TECHNICAL ASSISTANCE
(Financed by the Japan Special Fund)

TO THE

PEOPLE’S REPUBLIC OF CHINA

FOR THE

STUDY OF THE CARRYING CAPACITY OF WATER
RESOURCES

November 2002
CURRENCY EQUIVALENTS
(as of 31 August 2002)

Currency Unit – Yuan
Y1.00 = $0.1208
$1.00 = Y8.28

ABBREVIATIONS

ADB – Asian Development Bank
DFR – draft final report
EA – executing agency
m³ – cubic meter
MWR – Ministry of Water Resources
PRC – People’s Republic of China
TA – technical assistance
TOR – terms of reference

NOTE

In this report, "$" refers to US dollar

This report was prepared by a team consisting of: Binsar Tambunan (Team Leader), Zhou Yaozhou, and Xiaohua Peng.
I. INTRODUCTION

1. The Government of the People’s Republic of China (PRC) requested technical assistance (TA) from the Asian Development Bank (ADB), to undertake the Study on the Carrying Capacity1 of Water Resources. The TA2 was included in the PRC country strategy and program update for 2002. An ADB fact-finding mission visited the PRC from 19 to 30 August 2002 and reached an understanding with the Government on the objective, scope, cost and financing, and implementation arrangements of the TA. The TA framework is in Appendix 1.

II. ISSUES

2. The total available water resource (surface plus groundwater) in the PRC is estimated at about 2,800 billion cubic meters (m³) per annum including recharge from groundwater of 830 billion m³, or per capita availability in 1992 of 2,400 m³/person.3 The water availability has decreased to 2,220 m³/person in 1997 and is expected to decrease further to 1,700 m³/person by 2030, when the population is forecast to peak at 1.6 billion. Continuing population growth and rapid economic growth of about 7–8% per annum has increased water use per capita and competition among potential water uses, while aquifers are becoming depleted, water pollution is rising, and the ecosystem and environment are being degraded. Total water usage has increased from 530 billion m³ in 1993 to currently 552 billion m³. While agriculture and other rural uses dominate water use, accounting for 69%, industry (21%) and urban domestic (10%) uses have been increasing rapidly. The PRC’s water resources are unevenly distributed in time and space, with rainfall concentrated in April to September and less water in the north than in the south. For example, per capita water availability in the Haihe River Basin in the north is only 355 m³/person. However, 1,000 m³/person is the internationally accepted limit, below which water is defined as scarce.

3. Beside the need to meet increasing demands for domestic and industrial use, adequate flows need to be maintained in rivers to protect the environment and ecosystem. The present PRC guideline is that water use in a river basin should not exceed 40% of the average annual runoff to avoid serious ecological and environmental damage. In water-scarce regions and basins, water use has exceeded 95% of the average annual runoff, causing serious environmental and ecological problems, which are already evident in land subsidence, disappearance of wetlands, drying of riverbeds and estuaries, serious sedimentation in river mouths, sea water intrusion, depletion and pollution of groundwater, water quality degradation, and pollutant loads that are far beyond the self-purification capacity of rivers. This situation makes sustained economic growth impossible, and adversely affects the quality of life of the larger population, particularly the poor, who depend on these natural water regimes and who suffer disproportionately from lack of access to safe water.

4. The PRC’s Tenth Five-year Plan (2001–2005) points out the need for sustainable use of water resources based on river basin capacity, and balanced socioeconomic development based on existing natural and human resources by (i) establishing a water-saving society with focus on increasing water use efficiency, promoting water saving, and improving water use; (ii)

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1 Water resources carrying capacity is defined as “the maximum yield (exploitable amount of available surface and groundwater of a certain quality) of a river basin under the condition that water allocation to subsistence and commercial functions is reasonable and feasible from a technological and economical viewpoint and the environmental function and ecological value are sufficiently sustainable.” The TA will clearly define the water resources carrying capacity and provide the analytical and computational framework for water resources planning, which includes the methodology for estimating ecological and environmental water demands.


enhancing unified planning and management; (iii) optimizing allocation on a whole-basin basis; and (iv) coordinating water use for industrial, domestic, and ecological purposes. The Government realizes the need to protect its ecological environment to sustain its water resources and to establish an overall policy and institutional framework for setting the regulations and standards for integrated water resources management.

