



Technical Assistance Report

Project Number: 46463
Capacity Development Technical Assistance (CDTA)
February 2014

Kingdom of Bhutan: Adapting to Climate Change through Integrated Water Resources Management (Financed by the Japan Fund for Poverty Reduction and Multi- Donor Trust Fund under the Water Financing Partnership Facility)

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Asian Development Bank

CURRENCY EQUIVALENTS

(as of 3 January 2014)

Currency unit	–	ngultrum (Nu)
Nu1.00	=	\$0.0160
\$1.00	=	Nu62.334

ABBREVIATIONS

ADB	–	Asian Development Bank
DOA	–	Department of Agriculture
GLOF	–	glacial lake outburst flood
IWRM	–	integrated water resources management
NEC	–	National Environment Commission
NIMP	–	National Irrigation Master Plan
NIWRMP	–	National IWRM Plan
RBC	–	river basin committee
RBMP	–	river basin management plan
TA	–	technical assistance
WUA	–	water user association

TECHNICAL ASSISTANCE CLASSIFICATION

Type	–	Capacity development technical assistance (CDTA)
Targeting classification	–	General intervention
Sector (subsectors)	–	Agriculture and natural resources (water-based natural resources management, irrigation, drainage and flood protection)
Themes (subthemes)	–	Environmental sustainability (natural resources conservation, environmental policy and legislation), economic growth (knowledge, science and technological capacities), governance (public administration [national, decentralized, and regional], capacity development (institutional development, organizational development)
Climate change	–	Climate change adaptation
Location (impact)	–	Rural (medium), urban (medium), national (high)
Partnerships	–	Japan Fund for Poverty Reduction and Multi-Donor Trust Fund under the Water Financing Partnership Facility

NOTE

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

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I. INTRODUCTION

1. The Government of Bhutan has requested technical assistance (TA) from the Asian Development Bank (ADB) in building the capacity of the National Environment Commission (NEC) for adapting to climate change through integrated water resources management (IWRM). The TA is included in ADB's country operations business plan, 2013–2015 for Bhutan¹ and has been prepared with the government and NEC during two consultation missions to Bhutan. The design and monitoring framework is in Appendix 1.²

II. ISSUES

2. Integrated water resources management is a holistic approach to integrating water resources management within the broader environmental, socioeconomic, and political framework, and provides a basis for stronger coordination between all stakeholders in planning and managing water resources in river basins. In Bhutan, with its rich natural environment, steep terrain, abundant water resources, and as an emerging economy, IWRM can play an important role in the sustainable development of the country's vast hydropower resources. It also can protect the health and quality of Bhutan's watersheds and freshwater resources, and address the following challenges related to satisfying future demands for drinking, sanitation, agriculture, and other needs, particularly in view of anticipated climate change impacts such as varying seasonal rainfall and floods:

- (i) **Watershed protection and management of sub-basins for multisectoral use.** Sustainable development of water resources should ensure effective water allocation among sectors —irrigation, drinking supply, recreation, dry-season hydropower generation, and environmental flows. Sub-basins are the main sources for drinking water and irrigation. Despite an overall national abundance of per capita water availability, in many sub-basins water resources are less dependable, limiting access to drinking water and agricultural productivity for extended periods every year. These sources are primarily rainfed and springfed, and there are various reported cases of sources becoming dry during the winter season or permanently dry in some places. This has led to an increasing number of water-related conflicts between communities and users. Planned agricultural expansion and future population growth will place more pressure on these resources.
- (ii) **Irrigated agriculture.** Irrigated agriculture consumes more than 80% of used water, primarily for growing rice. Rice is Bhutan's most important cereal crop and has cultural, traditional, and environmental significance. Its production, however, has been constrained by shortages in water availability and labor. The Tenth Five-Year Plan focuses on food self-reliance, while the draft plan emphasizes expanding irrigation and improving water management by (a) increasing the secured irrigated area through rehabilitation and construction of new infrastructure; (b) increasing irrigation efficiency; (c) improving the productivity of water through on-farm practices such as applying System of Rice Intensification practices, mechanization, and crop diversification; and (d) building capacity among irrigation engineers and farmers.
- (iii) **Water supply and sanitation.** Sub-basin tributaries and springs cater for most of the country's domestic water supply in both urban and rural areas. Water scarcity in these seasonal sub-basins is threatening overall security in meeting water supply and sanitation needs. This scarcity is expected to worsen in the future from (a) population growth; (b) urban migration; (c) increasing per capita consumption; (d) increasing

¹ ADB. 2012. *Bhutan: Country Operations Business Plan, 2013–2015*. Manila.

² The TA first appeared in the business opportunities section of ADB's website on 1 July 2013.

competition between sectors, particularly irrigated agriculture; (e) reduced water availability;³ (f) increasing pollution of water sources; and (g) increasing temperatures and evapotranspiration due to climate change. Lack of comprehensive water resource data, understanding of alternative sources and integrated technical approaches, and institutional direction and coordination to plan and manage water supply and sanitation also limits access to safe and secure water.

