EXECUTIVE SUMMARY OF KNOWLEDGE PRODUCT: SUSTAINABLE LAKE MANAGEMENT IMPLICATIONS FOR CHAO LAKE REHABILITATION

I. INTRODUCTION

1. This report represents the continuation of analytical work initiated by ADB in 2008 on problems being encountered in the Peoples’ Republic of China (PRC) in the rehabilitation of lakes and wetlands and provides analytical background for the proposed Anhui Chao Lake Environmental Rehabilitation Project.

2. The report (i) provides a background on the problems being experienced with the environmental management of Chao Lake; (ii) summarizes the measures that the Anhui Provincial Government (APG) and local governments have taken to address the problem, including the development of the Master Plan for Integrated Water Environmental Management in the Chao Lake Basin (2008–2020); (iii) briefly summarizes the design of the proposed Anhui Chao Lake Environmental Rehabilitation Project; (iv) discusses how the current situation in the Chao Lake basin compares with international thinking on conditions necessary for sustainable management of lake basins; and (v) draws some conclusions.

II. BACKGROUND

3. Chao Lake, in Anhui Province, is the fifth largest freshwater lake in the PRC. It occupies about 10% of the total area of the province and it is the location of Hefei City, the provincial capital. The lake is important to industrial and agricultural water supply, water transport, and tourism, and recreational. But the lake is geographically pre-disposed to pollutant accumulation as it is shallow. The ratio between the catchment area and the volume of the lake is very large; water circulation is limited, and nearly 40% of soils in the catchment contain naturally high levels of phosphorous. This tendency has been exacerbated by the adverse environmental effects of some flood control infrastructure that was installed in the 1950s and 1960s combined with the adverse environmental effects of significant economic and population growth over the last 20 years, particularly in Hefei.

4. As early as 1996, Chao Lake has been identified as one of the top three priority lakes in the PRC for environmental rehabilitation due to poor water quality. Since then, the provincial and relevant local governments, supported by the State and ADB, have applied considerable resources to control municipal and industrial point sources of pollution within the lake catchment. Although these investments had considerable success in terms of addressing the principal targets, they did not address all dimensions of the problem and water quality in the lake continues to be unsatisfactory. The lake continues to experience excessive concentrations of organic matter such as nitrogen (N) and phosphorous (P). During summer times, the elevated levels of P and high temperatures result in unsightly algal blooms, depletion of oxygen in the water column, and emission of offensive odors.

5. At present, the average water quality in the lake is Class IV under the PRC’s national environmental water quality standard; although 50% of the water monitoring points in the lake falls into Class V or V+. Although this represents an improvement on the situation compared in 2005 when the average water quality in the lake was class V+, this is significantly below the government’s long term objective of achieving Class III.
6. Industrial pollution in the lake catchment is generally under control. The two main pollution sources yet to be fully controlled are municipal point sources and rural non-point source (NPS) emissions. According to the Anhui Environmental Protection Department (AEPD) estimates, municipal sources account for about 50% of existing organic emissions into the lake, 57% of emissions of N, and 54% of P. Rural NPS emissions are estimated to account for 42% of organic emissions, 38% of N, and 42% of P.

7. The pressures on Chao Lake are likely to be sustained and perhaps even increase in the near future. The strategic plan for the development of Hefei City intends to develop the city into a major national center for scientific research and education, innovation, and advanced manufacturing industry, as well as a national hub of integrated communications, and a regional center of public services. On the industrial side, future industrial development is likely to be significant due to the State Council’s decision in January 2010 to implement the “Plan for Wanjiang City Belt Demonstration Region”, which will result in significant new industrial development in the catchment. The APG and the Ministry of Environmental Protection (MEP) have signed a cooperation agreement to ensure that the environmental implications of these developments will be controlled; but nevertheless, these have the potential to significantly increase the water pollution hazard.

8. The pollution control challenge for the future will be to (i) maintain the current effectiveness level of management of industrial point source emissions; (ii) expand the municipal waste water collection and treatment system to maximize coverage of urban areas within the catchment and upgrade standards of treatment to Class 1A; and (iii) to get the NPS pollution problem under control.