5. ADB has been increasingly involved in water resources management in the PRC and has assisted the Government to plan water resources on a holistic river basin approach, thoroughly integrating environmental, social, and economic considerations in regional planning through analysis of different scenarios. TA 1835-PRC strengthened the institutional capacity of the Haihe River Water Conservancy Commission for water resources planning and resulted in a list of potential development projects. The Haihe Basin was also identified as one of three priority river basins targeted for environmental improvement.

6. ADB further assisted the Government to define a strategic planning process and identify and evaluate strategic options for addressing the main issues and constraints in the water sector, for effective water management. TA 2817-PRC identified seven priority issues relating to (i) mobilizing the institutional and financial means (viz. lack of unified water administration and management; gap between policy, planning, and implementation; and inadequacy of financial resources); and (ii) addressing major water resources problems (viz. escalating flood damage, water scarcity, and inefficient water use; and increasing water pollution, soil erosion, and ecosystem degradation. The need to strengthen present approaches in the water sector, and upgrade planning and management capacity over the longer term was highlighted.

7. To clarify the diverse responsibilities for water management, the National People’s Congress approved the revision of the 1988 Water Law on 29 August 2002, to become effective on 1 October 2002. New features of the revised law include (i) establishing a centralized authority for administration, management, and supervision, and allocation of water, including water rights and water use rights; (ii) licensing for the withdrawal of water; (iii) preparing plans for water resources development, use, protection, and saving based on river basins and administrative regions; (iv) introducing a zoning system for different uses of water and a system for setting total sewage discharge limits; (v) introducing the river basin management concept and defining the legal status of river basin administration agencies (commissions); and (vi) introducing a two-step water pricing mechanism. Many of these changes are consistent with ADB’s policy dialogue. ADB will assist the Government in setting out principles and procedures for integrated river basin management, including watershed management in the Yellow River. Also, taking the Yellow River as a case study, ADB is helping the Government to strengthen environmental management, develop local legislation and regulations for implementing the trans-jurisdiction provisions of the Water Pollution Prevention and Control Act, examine the need for a national law to integrate various dimensions of river basin environmental management, and disseminate the findings and recommendations for potential application in other river basins. The capacity of concerned institutions on hydrological units are also being strengthened on participatory approaches toward better integrated water management and water resources demand management, under the ongoing Water Sector Development Project assisted by the Department For International Development (DFID).

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5 ADB.1997. TA 2817-PRC: Strategic Options for the Water Sector, Manila.
Despite the progress made in its legal and policy framework, the PRC still needs to develop capacity to accurately estimate the amount and quality of water that is needed to protect the rapidly deteriorating ecosystem and environment within and along the rivers; assess water demands by various users to allow sustained economic growth; and develop appropriate conditions to allocate water, monitor use, and resolve conflicts among water users. Such planning capacity will, in turn, allow the determination of the maximum amount of water that can be sustainably used for other purposes, such as economic and domestic uses. The appropriate methodology to determine the carrying capacity of rivers is thus considered as a crucial basis to determine appropriate and sustainable allocation and use of water in the river basins. In the PRC, however, no systematic research to determine the water resources carrying capacity has been conducted. The TA will address this crucial element, to improve the management of water resources in a sustainable manner in the context of trans-jurisdictional, integrated river basin management, which is consistent with ADB’s water policy and its operational strategy for the PRC to promote integrated water resources management particularly in water deficit areas of the north and west. The recent Johannesburg World Summit has also reaffirmed commitment to managing the natural resource base in a sustainable and integrated manner as a central element of the international agenda, and includes in its plan for implementation, among others, to develop integrated water resources management and water efficiency plans by 2005.

The TA will help the PRC develop such capacity on a pilot basis for the Haihe River Basin, which covers parts of Hebei, Henan, Liaoning, Shandong, and Shanxi provinces and Inner Mongolia Autonomous Region. The basin is representative of the conditions in the north and northeast PRC, and is characterized by very high demands for water. The area is one of the three major crop-producing basins, but high economic activity in the basin has made it increasingly difficult to allocate water on an environmentally sustained basis. Shortages of water and conflicts among water users have become a major issue, constraining sustained economic growth. The basin is also characterized by the highly developed water monitoring system and availability of extensive river flow data, providing an optimum platform to pilot test the development of carrying capacity assessment.

