

**China**  
**Country Water Resources Assistance Strategy**

2002

The World Bank  
East Asia and Pacific Region

## Abbreviations and Acronyms

AAA	- Analytical and Advisory Assistance
CWRAS	- Country Water Resources Assistance Strategies
DFID	- Department for International Development
EPB	- Environmental Protection Bureau
ET	- Evapotranspiration
GEF	- Global Environment Facility
IRBM	- Integrated River Basin Management
IWRM	- Integrated Water Resources Management
M&I	- Municipal and Industrial
MOA	- Ministry of Agriculture
MOC	- Ministry of Construction
MOF	- Ministry of Finance
MWR	- Ministry of Water Resources
O&M	- Operation and Maintenance
RBM	- River Basin Management
SDPC	- State Development Planning Commission
SEPA	- State Environmental Protection Administration
SIDD	- Self-Managing Irrigation and Drainage District
SOCAD	- State Office for Comprehensive Agricultural Development
TA	- Technical Assistance
TBWRC	- Tarim Basin Water Resources Commission
TVIE	- Township and Village Industrial Enterprises
WCP	- Water Conservation Project
WRMP	- Water Resources Management Policy
WRSS	- Water Resources Sector Strategy
WSC	- Water Supply Corporation
WSO	- Water Supply Organization
WUA	- Water Users Association
WWTP	- Waste Water Treatment Plant

## I. Introduction

1. China faces a water resources crisis of multiple dimensions throughout the country, but the problems are particularly acute in dry northern China—that is, north of the Yangtze River Basin—and even more so in the catchments of the Huang (Yellow), Huai and Hai Rivers. The importance of water resources management is well recognized and considered to be a priority issue at the highest levels of the Chinese Government. As noted in Premier Zhu Rongji’s Report on the Tenth Five Year Plan:<sup>1</sup>

“Lack of water resources is a serious limitation on the economic and social development of our country. We need to put water conservation high on our work agenda, establish a rational system for management of water resources and a rational pricing mechanism, comprehensively adopt water conservation technologies and measures, develop water-efficient industries, and raise the entire society’s awareness of water conservation. Prevention and control of water pollution should be strengthened. We should improve sewage treatment and utilization. We need to expedite the planning and building of projects to divert water from the south to the north.”

2. China has very serious water problems despite substantial economic development achievements, strong technical expertise, and political stability. But in terms of its potential and the critical pressing needs for water resources management, China could do much better in managing its water resources. The World Bank’s assistance to China in water resources development and management in the past has tended to be reactive and downstream in the project cycle. However, this approach has significantly limited the potential benefits of Bank assistance to China which a more upstream approach, based on a strategic partnership, could provide.

3. In general, the Chinese government has requested assistance from the Bank for projects that the Chinese government has felt would benefit from Bank involvement and after the projects have been basically defined in terms of content. The Bank has then worked with its Chinese counterparts to make adjustments to the already defined projects in order to improve them and incorporate international experience. This has basically been the approach to Bank assistance in China because both China and the Bank have strongly emphasized the importance of the client (China) being in the driver’s seat and the Bank providing assistance where and how the client wants. But the result has been failure to gain the maximum value from Bank assistance. In effect, China has treated the Bank as a commercial source of financing rather than a strategic partner in development.

4. The fundamental issues for China are not only technical but concern the institutions and management instruments; their solution depends more on political understanding and strong will from the political leaders at all levels, rather than just funding. In order to accommodate a shift towards improved water resources management and to make better use of Bank assistance, it is important for the Bank to become more involved in upstream dialog and Analytical and Advisory Assistance (AAA) to help in defining the legal and institutional framework, policy, strategy and particularly in planning and implementing the overall water resources management and investment program for China. Selection of projects and activities for Bank involvement including the possibility of concentrating Bank assistance in critical areas, should also be a mutual exercise of the Chinese government and the Bank. China is now a much more sophisticated and internationally savvy client than it was during earlier years of Bank involvement. There is essentially no risk that China would allow the Bank’s assistance to drive the reform agenda, but China could benefit substantially from the Bank’s assistance and advice when considering these upstream aspects. As an honest broker with worldwide experience and access to expertise, the Bank can be a very effective partner for open dialogue and debate at all levels, which are needed for effective strategic reform of management in the water resources sector.

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<sup>1</sup> Premier Zhu Rongji’s Report on the Outline of the Tenth-Five Year Plan for the National Economic and Social Economic Development (2001-2005), delivered at the Fourth Session of the Ninth National People’s Congress on March 5, 2001.

5. This upstream assistance can include Bank support for interchanges with other developing and developed countries dealing with similar water related problems, seminars and workshops, more access of senior Bank water staff to Chinese leaders, improved cooperation and coordination with other multilateral and bi-lateral international organizations, more formal and informal AAA provided by the Bank, etc. But the fundamental requirement for such a partnership to work is that China must decide to use the Bank in a new, more comprehensive way for its strategic development purposes.

6. The Bank's assistance strategy for China in meeting its water resources challenges needs to revolve around three major dimensions:

- Keeping in mind that water resources management improvements are a long-term endeavor, the Bank should provide assistance to China in translating the rhetoric of water conservation and sustainability into practical-realistic programs and policies. The Bank should provide AAA when requested and assist the Government in developing policy and strategic approaches to addressing water resources management needs.
- For Bank financed infrastructure projects, the Bank should help assist the Government in formulating management components which will be an integral part of the projects, and focus on (i) generating the support of political leaders, and (ii) following a "bottom-up and top-down" approach that includes the active participation of water users. The Bank should also work with Government to develop non-infrastructure water resources management projects, such as the proposed GEF Hai Basin Integrated Water and Environment Management Project.
- The Bank should give priority to financing water conservation, watershed management, irrigation and drainage system rehabilitation, water pollution control including wastewater treatment, flood and drought management, bulk water supply for Municipal and Industrial (M&I) uses, rural water supply, hydropower including mini-hydro. The projects should be designed within a basin-wide or regional water resources perspective, with emphasis on poverty reduction and, where appropriate, on eco-system restoration of rivers, wetlands, lakes, and coastal waters.

7. This Strategy Paper identifies China's principal water resource challenges, what China is already doing, and how the Bank can assist in the future. The large size of the Bank's water portfolio and the urgency of the problems, demand a strategic framework for the Bank's support to China. In 2002, the Bank and the Chinese Government are cooperating on the evaluation of the last, and preparation of the new, Country Assistance Strategy. In October 2002, China promulgated a new Water Law, has recently prepared a new five-year plan, and is updating the master plans for the major river basins. The Bank hopes it can assist China in improving its water resources management, and accelerate implementation of reforms through a shared Country Water Resources Assistance Strategy (CWRAS).

8. The Bank's Water Resources Sector Strategy (WRSS) is currently being finalized and will support the 1993 Water Resources Management Policy (WRMP). The holistic approach recommended is generally described as Integrated Water Resources Management (IWRM) and sometimes as Integrated River Basin Management (IRBM). While unified management is an ideal, the integrated approach starts from the present institutions and stakeholders. One of the conclusions of the WRSS is that Country Water Resources Assistance Strategies should be produced for key countries in each of the Bank's six regions. During the Bank's fiscal year 2002, ending June 2002, each region is preparing one CWRAS in consultation with a selected client country. In the case of the Bank's East Asia and the Pacific Region, China has been chosen for the first CWRAS, which is elaborated in this Strategy Paper. A workshop was held in Beijing on June 5, 2002 co-sponsored by the Bank and the Ministry of Water Resources during which this Strategy Paper was discussed. This final version of the Strategy Paper incorporates the comments from the workshop and is an integral part of the process of CAS preparation.

9. The Bank provides AAA on policy-related issues and two recent documents have been used in preparation of this Strategy Paper:

- “Agenda for Water Sector Strategy for North China” is a comprehensive analytical report addressing water scarcity, floods, water for agriculture, water pollution, groundwater, and water management institutions in the Huang-Huai-Hai River Basins (3H basins). It represents the state of the art as far as analytic and technical engineering approaches to water resources management, encompassing water quality as well. It also enables the implications of alternative assumptions about key economic and financial parameters. The basins cover the North China Plain which is the breadbasket of China. The report outlines an action plan and provides an indicative assessment of investment needs.
- “China: Air, Land, and Water-Environmental Priorities for a New Millennium” also deals extensively with water resources management and water pollution issues.

10. Referred to as the Bank’s Analytical Reports in this Strategy Paper, these two reports conclude that:

- Pricing, institutional reform, development and enforcement of detailed policies/regulations and management are now critical issues for future water resources management and development;
- Investments in major hydraulic infrastructure and for irrigation rehabilitation are still needed;
- The financial demands on China to manage its water resources are enormous, even if demand management is implemented; and
- There is an urgent need to mobilize rapidly to meet these challenges.

