further improving the master plan. It took a year for the committee to improve the plan's design based on the above-mentioned documents.

On 13 and 14 January 2005, MOC, on behalf of the State Council, organized an interministerial review meeting to discuss the master plan. All ministries concerned expressed their principal approval of the plan and offered a few comments. The final version incorporating the comments from this meeting was approved by Vice Premier Zeng Peiyan on 1 September 2005. The committee spent 33 months to prepare, revise, improve, and obtain the final approval for the plan.

In this approved plan, the overall planning area is 59.04 km^2, while the core area for protection covers 14.6 km^2 and the rest of the 39.65 km^2 is assigned to an extended protection zone. In the West Lake scenic area, nine scenic sections have 122 view spots, over 40% of which are special and first-class spots.

The master plan also specifically prescribed the environmental standards for the West Lake scenic area:

(i) The air quality should reach the national Class-I standard of GB3095-1996.
(ii) The surface water quality should be consistent with the provisions of Class-IV standard of

GB3838-2002, and the drinking water with the provisions of GB5749-85 standard.

(iii) The noise allowed in the scenic area should follow the Class-I standard of GB3096-93.

In 2005, based on the approved master plan, the committee developed the 11th FYP for the West Lake Scenic Area Rehabilitation, which was identified as a priority program in the Hangzhou municipality's 11th FYP for economic and social development.

The plan called for the further strengthening of nature and cultural heritage in the lake, and the continuous improvement of water quality to enhance the lake's ecological functions. An integrated approach was clearly presented in this plan,

(i) taking into account all correlated issues including land use, social aspects of residential relocation, ecotourism, water engineering, safeguards, sewage and drainage system, transport, adjustment of inflow from Qiantang river, and outlet from West Lake, etc.;

(ii) focusing the efforts more on improving water quality, ecosystem service, water circulation, landscape attraction (harmonization among mountains, lakes, and grasses) and coordination among the related aspects;

(iii) paying attention to transforming forests, integrated pest management, biodiversity conservation, etc.; and

(iv) setting clear targets for 2010—80% of lake planned areas become a natural park; overall sewage treatment rate reaches 95%; extraction of groundwater decreases to 50% compared to 2005.

Table A1.2. Projects and Investments

(CNY billion)

Project	Main Construction Content	Planned Investment	Actual Investment
Sediment dredging	2.80 million m^3 sediment	0.23	0.23
Conformity project of south line	Construction of green area connection around the lake and cultural landscape corridor	0.23	0.41
New lakeside landscape (Shentang)	Land occupation of 2.8 ha; removed construction area of 36,000 m^2	0.65	0.65
First and second stage of Yanggong Bank	Land occupation of 334 ha, with six spots	1.55	1.32
West Hill historic streets conservative project (stage 1)	House removing and construction maintenance	0.33	0.12
Total		2.99	2.73

ha = hectare, m^2 = square meter, m^3 = cubic meter.

Sources: www.hangzhou.com.cn/20070515/ca/ca1312943.htm; www.hznet.gov.cn/hzdpc/0401/6144.htm.

Administrative Measures

In addition to reforming the system and preparing the master plan, the local government initiated the integrated protection project in 2002 to protect West Lake. Since then, overall protection and renovation have been accomplished, including ecological protection, environment beautification, culture continuation, landscape restoration, water quality control, and architecture renovation.

In 2002, implementing the south line conformity project at West Lake indicated the beginning of the integrated protection project. The "landscape for 10 miles around the lake" had been formed, too. In addition, the entrance fees of the parks were abolished, and the objective of "giving the lake back to its citizens" was accomplished.

The year 2003 marked the completion of the construction of three major landscapes (Yanggongti, Hubin, and Meijiawu tea culture village), and 36 historic places were designated. A new lake area of 90 ha was also recovered, accomplished by the water environment integrating protection of West Lake. As a result, the water quality and the ecosystem had improved remarkably.

Activities in 2004 focused on protecting West Hill's historic streets. After restoring and renovating them, 15 historic scenic areas were designated, further contributing to the beauty of West Lake.

In 2005, under the precondition of protecting historic heritages and original landscapes, eight projects were implemented, the fourth program carried out for West Lake.

In 2006, three main projects were implemented, including the integrated renovation of Lingyin scenic area, Wushan Mountain, and the "8 spots of Longjin". Further deepening the integrated protection project of West Lake, a number of activities were carried out, such as a protection project for the historic streets of West Hill, reconstructing Gaoli Temple, an epigraph stone, and the Lin Huiyin monument.

In the 5 years of implementing the project, illegally built buildings or those that were disfiguring the landscape and had no preservation value were torn down; 2,600 households (working units) were relocated, thereby reducing the population in the catchment by 7,300 people. In addition, a new public green space of more than 110 ha was created, the lake area was increased to 95.5 ha, and the average depth of West Lake increased from 1.65 m to 2.5 m. With an annual water supply amount of 0.12 billion m^3 of better quality water, transparency increased from 50 centimeters (cm) to 73 cm.

Results and Effectiveness

The comprehensive conservation project of the West Lake demonstrated the principle of "protecting first, prioritizing ecosystem conservation, and sustainable development." The streams were renovated and the lake area was enlarged. In addition, wetlands were recovered, polluting factories were relocated, and sewage from retentions and premises was intercepted and treated. Aquatic plants were grown in a large area and water diversion was increased so that the water in the lake was circulated once a month. Consequently, the eco- and tourism environments improved significantly, which helped enhance the living standard of local citizens and laid solid foundations for "world heritage" and "ecologically friendly" city applications.

Water Environment. The water quality of the West Lake was improved through water diversion, surface greening, cleaning, sewage interception, upstream watershed renovation, and ecological conservation. Generally, the average visibility in 2007 was 65 cm, higher by 5 cm than that of 2006; the ammonia nitrogen (NH_3-N) and TN indices improved—the former seeing a 100% drop to 0.184 milligrams per liter (mg/l), while the latter decreased by 30%; and 22.9 km of drainage pipes were laid to intercept 5,413 tons of sewage per day. A multifunctional Changqiao Stream eco-recovery project for purifying domestic sewage and sand interception was set up, which substantially improved the quality of water entering the lake.