- (iv) **Water-induced disaster risk management.** The main river systems originate from more than 2,674 glacial lakes, some of which pose the threat of glacial lake outburst floods (GLOFs). GLOFs had occurred in 1957, 1960, 1968, and 1994 with varying intensity, damage to properties, and loss of life. Bhutan is also prone to flash floods, especially in the eastern and southern foothill regions, due to the steep terrain, fragile geology, and high rainfall. In 2009, Cyclone Aila, originating in the Bay of Bengal, caused one of the worst recent disasters in Bhutan. The resulting floods were experienced across the country, causing loss of life and damaging agriculture land, roads, bridges, schools, hydropower stations, and other infrastructure. The cyclone also triggered landslides that isolated numerous communities and caused sedimentation within rivers, which impaired hydropower generation. Bhutan also experiences dry and drought conditions, most recently in 2005 and 2006 with no rain and snow.
- (v) **Resilience and adaptation to climate change.** Climate change projections⁴ indicate that by 2069, there may be an increase of more than 2 degrees in the current annual mean temperature, a 20% increase in current total annual precipitation, and more frequent extreme rainfall. Winters are predicted to become drier and warmer. Climate change impacts include (a) glacial retreat in the Himalaya–Hindu Kush region and elimination of smaller glaciers caused by increased temperatures; (b) increased and decreased flows in the main and tributary rivers depending on location and input parameters; and (c) increased variability, magnitudes, and frequencies of precipitation-related disasters such as floods, typhoons, and cyclones. Major secondary impacts include (a) increased frequency and intensity of GLOFs resulting from glacier melting; (b) landslides and increased soil erosion resulting from severe storms; and (c) changes in temperature, solar radiation, and atmospheric carbon dioxide content, which will impact crop yields. Risks from climate change include loss of property, more deaths and injuries, less agricultural productivity, and reduction in hydropower generation. Bhutan's current resilience to predicted climate change is low, and adaptation planning is necessary to minimize negative impacts on population, environment, and economy.

3. The government recognizes IWRM being the key to addressing these challenges, making it a cross-cutting objective of the environment sector in the Tenth Five-Year Plan, 2008–2013 and in the draft Eleventh Five-Year Plan, 2014–2019; and by enacting the Water Act in 2011, which is founded on the principles of IWRM. To support implementation of the Water Act, NEC is preparing an initial edition of the Water Regulation to be promulgated in 2014.⁵ The government has requested this TA to assist NEC in expanding and implementing the regulation, with other relevant agencies. The regulation will promote IWRM as an effective mechanism for overall river basin management and will strengthen resilience against current climate variability and anticipated impacts of climate change.

³ Owing to declining spring flow, loss of snowpack, and watershed degradation.

⁴ National Environment Commission. 2011. *Second National Communication to the United Nations Framework Convention on Climate Change (UNFCCC)*. Bhutan.

⁵ ADB is supporting preparation of the first-edition regulation, as part of the ADB–UNESCO-IHE Institute for Water Education Partnership Fund technical assistance entitled “Supporting National Water Legislation Projects in Asia under RETA 6498: Knowledge and Innovation Support for ADB’s Water Financing Program.

III. THE PROPOSED TECHNICAL ASSISTANCE

A. Impact and Outcome

4. The impact of the proposed TA will be that climate-adaptive water resource management is adopted in Bhutan. The outcome will be that Bhutan's institutional capacity for integrated water resources management is improved.

B. Methodology and Key Activities

5. The TA focuses on capacity development and will have the following outputs:

6. **Output 1: National IWRM Plan is finalized.** Finalization of the National IWRM Plan (NIWRMP) will consist of (i) updating NEC's geographic information system (GIS)-based water inventory and preparing baseline data and systems to monitor future water resources, water usage, and management; (ii) updating hydrometeorological data based on latest projected climate change scenarios and downscaling methods; (iii) preparing broad water balances for all river basins and sub-basins for current and future conditions; (iv) installing a tailored "Wisdom" agreement database system⁶ (or similar system) for managing water allocations and effluent discharges; (v) identifying critical basins and sub-basins where water scarcity occurs now or is likely to occur in the future; (vi) compiling and preparing a summary overview of water resource issues, constraints, and opportunities nationally and in river basins; (vii) preparing and implementing a communications plan for information dissemination and consultation with the public and other government agencies on water-related issues; (viii) undertaking local workshops to disseminate collected information and analyses, and to obtain stakeholder feedback and participation in the preparation of the NIWRMP; (ix) prioritizing river basins and sub-basins for preparation of river basin management plans (RBMPs); (x) preparing a framework for routine updating of the NIWRMP based on the spiral model of the United Nations Educational, Scientific and Cultural Organization (UNESCO), and for benchmarking Bhutan's current status using the Asian Water Development Outlook 2013⁷ water security indicators; and (xi) preparing the NIWRMP and disseminating it publicly.

7. **Output 2: A river basin management plan for one priority major river basin is finalized.** This will consist of (i) preparing detailed maps of the river basin showing watersheds, land uses, main infrastructure, administration boundaries, key sub-basins, and water abstractions and effluent discharges; (ii) preparing a detailed water balance for the river basin and key sub-basins, for both current and future watershed and climate conditions; (iii) identifying critical sub-basins where water scarcity occurs now or is likely to occur in the future, using both the water balance results and a participatory approach; (iv) preparing basic flood hazard maps⁸ for main river channels that account for GLOFs, storm burst floods, and monsoon and cyclonic events; (v) identifying priority IWRM infrastructure investments with the participation of relevant departments, local government, and water user associations (WUAs), and preparing the investment subprojects at a concept level;⁹ and (vi) preparing the RBMP document to form the framework for preparing RBMPs in other river basins.