III. PLANNING AND ADMINISTRATIVE DEVELOPMENTS

A. Planning

9. During the 11th Five-Year Plan, the Anhui Development and Reform Commission (ADRC) organized relevant departments to formulate the “Master Plan for Integrated Water Environment Management of Chao Lake Basin (2008–2020)” to provide the basis for a long term, comprehensive, and integrated approach to rehabilitation of the lake from which individual investment proposals for inclusion in successive five-year plans could be identified and selected.

10. The master plan, which was completed in 2007, is comprehensive and covers not only conventional environmental engineering strategies but also seeks to influence regional development strategies, industrial restructuring, urban development planning, integration of urban and rural areas, and other macro level planning activities. The master plan covers a 15-year time frame ending in 2020 with a total of 329 different investment projects identified, representing a total investment value of CNY46.1 billion (US$7.3 billion).

11. The long term management objectives are: (i) the water in the lake will reach the Class III standard for carbon oxygen demand (COD) and Class IV or better for total N and P; and (ii) water quality in the Nanfei, Shiwuli, Pai, and Shuangqiao rivers will be kept at Class IV or better, while all other rivers will be kept above Class III.

12. Unlike many other similar plans in the PRC, the master plan is very broad and comprehensive and covers not only engineering interventions but also ecological, research, and
educational interventions. The six main elements are: (i) application of restrictions on the total quantities of key pollutants emitted in the catchment; (ii) agricultural and industrial restructuring and improved spatial development in rural areas; (iii) pollution source control; (iv) ecological rehabilitation; (v) water transfer from Yangtze River to increase lake flushing; and, (vi) education, research, and institutional development.

13. Whether or not the master plan will be sufficient to achieve the water quality objectives is very difficult to know. The lake is already extremely overloaded,¹ and recently formulated urban and industrial development plans will be very challenging from an environmental point of view. Nevertheless, the plan represents a significant achievement and is arguably the most thorough and comprehensive plan of its kind in the PRC. The industrial and municipal wastewater control strategies are very solid, substantive, and to a large extent, represent a continuation and amplification of past actions which already had beneficial effects.

14. However, the program on NPS control is much less well-defined. The program is a mixture of substantive and aspirational components and there are also considerable gaps. Aspirational components include proposals to “encourage” more use of customized compound fertilizers, promote integrated pest management, and establish ecological farms. There is lack of ideas on how to go beyond encouragement of these actions, many of which are already being attempted without very much success. The rural NPS pollution problem has a large social dimension and requires plenty of work to identify effective ways of addressing these social aspects.

B. Administration

15. After the master plan was developed, the APG, acting on the instructions of the State Council, took two additional steps to improve the prospects for effective management of the lake basin environment:

(i) On 10 September 2011, the APG dissolved the prefecture-level municipality of Chaohu and merged those parts of it located in the upper catchment of the lake into Hefei Municipality.² The remaining three counties, which are located in the lower catchment and do not drain directly into the lake, were transferred to Wuhu and Ma’anshan municipalities. This had the effect of concentrating management authority for the entire surface area of the lake, all of the lake foreshore, and a substantial proportion of the upper catchment within a single local government authority, namely, the Hefei Municipality; and

(ii) At about the same time, the APG created a new, sub-provincial level agency which has been named the Chao Lake Management Authority (CLMA) with the aim of providing unified administration of general affairs relating to Chao Lake.

IV. PROPOSED CHAO LAKE ENVIRONMENTAL REHABILITATION PROJECT

16. Consistent with the ongoing implementation of the master plan, the APG has formulated the Anhui Chao Lake Environmental Rehabilitation Project for possible cofinancing by the ADB. The proposed project will result to investments in a range of interventions provided for in the

¹ According to calculations included in the Master Plan for the Integrated Water Environment Management of Chao Lake, in 2006, total COD emissions were 350% higher than the lake’s estimated assimilative capacity; total Phosphorus emissions were 1,730% higher than assimilative capacity; and, total Nitrogen emissions were 606% higher than assimilative capacity.