The water quality target in the West Lake is Class III, and three monitoring spots have been set up (central lake, youth palace, and west Xili Lake). Monitoring results for 2004–2006 show gradual improvement in eutrophication levels, although water quality has not seen remarkable changes.

Since the project was implemented, the lake area to the west of Su Dyke experienced significant improvement; it is no longer in eutrophication status. Water quality in the main body of the lake and main branches is better than that in 2002 before the project: less eutrophication, notable decrease in main indices (NH_3-N, TP, and permanganate indices close to Class III), and average visibility improved to 65 cm (with maxima of more than 90 cm).

Water Resources. A total lake area of 90 ha was recovered from 2002 to 2007, accompanied by the West Lake dredging project and water diversion and distribution project, which resulted in an increase in average depth from 1.65 m to 2.5 m. Since the water diversion project was completed in 1986, daily water supply of 0.3 million tons was recharged to the West Lake. The annual amount of water distribution of the lake arrived at 0.12 billion m^3, ensuring that all water is exchanged each month.

Water Ecosystem. The aquatic ecosystem in West Lake improved significantly. The number of migratory birds visiting the lake has risen from 1,000 to more than 10,000 birds of 10 species, such as wild duck and cormorant. In 2007, even rare species, such as swan and mandarin duck, were seen in the lake.

Before the project, waterweeds would die from lack of oxygen when planted at the bottom of the lake. Now they are able to grow smoothly, which is rare in megacities. Although now they still need periodic artificial planting, a clear underwater forest will result when they can grow in a large area spontaneously.

Right now, two ecological chains exist in West Lake: (i) microorganism—zoobenthos—zooplanktons—aquatic animal; (ii) submersed vegetation—floating leaf plant—emergent plant—hydrophytes. Although the lake still relies on the people's help to survive, once the ecological chains can live harmoniously, the lake will adopt a recycling and metabolic system for purification. Such water ecosystems can be acclaimed as benign, natural, and stable.

Social and Economic Effects. In 2005, the magazine *Chinese National Geography* honored West Lake as one of the five most beautiful lakes in the People's Republic of China (PRC), ruling out five historically famous big lakes—Boyang, Dongting, Tai, Hongze,

and Chao—because of environmental pollution and ecological degradation.

On 26 August 2005, the Chinese edition of the American magazine *Forbes* listed Hangzhou City as first among 661 cities—including Shanghai and Beijing—on its best commercial city billboard. It was the second time Hangzhou topped the list.

While increasingly more famous scenic spots nationwide were raising ticket fees, Hangzhou abolished fees at all parks and scenic areas. The free ticket policy is an important instrument of the West Lake Integrated Protection Project in achieving its objective of "giving the lake back to the people". The city carried out an economic assessment of the policy. Prior to its implementation, ticket sales at parks along West Lake provided revenue of about CNY26 million per annum. The loss of this revenue in addition to the anticipated higher costs of higher security and cleaning—totaling CNY60 million per annum—was expected to be offset by increased business opportunities and indirect economic benefits of increased tourism. In 2004, the number of domestic tourists visiting Hangzhou increased to 30.16 million, 2.4 million more than the previous best in 2003. The number of stay-over tourists exceeded 1.2 million (about 3,400 people per night), which was another record. As a result, Hangzhou ranked no. 6 among the domestic tourist cities and successfully surpassed the well-known tourist cities of Suzhou and Guilin.

The new scenic area of West Lake today has become the priority sightseeing choice of local and foreign tourists. The number of visitors during the National Holiday between 2002 and 2004 had been record breaking. In 2002, during the National Holiday, the number of tourists in Hangzhou was 2.44 million. In 2003, during the severe acute respiratory syndrome (SARS) epidemic in the PRC, the number of tourists unexpectedly climbed to 3.3 million, which was the highest number ever. Another record-high number came in 2004, at 3.04 million. During Labor Day from 2002 to 2005, the number of tourists in 2002 were pegged at 2.41 million; in 2003, they were lower because of SARS; but the number climbed to 2.55 million in 2004; and 3.01 million in 2005. Although tourists no longer have to pay to visit the West Lake scenic area, the higher numbers have led to increased demands for hotels, restaurants, shopping malls, transportation, and other services—all of which also support and benefit tourism development in towns nearby. In 2005, all indicators for Hangzhou tourism reached their highest records. These included the number of foreign tourists reaching 1 million for the first time, foreign income increasing by 26.8% compared to the same period the previous year, the domestic income increased by 11.9%, and the total income increased by 13.2%.[6]

In 2004, the comprehensive conservation project of West Lake won one of the 10 national major construction technology achievement awards of 2003, acclaimed the model of city ecosystem optimization. In July 2005, West Lake scenic area won a prize as one of the "top 10 satisfied scenic areas in China" in the first consumer-favored brands survey initiated by the *People's Daily Press*, more than 100 industry associations, and more than 30 authority web sites. In September 2005, the management committee of West Lake was recognized as among the "advanced units of integrated protection projects in major scenic areas in 2004." In October 2005, together with Qinghai and Kanasi Lakes, as well as Namucuo and Changbai Mountains, West Lake was appraised as one of the top five most beautiful lakes in the PRC by the *Chinese National Geography* magazine and 30 other news media. In 2006, during the first round of a civilized scenic areas selection activity initiated by the central civilization committee, Ministry of Construction, and State Tourism Administration, West Lake won first prize.

[6] *China Youth Daily*. 2006. Economic Significance of the Immense Fishnet in Hangzhou West Lake. 14 February.