### III. THE TECHNICAL ASSISTANCE

#### A. Purpose and Output

The purpose of the TA is to develop within the PRC’s water sector agencies, capacity (methodology, supporting tools, and human resources) to determine the quantity and quality of river flows needed to maintain the ecology and environment of the basin, thereby allowing the river basin agency to monitor the consumption of water against the river’s carrying capacity. The outputs of the TA will include (i) a methodology for estimating the environmental water demand and water demand-supply tradeoffs, (ii) a provisional river basin plan for the Haihe River Basin, and (iii) enhanced knowledge and skills in planning for integrated water resources management.

#### B. Methodology and Key Activities

The TA will take into account the relevant findings of previous ADB-funded TAs and other studies and will (i) develop a methodology to define and determine the quality and quantity of water needed to sustain the basin’s environment and ecosystem, including design of consolidated and water resources and environmental database based on Geographical Information System; (ii) develop a monitoring system of the ecological health of the basin.

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8 World Summit on Sustainable Development in Johannesburg, 26 August to 4 September 2002.
including but not limited to water quality, biodiversity, flora, and fauna; (iii) carry out a policy and institutional review to ensure effective management of consumption of river flows within its carrying capacity; and (iv) demonstrate the usefulness and suitability of the methodology in the Haihe River Basin.

12. Human resources capacity within the Ministry of Water Resources (MWR) will be improved through on-the-job and specific training sessions. International training (for a maximum of 10 staff) will also be carried out in an appropriate country (e.g. Institute for Infrastructural, Hydraulic and Environmental Engineering Delft, Netherlands). Training will be organized (i) at the policy level, for water resources planning, policy formulation, and decision making; and (ii) at managerial and technical levels, for staff and experts on water resources planning methodologies, principles, and evaluation of ecological and environmental water demands and estimation of water resources carrying capacity. Workshops will be organized to discuss (i) the methodologies for estimating ecological and environmental water demands; (ii) assessment of water resources carrying capacity; (iii) water resources planning and policy formulation with integrated social and economic development and environmental protection; and (iv) the study results.

C. Cost and Financing

13. The total cost of the TA is estimated at $755,000 equivalent, consisting of $350,000 in foreign exchange costs and $405,000 equivalent in local currency costs. ADB will finance $600,000 equivalent to cover the entire foreign exchange cost and $250,000 equivalent of the local currency cost. The TA will be financed on a grant basis by the Japan Special Fund, funded by the Government of Japan. The Government will finance the remaining local currency cost of $155,000 equivalent. Government financing will cover remuneration and per diem of counterpart staff; office accommodation and equipment; workshop expenses; translation and interpretation; and maps, documents, and reference materials required during the course of the study. Details of the cost estimates and financing plan are given in Appendix 2. ADB has informed the Government that approval of the TA does not commit ADB to extend any further TA for implementing any recommendations of the TA.

D. Implementation Arrangements

14. The Department of International Cooperation, Science and Technology in MWR will be the Executing Agency for the TA, and will coordinate activities with other stakeholders. MWR will provide necessary office space and logistical support for TA implementation. A project officer will be appointed within MWR to head a full-time counterpart team. The counterpart team will work closely with the TA consultants and liaise with ADB.

15. A TA technical panel will be set up to coordinate and guide, as required, the work of the TA consultant and counterpart team. The panel will consist of technical experts from government agencies, nongovernment organizations, universities, established experts in the PRC, the Global Water Partnership China Technical Advisory Committee, and other stakeholders as necessary. The technical panel in collaboration with the counterpart team will organize at least three 1 day workshops during TA implementation.

16. The TA will be implemented by a team of international consultants in association with domestic consultants. The consultants, to be engaged through a firm, will be selected by ADB in accordance with its Guidelines on the Use of Consultants and other arrangements satisfactory to ADB for the engagement of domestic consultants. Since the methodology and terms of
reference (TOR) are specific and clear, consultants will be selected on the basis of the simplified technical proposal procedure. TA implementation is expected to commence in April 2003 and end in March 2004 over a period of 12 months. A total of 56 person-months of consulting services will be required, comprising 11 person-months of international and 45 person-months of domestic consultants. The international consultants will comprise (i) a water resources specialist/team leader; (ii) a hydrologist; and (iii) a freshwater ecologist. The domestic consultants will comprise (i) a water resources planner and institutions specialist/team leader; (ii) an environmental specialist; (iii) a freshwater ecologist; (iv) a water resources specialist; (v) a geohydrologist; (vi) a hydrologist; (vii) an irrigated agriculture specialist; and (viii) an economic planner. Outline TOR for the consulting services are given in Appendix 3. The TA consultants will advise on and purchase a commercially available river basin planning software in accordance with ADB’s guidelines for procurement. The software will be transferred to MWR at TA completion.