⁶ Wisdom is an open-source database system used in the Mekong River Basin to manage water agreements.

⁷ Asian Development Bank. 2013. *Asian Water Development Outlook 2013*. Manila

⁸ Detailed flood hazard maps can be prepared during project design with accurate river cross-sections.

⁹ The concept-level design includes (a) pre-feasibility engineering designs based on recommended best practices and technologies, (b) improved watershed and water distribution management, (c) initial assessment of safeguard requirements, (d) preliminary engineering cost estimates, and (e) economic assessments.

8. **Output 3: National Irrigation Master Plan is finalized.** This will involve supporting the Department of Agriculture (DOA) in (i) updating the irrigation inventory to aid preparation of the National Irrigation Master Plan (NIMP); (ii) assessing how climate change, population growth, and internal migration will affect agricultural practices in Bhutan; (iii) reviewing Bhutan's irrigation, agriculture, and livestock policies, and accounting for the projected changes; (iv) preparing an integrated irrigation investment strategy and road map at the national, district, and subdistrict levels, accounting for the outcomes of tasks (ii) and (iii); (v) recommending international best practices and technologies for use in Bhutan to improve the design of current and planned investments;¹⁰ (vi) selecting priority interventions and preparing investment subprojects at the concept level with WUA participation; (vii) strengthening and supporting implementation of a monitoring and evaluation system; and (viii) preparing the NIMP.

9. **Output 4: Water resources governance strengthened.** This will comprise (i) updating and expanding the current version of the Water Regulation to factor in emerging issues; (ii) demarcating roles and responsibilities of stakeholders in basins, sub-basins, and districts to support preparation of the NIWRMP and RBMPs; (iii) supporting the formation of a river basin committee (RBC) for the priority river basin (output 2); (iv) preparing institutional and human resource development plans to support implementation of the Water Act, Water Regulation, and NIMP for NEC, DOA, other relevant departments, and the RBC; (v) developing a framework for interagency coordination for development and management of water resources, and facilitating coordination between the agencies during the project; (vi) undertaking training needs assessments for NEC, relevant departments, and RBC; (vii) preparing and implementing national training courses, and international training courses if required; (viii) facilitating budget planning and support from the Ministry of Finance for mainstreaming duties into NEC's and other relevant agencies' normal operations; and (ix) updating the 1990 Irrigation Engineering Manual.

10. The TA design assumes that (i) NEC and other key stakeholders continue to support the initiatives developed under the TA, and prepare and implement RBMPs for the remaining river basins; (ii) government agencies and local communities accept and implement recommendations in the planning documents and capacity development programs; and (iii) good intersector coordination continues and supports preparation and agreement of planning documents. There is a risk that climate change impacts are more severe than anticipated and that the future behavior of the climate and resulting impacts on water resources remain uncertain. This may constrain the development of effective national and river basin plans for water resources management and subsequent investments. To mitigate the risk, the TA will use the latest climate-model-based projections based on the most recent models and methods.

C. Cost and Financing

11. The TA is estimated to cost \$2.00 million, of which \$1.50 million will be financed on a grant basis by the Japan Fund for Poverty Reduction and \$0.25 million by the Multi-Donor Trust Fund under the Water Financing Partnership Facility,¹¹ both to be administered by ADB. The government will fund the remainder in the form of counterpart staff, office accommodation, data, facilities, and other in-kind contributions. The detailed cost estimates and financing plan are in Appendix 2.

¹⁰ The Pilot Asia-Pacific Climate Technology Finance Center will assist in determining appropriate climate adaptation technologies and related financing options for incremental costs.

¹¹ Contributors: the governments of Australia, Austria, Norway, Spain, and Switzerland.

D. Implementation Arrangements

12. NEC will be the executing agency for the TA. NEC's Water Resources Division, in close collaboration with the Climate Change Division, will be the implementing agency for all components related to IWRM, while DOA will be the implementing agency for outputs related to the preparation of the NIMP. Both NEC and DOA are expected to provide staff in technical roles such as updating of water resources and irrigation inventory, hydrological modeling, and database development. The Bhutan Water Partnership¹² is expected to assist with stakeholder consultations and knowledge sharing.

13. The TA will require 50 person-months of international and 30 person-months of national consulting inputs. Outline terms of reference are in Appendix 3. The team of experts will be provided by a consulting firm recruited through the quality- and cost-based selection method with a 90:10 ratio and full technical proposal. This ratio is necessary to ensure high-quality preparation of the outputs, because they are to provide a sound basis for future successful water resources management in Bhutan. Individual consultants will be recruited as needed to manage unforeseen issues. ADB will recruit consultants in accordance with its Guidelines on the Use of Consultants (2013, as amended from time to time). The consulting services extend over 18 months. The TA is expected to begin in April 2014 and close in December 2015, which will allow additional inputs that may be needed for revisions and follow-ups. All disbursements under the TA will be made in accordance with ADB's *Technical Assistance Disbursement Handbook* (2010, as amended from time to time).