Appendix 2

Lessons Learned from Lake Rehabilitation:

Tai Lake Restoration

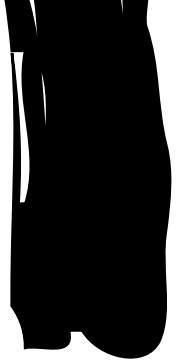
Characteristics of Tai Lake

Tai Lake is the third largest freshwater catchment in the PRC, with a total of 36,500 km^2. Its surface area alone, around 2,400 km^2, makes it the third largest freshwater lake[7] in the country. The catchment stretches across three provinces—Jiangsu, Zhejiang, and Anhui—and the Shanghai metropolis. Other notable features of the catchment include:

- the large ratio between the catchment and surface areas—15.21;
- the lake's shallowness—1.9 m on average with a maximum of only about 2.5 m;
- the high ratio between the catchment's surface area and the lake's volume—564.6 km^2/ km^3; and
- the lake's relatively short retention time—less than 0.8 years compared to ranges of 1.9 years for Lake Superior to 2.6 years for Lake Erie, two of the Great Lakes in North America.

The catchment is heavily populated and highly developed in economic terms, which has proven problematic in the rehabilitation planning process. In 2000, the average population density was 1,137 persons/km^2, and the GDP per unit area of the catchment was CNY29.1 million/km^2.

[7] Figures are quoted in various sources ranging from 2,250 km^2 to 2,400 km^2. The largest lake is Poyang Lake followed by Dongting Lake.



Decline of Tai Lake

As early as the 1960s, Tai Lake began showing the adverse signs of environmentally inconsiderate development. Today, many (if not most) of its endemic fish species have been lost because of unsustainable water resource developments, foreshore conversion, and over-fishing. A severe deterioration in the water quality of Tai Lake (Table A2.1) led to large cleanup programs during the 9th and 10th five-year plans (FYPs), which are being continued in the current planning period.

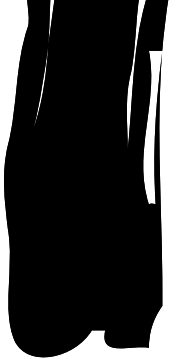
Table A2.1. Percentages of Samples from Tai Lake in Various Water Quality Classes

(%)

Proportion of Water Samples in Each Water Quality Class				
Year	**Class I+II**	**Class III**	**Class IV**	**Class V/V+**
1980–1981	69	30	1	0
1987–1988	59	37	3	1
1993–1994	15	70	14	1
2000	0	0	5	95
2004	0	14	29	57

Source: Louis Berger Group and EED Consulting Ltd. 2007. *Evaluation of Environmental Policy and Investment for the Water Pollution Control in the Huai River and Tai Lake Basins*. Prepared for State Environmental Protection Agency and the Asian Development Bank, TA 4447-PRC; adapted from Tables 2.1.3—1 and 2).

Restoration Process: Planned Versus Actual



Tai Lake restoration is a lesson in the difference between planned and actual commitment. The 9th and 10th FYPs have budgeted considerable investments for the lake's restoration, but the disbursement of those funds and the follow-through of objectives have fallen short. By the end of the 10th FYP, only 74% of the total CNY34.95 billion budgeted for Tai Lake restoration had actually been disbursed. That disbursements varied widely between provinces indicates a gap between the planning objectives and what could actually be achieved on the ground. Table A2.2 shows progress in completed expenditures during the 10th FYP.

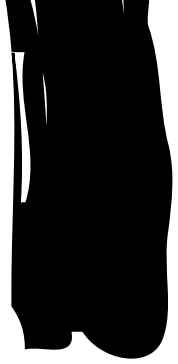
Table A2.2. Planned and Actual Pollution Control Expenditures in Tai Lake Basin during the 10th Five-Year Plan (CNY 10 Thousand)

Item	Planned	Actual	Actual/Planned (%)
Municipal WWTPs	1,073,155	1,068,450	+0.6
Solid waste management	126,925	105,090	-17.2
Industrial pollution control	11,260	13,630	+21.0
Ecosystem rehabilitation	208,000	65,580	-68.5
Dredging	397,948	156,960	-51.9
NPS control	229,693	148,190	-35.5
Water resource management	139,500	63,010	-54.8
Special industrial pollution control	9,200	8,470	+17.6
Management and capacity building	5,800	17,420	+200.3
Total	**2,201,481**	**1,646,800**	**-22.2**

NPS = nonpoint pollution source, WWTP = wastewater treatment plant.

Source: Louis Berger Group and EED Consulting Ltd. 2007. *Evaluation of Environmental Policy and Investment for the Water Pollution Control in the Huai River and Tai Lake Basins*. Prepared for State Environmental Protection Agency and the Asian Development Bank, TA 4447-PRC; adapted from Table 2.3.2-2.

Notably, the most significant under-expenditures were for activities without revenue-earning potential—ecosystem rehabilitation, dredging, nonpoint pollution source control, and water resource protection. This highlights the recurring problem of placing too much financial obligation on the provincial and lower levels of government, which under the PRC fiscal system have little revenue-generating potential, making it difficult for them to finance investments in local government infrastructure.



Planning Gaps

Despite the breadth of the investment program, as shown in Table A2.3, planning has been critically deficient in two general aspects. First, plans have not adequately accounted for the deleterious effects of continued, unabated economic, urban, and population growth, which has led to the second problem of pollution control measures that are limited in scope.

Table A2.3. Summary of Tai Lake Rehabilitation Investments Proposed Under the 10th Five-Year Plan

Type of Activity	**Planned Investment** (CNY 10 Thousand)	**Planned Investment as Proportion of Total** (%)
Municipal WWTP	1,073,155	48.8
Solid waste management	126,925	5.8
Industrial pollution control	11,260	0.5
Ecosystem rehabilitation	208,000	9.4
Dredging	397,948	18.1
NPS control	229,693	10.4
Water resource management	139,500	6.3
Special industrial pollution control	9,200	0.4
Management and capacity building	5,800	0.2
Total	**2,201,481**	

CNY = yuan, NPS = nonpoint pollution source, WWTP = wastewater treatment plant.