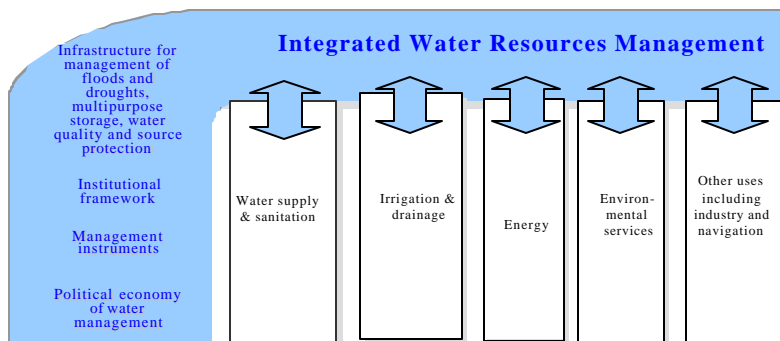
11. Loans for physical infrastructure will continue to be a vehicle for piloting new “software”, while integrating the particular project with basin wide management. Such components can address the full range of water issues including financial, environmental, agricultural and social objectives. Increased Bank AAA should be mobilized in parallel with the investment program, as such work can directly impact on the benefits from infrastructure and determine the quality of management. Misuse of resources to finance unproductive or not-well-targeted activities should be avoided. Investment in software and human and social capital benefit from international experience and expertise and the Bank would also like to assist China to disseminate knowledge of its own best practices and innovations. It is important that these software investments be properly designed and implemented.

12. The conceptual framework for water management, as proposed by the Global Water Partnership distinguishes between 5 user-sectors which are represented by the boxes in Figure 1. The WRSS emphasizes the importance of coordinating initiatives in the individual water-using sectors by focusing on integrated management to ensure optimal sustainable use and development of water resources, and environmental protection. The WRSS further elaborates that integrated water resources management means dealing with:

- **The institutional framework**, including the definition and establishment of laws, rights and licenses; the responsibilities of different actors; and standards for water quality and service provision (especially to the poor) for the environment, for land use management and for the construction and management of infrastructure which affects the quantity and quality of water resources, including international, national and state resource management agencies, river basin and aquifer agencies, and watershed management institutions;
- **The management instruments**, including regulatory arrangements, financial instruments; standards; plans; mechanisms for effective participation of stakeholders; and knowledge and information systems that increase transparency and accountability, motivate effective water allocation, use and conservation, and secure maintenance and physical sustainability of the water resource systems;
- **The development and management of infrastructure** for annual and multi-year flow regulation, for floods and droughts, multipurpose storage, and for water quality and source protection; and
- **The political economy of water management and reform**, in which there is particular emphasis on the distribution of benefits and costs, and on the incentives including water pricing which encourage or constrain the more productive and sustainable resource use.

13. The different integrated water resources management issues relate to the “handle” of the “comb” (see Figure 1) while key aspects relate to the “teeth”, which comprise sectoral activities including water supply and sanitation, irrigation and drainage, energy, environmental services, etc. The paper is not a comprehensive strategy for each of the sectors or “teeth”, but rather a water resources management strategy that addresses some aspects of the sectors where needed, because of linkages to water resources management.

**Figure 1**



14. In the past Bank has had a sectoral fragmented approach in its water program in China. The East Asia and the Pacific Region of the Bank has an Urban Development Unit, a Rural Development and Natural Resources Unit, an Environmental and Social Development Unit, an Energy and Mining Unit, a Transport Unit, a Human Development Unit and a Private Sector Development Unit all of which have programs in China that have included water related activities. The Bank has now established an informal EAP water team coordinated by a regional water resources adviser that is working to improve the coordination and integration of Bank supported water activities in China. One of the purposes of this Strategy Paper is to provide a framework for the more coordinated integrated approach to the Bank’s assistance to China.

## **II. China’s Water Resources Challenges and Government Focus**

15. China has three major water issues: water shortages, flooding and water pollution. Over-exploitation of groundwater particularly in the Hai Basin and overuse of surface water resulting in inadequate environmental flows in much of northern China, along with increasing groundwater and surface water pollution in many parts of the country, are contributing to the decline and deterioration of water resources and damage to freshwater and coastal environments. Flooding continues to be a major problem and the damages have increased in recent years because of economic and population growth. Watersheds and upper catchments have been degraded because of pressures from economic activities resulting in deforestation and inadequate agricultural and soil management practices.

16. The principal challenges for China are to halt groundwater overexploitation and surface water overuse, to severely restrict and control pollution, to increase levels of flood-protection and to stabilize watersheds. China needs to protect and restore the environment, while continuing with rapid economic and social development. These problems are major constraints to continued growth and development. Without a major concerted successful program to improve water resources management, the damage to the environment and to Chinese natural resources will become irreversible, resulting in huge negative impacts on the quality of life of the Chinese people and on the Chinese economy in the future. The Bank is well placed to provide assistance to China in meeting these challenges by better mobilizing and coordinating international experience and assistance in the various aspects of sustainable water resources management and development. One key area where the Bank could assist would be in carrying out AAA to determine the economic value of water and the environmental costs related to water resources overexploitation and

degradation compared to a prioritization of activities and their associated costs in order to achieve water resources management sustainability.

17. The Chinese Government has recently dedicated substantial efforts and priority to addressing water related issues which figured prominently in the National Tenth Five-year Plan on Social and Economic Development and the Tenth Five-year Plan on Water Resources Development. In addition the Minister from the Ministry of Water Resources has made several important speeches on water resources issues and there has been a recent Study Report on Strategies for Sustainable Water Resources Development in China coordinated by high Chinese Government officials with input from 43 academicians and 300 senior water specialists. There has also been a major effort in the Chinese Government to revise and improve the National Water Law which was approved in October 2002. These activities are collectively referred to as the Chinese Planning and Strategy Documents in this Strategy Paper. These documents have identified and highlighted a shift in the nation's water policy, which is summarized as:

- people need to live in harmony with nature and not only exploit it;
- water is a strategic resource and lifeline for social and economic development;
- the focus needs to be shifted from a construction orientation to a management orientation;
- conserve the quantity and quality of water;
- optimize planning/allocation/use, conservation and protection of water rather than maximization of utilization;
- combine structural and nonstructural measures;
- increase demand management; do not depend entirely on supply augmentation;
- improve irrigation technologies, including scientific irrigation;
- treat water as an economic good and price it accordingly;
- establish a functioning water rights and discharge control system; and
- place more emphasis on comprehensive integrated water resources management.

18. This shift in thinking and approach is precisely in line with the Bank's Water Policy and WRSS. Other countries are also in different stages of shifting focus and emphasis and international experience and assistance will be valuable to China to achieve this goal.

### III. General Strategic Themes

19. The overall strategic objective is to improve water resources management. This objective and the general themes described below are all in line with Government policy as outlined in Planning and Strategy Documents, and the Bank's Analytical Reports. **The critical unsolved problem for China is inadequate water resources management, or more accurately ineffective/fragmented water management systems.** A good foundation for addressing this problem is established in the newly approved water law, and the Bank is providing specific support for addressing this problem in many lending and AAA activities and most importantly in the GEF Hai Basin Integrated Water and Environment Management Project that is presently under preparation. The financial burden of planned infrastructure can be lightened by resolute demand management.

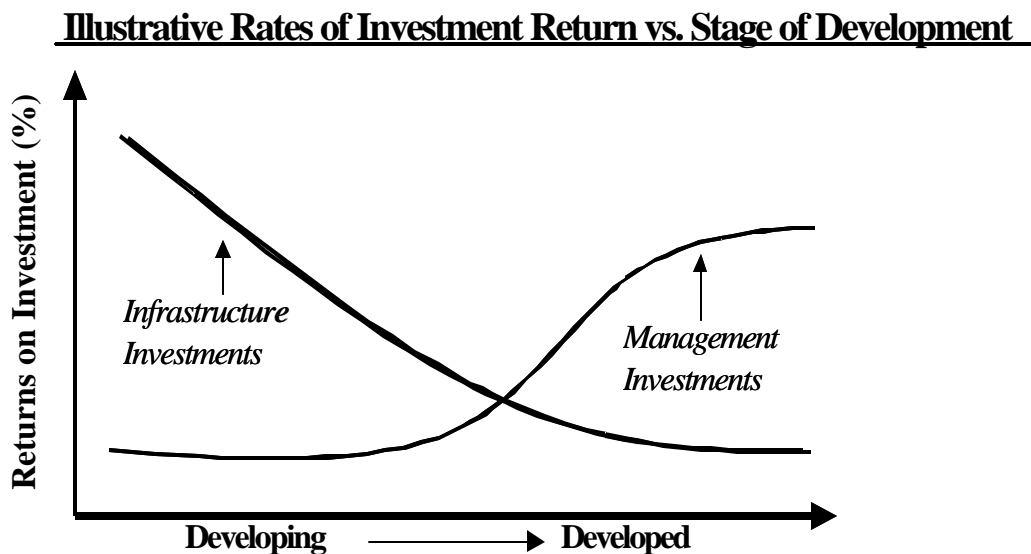
**Theme 1: The environment, and the land and water resource base must be preserved for future generations.**

20. Water resources development, management and use have to provide ecological protection and sustain the environment. This requires more long-term approaches and better scientific and technical input. The national guidelines for comprehensive river-basin planning should include a requirement for environmental flows in rivers providing water to ecologically important areas. With the help of international experience and through Bank-financed projects and AAA work, China can work to find successful approaches to achieving sustainable utilization of water resources and environmental protection in China's water resources program.