14. Knowledge dissemination will include planning documents and workshops. Good practices and lessons learned will be disseminated through (i) seminars in ADB; (ii) a workshop of the Network of Asian River Basin Organizations; (iii) a national workshop; (iv) knowledge products that may cover (a) applying IWRM to adapt to climate change and resolve water conflict, (b) developing water inventories in mountainous regions using remote sensing technology, (c) preparing RBMPs, and (d) formulating an RBC; and (v) publication of all outputs on the ADB website, if applicable.

IV. THE PRESIDENT'S DECISION

15. The President, acting under the authority delegated by the Board, has approved (i) ADB administering technical assistance not exceeding the equivalent of \$1,500,000 to be financed on a grant basis by the Japan Fund for Poverty Reduction, and (ii) ADB administering technical assistance not exceeding the equivalent of \$250,000 to be financed on a grant basis by the Multi-Donor Trust Fund under the Water Financing Partnership Facility, to the Government of Bhutan for Adapting to Climate Change through Integrated Water Resources Management, and hereby reports this action to the Board.

¹² Local branch of the Global Water Partnership.

DESIGN AND MONITORING FRAMEWORK

Design Summary	Performance Targets and Indicators with Baselines	Data Sources and Reporting Mechanisms	Assumptions and Risks
<p>Impact Climate-adaptive water resource management is adopted</p>	<p>By 2020: RBMPs are used for managing the four major river basins (2013 baseline: zero)</p> <p>National water security indicator from the <i>Asian Water Development Outlook 2013</i> exceeds 2.8 (2013 baseline: 2.2)</p>	<p>NEC “State of the Basin” reports</p> <p>NEC “State of the Basin” reports</p>	<p>Assumption NEC and competent authorities prepare and implement RBMPs for the remaining river basins</p> <p>Risk Impact of climate change is more severe than anticipated</p>
<p>Outcome Institutional capacity for IWRM is improved</p>	<p>By 2015: NEC has approved procedures and regulations for setting and enforcing environmental flows</p> <p>Within project basins, 10% of all water withdrawals and discharges operate with appropriate agreements</p> <p>50% of all new and existing water-related infrastructure is planned, developed, and maintained according to the RBMP (2013 baseline: zero)</p>	<p>NEC reports</p> <p>NEC, municipalities, and Department of Public Health and Statistics</p> <p>NEC database prepared under this TA</p>	<p>Assumption Government agencies and local communities accept, and are ready to implement, recommendations in the planning documents and capacity development programs</p>
<p>Outputs</p> <p>1. NIWRMP is finalized</p> <p>2. River Basin Management Plan for one priority major river basin is finalized</p> <p>3. National Irrigation Master Plan is finalized</p>	<p>By 2015: Stakeholders have approved the NIWRMP and the plan is launched at a national workshop</p> <p>The RBMP, which is socially and gender inclusive, is approved by relevant stakeholders with investment plans and priority subprojects developed at the concept level</p> <p>The NIMP, which is socially and gender inclusive, is approved by Department of Agriculture and priority subprojects developed at the concept level</p>	<p>NIWRMP and RBMP published on NEC website</p> <p>NIMP published on MOAF website</p> <p>Updated Water Regulation published on government website</p> <p>NIWRMP, NIMP, and certificates</p> <p>Copies of certificates filed with NEC</p>	<p>Assumptions NEC prepares an initial water resources inventory</p> <p>Good intersector coordination continues and supports preparation and agreement of planning documents</p>