Source: Louis Berger Group and EED Consulting Ltd. 2007. *Evaluation of Environmental Policy and Investment for the Water Pollution Control in the Huai River and Tai Lake Basins*. Prepared for the State Environmental Protection Agency and the Asian Development Bank, TA 4447-PRC; adapted from Table 2.3.2-1.

Urbanization. Economic and urban growth within the catchment is exacerbated by the large number of jurisdictions governing the management of different parts of the catchment.[8] Lack of effective control has led to rapid and significant increases in the urban population within the catchment and of urban wastewater flows. The large investment programs under the 9th and 10th FYPs provided a significant increase in municipal wastewater treatment capacity throughout the Tai Lake catchment; but lack of coordination of expenditures resulted in underinvestment in drainage systems, resulting in many wastewater treatment plants operating significantly below their design capacity, as shown in Table A2.4.

Table A2.4. Municipal Wastewater Treatment Plant Treatment Ratios, 2000 and 2005[a]

(%)

City	Wastewater Treatment Ratio	
	2000	2005
Hangzhou	56	78
Jiaxing	41	56
Huzhou	35	67
Shanghai	72	71
Wuxi	51	72
Changzhou	69	72
Suzhou	80	73
Zhenjiang	60	76

[a] The wastewater treatment ratio is the actual throughput of a wastewater treatment plant as a percentage of its design capacity.

Source: Louis Berger Group and EED Consulting Ltd. 2007. *Evaluation of Environmental Policy and Investment for the Water Pollution Control in the Huai River and Tai Lake Basins.* Prepared for State Environmental Protection Agency and the Asian Development Bank, TA 4447-PRC; adapted from Table 4.2.4.3.

Industry. In the industrial sector, significant advances in wastewater discharge compliance rates were made throughout the catchment during both FYP periods, particularly during the 10th FYP period. But as shown in Table A2.5, compliance rates are far more variable than they should be, given the critical nature of the water pollution situation[9] in Tai Lake and its national significance. A stronger and more integrated management structure as would be provided by, for example, some kind of "Lake Basin Management Authority"— provided it was structured in a way to gain the concurrence of all relevant levels of government (particularly the provincial

[8] The catchment falls within three different provinces and one provincial level municipality, seven prefecture level cities (four in Jiangsu and three in Zhejiang), and 30 county level cities.

[9] Compliance was measured based on self-reported discharge water quality data. Spot surveys by the State Environmental Protection Administration suggested that such data frequently overstate the level of compliance actually being achieved.

Table A2.5. Industrial COD Discharge Compliance Rates 2000 and 2005 (%)

City	Proportion of Sampled Enterprises Complying with the Secondary Discharge Standard[a]	
	2000	2005
Hangzhou	73.4	70.9
Huzhou	89.6	93.0
Jiaxing	87.7	95.8
Suzhou	82.5	97.0
Wuxi	94.3	93.4
Zhenjiang	58.6	83.3

COD = chemical oxygen demand.

[a] A total of 1,309 enterprises were included in the year 2000 assessment and 1,595 in the year 2005 assessment.

Source: Louis Berger Group and EED Consulting Ltd. 2007. *Evaluation of Environmental Policy and Investment for the Water Pollution Control in the Huai River and Tai Lake Basins*. Prepared for State Environmental Protection Agency and the Asian Development Bank, TA 4447-PRC; adapted from Tables 4.2.3.1–1 and 2.

and municipal levels) and given the right sort of enforcement authority—might have provided more effectiveness in terms of compliance rates.

Agriculture. In the agriculture sector, planning included substantial funds for nonpoint source pollution control but no measures were included to control the growth of livestock numbers during the planning periods, outweighing some successes achieved in restricting the growth of in-lake aquaculture activities. As shown in Table A2.6, the net effect was to significantly increase total nonpoint and total point source pollution over the two planning periods.

This lack of comprehensive pollution control is having an adverse effect on certain hydraulic measures that have been considered to improve water quality, such as the "coordinated water quality and quantity operation." This operation would direct Yangtze River water via the Wangyu River, increasing the rate at which water flows through Tai Lake and thus reducing retention time. However, the declining water quality from the Yangtze River and pollution discharges into the Wangyu River may be increasing the sedimentation in Tai Lake and its tributaries. Ultimately, the lack of adequate pollution control planning for Tai Lake is undermining the larger rehabilitation processes being attempted.

Table A2.6. Estimated Quantities of Total Nitrogen and Total Phosphorus from Nonpoint Source Pollution in the Tai Lake Basin, 1995–2004[a]

(tons)

Form and Source of Nonpoint Source Pollution	1995	2000	2005	Increase 1995–2004 (%)
Total N				
Livestock	24,601	19,978	33,248	+35.0
Households	19,710	32,582	39,973	+103.0
Aquaculture	9,302	23,874	18,752	+101.0
Total	**53,613**	**76,434**	**91,973**	**+71.6**
Total P				
Livestock	4,911	3,915	6,514	+32.6
Households	3,185	5,265	6,459	+102.8
Aquaculture	900	2,310	1,814	+101.6
Total	**8,996**	**11,490**	**14,787**	**+64.4**

N = nitrogen, P = phosphorus, + = positive value.

[a] Excluding rainfall runoff. These are not measured data but estimates derived from statistical data and assumptions about pollution generation rates for different activities.

Source: Louis Berger Group and EED Consulting Ltd. 2007. *Evaluation of Environmental Policy and Investment for the Water Pollution Control in the Huai River and Tai Lake Basins*. Prepared for State Environmental Protection Agency and the Asian Development Bank, TA 4447- PRC; adapted from Tables 4.1.3.2–4.2.3.2.

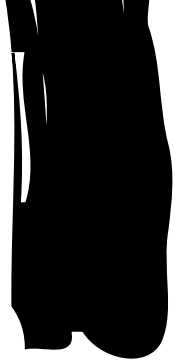
Appendix 3

Early and Projected Setbacks of Baiyangdian Lake Restoration

Characteristics of Baiyangdian Lake

Baiyangdian Lake in Hebei Province is the largest remaining semi-closed freshwater body in northern People's Republic of China (PRC). With a surface area of 366 km^2, it lies in the middle reaches of the Daqing River basin and ultimately discharges into the Bohai Gulf of the Yellow Sea. Baiyangdian Lake and most of its watershed, totaling 31,500 m^2, are located entirely within the Baoding Municipality.