**Theme 2: More money, government attention and international knowledge are needed to address the management side of water resources issues.**

21. A key strategic thrust in China should be more water resources management investments because they generally have high returns and are sometimes more efficient in achieving improvements than infrastructure investments. The Bank is assisting other large and sophisticated borrowers, such as Brazil and Mexico, to address their water management problems by financing both infrastructure and management activities. Bank (IBRD) financed projects for both these countries devote approximately 25 percent to capacity building, institutional development, and non-infrastructure activities. China, in contrast, uses less than 5 percent of the Bank-financed project costs for non-infrastructure related activities. China is at a stage of economic development, particularly in the north, where much of the water storage, control, and distribution infrastructure has already been constructed and the marginal returns from additional infrastructure investments are diminishing. With such limited and high-cost water resources, now is the time to concentrate on water management investments. Figure 2 graphically depicts this evolution. This transition from hardware to software investments is almost inevitable; countries throughout the world typically focus on supply-side solutions first, and then gradually shift to more demand and management based approaches as the resource base gets closer to full utilization. In China there has been a disparity in development in the east and north that have developed more quickly than the west. The need for infrastructure and management investments will be different depending on the development needs in different parts of the country, and there is still a major need for infrastructure investments in China particularly in the western part of the country. However, management investments are important and needed in conjunction with infrastructure investments in all parts of the country. The Box that follows lists examples of different types of “water resources management investments”.

**Figure 2**





### **Box - Water Resources Management Investments**

In this Strategy Paper, the term Water Resources Management Investments is broadly interpreted to encompass the types of activities described below. These activities can be considered “investments” because they typically require cash expenditures for staff, consultants, equipment, software, buildings, studies, surveys, etc. as well as the time of managers and decision-makers, which should produce benefits that are in excess of the applied resources.

#### ***Examples of Studies and Surveys:***

- Aquifer Characterization
- Flood Plain Mapping
- Rainfall-Runoff Studies
- River Basin Planning
- Basin Consumptive Use Studies
- Water User Inventories
- Wastewater Flow and Quality Field Studies
- Local Water and Land Planning

#### ***Examples of Monitoring, Measurement, and Modeling:***

- River Flow Monitoring
- Water Quality Monitoring
- Municipal and Industrial Discharge Monitoring
- Regional Groundwater Monitoring
- Irrigation Scheme Water Distribution
- Measurement of diversions and extractions
- Satellite Imagery
- Hydrologic and Hydrodynamic Models
- Reservoir Optimization Models
- Socio-economic Models
- Decision Support Models
- Demand Estimation

#### ***Examples of Institutional Development and Capacity Building:***

- River Basin Councils & Agencies
- Groundwater Units & Aquifer Committees
- Self-Managed Irrigation and Drainage Districts
- Irrigation Water User Associations
- Measurement and volumetric charging
- Demand Management
- Water Rights Administration
- System of Tradable Water Rights
- Utility Regulatory Commission
- Mass-Based Pollution Discharge System
- Financing of Municipal Infrastructure
- Public-Private Utility Partnerships
- Flood Management Agencies
- Training and Study Tours

22. Management investments when well designed and implemented with the support of the Bank can bring major benefits. The State Development Planning Commission (SDPC) and the Ministry of Finance (MOF) have shown concern about the misuse of funds for not-well-designed study tours, conferences, meetings, studies and research. SDPC and MOF with Bank assistance need to make the distinction between good management investments and poorly-designed activities that are wasteful. Most provincial and local governments are also reluctant to borrow for upgrading water resources management. They request bilateral grant support or provide minimal amounts of counterpart financing for non-infrastructure related activities. But there are many examples of high-return investments in management. Some examples include: (a) the optimal hydraulic management of the Sihui Lakes in Hubei utilizing computerized decision support systems; (b) groundwater modeling in the Tarim Basin (e.g. Bosten Lake watershed) demonstrating how to reduce non-beneficial evapotranspiration and thereby satisfy water demand while making more water available for environmental purposes; (c) Yellow River modeling and planning to better define investment and operation strategies; and (d) water savings by volumetric measurement and water pricing. Use of large amounts of

government financial resources and Bank lending resources for management investments are justified, and when these investments support public -goods, subsidies (no cost recovery from water users) are also justified.

**Theme 3: Leadership and support from political leaders is needed at all levels in order to accelerate and deepen water management reforms.**

23. Political support of high-level Government leadership is essential to implement water sector reform. Without dedicated political commitment, fundamental institutional and management reform is probably not possible. Mexico and in Andhra Pradesh State (India) have worked to reform their water resources management through new institutional mechanisms for coordination and cooperation among different groups. But this required strong and active intervention from the top levels of government. With the backing and facilitation of political leaders at all levels and the national Government, the Bank can work to promote more dialogue on institutional and organizational issues related to water resources management.

24. There is a strong need for increased coordination and cooperation between various government entities, water user groups and other stakeholders, which will require strong government leadership. Individual sectoral agencies still have to play the major role in implementation of the new water resources management agenda, but it may be difficult for organizations that have developed a culture of infrastructure development to shift their priorities and focus more on management. Again strong leadership will be required to overcome these difficulties. Political commitment is also required to ensure that the financial burden related to improvements in water resources management is not imposed entirely on the pilot projects and programs and on associated local governments.

**Theme 4: Water resources management needs to be both a “top-down” and a “bottom-up” undertaking, as well as be a dynamic, iterative, participatory process.**

25. The Bank can help to bring international assistance and experience to bear in addressing both top-down and bottom-up aspects of water resources management. China has made some progress in top-down water resources management in recent years, although there is still much to be done. Sustainable management, use, and environmental protection require:

- establishing policies, laws, organizations, and regulations for managing water;
- defining the availability of water and determining broad water allocations within river basins and aquifers for different sectors and political administrative entities (provinces, prefectures, counties);
- setting quality standards;
- cross-sectoral and interprovincial cooperation at the river basin and/or aquifer level.

26. The bottom-up part of water resources management requires participation of water users, including farmers, towns, cities, industries, and infrastructure operators, who are the actors that ultimately determine how the resources will be used, or abused. Their views and incentives need to be taken into account and their responsibilities need to be defined and strengthened when establishing a “rational water management system”. Bottom-up approaches can be developed by the establishment of new institutions for suppliers and users of water services in pilot projects, for instance water user organizations and bulk water suppliers. China has already begun to address bottom-up aspects of water resources management; innovations such as the Self-Managing Irrigation and Drainage Districts (SIDDs) that are at the cutting edge of participatory irrigation management. Major increased attention is needed in the area of bottom-up water resources management by:

- educating and mobilizing water users, as well as incorporating their views into the planning and management processes;

- involving more participation at the county and township level, establishing more ownership, accountability and contractual relationships
- improving water use efficiency and water conservation in conjunction with the water users;
- implementing a complete system of water rights and discharge permits; registering, licensing, control and enforcing within strictly and locally defined criteria of water availability and quality objectives;
- defining rights and obligations in terms of water rights and permissible discharges and the system for coordinating, regulating and controlling stakeholder actions

27. The top-down and bottom-up processes need to be dynamic, iterative and participatory. Top-down policies, regulations, standards, allocations need to be continuously reviewed and revised based on feedback from bottom-up programs, and the bottom-up programs need to be adjusted and improved in accordance top-down revisions. Different government agencies, the private sector, civil society and water users need to continuously participate in defining and implementing the top-down and bottom-up aspects of water resources management to ensure transparency, fairness and broad input.