² Those are the parts of the total catchment upstream of the Yangtze River that drain directly into the lake.
master plan, including construction of advanced domestic wastewater treatment plants (WWTPs), dredging of polluted sediments from the main tributaries of the lake, riverbank stabilization, and construction of engineered wetlands. Funds will also be provided for investment in non-structural measures relating to non-point source (NPS) pollution control and technical assistance and training will be provided for the CLMA.

17. The project comprises four outputs: (i) increased municipal point source pollution control; (ii) enhanced NPS pollution control; (iii) improved institutional capacity of Chao Lake Management Authority; and (iv) strengthened project management capacity.

V. SITUATIONAL ASSESSMENT

18. Environmentally sustainable lake management is a global problem and there are few successful examples that might be used as comparators. Nevertheless, there have been two recent reviews; one global,\(^3\) and one focused on the PRC,\(^4\) that provide guidance on the factors comprising an effective approach.

19. The international study (the ILEC study) identified six factors necessary for sustainable management of lakes and reservoirs. As shown in the following table, all these six factors are either already in present in the Chao Lake situation or, at least, some progress has been made to get them in place.

<table>
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<tr>
<th>Management Factor</th>
<th>Status in Chao Lake</th>
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<tr>
<td>Adequate institutions for implementing change</td>
<td>Major step towards achieving this goal has been taken by restructuring of local government within the up-sluice lake catchment and creation of the Chao Lake Management Authority (CLMA).</td>
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<td>Efficient, effective, and equitable policies</td>
<td>The policy framework on point source pollution control is already in place. Policy framework for non-point source (NPS) pollution control is less well developed.</td>
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<td>Meaningful participation of all stakeholders involved</td>
<td>There has been considerable participation of government stakeholders but more work needs to be done to improve participation of private sector, local communities, and farmers.</td>
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<td>Application of relevant technical measures to ameliorate specific problems</td>
<td>Relevant technical measures for point source pollution control and treating the symptoms of NPS control (e.g. sediment dredging) have been identified but considerable work still needs to be done to pilot control strategies that would address the root causes of NPS pollution.</td>
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<tr>
<td>Appropriate information about current and future environmental conditions</td>
<td>An environmental monitoring system is in place but it needs to be significantly strengthened in terms of the density of sampling points, frequency of sampling, and range of parameters analyzed.</td>
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<td>Sufficient financing to permit all of the above to be applied</td>
<td>Financing for capital hardware investments is likely to be adequate. Provision of adequate funds for operation and maintenance of capital equipment and financing for “software” investments (training, public awareness, etc.) may be a challenge.</td>
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A similar conclusion applies to the study that focused on the PRC (footnote 4). This study identified four key determining factors. As shown below, all four factors are in place in Chao Lake, at least to some degree.

Table 2: Status of Key Lakes and Wetlands Indicators for Sustainable Management of Chao Lake