Historically, the lake served many environmental and economic functions and has been described as the "kidney" of northern PRC. The open water and aquatic beds of the lake serve as spawning grounds and feeding habitats for a diverse array of fish and other animal species, and the lake is also a globally important resting site for migratory birds on the East Asian–Australasian flyway. The lake also has economic importance, with more than 200,000 people living within its wetlands and peripheral zones. The lake resources provide them with livelihood opportunities (freshwater fishery, reed production, and tourism-related jobs and businesses), drinking water, and irrigation; and it is a major transportation route. The lake also regulates floodwaters and moderates the microclimate of the surrounding areas.



Decline of Baiyangdian Lake

In the last four decades, the functions and values of the basin and the lake itself have been eroded with adverse impacts on its ecosystem.

Upstream construction of large reservoirs has seriously reduced inflows from an average of 1,730 million m^3 in the 1960s to 65 million m^3 in 2002. Water demands in the Daqing River have increased rapidly and now exceed supply, resulting in an increase in the incidence of "no" or "low" inflows to the lake. Since the 1960s, the size of the lake has decreased by almost half because of controlled water flows, increasing drought frequency, and increased sedimentation and soil erosion in the catchment. Moreover, rising population, expanded agricultural and industrial activities, limited solid waste and wastewater disposal measures in the watershed as well as within the lake, and deforestation of the watershed have transformed the lake into a major depository of wastewater discharges, solid wastes, and sediments. The decreasing inflow of water and the increasing discharge of pollutants have reduced lake water quality over the past four decades (Table A3.1). Biodiversity and livelihoods have been lost.

The degradation is symptomatic of weak institutions, inadequate capacity of the local government, and poor planning in the use and allocation of the lake's water resources. Furthermore, there are gaps and overlaps in the roles of government agencies at the provincial and municipal levels; and approaches to water use and allocation tend to be driven sectorally. Also, as economic growth became the primary goal of local governments, environmental protection laws and regulations have not been adequately enforced.

Historically, investments in Baiyangdian Lake's rehabilitation have been premature, running ahead of comprehensive studies that could have informed the programs on the full range of problems in the catchment. Investments have addressed only parts of the problem and not much has been done to deal with all the pollution sources, particularly domestic wastewater, irrational and unsustainable aquatic farming in the lakes itself, and overall socioeconomic development in the lake basin and surroundings.

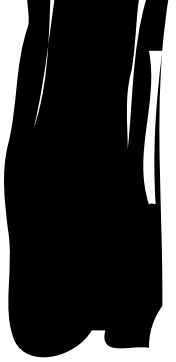
Table A3.1. Present Water Quality of Baiyangdian Lake

Monitoring Section	Existing Water Quality	Water Quality Target	Major Pollutants Exceeding the Required Limits
Shaochedian	IV	III	BOD_5, COD_{Cr}, NH_3-N, TP
Zhaolindian	IV	III	
Wangjiazhai	IV	III	
Quantou	IV	III	
Duancun	IV	III	
Caiputai	IV	III	
Guangdianzhangzhua	IV	III	
Nanliuzhuang	Below V	IV	
Gudingdian	–	V	

BOD = biological oxygen demand, COD = chemical oxygen demand, NH3-N = ammonia nitrogen, TP = total phosphorus, – = data not available.

Source: Baiyangdian Ecosystem Rehabilitation Plan, Baoding Municipality, Hebei Province, PRC, 2004.

Rehabilitation Process: The Plan



Hebei Province and Baoding City have recognized that a more holistic approach needs to be adopted. By the end of 2005, the two government levels agreed on a comprehensive plan to protect and rehabilitate the lake. The plan covered a 10-year period, and it was envisioned that CNY8 billion ($991 million) would be required to carry it out. It has yet to commence, but its design offers some lessons for future planning endeavors.

The plan has two parts:

(i) The 5-Year Environmental Protection Plan (2006–2010) requires (a) constructing 27 wastewater treatment plants in the watershed to treat all urban sewage in Baoding City and about 60% in the 22 counties by 2010, (b) rehabilitating the Baiyangdian Lake Wetland Reserve, (c) improving disposal of fly ash from thermal power plants in the catchment, (d) promoting clean energy by developing geothermal resources, and (e) reducing the number of people without access to safe drinking water. This is intended to reduce chemical oxygen demand (COD) by 8% and improve lake water quality to Class III.

(ii) The associated Baiyangdian Ecosystem Rehabilitation Master Plan (2005–2015) addresses environmental degradation and calls for an integrated approach with a planned investment of over $1 billion. The master plan comprises 17 projects in Phase 1 (2005–2009) and seven projects in Phase 2 (Table A3.2). The plans are only just getting started, so it remains to be seen whether the required financing will be secured when the various components need to be implemented. Even at this early stage, though, the program is underfinanced. Unless this situation is rectified, there will either be delays in implementing the plan or certain components will not be implemented at all.