**Theme 5: Water resources management needs to support Poverty Reduction.**

28. The Bank can assist in implementing projects in western areas and in improving project design and implementation aspects in Bank-financed projects to help address poverty reduction issues and to ensure the poor are not negatively impacted by water resources projects. Irrigation, Watershed Management, Water Supply and Sanitation, Flood control and mini-hydropower development are instruments for addressing poverty in western areas and in rural and urban areas with pockets of poverty. Sustainable water resources management and environmental preservation can also be critical to the poor because they are often the first and most severely affected by deteriorating resources. China has already made major strides in reducing poverty and improving social well-being by providing water infrastructure in disadvantaged areas.

**Theme 6: New water resources infrastructure, rehabilitation/upgrading of existing infrastructure, and adequate O&M are key requirements to achieve the objective of continued sustainable economic and social development.**

29. The Bank can assist in the design and implementation of water resources infrastructure projects that are set within an adequate water resources management framework. Infrastructure investments need to be carried out while at the same time attaining sustainable water resources management and use. There are many infrastructure classes that continue to have high economic—not necessarily financial—rates of return, including: wastewater treatment plants, inter-basin transfer projects, agricultural water conservation, irrigation and drainage system rehabilitation, dams, flood control works, watershed management works and industrial water pollution control facilities. The benefits from these investments can be maximized by embedding them within an improved water resources planning and management system.

30. China as elsewhere in the world has focused much more attention on infrastructure development than on Operation and Maintenance (O&M) of existing infrastructure. Adequate institutional and financial mechanisms need to be designed and implemented to ensure sustainability of the investments. The Bank can assist China in ensuring that appropriate institutional systems including adequate O&M mechanisms are built into water resources management programs.

**IV. Key Strategic Issues**

31. China has done well—indeed perhaps too well in some cases—in constructing infrastructure to develop and control water resources. It has, however, done much less well in establishing the institutional framework and systems needed for efficient management of water resources. That should now be the focus of Ministry of Water Resources (MWR) and Bank partnership and work in the water resources sector. The

first and most critical requirement for better water resources management is institutional development. The force and effectiveness of institutional development and change will determine how well China meets the critical challenges of water scarcity, pollution and flood control which threaten to limit the speed and quality of the country's future economic growth. A number of key or priority issues, some of which cut across the above themes, need special Government attention. The Bank can help MWR address many of these issues, either by incorporating them into investment loans, and through AAA work specifically designed for and targeted on reforming management of the water resources sector. Most of these issues are already emphasized in various Chinese Planning and Strategy Documents and in Bank Analytical Reports. The suggestion here is that they be attacked jointly by MWR and the Bank working in close partnership.

## **Institutional Development**

32. **Issue 1: Revising the National Water Law.** During the past several years China has been dedicating a great deal of effort to revising the 1988 National Water Law. The Bank assisted Department for International Development (DFID) and MWR with a large-scale review of the 1988 water law and proposed revisions. The revised law approved in October 2002 supports many of the water resources management improvements addressed in this Strategy Paper, including: (a) integrated water resources management; (b) water conservation; (c) water resources planning; (d) water rights and discharge control systems; (e) water allocation for ecological and environmental protection and restoration; (f) the rule of law overriding administrative decision making; and (g) participatory irrigation management. The Bank can continue to provide advice to China in reviewing and revising laws, as well as ensure that the laws are implemented and enforced in Bank-financed water resources projects.

33. **Issue 2: River Basin Management.** Based upon the lessons learned in the Yellow, Yangtze, Hai and Tarim<sup>2</sup> River Basins and the Taihu Basin, and on experiences around the world, the Bank has substantial experience which can assist China with improving river basin management. Establishment of integrated basin management institutions such as river basin councils and other actions geared towards cross-sectoral, intergovernmental and stakeholder cooperation could be designed into components of future Bank-financed activities. The Bank proposes implementing institutional solutions in one priority basin – the Hai River, one of China's most water-stressed and polluted basins, where several provinces/municipalities are involved, including principally Beijing, Hebei, and Tianjin. If sufficient effort and resources were applied, results could be obtained by 2008 when the Olympics will be held in Beijing. Even with this focus, however, support and participation from the highest levels of Chinese leadership will be needed to deal with the severe institutional, management and ecological issues facing the water sector.

34. Institutional arrangements for River Basin Management (RBM) in China have not proven to be very effective in dealing with RBM issues such as water allocation among competing uses and political/administrative jurisdictions (provinces, prefectures, counties), water shortages and pollution control. A new institutional framework is needed, such as high-level River Basin Councils, which would have the authority and political backing to break through or override the bureaucratic, administrative and jurisdictional boundaries which prevent efficient IWRM and RBM and effective stewardship of the water resources.

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<sup>2</sup> The Bank has started to assist China in developing basin management institutions, most notably under the Tarim Basin II project in Xinjiang, which supports the establishment and strengthening of the Tarim Basin Water Resources Commission (TBWRC). The Tarim Basin suffers from severe water scarcity and water and land salinity, among other problems. Significant progress has been made in Xinjiang, but a fully functional basin-wide water management institution has yet to be achieved. The TBWRC includes representatives from the various provincial level bureaus including water, environment, agriculture, finance, land and the planning commission. The prefecture governments also play a key role in TBWRC, and therefore all of the important players are represented. However, TBWRC still has a long way to go before it is fully functional. For example, water allocations between prefectures have been agreed, yet there are still inadequate mechanisms to monitor and enforce the allocations. Progress is being made in Xinjiang, partly because it is within one province and has high-level political support of leaders at both the provincial and prefecture levels, and has strong support from the central government as well.

35. Severe fragmentation of responsibility and accountability exists both vertically and horizontally in the administration of water resources management. MWR, through the Hai Basin Commission for example, is responsible for inter-provincial water allocation and flood control, yet the responsibility for functional control in most instances lies at the provincial, prefecture and county levels. The Hai Basin Commission is seen primarily as a department of MWR. The provinces/municipalities, prefectures and counties have no direct involvement in the Commission. Jurisdiction over water quality issues is blurry and often contested between State Environmental Protection Administration (SEPA) and MWR with duplication of effort and data collection. The Ministry of Construction (MOC), nominally responsible for guiding investments in municipal wastewater treatment, serves primarily as an advisor and cities are left to their own devices to finance and pay for expensive wastewater treatment projects. The State Office for Comprehensive Agricultural Development (SOCAD) under MOF has certain responsibilities for improving agricultural production and irrigation services at the onfarm level. The Ministry of Agriculture (MOA) needs to be more involved in delivering the type of agricultural engineering and extension services that will be required to facilitate water conservation in agriculture. Agricultural Engineering is a profession that is in short supply in China and should be supported to ensure that there is a specially trained cadre of engineering professionals who can work with both agricultural and irrigation professionals, and link the two, to design and implement comprehensive water conservation activities and projects.

36. Although Government recognizes the seriousness of the problems at a conceptual level, concerted high-level political leadership is essential to break the jurisdictional impasses which now stymie efforts to manage water in a comprehensive, integrated fashion. River Basin master plans in China are prepared by Class A institutes, but in order for the plans to be effective management tools, the different responsible entities (at the provincial, prefecture, county levels) need to have direct involvement in their preparation. Otherwise they will only be a listing and prioritization of infrastructure investments without including a detailed agreed-upon plan for improving water resources management to be carried out by the different political/administrative entities (provinces, prefectures, counties) and line agencies in a coordinated and integrated fashion. The recipe for success includes establishing high-level participatory entities (such as River Basin Councils) for coordination which have the authority to direct and manage sectoral agencies according to agreed upon basin (or sub-basin) management principles, policies and plans.

37. Finally it is essential that integrated water resources management be built from both the bottom-up and top-down. In China this means working more at the county level for coordination of activities of the water, environmental protection, construction, civil affairs, finance bureaus and the planning commission, as well as establishing and working with water user organizations. Water committees or other coordinating bodies can be established at the county government level to facilitate this integration of activities. It is recognized that county borders are established on the basis of political boundaries and not hydraulic boundaries, so institutional development to link and improve coordination of bottom-up activities with neighboring counties that share the same water resource will also need to be a priority.

38. **Issue 3: Data and Information Systems.** It is obvious that you cannot manage what you do and not measure. The Government needs to focus much more attention, emphasis and financial resources on measurement, monitoring and knowledge systems, and their integration with effective water rights and discharge permitting systems and water resources management in general. The Bank can bring international experience in water rights, discharge control systems, information systems, and water markets, which can be very useful to China as it works to design and implement adequate functional systems.