17. ADB will select and engage consultants based on the quality of the proposal and the cost of the services to be provided (the quality and cost-based selection method). The Government may recommend specific consulting firms to be included in the long list of firms, which ADB will take into consideration in preparing the short list. The short list of consulting firms, once prepared, will be sent to the Government for comment and statement of any objections before the invitation to submit technical and financial proposals is issued to the firms. The Government is encouraged to meet with the invited firms to explain its expectations of the outcome and implementation of the TA and consulting services. A representative of the Government will be invited to participate in contract negotiations with the consultant.

18. At the end of the first month of TA implementation, the consultant will submit an inception report to the Government and ADB that will be discussed in a tripartite review meeting. At the end of the fourth month, the consultant will conduct an international workshop to discuss the analytical and computational framework developed under the studies and to apprise relevant stakeholders of the TA’s objectives and scope. An interim report will be submitted to the Government and ADB at the end of the eighth month, the findings of which will be discussed in an interim stakeholder workshop and subsequently in a second tripartite review meeting. A draft final report (DFR) will be submitted to the Government and ADB on the eleventh month, and will be presented by the consultant in a final workshop. A third tripartite review meeting will be held prior to the conclusion of the TA to discuss the DFR. The suggestions and comments generated during the final workshop and the tripartite review meeting will be incorporated into the TA final report, to be submitted to the Government and ADB at the end of the TA implementation period.

IV. THE PRESIDENT’S DECISION

19. The President, acting under the authority delegated by the Board, has approved the provision of technical assistance not exceeding the equivalent of $600,000 on a grant basis to the Government of the People’s Republic of China for the Study of the Carrying Capacity of Water Resources, and hereby reports such action to the Board.
## TECHNICAL ASSISTANCE FRAMEWORK

<table>
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<tr>
<th>Design Summary</th>
<th>Performance Indicators/Targets</th>
<th>Monitoring Mechanisms</th>
<th>Assumptions and Risks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Goal</strong></td>
<td>To improve management of water resources in a sustainable manner.</td>
<td>National polices on water resources utilization and environmental and ecological protection issued. Specific plans updated in all river basins by 2007.</td>
<td>Government reports</td>
</tr>
<tr>
<td><strong>Purpose</strong></td>
<td>To develop within the People’s Republic of China’s water sector agencies capacity to determine the quantity and quality of river flows needed to maintain the ecology and environment of the basin, which allows the river basin agency to monitor the consumption of water against the river’s carrying capacity.</td>
<td>Appropriate regulations issued on water resources use by 2004. Systematic water abstraction permits operational by 2004.</td>
<td>Asian Development Bank review missions and policy dialogues. Ministry of Water Resources Reports.</td>
</tr>
<tr>
<td><strong>Outputs</strong></td>
<td>1. Methodology for demand estimation and demand-supply trade-offs established. 2. Provisional Haihe River Basin plan developed. 3. Enhanced knowledge and skills in planning for better integrated water resources management.</td>
<td>Generally applicable basin planning tools developed (models and GIS databases). Pilot study, policy, and institutional review completed by month 12. Monitoring system of the ecological/environmental health of the basin developed by month 12. Number of staff trained.</td>
<td>Technical Assistance completion report TA progress reports Workshops TA review missions</td>
</tr>
<tr>
<td><strong>Activities</strong></td>
<td>1. Methodology and Techniques  a. Estimate minimum water demand in relation to ecological and environmental protection. b. Assess water resources carrying capacity. 2. Conduct a pilot study on</td>
<td>Start: Month 1 Complete: Month 4 Responsibility: MWR Start: Month 2 Complete: Month 5 Responsibility: MWR Start: Month 4</td>
<td>TA progress monitoring reports TA review missions Tripartite review meeting</td>
</tr>
<tr>
<td>Design Summary</td>
<td>Performance Indicators/Targets</td>
<td>Monitoring Mechanisms</td>
<td>Assumptions and Risks</td>
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<tr>
<td>Haihe River Basin.</td>
<td>Complete: Month 12 Responsibility: MWR Start: Month 4 Complete: Month 11 Responsibility: MWR</td>
<td>TA progress reports TA review missions</td>
<td>• Appropriately qualified MWR staff available • Timely and adequate counterpart funding</td>
</tr>
<tr>
<td>3. Organize stakeholder workshop and external training</td>
<td></td>
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<tr>
<td>Inputs</td>
<td></td>
<td></td>
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<tr>
<td>Consultants</td>
<td>$415,000 11 person-months international 45 person-months domestic $20,000 $45,000 $40,000 $155,000 $600,000 $755,000</td>
<td>TA progress reports TA review missions</td>
<td></td>
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<tr>
<td>Software Training, conference, workshops Counterpart staff costs Government Funding ADB</td>
<td>Total TA Amount</td>
<td></td>
<td></td>
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</table>
## COST ESTIMATES AND FINANCING PLAN