Table A3.2. Investment Plan of Baiyangdian Ecosystem Rehabilitation Master Plan

(CNY million)

No.		Project	Investment
Phase 1 (2005–2009)			
A	Montane Ecological Restoration in Upstream Baiyangdian		
	1	Soil erosion control project (Phase 1)	582
	2	Project for ecological restoration of forestry (Phase 1)	650
	3	Dry farming project	45
	Subtotal A		**1,277**
B	Pollution Abatement in Baiyangdian Basin		
	4	Clean production project in key enterprises	580
	5	Municipal sewage treatment plant construction project	1,911
		i. Extension project for Baoding Municipal Sewage Treatment Plant	530
		ii. Comprehensive treatment project for Baoding's Moat and Fu River	303
		iii. Baiyangdian reed wetlands management project	35
		iv. Sewage treatment projects in upstream and neighboring Baiyangdian	1,043
	6	Capacity building on environmental infrastructure	299
	7	Demonstration project of ecological agriculture	44
	8	Sewage reuse project in Baoding City	27
	Subtotal B		**2,861**
C	Pipeline Construction for Water Transfer in Baiyangdian		
	9	Water saving and waterproof projects in Baiyangdian irrigation regions	340
		Environmental management project of Xiaoyi River	100
		Wangkuai and Xidayang Reservoirs connecting projects	129

continue on next page

Table A3.2 continued

No.		Project	Investment
		Environmental management project of Zhongyi River	65
		Reconstruction project of Cao River watercourse	120
Subtotal C			**754**
D	Integrated Management of Ecological Environment in Baiyangdian		
		Forestation projects in entry watercourses and neighboring Baiyangdian	18
		Mao stone revetment project in Baiyangdian	107
		Project of estuary management and dredging the fundus and watercourses of Baiyangdian	600
		Ecological farming project in Baiyangdian	132
		Nature reserve project of Baiyangdian Wetlands	42
		North flood control project of Anxin Town	40
Subtotal D			**938**
Phase 1 Total			**5,829**
Phase 2 (2010–2014)			
A	Montane Ecological Restoration in Upstream Baiyangdian		
	1	Soil erosion control project (Phase 2)	582
	2	Project for ecological restoration of forestry (Phase 2)	400
Subtotal A			**982**
B	Pollution Abatement in Baiyangdian Basin		
	3	Municipal sewage treatment plant construction project	252
Subtotal B			**252**

continue on next page

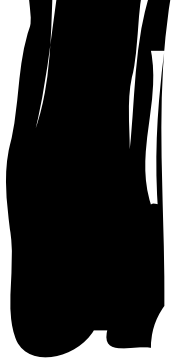
Table A3.2 continued

No.		Project	Investment
C	Integrated Management of Ecological Environment in Baiyangdian		
	4	Project of estuary management and dredging the fundus and watercourses of Baiyangdian	677
	5	Solid waste reuse project in Baiyangdian Region	52
	6	Reconstruction and resident control of water-surrounded villages in Baiyangdian Region	240
	7	Integrated treatment field for municipal solid waste from Anxin Town	21
Subtotal C			**990**
Phase 2 Total			**2,224**
Grand Total			**8,054**

Source: Ecological Restoration and Integrated Environmental Management Project List for Baiyangdian in Hebei Province, PRC.

Despite the comprehensive range of activities proposed, some gaps remain. There is no plan to deal with the problem of "in-lake" pollution—domestic wastewater emissions from the approximately 100,000 people whose houses are located on the lake or right on the waterfront. Some components of the plan, most notably a proposal to supplement inflows to Baiyangdian Lake by constructing a water transfer system may also not be the optimum solution. Feasible alternatives may include changing water release rules for dams in the upper parts of the catchment and introducing water savings programs for both industrial and irrigation water.

An integrated approach to environmental management and watershed management has been promoted in many regions of the PRC, but the common challenge has always been coordinating the relevant institutions to adopt a concerted multisector approach. The advantage of the Baiyangdian Lake basin is that its watershed is geographically confined mostly within the city's administrative boundary.



Early and Projected Setbacks

A couple of features about the overall rehabilitation project and the experience it has had in getting off the ground point to some upcoming setbacks. First, the rehabilitation plan has not been endorsed and approved by the National Development and Reform Commission, which has forced a detour from a project approach to a program basis, preventing full financing from being secured. A second issue is that some participating counties are having difficulty providing counterpart funds, which means that some components of the plan are also underfinanced for this reason.

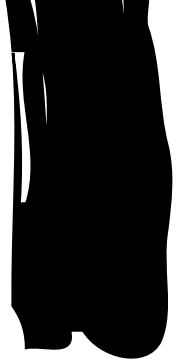
The executing agency of the ADB project will be the Baoding Development and Reform Commission, where a central project management office will be established. Project implementation units will also be established in each county government for oversight of county-related activities. This approach may be adequate for managing and coordinating the implementation of individual project components, but it will not be able to provide the long-term, comprehensive basin management that is necessary for future growth and development in the catchment. A short-term solution might be to establish a leading group involving senior officials of all relevant departments, but a better solution for the long term would be to establish an agency with a high level of control over future developments in the catchment.

Appendix 4

Integrated Management Needed for Sanjiang Plain Rehabilitation

Characteristics of the Sanjiang Plain

The Sanjiang Plain, a 108,900 km^2 area in the northeastern tip of the PRC, contains the largest area of wetlands in the country, estimated at 0.89–1.28 million hectares in 2000. The wetlands represent one of the most important breeding sites and migratory routes for waterfowl in north-eastern Asia, and are significant for the number and variety of globally threat-ened waterfowl species.



Decline of Sanjiang Plain

Since the 1950s, the Sanjiang Plain has been a major focus for agricultural development, which has resulted in considerable loss of wetlands (Table A4.1).

To protect the wetlands, the Sanjiang Plain Wetlands Protection Project—cosponsored by the Heilongjiang provincial government, ADB, and GEF—commenced in March 2007. This 5-year project costs $55.55 million, of which $15 million is an ADB loan, $12.14 million is GEF co-financing, and $28.41 million is government counterpart funding. The objectives of the project are to (i) protect the natural resources of the Sanjiang Plain wetlands and the watersheds (biodiversity, water, forests) from continued threats; (ii) promote sustainable use of natural resources through integrated conservation planning; and (iii) improve the well-being of local communities.

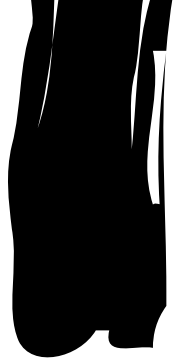
Table A4.1. Estimates of the Decline in Wetland Area on the Sanjiang Plain

Year	Wetland on Sanjiang Plain		Farmland on Sanjiang Plain	
	Area (ha)	**Percent** (%)	**Area** (ha)	**Percent** (%)
1949[a]	5,340,000	49.0	786,000	7.2
1983[a]	2,275,700	20.9	3,778,300	34.7
1994[a]	1,481,600	13.6	4,572,400	42.0
2000[b]	889,786	8.2	5,164,214	47.4

ha = hectare.