39. Water measurement systems throughout China are generally deficient, rendering sincere efforts to manage water almost impossible. The establishment of a unified database system integrating both quality and flow measurement is urgently needed. A unified database needs an institutional home at the highest level of water resources management in a Basin. Such a system might replace the separate MWR and SEPA systems by transferring the consolidation of distributed measurement systems to a secretariat level organization under a River Basin Council. Rationalization of measurement and reporting systems could borrow from international experience. Measurement of water flows, usage and quality are the foundation of many activities including water rights administration, groundwater management, irrigation and water supply

service delivery, volumetric water charging, demand management, flood control, and enforcement of discharge standards. Closely allied with measurement and monitoring are knowledge management systems, which consist of models, Decision Support Systems, GIS, remote sensing systems, which help process and analyze data, and inform decision making by technocrats, decision-makers, and the general public.

40. **Issue 4: Water Rights and Water Rights Systems.** An efficient water rights system is essential for effective water resources management and allocation, and to promote mobilization of investment resources. At present, administrative decisions which are at times arbitrary substitute for a water rights system, and the data, accurate measurement and data integrity required for a water rights system to operate do not generally exist. Establishment and implementation of water rights systems covers a broad array of activities, including water use surveys and cadastres, licensing and permitting, measurement, monitoring, and enforcement. In China, the water rights are not well defined. Although there are inter-provincial water allocations in some major basins, the lack of effective water rights systems at the county level often means that provinces can not control their own consumptive water use from the bottom up. During drought periods, particularly in rural areas, the equitable allocation of water is almost impossible. Water rights should encompass both surface and ground water. A functioning system of water rights with water rights limited to water availability (including during droughts) can provide the foundation for water markets that would allow for the partial reallocation of water from lower-value to higher-value uses. Without a reasonably effective water rights system, water markets or trading are not feasible because of the risks to the parties involved. Water rights are therefore an essential prerequisite for effective handling many of the water allocation problems currently being encountered, especially in the water-scarce north.

41. **Issue 5: Volumetric Water Pricing.** Government policy is that users should pay for water according to the amount used. This requires volumetric water pricing for both M&I and irrigation water. The Bank will continue to support the Government in Bank-financed projects to establish volumetric water charges and pricing structures and policies so that the water price covers the full cost of water, and also so that in water short areas and overexploitation areas the price is set higher to encourage conservation. However, it is also essential to recognize that agriculture is by far the biggest water user and the present method of area based (per mu) irrigation water charges encourages vast water waste by farmers; simply raising water rates under the present area-based charge system will not reduce water waste, but will simply increase the burden on farmers. The critical need is to change the agricultural water charge system to volumetric water charges. This is consistent with the policy above that users should pay according to the amount used.

42. **Issue 6: Water Charges to Cover Costs.** For sustainability, it is essential that water charges cover costs. In irrigated agriculture areas it is Chinese policy that water prices need to reflect the full cost of water including the O&M costs plus overhaul and replacement costs of water delivery systems. In reality, however, water prices are rarely set at this level because it is politically and socially extremely difficult, especially with the water supplier not accountable and responsive to the requirements of users. In addition, the equity and incentive effects of prices are important in the allocation and rationing of available supplies amongst users. When water prices are set at the full-cost-of-water level and when they are based on volumetrically measured water deliveries, there is a dual benefit of demand management by encouraging water conservation (including conversion to higher-value crops) and providing sufficient financial resources to ensure the sustainability of the systems.

43. The Chinese Government has stated that it does not consider the water charge in irrigated agriculture areas to be part of the farmer's tax burden, but instead water cost is a cost of production that the farmer needs to sustain. This is critical; world wide experience shows that irrigation which depends on government subsidies for its survival will not be efficient or sustainable. Conversely, irrigation based on autonomous self-managing user groups has been shown to be sustainable for hundreds of years without the need for government intervention. To promote willingness to pay, needed for sustainability, water pricing must also be transparent. Water charging needs to be completely separated out from tax collection and other fee collection mechanisms and should be calculated in a transparent manner based on the full cost of water

delivery by institutions (such as the WSCs and WUAs in the SIDD system) specifically set up for the irrigation and drainage system management function.

44. For city water supply and sanitation systems, Chinese policy is that the price should reflect the full cost of water/sewerage and provide for the financial sustainability of the company providing the service, and that the charge should reflect the amount used. Great strides are being made in urban water tariff reform, and the price of water has increased dramatically in the last few years in many Chinese cities, particularly in the north. This, along with industrial restructuring, has dampened demand for water, at least in the short-run. Many Chinese water companies are now financially strained because of overcapacity in infrastructure and the subsequent debt service, while at the same time facing a decrease in water demand. Increasing revenues, while reducing costs, in order to improve profitability is now one of the major challenges facing urban water utilities. Most Chinese cities are moving in the direction of transforming municipal drainage departments into wastewater companies, and many are exploring opportunities for private sector participation. Likewise, recent governmental decrees have mandated that wastewater fees should cover O&M costs (including depreciation) and a “suitable profit”. Nevertheless, the wastewater sector is far behind the urban water sector in implementing sustainable financial policies, and new regulatory structures need to be developed to monitor wastewater services.

45. Chinese cities also need to properly maintain and continually renew the existing water supply, storm water, and sewerage infrastructure. International experience is that deterioration of assets must be captured within the accounting framework used by water companies and renewal costs covered by water tariffs. The Bank can assist in designing tariff regimes and financial targets for specific projects, and through AAA study support in defining pricing regulation and policies.

46. **Issue 7: Role of Government and Private Sector.** As China moves more and more towards a socialist market economy, it is important to clearly define those activities that are and should remain the responsibility of government and those activities which could be better carried out by the private sector. Experience throughout the world has shown that the government’s principal role should be involved with those aspects which can be defined as “public” goods, and the private sector should have responsibility for “private” goods. Policy, regulation, enforcement, adjudication and the like are clearly public functions. Water services that relate to environmental protection, health, flood control, water rights and discharge permits administration and sustainable natural resources management are also public goods where direct beneficiaries of services are not easily identified. For these types of public functions and goods in water service, substantial financial subsidies may be required and justified. However, certain water services can also be considered a private good to the extent that they are utilized by water users for municipal, industrial, agricultural and other profitable purposes, and the beneficiaries can be identified. Charges for these services should include cost recovery. The Government needs to play a policy and regulatory role to ensure adequate water rights, discharge control, and environmental protection, and to regulate water pricing, while the private sector needs to take on more and more the role of developer and user of water as a private good. With its international experience and networks, the Bank is well suited to providing support in developing and implementing the institutional framework for government and private sector water management mechanisms, and adapting them to individual projects as they are prepared and implemented.

47. Bank projects should also support efforts to mitigate risk and improve efficiency through regulation. Regulatory agencies need to be developed and staffed to focus on comparative regulation of service coverage, quality, efficiency, and tariffs. There should be no difference in regulatory requirements between public and private service providers. Regulatory efforts should seek to establish performance that matches best utility practice in China and internationally. The Bank could, for example, finance a study on how comparative yardstick regulations could be introduced in the water supply sector.

48. While the state has much strength in the engineering of large-scale hydraulic infrastructure, it is not well equipped for the more entrepreneurial and locally based initiatives, which will yield workable and replicable institutional and financial innovations. The SIDD concept is a good case in point – the final outcome was not predicted but strategic principles based on international experience were incorporated in the

original designs, which were based on Chinese policies and conditions and which employed an iterative “learning by doing” approach. Central and Provincial Governments must pull back from physical implementation of projects and concentrate on facilitation, providing grants to support investment in public goods, local political support, and the development of regulatory mechanisms at national, basin and local government levels.

49. Decentralized assignment of expenditure and revenue authorities among government entities, and the high level of off-budget transactions complicate the financial picture even further. The non-transparency and uncertainties not only deter the involvement of legitimate private companies and corporations, but also undermine the financing of water resources management institutions. Modernization requires less negotiation, more legal process, and a lower degree of uncertainty in the mediation of transactions between the public and private sectors. Law must replace power as the arbiter of “deals”.

50. Increasing the awareness and understanding of the importance of water and water resources management issues at all levels of civil society and government are important first steps in moving towards major improvements in water resources management in China. The Chinese Government with Bank’s assistance, should design and implement targeted programs in information, education and communication for children and adults, as well as training programs for government functionaries and leaders in all aspects of water resources and environment management. Care should be taken in ensuring that appropriate staff are selected for specific training programs in consideration of skills, needs and responsibilities.