Design Summary	Performance Targets and Indicators with Baselines	Data Sources and Reporting Mechanisms	Assumptions and Risks																		
4. Water resources governance strengthened	<p>Water Regulation is updated and expanded</p> <p>For the priority river basin, the river basin committee is operational and supports preparation and implementation of the RBMP</p> <p>Targeted capacity strengthening programs are developed and implemented for IWRM, river basin management, irrigation design and management, and climate change. At least 100 people attend courses, and at least one-third of participants are women</p> <p>Irrigation Engineering Manual is used to support design of new schemes (2013 baseline: zero)</p>	<p>MOAF publication</p> <p>MOAF publication</p> <p>MOAF publication</p> <p>MOAF publication</p>																			
<p>Activities with Milestones</p> <p>1. NIWRMP is finalized</p> <p>1.1 Update inventories, databases, and maps; undertake climate change and river basin modeling at broad basin and main sub-basin level (by month 9)</p> <p>1.2 Identify critical areas and prepare overview of issues, constraints, and opportunities at national, basin, and sub-basin levels; prioritize preparation of RBMPs (by month 11)</p> <p>1.3 Prepare communications plan, undertake preparatory workshops during the project, and prepare and implement national workshop (month 16)</p> <p>1.4 Prepare NIWRMP, State of Basins Report, and knowledge products (finalize by month 17)</p> <p>2. River Basin Management Plan for one priority major river basin is finalized</p> <p>2.1 Undertake detailed river basin modeling (by month 8)</p> <p>2.2 Identify critical sub-basins where water scarcity occurs or is likely to occur (by month 10)</p> <p>2.3 Identify priority IWRM infrastructure investments with the participation of relevant departments, local government, and water user associations, and prepare the investment subprojects at a concept level (by month 12)</p>		<p>Inputs</p> <p>Japan Fund for Poverty Reduction: \$1.50 million</p> <table border="1" data-bbox="896 1171 1442 1451"> <thead> <tr> <th data-bbox="896 1171 1214 1199">Item</th> <th data-bbox="1219 1171 1442 1199">Amount (\$'000)</th> </tr> </thead> <tbody> <tr> <td data-bbox="896 1205 1214 1232">Consultants</td> <td data-bbox="1219 1205 1442 1232">1,226.3</td> </tr> <tr> <td data-bbox="896 1239 1214 1293">Training, seminars, and conferences</td> <td data-bbox="1219 1239 1442 1293">75.0</td> </tr> <tr> <td data-bbox="896 1299 1214 1327">Surveys</td> <td data-bbox="1219 1299 1442 1327">50.0</td> </tr> <tr> <td data-bbox="896 1333 1214 1360">Miscellaneous</td> <td data-bbox="1219 1333 1442 1360">2.6</td> </tr> <tr> <td data-bbox="896 1367 1214 1421">Representative for contract negotiations</td> <td data-bbox="1219 1367 1442 1421">10.0</td> </tr> <tr> <td data-bbox="896 1428 1214 1455">Contingencies</td> <td data-bbox="1219 1428 1442 1455">136.1</td> </tr> </tbody> </table> <p>Multi-Donor Trust Fund under the Water Financing Partnership Facility: \$0.25 million</p> <table border="1" data-bbox="896 1570 1442 1640"> <thead> <tr> <th data-bbox="896 1570 1214 1598">Item</th> <th data-bbox="1219 1570 1442 1598">Amount (\$'000)</th> </tr> </thead> <tbody> <tr> <td data-bbox="896 1604 1214 1631">Consultants</td> <td data-bbox="1219 1604 1442 1631">250.0</td> </tr> </tbody> </table> <p>Note: The government will provide counterpart support in the form of counterpart staff, office accommodation, data, facilities, and other in-kind contributions</p>		Item	Amount (\$'000)	Consultants	1,226.3	Training, seminars, and conferences	75.0	Surveys	50.0	Miscellaneous	2.6	Representative for contract negotiations	10.0	Contingencies	136.1	Item	Amount (\$'000)	Consultants	250.0
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<p>2.4 Prepare RBMP (finalize by month 14)</p> <p>3. National Irrigation Master Plan is finalized</p> <p>3.1 Update inventories and maps; assess how climate change, demographics, and government policies will influence irrigation investment strategies at the national, district, and subdistrict levels (by month 5)</p> <p>3.2 Recommend international best practices and technologies, select priority interventions, and prepare subproject at a concept level (by month 8)</p> <p>3.3 Prepare NIMP and provide training on items 3.1–3.3 (by month 11)</p> <p>4. Water resources governance strengthened</p> <p>4.1 Update the Water Regulation (by month 4)</p> <p>4.2 Identify stakeholders and demarcate their roles and responsibilities to support preparation of the NIWRMP and RBMP; assist the formation of the River Basin Committee (by month 7)</p> <p>4.3 Update the Irrigation Engineering Manual (by month 8)</p> <p>4.4 Facilitate budget planning and support from the Ministry of Finance for mainstreaming of IWRM activities with government agencies (by month 10)</p> <p>4.5 Undertake training needs assessment, prepare capacity development program, implement internal training, and facilitate external training (by month 15)</p>	
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IWRM = integrated water resources management, MOAF = Ministry of Agriculture and Forests, NEC = National Environment Commission, NIMP = National Irrigation Master Plan, NIWRMP = National IWRM Plan, RBMP = river basin management plan, TA = technical assistance, WUA = water user association.
 Source: Asian Development Bank.

COST ESTIMATES AND FINANCING PLAN
(\$'000)

Item	Amount
A. Japan Fund for Poverty Reduction^a	
1. Consultants	
a. Remuneration and per diem	
i. International consultants	965.0
ii. National consultants	165.0
b. International and local travel	86.3
c. Reports and communications	10.0
2. Training, seminars, and conferences	
a. Facilitators	5.0
b. Training program	70.0
3. Surveys	50.0
4. Miscellaneous administration and support costs	2.6
5. Representative for contract negotiations	10.0
6. Contingencies	136.1
Subtotal (A)	1,500.0
B. Multi-Donor Trust Fund under the Water Financing Partnership Facility^b	
1. Consultants' remuneration and per diem	250.0
Subtotal (B)	250.0
Total	1,750.0

Note: The technical assistance (TA) is estimated to cost \$2 million, of which contributions from the Japan Fund for Poverty Reduction and Multi-Donor Trust Fund under the Water Financing Partnership Facility are presented in the table above. The government will provide counterpart support in the form of counterpart staff, office accommodation, data, facilities, and other in-kind contributions. The value of government contribution is estimated to account for 12.5% of the total TA cost.

^a Administered by the Asian Development Bank.

^b Contributors: the governments of Australia, Austria, Norway, Spain, and Switzerland. Administered by the Asian Development Bank.

Source: Asian Development Bank estimates.

