



# Technical Assistance Report

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Project Number: 45519  
Capacity Development Technical Assistance (CDTA)  
October 2011

**People's Republic of Bangladesh: Strengthening the Resilience of the Urban Water Supply, Drainage, and Sanitation to Climate Change in Coastal Towns (Financed by the Japan Fund for Poverty Reduction)**

## CURRENCY EQUIVALENTS

(as of 21 September 2011)

Currency Unit	–	taka (Tk)
Tk1.00	=	\$0.013327
\$1.00	=	Tk75.035

## ABBREVIATIONS

ADB	–	Asian Development Bank
BCCSAP	–	Bangladesh Climate Change Strategy and Action Plan
GIS	–	geographic information system
LGED	–	Local Government Engineering Department
PPCR	–	Pilot Program for Climate Resilience
TA	–	technical assistance

## TECHNICAL ASSISTANCE CLASSIFICATION

<b>Type</b>	–	Capacity development technical assistance (CDTA)
<b>Targeting classification</b>	–	General intervention
<b>Sector (subsector)</b>	–	Water supply and other municipal infrastructure and services (water supply and sanitation)
<b>Themes (subthemes)</b>	–	<b>Economic growth, environmental sustainability, capacity development</b> (developing urban areas, urban environmental improvement, client relations, network, and partnership development)
<b>Climate change</b>	–	Climate change adaptation
<b>Location impact</b>	–	Rural (low), urban (high), national (medium), regional (low)
<b>Partnership</b>	–	Japan Fund for Poverty Reduction

## NOTE

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

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## I. INTRODUCTION

1. With vast low-lying deltas, Bangladesh is a country greatly at risk from climate change. The coastal towns in Bangladesh are especially vulnerable to climate change. The Asian Development Bank (ADB) country operations business plan for Bangladesh, 2011–2013<sup>1</sup> identifies the Coastal Towns Infrastructure Improvement Project. The timely implementation of capacity development technical assistance (TA) for assessing the impacts of climate change and identifying adaptation options is deemed essential in maximizing the development impacts of the planned project in the coastal towns. This view has been fully endorsed by the Government of Bangladesh.

2. An ADB fact-finding mission was conducted from 23 to 31 January 2011. This report is based on the understandings reached with the government during the mission regarding the impact, outcome, outputs, implementation arrangements, cost, financing arrangements, and outline terms of reference for the TA. The design and monitoring framework is in Appendix 1.<sup>2</sup>

## II. ISSUES

3. Bangladesh is made vulnerable to climate change by its geography, poverty, inadequate infrastructure, limited social development, lack of institutional capacity, and high dependency on natural resources. Though Bangladesh has made steady progress in social and economic development and poverty alleviation, the country as a whole, and in particular its poorer communities, could suffer early and badly from climate change, negating past achievements. Therefore, strengthening resilience to climate change in coastal towns is a high priority on the development and poverty reduction agenda in Bangladesh.

4. In response to this vulnerability, the Government of Bangladesh prepared in November 2005 the National Adaptation Program of Action, which determined that the most damaging effects of climate change are flooding, salinity intrusion, and drought, and that challenges induced by climate change include scarcity of freshwater; drainage congestion; riverbank erosion; and wider salinity in surface water, groundwater, and soil. Most of the issues are related to urban water supply, drainage, and sanitation. Thorough analysis identified as future adaptation strategies to include (i) capacity building for integrating climate change in planning and designing infrastructure; and (ii) enhancing the resilience of urban infrastructure. However, these strategies have not been adequately translated into concrete actions because of constraints on human resources and the lack of technical, institutional, and financial capacity. The government adopted in September 2008 the Bangladesh Climate Change Strategy and Action Plan (BCCSAP), which is the basis of the country's efforts to combat climate change until 2018. The BCCSAP addresses both mitigation and adaptation, with the emphasis on the latter, and identifies 37 priority programs under six pillars. Pillars for adaptation are comprehensive disaster management, infrastructure, research and knowledge management, and capacity building.

5. The impacts of climate change will be particularly severe in remote coastal towns. Firstly, the major challenge in urban areas is the provision of safe water. The worsening incidence of drought is affecting surface water and hand and shallow tube wells, and the situation may further deteriorate. In the coastal zones, salt water intrusion caused by sea level rise may affect the availability of fresh surface water and groundwater. Consideration should be given to such

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<sup>1</sup> ADB. 2010. *Country Operations Business Plan: Bangladesh, 2011–2013*. Manila.

<sup>2</sup> The TA first appeared in the business opportunities section of ADB's website on 19 September 2011.

measures as conserving and treating water, rainwater harvesting, and monitoring water quality and quantity. Secondly, drainage is already a serious problem, as sewers frequently back up in the wet monsoon, especially following intense rainfall. In addition, sea level rise may delay discharge from the drainage system in low-lying areas. Moreover, flooding contaminated by wastewater can cause serious health risks. Coastal towns are increasingly vulnerable, and drainage capacity needs to be improved to prevent waterlogging. Implementing water and sanitation programs and improving urban drainage in urban areas vulnerable to climate change are among priority actions under the BCCSAP.

6. Coastal towns are in remote areas, where the consequences of climate change are expected to be particularly severe. In 2010, coastal towns had a population of 7 million. Water supply to coastal towns is mainly from groundwater sources drawn from deep and shallow tube wells. To cope with current insufficient supply and increasing demand, local government bodies plan to build or expand water supply facilities. Especially in coastal areas, all planning and designs for water supply facilities should include strengthened resilience to climate change.