51. **Issue 8: Financing Strategy and Mechanisms.** A financing strategy and mechanisms for the water sector needs to address the following issues:

- ❑ *Tariff Reform.* Political obstacles to rational water pricing must be overcome, both to reverse the unsustainably high level of utilization of water resources, and to provide the future cash flow to service existing and future debt. The public can also be influenced by government-sponsored campaigns exhorting them to use water more carefully, but there are limits to how much consumption can be reduced to sustainable levels. Price remains the main instrument of demand management and does not require government funding. Tariff reform is not incompatible with government subsidization of investment and is required, whatever the ownership status of utilities. International experience shows that government support for equity and public good reasons is best achieved through transparent targeted subsidies (either to investment or through so-called output based subsidies) and which are on-budget, rather than by holding down tariff rates or providing soft loans to utilities and local governments.
- ❑ *Funding of Software Investments.* The need for rapid and sustained institutional reform, workable regulation and modern management systems requires heavy investments in human capital, knowledge and other management investments (See Box above). Government itself must have the resources to retain and engage the best professionals for the most demanding tasks, such as regulation. The private sector can also provide services for planning, investment and the operational stages of infrastructure development. For instance a competitive market for consulting services is needed, scientific and managerial knowledge must be transferred through a variety of channels, including private investment. Because public goods benefit the general public and future generations of people their provision should be financed out of government budgets and not through cost recovery from water users. To what extent private activities should be subsidized from the public purse depends not only on the public good argument but also the effectiveness of the incentives required to ensure desired behaviors.
- ❑ *Private Sector Involvement in Infrastructure Financing.* The next generation of Bank sector projects need to include private sector participation where there is political support in favor of private sector participation. The funding for projected investment over the next decade is measured in hundreds of billions of dollars. Direct financing is beyond government’s fiscal capacity, even with access to international donor assistance and borrowing from multilaterals. The private sector needs to be



drawn into infrastructure financing. International donor and government funding of infrastructure projects must be done in a way, which enhances investment opportunities for the private sector and does not crowd them out. The long-term goal is to achieve commercially based project financing by a combination of loans, debt and equity. The returns to these financial instruments should be tied directly to and solely to the project and its cash flows (so-called non-recourse financing), and perhaps related enhancements (e.g. those issued by project sponsor, third parties, export credit agencies etc.). It is only through looking at investment from the issuer's perspective that China will attract the requisite level of financing.

52. Methods to deal with these issues can and have been built into Bank-financed projects on limited basis. For example, several projects have included support for the SIDD irrigation management "software" reforms, and those reforms themselves have included reform of irrigation tariffs and mobilization of private (farmer) resources. However, this has been done only on a case by case basis where windows of opportunity presented themselves. Needed is a systematic national strategy in support of such reforms and more importantly this approach.

### **Water Scarcity**

53. **Issue 9: Groundwater Management.** Groundwater in North China is an invaluable resource which at present is over-exploited with much of it wasted. Moreover, what is happening to groundwater in the north is a sign of an impending water crises which has already begun. The Bank can assist in meeting this crises by including groundwater management components in Bank-financed projects with irrigation or components that based partly on groundwater.

54. In many parts of northern and western China, increasing reliance on groundwater to compensate for surface water scarcity and pollution has compromised sustainable availability of the groundwater resource for future generations, with groundwater levels falling by a meter or more a year in some areas. In some areas, water supplies are so dependent on groundwater resources that limiting extraction will dramatically increase water shortages. In addition, groundwater has traditionally been a strategic source of water for dry years, like drought insurance, but this insurance has been severely compromised because of excessive overdraft and lowered water tables. In the Hai Basin, for example, estimates of the sustainable groundwater supply are on the order of 17 bcm per year, while 1998 withdrawals were 26 bcm. As a result, groundwater tables have dropped precipitously and other problems such as salinity intrusion and land subsidence have become increasingly serious. In addition to absolute overuse of water, increasing pollution of groundwater has further reduced the amount of usable groundwater available.

55. Clearly this situation is unsustainable in the long run. Action to redress the imbalance between recharge and abstraction will need to be taken, or the resources will be lost for beneficial use entirely. Taking action now will help ensure that groundwater resources remain available for future generations. At present, however, the Government's efforts to bring groundwater overdraft under control are ineffective in most areas, and groundwater levels continue to fall. It is important to halt further decline in water levels and quality. If this is not done, pumping depths will become so great that only the most high value uses can support groundwater. The key actions required in areas suffering from groundwater overdraft include: (i) defining groundwater management units and determining sustainable yields; and (ii) preparation and implementation of groundwater management plans that strictly monitor and control abstraction and pollution. Strong, high level efforts are needed to bring water consumption strictly into line with availability and to stop groundwater pollution.

56. MWR's Water Conservation Project (FY01) financed by the Bank is helping to pilot the preparation of groundwater management plans in four counties in Northern China. These efforts are still in the early stages of formulation and implementation and cover very limited areas. The proposed GEF Hai Basin Project provide more support for groundwater management at the basin, municipality (Tianjin), and county levels. Despite their acknowledged importance, these efforts have proven extremely difficult to start.

57. **Issue 10: Irrigated Agriculture.** Agriculture is by far the largest user of water in China, and maintaining the share of agriculture in total water use will be probably not be possible as municipal and industrial water demands increase in most parts of the country. There are, however, important food security, social and political justifications for maintaining adequate water supplies to agriculture and rural areas. At the same time, the actual and opportunity cost of supplying large volumes of water, much of which is wasted, to low value-added agricultural is clearly no longer sustainable. The opportunity costs for the water are simply too high. China with Bank assistance needs to dedicate a major attention and resources to improving water use efficiencies, and particularly to increasing production and the value of production per unit of evapotranspiration (ET).

58. Over-exploitation of groundwater particularly in the Hai Basin and the overuse of surface water in water short basins such as the Huang and the Hai to produce low-value irrigated grains is shortsighted. International studies have estimated that it takes about 1000 m<sup>3</sup> of water to produce one ton of grain. Curtailing the overuse of water resources in Northern China would entail reducing water consumption (ET) in irrigated agricultural areas by about 30 bcm per year resulting in a reduction of 30 million tons of grain production. The reduction could partially be offset through holistic water conservation measures and the importation of a relatively small proportion of grains when compared to China's annual production of about 450 million tons. Fortunately, there is significant scope for reducing the use of irrigation water and groundwater over abstraction, while at the same time not endangering the rural economy.

59. Three components are suggested in a strategy for water use in agriculture:

- *Water Saving or Conservation.*<sup>3</sup> For irrigation projects in water short areas the Chinese Government with Bank support should focus on a water conservation approach. The Government plans to use the MWR-managed Water Conservation Project (WCP), which adopts a comprehensive view of water saving, as a pilot demonstration project to help improve its ongoing National Irrigated Agriculture Water Savings Program.<sup>4</sup> The approach being implemented in WCP focuses on generating “resource water savings.” In addition, in order to achieve sustainability, there will need to be restrictions on the use of groundwater and surface water for the production of grains in water scarce areas. The Bank could also support applied research in irrigated agriculture to achieve maximum production and maximum value of production per unit of water consumed. This could be included in a Bank-financed agriculture technology project presently in the initial stages of preparation.
- *Institutional Reforms.* Irrigation institutional reforms including mechanisms for water measurement and volumetric water charging should continue to have high priority to the Chinese Government and will continue to be an important part of Bank-financed irrigation projects. The Chinese Government with Bank support has been strongly focusing on the “Self-Managing Irrigation and Drainage District” (SIDD). This model fosters the development of farmer “Water User Associations” (WUAs) and the creation of financially autonomous Water Supply Corporations or Organizations (WSCs/WSOs) which sell bulk water to the WUAs. This new model has proven to be much more effective in providing good services and properly maintained infrastructure than conventional government bureau irrigation and drainage system management. A key element in the SIDD concept

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<sup>3</sup> Resource water savings can be achieved through three primary mechanisms:

**agronomic measures**, such as land-leveling, deep plowing in the rainy season, plastic and organic mulching, development and use of less-water-consuming varieties, and cropping pattern adjustments to less-water-consuming crops;

**better infrastructure**, such as canal lining, low-pressure water pipe, drainage systems and reuse of return flows, sprinkler systems and micro-irrigation systems.

**management measures**, including irrigation and drainage institutional reforms, improved water measurement and transparent volumetric charging, and better on-farm application of water including scientific irrigation and deficit irrigation.

<sup>4</sup> The Government's National Irrigated Agricultural Water Savings Program focuses primarily on an engineering approach to water saving, such as onfarm irrigation technology improvements and canal lining. Many farming areas take advantage of this program to reduce losses (which before improvements returned to the groundwater or surface water system and therefore were not really lost to the available water resource) and increase water availability to crops by providing a full supply where only a partial supply was previously available, and by expanding irrigated areas. The engineering water savings measures thus often result in more water consumption than previously and have a negative impact on the water source.

is the introduction of water measurement and volumetric transparent water pricing; the SIDD concept provides an institutional framework for transparent water pricing.