OUTLINE TERMS OF REFERENCE FOR CONSULTANTS

1. Team leader and institutional strengthening specialist (national, 17 person-months). The consultant should have at least 15 years of experience in project management, implementation, and supervision of projects in the water or agriculture sectors; and 10 years of experience with institutional strengthening, capacity development, and communications. Experience with projects funded by multinational development partners will be preferred. A master's degree or equivalent in a discipline related to project management or institutional development is required. The candidate should also have strong verbal and written communication skills and have fluency in the English language. Responsibilities include: (i) providing overall support and advice to the National Environment Commission (NEC) project director in the day-to-day management of the project; (ii) supervising the consultants' activities and ensuring that their inputs are delivered as and when required; (iii) providing support to review missions fielded by the Asian Development Bank (ADB); (iv) undertaking training needs assessments with the international institutional strengthening, capacity development, and communications specialist; (v) designing and providing guidance on the implementation of training programs and courses; and (vi) leading the preparation and timely delivery of the inception, interim, and final reports to ADB and government.

2. Integrated water resources management specialist and deputy team leader (international, 11 person-months). The consultant should have at least 20 years of experience in planning, designing, and implementing integrated water resources management (IWRM) projects, preferably within the region and in mountainous areas. A master's degree or equivalent in a water-resources-related discipline is required. Responsibilities include supporting the team leader in preparing the inception report and in general project management. In addition, he or she will (i) with NEC, identify critical basins and sub-basins where water scarcity occurs or is likely to occur—first, generally for the main river basins and second, in detail for the priority river basin; (ii) assist prioritization of remaining river basins for preparation of river basin management plans (RBMPs) by NEC; (iii) identify relevant stakeholders in basins, sub-basins, and districts, and demarcate their roles and responsibilities to support preparation of the National IWRM Plan (NIWRMP); (iv) compile and prepare an overview of the issues, constraints, and opportunities nationally and in river basins; (v) prepare a “State of the Basins” report that will be used as framework for annual revisions—the inaugural report will provide benchmark values; (vi) facilitate NEC-led workshops across Bhutan to disseminate information and analyses, and obtain stakeholder feedback and participation in preparing the NIWRMP; (vii) prepare a framework for routine updating of the NIWRMP based on the spiral model of the United Nations Educational, Scientific and Cultural Organization (UNESCO), and for benchmarking Bhutan's current status; (viii) assess the water security status of the individual major river basins by applying the Asian Water Development Outlook 2013¹³ framework using available information and by recommending and implementing a program to collect outstanding information, if necessary; (ix) prepare the draft and final NIWRMP, and assist its national launching workshop; (x) facilitate the selection and participation of key river basin stakeholders for the river basin committee (RBC) in preparing the RBMP; (xi) assist NEC and RBC to identify and select priority IWRM infrastructure investments with the participation of relevant departments, local government, and water user associations (WUAs), and prepare the

¹³ Asian Development Bank. 2013. *Asian Water Development Outlook 2013*. Manila.

investment subprojects at a concept level¹⁴; (xii) assist NEC and RBC in preparing the draft and final RBMP;¹⁵ and (xiii) assist ADB in preparing knowledge products that may include (a) applying IWRM to resolve water conflicts, (b) developing water inventories in mountainous regions using remote sensing technology, (c) preparing RBMPs, and (d) formulating an RBC. This will require direction of and support from all team members.

3. Geographic information systems, remote sensing, and database specialist (international, 7 person-months). The consultant should have at least 15 years of experience in planning, developing, implementing, and using a geographic information system (GIS), remote sensing, and database systems. Regional experience will be considered positively. A master's degree or equivalent in GIS, databases, or information systems is required. Responsibilities will include (i) updating GIS-based water inventory and preparing baseline data and systems to monitor future water resources, water usage, and management; (ii) establishing a database system for managing water allocations;¹⁶ (iii) updating water inventory to a detailed level for selected river basins; (iv) preparing detailed maps of the river basin showing watersheds, land use, infrastructure, administration boundaries, water abstractions, and effluent discharges; (v) helping the IWRM specialist prepare investment subprojects at the concept level; and (vi) recommending and implementing improvements to the irrigation inventory to facilitate preparation of the National Irrigation Master Plan (NIMP).

4. Climate change and hydrology specialist (international, 4 person-months). The consultant should have a PhD or equivalent in hydrology, atmospheric science, water resources management, or closely related discipline with minimum experience of 15 years encompassing climate science and modeling, hydrologic and water resources modeling, and hydroclimatic field instrumentation. Regional and project preparation experience is preferred. The consultant will provide a review, assessment, and synthesis of climate model projections for the Hindu–Kush Himalaya region generally and for Bhutan specifically, emphasizing the implications of the projections for the development, management, and use of Bhutan's water resources. Responsibilities will include (i) updating the hydrometeorological data projections based on latest climate change scenarios, and undertaking statistical downscaling to project local conditions (precipitation, temperature, and evaporation time series and statistics including extreme value analysis) for the short-, medium-, and long-term horizons; (ii) reviewing all available background information on climate change and climate change modeling for water resources, agriculture, and hydropower in Bhutan; (iii) reviewing results of global (General Circulation Model) and regional climate modeling conducted under the “Fifth Coupled Model Intercomparison Project” (CMIP5) of the World Climate Research Program supporting the Intergovernmental Panel on Climate Change Fifth Assessment Report; and providing a synthesis of this work and its implications for Bhutan with emphasis on water resources and irrigated agriculture; (iv) reviewing existing, ongoing, and planned projects and activities involving the downscaling of outputs of the CMIP5 global projections (both dynamically via regional climate models and statistically), including the South Asia Coordinated Regional

¹⁴ The concept-level design includes (a) pre-feasibility engineering designs based on recommended best practices and technologies, (b) improved watershed and water distribution management, (c) initial assessment of safeguard requirements, (d) preliminary engineering cost estimates, and (e) economic assessments.