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<thead>
<tr>
<th>Determinant for Success</th>
<th>Current Status in Chao Lake</th>
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<tr>
<td>Strong and consistent political support</td>
<td>High degree of commitment from both the central and provincial levels of government since the beginning of the 9th Five-Year Plan through the “Three Rivers and Three Lakes” program and continues to the present day at the provincial and municipal levels with very large and consistent investments in environmental infrastructure, as well as planning.</td>
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<td>Integrated planning and analysis</td>
<td>The Master Plan for the Integrated Water Environment Management of Chao Lake provides a long-term perspective which extends beyond the traditional five-year planning framework and is a very positive development. Nevertheless, it needs to be continually updated to account for new knowledge and developments on the ground and the non-point source (NPS) control strategy needs to be strengthened. On the other hand, establishment of Chao Lake Management Authority (CLMA) has provided an excellent opportunity to fill these gaps as the State Council's enabling document clearly provides the CLMA with a land use planning mandate. How to act on this assignment is one of the significant issues that the CLMA will have to deal with.</td>
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<tr>
<td>Effective management structures</td>
<td>The Anhui Provincial Government (APG) has taken significant and decisive actions to strengthen management through the amalgamation of Hefei and Chaohu City municipalities and the creation of the CLMA. It has further increased CLMA’s chances of success by creating it through the transfer of existing staff and operational units rather than attempting to create the CLMA from scratch. These actions have provided an excellent basis for effective management but a great deal of work will be required to convert the CLMA from a good idea into a skilled, effective, and successful regional planning and management organization that has a clear vision of what it is trying to achieve and the staff and resources necessary to get there.</td>
</tr>
<tr>
<td>Effective financial engineering</td>
<td>The APG and ADB have maintained a long-term financial and technical collaboration and the project provides a basis for continuing the relationship into the long-term future. The project of rehabilitating Chao Lake is at a crossroads and needs to move from its former focus that is principally on environmental engineering to a broader approach that continues to support investments in hard engineering but expands the scope to cover non-structural measures and institutional development. The Master Plan for the Integrated Water Environment Management of Chao Lake provides for an investment of at least CNY46 billion (US$7.3 billion) through to 2020 and the provisions of the plan are being reflected in relevant five-year planning proposals.</td>
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VI. CONCLUSIONS

21. The APG has taken significant and, arguably, unprecedented steps to create a basic framework to achieve its long term objective of improving water quality in Chao Lake and protecting and maintaining all its economic, ecological, and aesthetic values. The key steps were: (i) the development of a coherent and comprehensive master plan; (ii) the creation of an administrative structure that places the greater part of the upper catchment within the jurisdiction of a single administrative body (Hefei municipality); and, (iii) the creation of the CLMA to be the institution that has the primary responsibility for managing the lake.

22. These steps form the basic and essential framework for solving the lake problem. Obstacles and challenges remain to stand in the way of achieving the government’s ultimate objectives. Three of the most important challenges are:

(i) **CLMA development.** A great deal of work will be required to convert the CLMA from a good idea into a skilled, effective, and successful regional planning and management organization that has a clear vision of what it is trying to achieve and the staff and resources necessary to get there. The action taken so far represents a very significant start. CLMA needs to: (i) do as much as possible to study the experiences of governments and institutions in other countries in dealing with similar challenges; (ii) articulate (for itself and also for the relevant governments) a clear vision of what it wants to achieve and what measures it needs to take to get there; (iii) work out ways to work constructively and collaboratively with other important institutions whose work impinges on the CLMA’s mission such as (at the provincial level) the provincial departments of environmental protection, water resources, agriculture, and land administration to say nothing of the Provincial Development Reform Commission; (iii) reorganize itself so that the structural arrangement of the organization is optimally adapted to support its mission and objectives; (iv) create a human resources development plan that will establish a better match between the staff skills the institution has and the skills it needs to achieve its objectives; and. (v) procure and/or develop the facilities and equipment necessary to do the organization’s work.

(ii) **Research.** The master plan’s greatest weakness is that most of the data relating to NPS pollution is speculative and not based on empirical measurements taken in the Chao Lake area. This deficiency needs to be overcome through development and implementation of a long term applied research program designed to provide a stronger empirical base for the NPS pollution emission factors used for planning purposes. This work arguably should be coordinated by the CLMA but would need to be done in collaboration with both the environmental protection and agriculture departments, and possibly also with a relevant university or research institute. CLMA also needs to implement a program to verify the accuracy of National Bureau of Statistics data on factors relevant to CLMA’s work, particularly fertilizer consumption, distribution of cultivated land, and livestock numbers through structured sample surveys, satellite image interpretation, etc. CLMA also needs to work with the Departments of Water Resources and Environmental Protection to develop and calibrate some simple mathematical models to simulate changes in catchment land use and pollution patterns, and predicting their effects on lake water quality.
(iii) **Master plan updates.** Since the economic environment in the Chao Lake Basin is so dynamic, and the state of knowledge of the technical aspects underlying the analysis on which the plan is based are in a constant state of improvement, the master plan needs to be updated on at least a bi-annual basis to ensure that it remains relevant.