- *Improvement of large-scale irrigation and drainage systems.* China has about 220 large scale irrigation and drainage systems. These systems need to be efficient. With 22 percent of the world's population, China has only 7 percent of the arable land, about 50 percent of which is irrigated producing about 75 percent of national agriculture output. In addition, encroachment of urban and industrial areas continually reduces the land available for agricultural production, further increasing the need to raise yields. These circumstances require increasingly intensive use of irrigated agriculture, and it is essential to increase output from irrigated land where yield potentials are highest. However, most of the irrigation and drainage systems in China were built in the 1960s, in many cases originally with substandard designs and quality, many were left incomplete due to lack of resources, and most have further deteriorated due to deferred maintenance. The majority of these irrigation and drainage systems are very inefficient and in urgent need of major repair and upgrading, including improvements of water conveyance and field efficiencies. A major issue will be how the large costs of these rehabilitation projects will be repaid. It will be important to identify which investments benefit the farmers and which investments are for public goods (such as environmental protection and restoration, and resource water savings) and then determine a repayment structure that allocates repayment responsibilities based on this analysis. The Bank stands ready to assist in these projects and to help to help ensure that they are carried out in conjunction with institutional reform, comprehensive integrated water conservation measures, and appropriate repayment responsibilities. A possible new irrigation and drainage system improvement project for Bank financing is currently being discussed with MWR and the Chinese Government and would be an excellent vehicle to carry out many of the reforms discussed above, as well as to improve technical efficiency.

60. **Issue 11: Water Transfers for Future Municipal and Industrial (M&I) Water.** The Chinese Government will probably need to continue to focus considerable attention and resources on the design and implementation of long-distance water transfer projects, often times across basins. Notable examples include the Bank-financed Wanjiashai project which transfers water from the Yellow River, and the Government-proposed South-North water transfer scheme from the Yangtze River Basin to the North China Plain. The Bank can assist China with the planning and implementation of feasible water transfer schemes within a sound management framework, and particularly in the structuring of contractual, organizational and financial arrangements. However, due to the high cost of the water transferred, water demand will have to come from municipalities and industry, and this will mean substituting high cost surface water (which will need the added cost of treatment) for comparatively low cost groundwater which usually needs minimal treatment. This is clearly a difficult challenge, politically and institutionally.

61. Transfer projects should be economically and financially justified, which will usually limit them to the supply of M&I water, and be prepared and implemented in an environmentally and socially sound manner. As the Chinese economy and population grow, the demand for M&I water use will increase, placing more strains on already over-utilized water resources, particularly in north China where most of the economically feasible reservoir sites have already been developed. The first line of attack should be (a) demand management and leakage control in M&I systems; and (b) demand management and water conservation in irrigated agriculture areas; and (c) some reallocation of irrigation water to M&I uses. Changing technology and higher pricing of water (including for wastewater service) will reduce demand, but additional water will still be needed in some areas.

62. The entity operating the transfer infrastructure should be fully corporatized, financially autonomous, and under regulatory control; alternatively the private sector could play a key role through management contracts, lease arrangement, financing, and/or BOT schemes. One of the keys to sound planning of water transfer schemes is the up-front financial commitment of the beneficiary cities or large industrial users. This is typically done through legally binding "take-or-pay" type contracts which force the beneficiaries to honestly evaluate their real water needs and their ability to pay. Moreover, when firm financial commitments by water users are made up-front, the sponsoring agency can usually access private financing

through commercial banks, project bonds, etc. Moreover, the high-cost transferred water should be delivered to an area with adequate water resources management systems already in place and functioning, to minimize water waste.

63. **Issue 12: Urban water conservation and non-conventional water sources.** More emphasis on demand management in urban areas including measurement of all deliveries and higher water prices coupled with programs to educate and promote water conservation by urban users is needed in China. More attention needs to be given to non-conventional water sources such as rainfall harvesting; rainfall enhancement; wastewater reuse; improving flood management to optimize flood control, water storage and groundwater recharge; utilization of brackish water and desalination. There is considerable international experience in these areas that, through the Bank, can be used to design and implement water conservation and non-conventional water source actions.

### **Ecological Protection and Pollution Control**

64. **Issue 13: Watershed Management.** The effective management of land and water resources to preserve the natural resource base is a fundamental element of environmental management. In some parts of China, watersheds are seriously degraded due to deforestation, overgrazing and poor agricultural practices. This contributes to habitat destruction and its negative impact on bio-diversity, serious river sedimentation problems and increased flooding in downstream areas, and to severely deteriorated land and low productivity in the upper catchments. Therefore, implementation of watershed management projects should continue throughout the country and particularly in the western regions, and the Bank is ready to support these projects. The Chinese Government through the Bank-financed Loess Plateau I and II Projects has been highly successful in implementing community-based, economically, socially and environmentally sound watershed management activities that have protected and restored forests and grasslands, improved agriculture and local irrigation practices, and reduced erosion. These projects have promoted community participation, building in ownership, responsibility, accountability and cost recovery. Two new watershed management projects in the upper Yangtze and Pearl River basins are currently being considered for Bank financing and would build in the lessons learned in the Loess projects.

65. **Issue 14: Environmental Flows.** Water resources management in China needs to pay much greater attention to allocating and managing water for environmental purposes. Consideration needs to be given to ensuring adequate flows in environmentally important river reaches, provision of water for wetlands and to preserve and restore riverine environments and bio-diversity, and to maintaining sufficient outflows to the sea for sediment transport and to preserve coastal environments. China has recently begun to place emphasis on these issues as demonstrated by water deliveries to the lower Tarim River to restore the “green corridor”, deliveries of Yangtze river water to Taihu Lake for water quality improvement and operation of the newly constructed Xiaolangdi Dam to restore continuous flows top lower reaches of the Yellow River and short-duration high-volume discharges in order to flush out to the sea sediment build up in lower Yellow River reaches. Allocation of water for environmental purposes in water short areas will require reductions in consumptive uses which could come from water conservation activities, and water rights restrictions. The Bank can mobilize the considerable international experience in determining needs for environmental flows and in allocating and managing water for this purpose in addition to other purposes.

66. **Issue 15: Water Pollution Control and Urban Environmental Management.** Over the last ten years there have been improvements in some of the larger rivers, but the remainder have deteriorated. China’s freshwater lakes and costal waters are experiencing continued degradation or, at best, only minimal signs of improvement. Pollution negatively impacts the environment and public health, and because water can become unfit for different uses, pollution can significantly impact water availability. Water pollution control is becoming more complex in China, as the diversification in pollution sources increases. There has been a general decrease in industrial pollution over the 1990s, although there are still challenges with the Township and Village Industrial Enterprises (TVIEs). Pollution from municipal sources is gradually leveling off as large cities invest in wastewater treatment, but the explosive growth of small cities and towns have resulted in new challenges for municipal pollution. China is also experiencing a rapid increase in non-point

sources from fertilizer and pesticide use, and particularly from growth in large animal husbandry operations. A key water pollution control challenge is therefore how to deal with this diversification in pollution sources taking into account that financial resources and technical capabilities are concentrated in the industrial sector and large cities, while some of the greatest challenges are with smaller cities and towns, and non-point sources. Future Bank projects in wastewater need to continue to address a wide array of technical, financial and institutional problems and be consistent with the Bank and China's environmental strategy as outlined in "China: Air, Land and Water." China needs a tightly integrated water resource and management strategy and wastewater treatment is key to remedying existing and preventing future pollution. Some of the problems are technical, but once again the pivotal constraints are primarily institutional, managerial and financial.

67. The Environmental Protection Bureaus (EPBs) at the provincial and local levels are responsible for monitoring and enforcing guidelines and standards established by SEPA. The regulatory effectiveness varies across the country, and in many areas is inadequate. Central to any effort to control water pollution, are environmentally sound and financially attainable standards. Although SEPA guidelines conceptually link discharge requirements to ambient water quality objectives, specific discharge standards are often higher than what is environmentally justified and impose a significant financial burden on industries and municipalities. There are many cases in China where municipalities could discharge primary (or enhanced primary) treated wastewater into large rivers or coastal areas without significant environmental damage -yet the discharge standards require secondary and even occasionally nutrient removal. Investment in unnecessary treatment increases investment costs, and adds to debt servicing and O&M costs, straining municipal budgets and increasing sewerage fees. Specific environmental discharge requirements should be fashioned within a comprehensive basin-wide framework, and with due consideration of financial constraints. Industrial pollution discharge standards are expressed in concentration terms (mg/l), which can be easily met through dilution. Internationally, effective industrial discharge standards are typically stated in mass loading terms (i.e., kg of pollutant per ton of product) as well as concentrations, thus forcing industries to reduce actual pollutant discharges. More emphasis also needs to be placed on the use of clean industrial technologies as a way of reducing pollutant loading. Standards for industries discharging into municipal sewers also needed to be reviewed, and the general goal should be to remove toxic and hazardous wastes on-site, allowing the municipal plants to treat the conventional pollutants. A comprehensive re-evaluation of water pollution standards in terms of categories of water bodies taking into account their function and assimilation capacity is needed, and the Bank could assist in this effort.