($’000)

<table>
<thead>
<tr>
<th>Item</th>
<th>Foreign Exchange</th>
<th>Local Currency</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Asian Development Bank Financing</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Consultants</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Remuneration and Per Diem</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i. International Consultants</td>
<td>235</td>
<td>0</td>
<td>235</td>
</tr>
<tr>
<td>ii. Domestic Consultants</td>
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<td>180</td>
<td>180</td>
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<tr>
<td>1.4. International and Local Travel</td>
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<td>5</td>
<td>35</td>
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<tr>
<td>2. Software</td>
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<td>20</td>
</tr>
<tr>
<td>3. Conference and Workshops</td>
<td>10</td>
<td>15</td>
<td>25</td>
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<tr>
<td>4. International Training</td>
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<td>20</td>
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<tr>
<td>5. Surveys</td>
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<td>6. Miscellaneous Administration and Support Cost</td>
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<td>10</td>
</tr>
<tr>
<td>7. Government representative for Contract Negotiations</td>
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<td>0</td>
<td>5</td>
</tr>
<tr>
<td>8. Contingencies</td>
<td>30</td>
<td>20</td>
<td>50</td>
</tr>
<tr>
<td><strong>Subtotal (A)</strong></td>
<td><strong>350</strong></td>
<td><strong>250</strong></td>
<td><strong>600</strong></td>
</tr>
</tbody>
</table>

**B. Government Financing**

1. Counterpart Staff, Per Diem, and Travel                           | 0                | 40             | 40         |
2. Office Accommodation and Equipment                                | 0                | 30             | 30         |
3. Workshop Expenses                                                 | 0                | 30             | 30         |
4. Translation and interpretation                                    | 0                | 30             | 30         |
5. Maps, Documents and Reference Materials                            | 0                | 25             | 25         |

**Subtotal (B)**                                                      | **0**            | **155**        | **155**    |

**TOTAL (A+B)**                                                       | **350**          | **405**        | **755**    |

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**Footnotes:**

- ^a^ Financed by the Japan Special Fund
- ^b^ Includes the purchase of a commercially available river basin planning software.

**Source:** Asian Development Bank estimates.
OUTLINE TERMS OF REFERENCE

A. General Requirement

1. The consultants will have demonstrated project-related experience in their fields. The team leader and all other international consultants will have had extensive experience mainly in the People’s Republic of China or in other countries with similar conditions. In general, the international and domestic consultants are responsible to transfer knowledge through on-the-job training to the PRC counterpart team. The tasks of the consultants are presented below.

1. International Consultants

   a. Water Resources Specialist/Team Leader (7.5 person-months)

2. The team leader will

   (i) prepare a detailed work plan and monitor Technical Assistance (TA) progress;
   (ii) collect and evaluate reports, data, inventories, drawings, and maps as required, especially for the Haihe River Basin;
   (iii) review Government policies and strategies for integrated water resources planning and management;
   (iv) evaluate data of the main water resources, related structures, and water users in the Haihe River Basin, and prepare a river basin scheme for modeling purposes;
   (v) assess available methodologies and the best practices for water resources carrying capacity studies and integration of this concept into river basin planning;
   (vi) develop a methodology and associated modeling tools for evaluating the water resources carrying capacity in basin planning in the PRC and illustrate this in the Haihe Basin planning study;
   (vii) evaluate long-term proposals and assess the sustainable development paths and limits on resources for the Haihe River Basin;
   (viii) integrate the water resources and spatial planning aspects in the Haihe River Basin;
   (ix) prepare the provisional river basin plan for the Haihe River Basin;
   (x) contribute to the reporting and organization of presentations, workshops, and seminars; and
   (xi) assess available data systems for carrying capacity studies and recommend a system for data and information collection in Haihe and as general guidance for the PRC.