¹⁵ These plans will be prepared following UNESCO's “IWRM Guidelines at River Basin Level”. Furthermore, all interventions are to factor in climate change using the best applicable “Decision Making under Uncertainty” decision support method for climate change adaptation following guidance from the “Methodology for Effective Decision-making on Impacts and Adaptation” (MEDIATION) project.

¹⁶ “Wisdom” database approach may be considered which is a bilateral research project between Germany and Vietnam, focusing on the creation of a water related Information System for the Mekong Delta. <http://www.wisdom.caf.dlr.de/en/content/objectives-wisdom-project>

Climate Downscaling Experiment,¹⁷ and provide a synthesis of this work and its implications for Bhutan with emphasis on water resources; (v) identifying gaps in existing, ongoing, and planned high-resolution (downscaled) climate modeling activities discussed in item (iii) with respect to planning, management, modeling, and design needs in the Bhutanese water sector; (vi) preparing a plan for the development and use of high-resolution climate model projections to support planning and decision making in Bhutan's water sector, including customized scenario development as required; and (vii) providing advice and information to other specialists as necessary.

5. River basin modeling specialists (international, 3 person-months; national, 11 person-months). The international specialist should have at least 15 years of experience in planning, developing, implementing, and using hydrologic, hydraulic, and river basin models. Regional experience will be considered positively. The international specialist should have a master's degree or equivalent in water resources, while the national specialists should have 5 years of experience and a bachelor's degree or equivalent in water resources. The specialists will review and assess Bhutan's existing hydrologic, hydraulic, and water resources management modeling capabilities; and recommend improvements to the national modeling capacity to provide decision support to the water sector, inclusive of domestic water supply, irrigation, hydropower generation, and environmental flow requirements in the face of climate change at the scale of major river basins. Responsibilities include (i) under the guidance of the IWRM specialist, lead the modeling activities and provide training and support to the national specialists; (ii) review and assess Bhutan's existing hydrologic, hydraulic, and water resources management modeling capabilities with particular emphasis on capacity to simulate hydrology and water resources on the basis of climate change projections; (iii) provide recommendations for improving national water resources modeling capacity to enable decision support to the water sector, inclusive of domestic water supply, irrigation, hydropower generation, and environmental flow requirements; and of water-related hazards (e.g., rain and glacial lake outburst floods [GLOFs]), in the face of climate change at the scale appropriate for the four main river basins; (iv) select and use suitable mathematical models¹⁸ capable of simulating (a) physical hydrology, (b) flood hydrology and hydraulics, and (c) water resources management and allocation at a river basin scale under current conditions and projected climate change; and supervise the specification, calibration, and validation of these models to support IWRM; (v) support preparation of the NIWRMP and RBMP for current and future conditions, as well as develop, calibrate, and use the above models to broadly assess all river basins and significant sub-basins (excluding the priority basin), and assess in detail the priority river basin and sub-basins; (vi) prepare basic flood hazard maps for main river channels accounting for GLOFs, storm burst, monsoon, and cyclonic events; and (vii) provide training to NEC staff on developing and using the models.

6. Institutional strengthening, capacity development, and communications specialist (international, 7 person-months). The consultant should have at least 15 years of experience in institutional strengthening, capacity development, and communications in water resources projects. Regional experience is preferred. The specialist should have a master's degree or equivalent in water resources management, institutional strengthening, or financial management. Responsibilities include preparing the draft and final reports and providing support to the team leader. In particular, he or she will (i) prepare the training needs assessment and design of the training program; (ii) provide advice and guidance on the implementation of the training program;

¹⁷ World Climate Research Program. South Asia Coordinated Regional Climate Downscaling Experiment (CORDEX). <http://wcrp-cordex.ipsl.jussieu.fr/index.php/community/domain-south-asia-cordex>

¹⁸ Modeling software to be agreed with the National Environment Commission and ADB.

(iii) prepare a communications plan for information dissemination to, and consultation with, the public and other government agencies; (iv) undertake workshops across Bhutan to disseminate collected information and analyses, obtain stakeholder feedback and participation on preparing the NIWRMP, and assist in the preparation of the draft and final NIWRMP incorporating the above activities; (v) lead the preparation and facilitation of the national workshop to launch the NIWRMP; (vi) identify relevant stakeholders in basins, sub-basins, districts, and subdistricts, and demarcate their roles and responsibilities in preparing the RBMP and NIWRMP; (vii) assist the formation of the RBC for the priority river basin; (viii) with the team leader, prepare institutional and staff development plans that will support implementation of the Water Act, Water Regulation, and NIMP for NEC, Department of Agriculture (DOA), other pertinent authorities, and at least one RBC; define the new roles required in each relevant authority, and prepare their terms of reference; (ix) assist the development of a framework for interagency coordination for development and management of water resources; (x) undertake training needs assessments for NEC, relevant authorities, and RBCs; (xi) prepare and implement national training courses; (xii) facilitate participation in international training courses if required; and (xiii) facilitate budget planning and support from the Ministry of Finance for mainstreaming the duties into normal operations of competent authorities.