68. At the beginning of the 1990s, the dominant water pollution issue in China was industrial point source pollution, particularly within the state-owned sector. Many industries discharge toxic and hazardous waste, such as heavy metals, which are not biodegradable. Toxic and hazardous wastes discharge, either directly into the receiving water bodies or indirectly into wastewater treatment plants, which cannot properly treat them. When toxic or hazardous wastes are discharged into sewage collection and treatment systems, they have the potential for corroding pipes and pumps, upsetting the treatment process, and making residual waste toxic and therefore difficult to dispose of, and unusable for reuse. Considerable strides have been made in reducing pollution from state-owned industries, with significant gains coming from the closure of unprofitable and heavily polluting industries in large urban areas. Although the proportion of industrial wastewater passing through wastewater treatment plants increased through the 1990s, the effectiveness of the treatment process, as defined by the proportion of treated wastewater meeting national standards, has declined. This observation supports the view that while the regulatory system provides good incentives for installing treatment facilities, it provides far less incentive to operate them effectively. The next great industrial pollution challenge in China, however, is controlling isolated industries in peri-urban areas and town-and-villages without wastewater treatment.

69. In absolute terms, China has the largest urban population of any country in the world, around 400 million, and the rate of urbanization is increasing. Total wastewater flows from municipal sources now exceed those from industrial sources. Despite double-digit growth of municipal wastewater treatment capacity over the last decade, Chinese cities continue to be underserved by sewers and wastewater treatment plants. It is estimated that only about 10 percent of the non-industrial municipal wastewater receives secondary treatment, and that treatment capacity will have to be increased six-fold over the next twenty years

to double the current treatment rate, which will require massive investments.<sup>5</sup> In order to finance these investments, Chinese cities will need to increasingly turn to private capital, either through commercial loans, bonds, and occasionally equity markets. Private capital, however, will require sound and transparent utility management systems, including rational and stable tariff structures, accountable management, transparent financial reporting, and well-defined regulatory mechanisms.

70. An analysis of municipal water pollution control efforts should distinguish between different sizes of cities, and townships. There are approximately 663 cities in China, around 93 cities have populations greater than 500,000. These large Chinese cities have, and are continuing to, invest huge sums on wastewater collection and treatment throughout the country--making it one of the largest wastewater investment programs in history. In the rush to construct the infrastructure, there are understandably planning and design inefficiencies. Most of the plants and collection systems are built on standard design criteria rather than adequate field measurements of flows, concentrations, variability, etc. Bench or pilot scale tests of different treatment processes are almost never done. Estimates of demand are too high and not realistic given the resource constraint for water supply deliveries. In addition, the treatment efficiency of many existing municipal WWTPs is less than optimal, and enforcement of discharge standards is lax. Often the collector infrastructure to link sources of wastewater (sewerage and industrial wastewater) and the wastewater treatment plant, are inadequate. Investment in upgrading and expanding collection systems are potentially as large or larger than the investment in WWTPs. Industries should be connected to municipal wastewater systems wherever possible (after removing toxic and hazardous wastes). Establishment of functional wastewater discharge permit systems including discharge into sewage systems, needs continued Chinese Government focus, and can be assisted through Bank-financed water pollution control projects. Removing toxic compounds is also a prerequisite for safe reuse of treated wastewater.

71. There are approximately 570 cities with populations less than 500,000 and these cities are lagging in efforts to control water pollution, and face many financial and operational constraints. Addressing these problems is fundamental to improving the water environment because small cities are experiencing the most rapid population and industrial growth. The government does not encourage economic migration into the large cities, but smaller cities are generally more welcoming. Moreover, there is a general policy to turn large cities into service centers, and relocate industries to smaller cities and towns. Financially, smaller cities have less money for funding projects and only limited access to suitable maturity debt. A key challenge is to develop new financing arrangements for small cities. The Bank would be ready to assist in defining and establishing new financing mechanisms for smaller cities, perhaps using a more programmatic or wholesale financing approach. The future infrastructure financing needs for small cities is enormous, and China and the Bank need work together to find suitable approaches to tackle these problems.

72. There are approximately 18,000 “established towns” in China and pollution from many of these towns and non-point source pollution are perhaps the most difficult of all water pollution management and control challenges. Township water pollution issues are poorly documented and there is little experience in addressing these issues in China. The Bank can help plan, implement and finance pilot small town and agricultural projects to help control water pollution in critical watersheds and to bring international experience in addressing these problems in other parts of the world.

73. **Issue 16: Rural Water Supply and Sanitation.** China with Bank support has had a very successful program of providing rural water supply and sanitation systems. Presently about 50 percent of the rural population has access to safe drinking water. The 10<sup>th</sup> Five Year has the goal for this to reach 65 percent. This will have positive health and poverty reduction benefits and contribute significantly to reaching one of the millennium development goals. A very positive aspect to this program is that rural water users pay about 75 percent of the investment costs and 100 percent of the O&M costs. The Bank can continue to support this important program.

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<sup>5</sup> Ibid., pg. 58.

74. **Issue 17: Hydropower and Mini-Hydro in Poor Areas.** There is considerable potential throughout China for hydropower development, and particularly for economic and social development at the community level and in poverty regions through the construction of mini-hydro power facilities. Such investments can also have substantial positive environmental impacts by providing a source of local energy for cooking and light, rather than burning wood. The Bank can assist the Chinese Government in preparing and implementing these types of projects. The projects could include investments in developing mini-hydro including local transmission grids in pilot zones such as the upper Yangtze and upper Yellow River basins. The Bank could also assist in AAA and Technical Assistance (TA) work to support mini-hydro development, including: (a) development of strategies, policies and procedures; (b) regional planning and project feasibility studies; (c) integrated management of water and energy; (d) defining mini-hydro's relationship to power sector reform in China; and (e) other legal and institutional aspects. A mini-hydro project is currently being considered for Bank financing.

## **Flood Control**

75. **Issue 18: Flood Control and Protection.** The critical importance of flood control and protection in China, both historically and currently, cannot be overemphasized. Direct economic losses from floods have accelerated dramatically in recent years in China due to rapid economic and population growth. This trend is likely to continue. Emphasis has generally been on dike construction and other flood control works, and huge investments are still needed in the future. Some 450 million people live under constant threat of flood, which is especially severe for the Yangtze, Yellow, Huai and Song-Liao River Basins, and their protection depends heavily on continuation and improvement of flood protection infrastructure.

76. In addition to support for infrastructure, however, the Chinese Government should focus more attention on nonstructural measures. A methodology is needed to prioritize flood protection areas with priority attention accorded the protection of densely built-up residential and industrial areas where the benefit-cost ratios would be maximized – although, in general, flood protection should be consistent with overall basin needs to ensure a reasonably equitable distribution of flood hazards. The guiding principles for planning nonstructural measures for seriously affected lowland areas include: (a) providing modern technology in flood forecasting and flood warning including the development of hydrodynamic and decision support models with flood progression mapping and other non-structural flood control warning and protection measures; (b) establishing and enforcing of better flood plain management to reduce losses, especially measures to reduce the frequency and intensity of flood plain and lowlands use; (c) giving priority to achieving a high standard of safety for residents with respect to buildings, refuges, and evacuation routes; (d) assuring that emergency response plans are effective and regularly tested; (e) using community education to raise and maintain awareness of the flood risk and ensure that the populations at risk are prepared and would respond during flood emergencies; and (f) exploring options for compensation, flood insurance and related financial methods of dealing with flood losses.

77. The Bank has been providing and continues to provide significant support to projects with flood control and management components, both structural and non-structural, including Xiaolangdi Multipurpose Project, Taihu Basin Flood control Project, Yangtze Basin Water Resources Project and more recently the Yangtze Dike Strengthening Project. All of these projects include both structural and non-structural measures. Under Yangtze Dike Strengthening Project, the Bank is financing the establishment of a National Flood Disaster Prevention Center to improve information sharing, policy formulation and implementation and technical assistance for flood management throughout the country. The Bank can continue to provide assistance in flood management through the financing of both structural and non-structural measures. The Bank can also assist in improving the Dam Safety program for China's numerous dams. There is considerable international experience in non-structural flood control measures and dam safety that can be of assistance to China.