b. Hydrologist (1.5 person-months)

3. The hydrologist will

   (i) review and evaluate the hydrological data base and set up the series to be used in the model for the Haihe River Basin;
   (ii) analyze the water demand-supply allocation and specifically the trade-off between the water resources carrying capacity and present and future socioeconomic development in the Haihe River Basin;
   (iii) select and recommend commercially available water demand and allocation model covering all water resources system elements on any appropriate level of detail and linking hydrologic inputs of water at various locations (supply) with
various water-using functions (demand) to evaluate varieties of measures related to infrastructure and operational management;
(iv) assist in development of methodology and associated modeling tools for river basin planning based on carrying capacity; and
(v) contribute to workshops and reports.

c. **Freshwater Ecologist** (2 person-months)

4. The ecologist will

(i) review reports on environmental and ecological demand estimation, water use, norms, standards, regulations, and laws in and outside the PRC, including on water quality;
(ii) recommend a methodology and associated modeling tools for estimating ecological demand to fit in basin planning practice in the PRC;
(iii) assess the ecological problems in the basins in north and northeast PRC, and specifically the Haihe River Basin;
(iv) assess the environmental and ecological impacts of the alternative measures proposed in the Haihe River Basin plan;
(v) assist in the specification of the approach for analysis of the water resources carrying capacity related to the ecological aspects in the Haihe River Basin;
(vi) contribute to the workshops and reports.

2. **Domestic Consultants**

5. The domestic consultants will cooperate closely with the international consultants and the government counterpart staff.

a. **Water Resources Planner/Institutions Specialist and Team Coleader** (12 person-months)

6. Team coleader will

(i) prepare with the international team leader the detailed work plan and monitor TA implementation progress;
(ii) review and discuss with relevant institutions at the central and provincial levels, including the ministries of agriculture; construction; forestry; geology and mineral resources; and water resources; the State Environment Protection Agency; and the State Planning Commission to assess current administrative arrangements, policies, and strategies for integrated water resources planning and management in the Haihe River Basin;
(iii) review the roles and assess the efficiency and effectiveness of the Haihe River Conservancy Commission in integrating water management at the basin level, and identify areas for improvement;
(iv) develop a methodology and associated modeling tools for estimating the water resources carrying capacity in the basin planning in the PRC and illustrate this in the Haihe Basin planning study;
(v) prepare a scheme of the Haihe River Basin for the water resources carrying capacity evaluation and specify the type of computation to be carried out and the associated requirements for the computational framework and data base;
(vi) carry out the water resources carrying capacity assessment for the Haihe River Basin;
(vii) identify and analyze measures with particular emphasis on future options for the Haihe River Basin;
(viii) review the present spatial plan, integrating it with water resources aspects, and determine the sustainable development paths and limits on the resources for the basin;
(ix) prepare the provisional Haihe River Basin plan; and
(x) help organize workshops and seminars, and contribute to presentations and reports.

b. **Environmental Specialist** (8 person-months)

7. The specialist will

(i) review reports on environmental demand estimation, water use, norms, standards, regulations and laws in the PRC;
(ii) prepare an inventory of the environmental problems and causes in the basins in the north and northeast PRC, and specifically the Haihe River Basin;
(iii) develop a methodology and associated modeling tools for estimating water demand, evaluate the water resources carrying capacity to fit basin planning practice in the PRC, and demonstrate this in the Haihe River Basin pilot study;
(iv) make an inventory of the environmental impacts of the remedial measures proposed in the provisional Haihe River Basin plan;
(v) set up an ecological data base, estimate the water demand, and contribute to the water resources carrying capacity for the Haihe River Basin;
(vi) contribute to the provisional Haihe River Basin plan; and
(vii) contribute to the workshops and reports.

c. **Freshwater Ecologist** (8 person-months)

8. The ecologist will

(i) review reports on ecological demand estimation, water use, norms, standards, regulations and laws in the PRC;
(ii) develop a methodology and associated modeling tools for ecological demand estimation and for the water resources carrying capacity evaluation to fit in basin planning practice in the PRC and demonstrate this in the Haihe River Basin pilot study;
(iii) prepare an inventory of the ecological problems and causes in the basins in the north and northeast PRC, and specifically the Haihe River Basin;
(iv) assess the ecological impacts of the remedial measures proposed in the provisional Haihe River Basin plan;
(v) set-up an ecological data base, estimate the ecological water demand, and help evaluate the water resources carrying capacity for the Haihe River Basin;
(vi) contribute to the provisional Haihe River Basin plan; and
(vii) contribute to the workshops and reports.
d. **Water Resources Specialist** (8 person-months)