7. Irrigation and hydraulic structure specialist (international, 8 person-months). The consultant should have at least 15 years of experience in planning and designing irrigation and rural water hydraulic structures, preferably with regional experience. The specialist should have a master's degree or equivalent in civil engineering or hydraulic structures. Responsibilities include: (i) with the irrigation planning specialist, review, recommend, and implement improvements to the irrigation inventory to facilitate preparation of the NIMP; (ii) recommend international best practices and technologies to be used in Bhutan that will support current and planned investments; (iii) prepare investment subprojects at concept level by involving relevant departments, local government, and WUAs; and (iv) update DOA's Irrigation Engineering Manual to provide guidance on applying modern methods to planning, designing, implementing, and managing irrigation schemes in Bhutan, including applying modern methods for assessing scheme water availability and crop water requirements.

8. Irrigation planning specialist (international, 5 person-months). The consultant should have with at least 15 years of experience in planning and designing irrigation systems, and a master's degree or equivalent in civil engineering, agriculture, or irrigation planning. Experience with planning innovative systems in the region with similar terrain will be considered positively. Responsibilities include: (i) prepare the draft and final NIMP; (ii) identify critical sub-basins, using models and participatory approach, where water scarcity occurs or is likely to occur; (iii) with the irrigation and hydraulic structures specialist, review, recommend, and implement improvements to the irrigation inventory; (iv) assess how climate change, population growth, and internal migration will affect agriculture practices in Bhutan; (v) review Bhutan's irrigation, agriculture, and livestock policies, and also account for the outcomes of task (iv), as well as prepare an integrated irrigation investment strategy and road map at the national, district, and subdistrict levels;¹⁹ (vi) help select priority interventions and prepare investment subprojects at the concept level with WUA participation; and (vii) strengthen and support implementation of the monitoring and evaluation system.

9. Water law specialists (international, 1 person-month; national, 2 person-months). Both specialists should have at least 15 years of experience in drafting legislation, preferably in

¹⁹ Assessments will consider climate change using the best applicable "Decision Making under Uncertainty" decision support method for climate change adaptation following guidance from the MEDIATION project.

the water sector. Regional experience in development projects for the international specialist will be considered positively. Both specialists should have a master's degree or equivalent in water resources or law. Responsibilities include (i) updating and expanding the Water Regulation to include missing activities, (ii) facilitating their circulation among relevant government agencies, (iii) facilitating discussion at meetings with relevant government agencies and other key stakeholders to solicit their feedback, and (iv) finalizing the regulations and facilitating their confirmation by the government.

10. **Economist (international, 1 person-month).** The economist should have at least 15 years of experience in preparing economic appraisals for agriculture and water sector development projects. Regional experience will be considered positively. A master's degree or equivalent in economics is required. Responsibilities include (i) establishing socio- and agro-economic benchmarks for IWRM and irrigation, (ii) assessing the economic and financial risks associated with the subprojects and conducting sensitivity and risk analyses, and (iii) preparing economic and financial analyses of proposed interventions in coordination with the team for the prefeasibility studies following ADB's Guidelines for the Economic Analysis of Projects.²⁰

11. **Social development and gender specialist (international, 3 person-months).** The specialist should have at least a master's degree in a relevant social science field and at least 15 years of experience in gender-sensitive, participatory rural appraisal for community development. Regional experience will be considered positively. Responsibilities include (i) identifying key poor and vulnerable communities, their water management-related interests, and their barriers to participation in management of water resources; as well as undertaking stakeholder consultations in project areas and in separate focus group discussions with men, women, occupational groups, and civil society organizations; (ii) gathering sex-disaggregated baseline data and undertaking socioeconomic analysis on water management, water conflicts, and impact of current environmental factors (e.g., temperature, droughts, floods) on the daily lives of communities, including their means of livelihood, income, access to water and other services, security and protection from natural disasters; (iii) developing strategies respond to the concerns of these stakeholders and encouraging their participation in preparing the NIWRMP, RBMP, and NIMP; (iv) supporting preparation of the NIWRMP, RBMP, and NIMP by including policies on gender mainstreaming and pro-poor approaches to effective water resources management, taking into consideration anticipated impacts of climate change; (v) reviewing the current Water Regulation and recommending improvements to support the interests and involvement in water resources management of key poor and vulnerable communities; (vi) carrying out a gender analysis to distill prominent gender issues in Bhutan, project-specific gender concerns, and gender-related social vulnerabilities and translate them into actions that recognize women's different social status, needs, abilities, gender roles, and social vulnerabilities, and which will promote women's participation in project planning and implementation; provide opportunities to increase women's skills, incomes, and participation in decision making (practical and strategic benefits to women, progress toward gender equality); and minimize social vulnerability.

²⁰ Asian Development Bank. 1997. *Guidelines for the Economic Analysis of Projects*. Manila.