[a] Data from Liu Xingtu and Ma Xuehui 2002.
[b] Unpublished data from Center for Chinese Agriculture Policy.

Threats



Although a series of government actions have been undertaken to protect the wetlands, degradation of the wetland ecosystem has yet to be controlled. Continuous loss of wetlands is only one major indicator. The others are more fundamental, some are not even well understood and addressed.

Water Pollution. Water quality in the wetlands has always been assumed to be very high. However, field monitoring in Qixinghe National Nature Reserve, one of the most well-preserved wetlands in the Sanjiang Plain, revealed the water quality to be much worse than its assumed Class 1 status (Table A4.2). The field survey showed that the main sources of pollution are upstream coal and gold mines and nonpoint sources in the surrounding area.

Water Use. The water resources in this area are abundant, especially in terms of water volume flowing across the plain, which amounts to 200 billion m^3. The total water resource volume of the Sanjiang Plain is 17.5 billion m^3. The annual mean value of surface water runoff is 11.4 billion m^3 and the annual mean value of groundwater is 5.8 billion m^3.

Water use in the Sanjiang Plain is determined largely by agricultural development. According to the National Rice Base Development Plan of Heilongjiang Province (2006), the paddy acreage will increase from 15 million mu (1 mu = 0.067 ha) in 2006 to 28 million mu by 2020.[10]

The water flow in the Sanjiang Plain has been more and more controlled by engineering works, including reservoirs, drainage, and diversions. The total capacity of reservoirs reaches 2.12 billion m^3 in the Sanjiang Plain. Of these reservoirs, 25 are of medium and large size, all of which fundamentally change the natural patterns of river water flow.

Table A4.2. Water Quality in Qixinghe Natural Reserve
(mg/l)

Pollutant	2006		2007	
	Level	Class	Level	Class
Oil	10.5	V+	0.26	IV
COD	245.5	V+	32.0	V
TP	1.7	V+	0.198	III
NH_3-N	0	I	0.250	II

COD = chemical oxygen demand, mg/l = milligrams per liter, NH_3-N = ammonia nitrogen, TP = total phosphorus.

Source: Monitoring Results by School of Environment and Natural Resources, Renmin University.

Policy Conflicts. Although the national 11th 5-year plan has addressed the priority of wetland conservation in the Sanjiang Plain and limited both agricultural and urban development, there seem to be inconsistencies between national policies. For example, in the policy recommendation of the Chinese Academy of Engineering to the State Council, 8 billion m^3 of water will be

[10] *Heilongjiang Daily*. 2005. Development of the Rice Farming Base. 23 October.

diverted from the Amur River, Ussuri River, and Xingkai Lake to support expanding 15 million mu of paddy field, which the State Council's Promotion Plan of Northeast Industrial Base has accepted contrary to conservation plans.

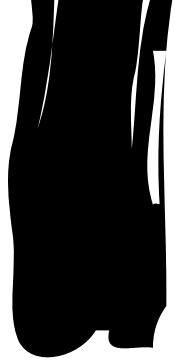
Institutional Barriers. Institutional barriers in terms of water management and ecological conservation are making the threats more serious. The main problems are:

(i) The boundaries of natural reserves are usually determined by jurisdictional borders instead of watersheds. Within one river basin, several neighboring reserves are under the control of different local governments, resulting in conflicts instead of collaboration.

(ii) Water use, water pollution control, nature reserves management, and water ecosystem conservation are run by different agencies, without any coordination between them.

(iii) Furthermore, management of wetland natural reserves is fully isolated from the social and economic development of the regions and watersheds, where the reserves are located inside or in the downstream, making conservation plans hard to implement effectively.

Notes for the Future: Focus on Quality, Integrated Management



To summarize the analysis on threats, the most critical threat to the wetland natural reserves in Sanjiang Plain is the exploitation of the entire basin for overall development—agricultural development, urbanization, and industrialization. The ecological effect of using these water resources for new rural construction is not being given enough attention.

Ultimately, water resource shortage is not as critical an issue because of the extensive storage. Adding further storage could even address one more pressing issue—the inefficiency of water usage. In addition to controlling the exploitation of groundwater, surface water could be used for recharging the ground table.

Overall, water management must shift from being driven by agricultural development to being integrated, considering the sustainability needs of the environment itself, communities, and emerging urban economies in the area.

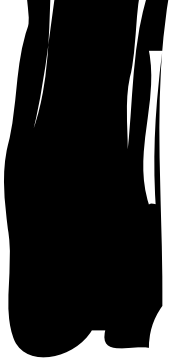
In balancing economic development and ecological protection, water pollution and water quantity must be resolved together. The local government level cannot resolve this alone. An integrated water basin management system needs to be established, incorporating the local level. But overall wetland water supply must be managed at the wider basin level.

Appendix 5

Summary of Discussions:

Consultation Workshop on the Knowledge Product

Consultation Workshop on the Knowledge Product Summary of Discussions, Harbin, PRC, 23 June 2008



This appendix is a summary of discussions at a multi-stakeholder workshop on the final draft of the "Reviving Lakes and Wetlands" knowledge product. The workshop, held on 23 June 2008 in Harbin, capital of Heilongjiang Province and location of Sanjiang Plain, elicited feedback from 90 participants that included representatives from central governments,[11] international organizations,[12] academic institutions,[13] Heilongjiang provincial government and other local governments, and international and national consultants.