9. The specialist will

(i) coordinate activities for setting up the general computational framework (models, geographical information system, and data bases) for estimating ecological and environmental water demand, and evaluating the water resources carrying capacity in a river basin;

(ii) review and advise on acquiring commercially available computer software for the required computational framework;

(iii) set up, develop, and implement the computational framework, with the river basin planning model and hydrological, geohydrological, agriculture, water quality, ecological and other data;

(iv) collect and process data bases from previous studies in the Haihe River Basin and structure those data for assessing the water resources carrying capacity;

(v) contribute to the model computations for estimating water demand, and assessing the water resources carrying capacity for the Haihe River Basin; and

(vi) contribute to the workshops and reports.

e. **Geohydrologist** (3 person-months)

10. The geohydrologist will

(i) describe the geohydrological situation in the Haihe River Basin and assess the groundwater potential, its present and future development and its management;

(ii) set up a geohydrological data base and modeling system for the Haihe River Basin, and contribute to evaluating the water resources carrying capacity of the Haihe River Basin;

(iii) make groundwater balances and estimate the potential contribution of groundwater to the water uses in Haihe River Basin;

(iv) contribute to the workshops and reports.

f. **Hydrologist** (2 person-months)

11. The hydrologist will

(i) prepare the hydrological time series of surface water runoff, rainfall, etc., which will be used in the river basin planning model for the Haihe River Basin;

(ii) prepare surface water balances and estimate the potential contribution of surface water to the various water users in Haihe River Basin;

(iii) set up a hydrological data base and modeling system for the Haihe River Basin, and contribute to the water resources carrying capacity evaluation for the basin; and

(iv) contribute to the workshops and reports.

g. **Irrigated Agriculture Specialist** (2 person-months)

12. The specialist will

(i) collect and evaluate relevant agricultural and irrigation data for the Haihe River Basin focusing on agricultural and irrigation water demand;
(ii) prepare projections of agriculture and irrigation activities for the Haihe River Basin;
(iii) estimate the agriculture water demand in the Haihe River Basin and contribute to the water resources carrying capacity evaluation for the Haihe River Basin;
(iv) evaluate agricultural projects in the Haihe River Basin;
(v) contribute to the workshops and reports.

**h. Economic Planner (2 person-months)**

13. The economic planner will

(i) collect and evaluate relevant socioeconomic data for the Haihe River Basin focusing on domestic, municipal and industrial water use;
(ii) prepare projections of socioeconomic activities for domestic, municipal and industrial for the Haihe River Basin and estimate demands based on the projections;
(iii) analyze the relationship between water diversions and the marginal value of water in different uses;
(iv) based on established unit rate requirements for different categories of water users, determine an appropriate water tariff structure;
(v) help estimate the contribution of groundwater to domestic, municipal and industrial water supply;
(vi) specify water resources strategies for the Haihe River Basin taking into account sustained resource use, limits on resources, and choices in the mix of resource use;
(vii) advise on the integration of water resources and spatial planning in the context of optimal resource use for the Haihe River Basin;
(viii) evaluate the trade-off between the carrying capacity for water resources and socioeconomic development in the Haihe River Basin;
(ix) estimate the economic unit value of different uses of water or categories of uses and suggest how, in the PRC context, carrying capacity planning can facilitate use of market-based instruments in water resources and environmental management; and
(x) contribute to the workshops and reports.

**B. Reporting**

14. The consultants will submit three reports. An inception report will be submitted at the end of the first month of TA implementation, presenting initial findings and, based on this, an updated work plan. The inception report will be received in a first tripartite meeting between senior Government representatives, the technical panel, and ADB. An interim report will be submitted at the end of the eighth month, and will be reviewed in a second tripartite meeting. The draft final report will be submitted at the end of the eleventh month to be reviewed in a third tripartite meeting. Comments generated during the third tripartite meeting will be incorporated into the final report, which will be submitted to the Government and ADB at the end of the implementation period.

15. The consultants will provide 20 copies each of the inception and interim reports and 50 copies of the final report to the Ministry of Water Resources at TA completion. ADB will require 5 copies of the inception and interim reports and 10 copies of the final report, in English.