The participants easily agreed on three of the four success factors for an effective restoration program identified in the report. Some of their comments reinforce the report while others offer new points for consideration. The comments on the three success factors are summarized as follows:

(i) **Strong and consistent leadership and action.** Restoration takes time and resources that are often beyond the narrow focus of the typical 5-year plan (FYP). Restoration also requires effective cross-sectoral and transjurisdictional coordination. Catchment boundaries are rarely the same as jurisdictional boundaries. Thus, there is a need to have strong and consistent leadership to ensure coordination across administrative and sectoral boundaries.

(ii) **Integrated planning and analysis.** Planning needs better integration of many sectors, especially land use sectors, and serves as a development strategy agreed to by all stakeholders. The development of an integrated planning framework has often led to notable long-term partnerships between the PRC and major development agencies and banks.

(iii) **Effective financial engineering.** Too many programs have failed because of the inability of lower level governments to raise counterpart funds, or have been distorted because of the need for local governments to focus spending only on activities that create short- and medium-term revenue-raising possibilities. Development banks need to fund areas that traditional and/or private funding sources do not find attractive, such as domestic wastewater networks and nonpoint source pollution, because they do not directly generate revenues.

There was lesser consensus from participants regarding **effective management structure** as a key success factor. The report suggests establishing a leading group of senior officials from all departments as a short-term solution, and establishing an agency with a high level of control over future developments in the catchment in the long term. Risks to this long-term solution recommendation, however, are coordination and whether the proposed new agency would have sufficient authority to be effective. Participants agreed that a more effective management structure would refer to building on, strengthening, and streamlining current government institutions rather than developing

[11] Among the government representatives are delegates from the National Development and Reform Commission, Ministry of Finance, Ministry of Water Resources, and State Forestry Administration.

[12] These included delegates from ADB, European Union, International Union for Conservation of Nature, Conservation International, World Wide Fund for Nature, and Australian Agency for Fund for International Development.

[13] Among the participating academic institutions were the Chinese Academy of Social Sciences, Renmin University of China, and China Agricultural University.

new parallel departments.[14] External help may be needed to assist government in moving from "rowing" to "steering," and enable government departments to work together under the umbrella of "leading groups." It was common understanding that integrated planning is the first and most effective step toward coordination. The authors appreciated these useful inputs, and clarified that the long-term solution highlights the sufficient authority of the new agency to control future developments in the catchment. This is one key experience from the success of the West Lake restoration.

Discussions reinforced a shared concern on the sufficiency of the integrated river basin management approach to generate immediate solutions to the current crisis. The country was credited, however, for its progress in this area.

This workshop also provided an opportunity for the participants to share their site-specific experiences and related comments on a number of issues:

(i) **Water Charge/Recharge into Wetlands and Lakes.** Water charge/recharge into wetlands and lakes is fundamental to rehabilitate heavily degraded wetlands and lakes. The representative from the Ministry of Water Resources introduced case studies of water charge into the Zhalong Wetland, which is an internationally cited vital wetland in Heilongjiang Province, and water recharge into the Baiyangdian Lake, which is vital for ecosystems in the northern PRC.

(ii) **Payment for Environmental Services.** Payment for environmental services is a promising financing tool in addition to government regulatory instruments for wetlands and lakes protection. Conservation International demonstrated how these payments were integral parts of an initiative to protect Lashi Lake in Lijiang, Yunnan Province.

(iii) **Alternative Livelihood.** It is vital for sustainable wetlands and lakes protection to support or provide alternative livelihoods for local communities living on natural resources of the wetlands or lakes. Alternative livelihoods are organic fishery and ecotourism in the Dongting Lake protection program initiated by World Wide Fund for Nature (WWF), sustainable/ecological agriculture in Yunnan program initiated by the Center for Biodiversity and Indigenous Knowledge, and animal raising and handicraft in the Caohai Lake protection program.

(iv) **Microfinance or community revolving fund.** Village-based microfinance proved conditional for supporting alternative livelihoods. This was discussed in the presentation by the representative from Guizhou for the Caohai Lake protection program.

(v) **Comanagement of Natural Resources**. Comanagement and participation of multiple stakeholders are important for reconciling the needs of conservation and livelihoods in ways that sustain and protect wetlands and lakes. This was suggested from a number of experiences by the European Union–China Biodiversity Program, International Union for Conservation of Nature (IUCN's) work on water and wetlands conservation in Asia, and the Caohe Lake protection program.

A conservation planning specialist from Aonyx Environmental pointed out that these site-specific, issue-focused efforts will be very important in other Asian countries where there are difficult political and policy obstacles. He cited three examples:

(i) **Chilka Lake, India** – one of the world's top examples of community-led conservation and restoration initiatives, subject to a politically weak environment, involved the participation of a nongovernment organization,

[14] A participant cited the recently established Dianche Lake Management Bureau for its ineffective management structure. The bureau has no greater authority than the Water Resources Bureau and other line agencies.

and won the Ramsar award for lake conservation;

(ii) **Laguna de Bay, Philippines** – demonstrates comanagement, resource partitioning, covenants, and community involvement;

(iii) **Tonle Sap, Cambodia** – floodplain ecosystem; demonstrates a lake system that differs from the Chinese cases ecologically but compares with traditional community fisheries and systems; showcases alternative livelihoods, village cooperatives, and tourism based on waterbird colonies.

In the PRC, there is a strong political willingness to change the course of the deteriorating ecosystems. Most notable is the 11th FYP that is determined to develop a "resource-efficient and environment-friendly society." The question is how to turn these concepts into solid, sensible, and well-considered interventions on the ground. This workshop concluded that with the support of the issue-specific experiences, accomplishing the above four success factors will offer the promise of a change in course.

About Reviving Lakes and Wetlands – Lessons Learned from the People's Republic of China

Lakes and wetlands in the People's Republic of China face serious threats, yet the restoration programs designed to save them have achieved little success over the last 20 years. Today, more than ever, these resources need to be better managed and protected.

The experience of three lake restoration programs highlights the need for an integrated strategy that takes on the complex challenges of rehabilitating water and land resources, while strengthening the links among stakeholders. The key elements for success are strong and consistent political leadership, integrated planning and analysis, and effective management structures and financial engineering.

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