7. Water salinity has increased in and near coastal towns in recent years, recording in 2010 the highest level since 1980. Sea level rise and prolonged dry weather are expected to further drive up salinity in coastal towns. Therefore, future investments in water supply, such as in constructing water-intake and -treatment plants, need to incorporate into their design responses to climate change risks. As groundwater is currently the major source of water in the area, assessing groundwater resources needs to be done and include investigating the possibility of salinity intrusion in the aquifer.

8. Coastal towns currently suffer recurring and worsening waterlogging problems. The situation can be further exacerbated by increased rainfall and sea level rise. Careful assessments need to be undertaken on the extent of the impacts, on the bases of which appropriate response mechanisms need to be developed.

9. The Government of Bangladesh prepared its Strategic Program for Climate Resilience with assistance from ADB, the World Bank, and the International Finance Corporation. The program was approved by the Pilot Program for Climate Resilience (PPCR) steering committee. This involves \$21 million in PPCR grant finance, \$50 million in concessionary loans, and \$215 million in ADB loans from the Asian Development Fund. The Coastal Towns Infrastructure Improvement Project has been selected as a component of the PPCR. Similarly ADB's country operations business plan for Bangladesh, 2011–2013 also identifies the Coastal Towns Infrastructure Improvement Project, for implementation in 2013. Considering that increased saline intrusion in coastal areas has already been reported in the National Adaptation Program of Action, and that rainfall intensity will likely increase, future investment projects on urban water supply, drainage, and sanitation need to be climate-proofed. Therefore, the TA will assess the impacts of climate change on urban water supply, sanitation, drainage systems, water availability, and salinity. The TA will recommend practical and effective options for the location of water-intake works, the appropriate design of drainage systems, urban wastewater discharge, and the location of sanitation infrastructure. Structural and other options will be identified in the TA and prioritized in a participatory manner. The output of the TA will be reflected in the design of this future project and other government interventions.

### III. THE TECHNICAL ASSISTANCE

#### A. Impact and Outcome

10. The main outcome of the capacity development TA will be strengthened capacity in the Government of Bangladesh to develop climate-resilient urban water, drainage, and sanitation projects in coastal towns. Its result will be guidance for project preparatory TA for the Coastal Towns Infrastructure Improvement Project. The impact of the TA will be improved design of urban infrastructure projects in coastal towns.

#### B. Methodology and Key Activities

11. The TA will be implemented in three stages. The first stage will (i) collect existing data on hydrometeorology, water salinity, and the outputs of various modeling results and analyses in selected coastal towns and surroundings; (ii) structure and improve planning in water supply, sanitation, and drainage; and (iii) collect socioeconomic data such as population density, population trends, and damage caused by past extreme weather events, as well as data related to physical characteristics such as topography, land use, and land subsidence. The second stage will assess plausible climate scenarios for 2030 and 2050, specifically (i) reviewing existing structures and future improvement plans for water supply, sanitation, and drainage; (ii) reviewing land-use plans and current local practices for coping with climate variability and extreme weather events, such as early warning systems and evacuation plans; and (iii) conducting hydrological simulation and assessment of flooding, water salinity, and other impacts on water supply, sanitation, and drainage using mathematical modeling. Assessment results will be presented in a map using geographic information systems. Finally, the TA team will (i) identify adaptation options, both structural and nonstructural, focusing on urban water supply, sanitation, and drainage; (ii) make a preliminary assessment of the feasibility of each option, with due consideration to effectiveness, urgency, associated benefits and costs, and social acceptability, as well as identify the agencies responsible for implementation; (iii) prioritize preferred options through a participatory approach; and (iv) integrate priority actions into the designs of future ADB-assisted coastal towns infrastructure improvement projects and other government projects and policy actions.

12. The TA will strengthen capacity and raise awareness regarding climate change. Workshops and training programs will be carried out mainly for officials of central and local government departments and other agencies. Other key stakeholders, such as universities, research institutes, nongovernment organizations, and the private sector, will be invited to the workshops, where the objectives, progress, and outputs of the TA will be shared and discussions will prioritize various adaptation options. Recommendations based on TA experience will be provided for further capacity-building and public-awareness programs, as well as for scaling up and replicating interventions in other areas.

13. A major risk of the TA arises from (i) the uncertainty of assumptions about greenhouse gas emissions trajectories, particularly after mid-century; (ii) differences in results emerging from the various global climate models; and (iii) the models' limited ability to simulate all important climatic processes and sensitivity to initial conditions, among other factors. Even if very high-resolution, local-scaled climate projections were available for the project area, the uncertainty problem would remain. There are risks in many respects:

- (i) The quality and quantity of data used for mathematical modeling is a risk, so TA consultants will collect primary data as necessary for model development and

calibration. The most up-to-date data will be utilized, and the appropriateness of the identified scenarios will be ensured by experienced international experts. The degree of uncertainty will be addressed in evaluating various adaptation options and considered in prioritization, which include robustness and "no regrets" approaches that perform well under different scenarios.

- (ii) Another risk is a potential delay in prioritizing options, as selection involves value judgments and divergent views are expected among stakeholders. To mitigate this risk, the TA will be undertaken in a consultative and participatory manner from the beginning to foster common understanding and raise awareness, and it will present options in an easily understandable manner to facilitate prioritization. The TA will closely coordinate with other planned project preparatory work to avoid duplication and ensure that prioritized options are taken up by future ADB-funded projects and other interventions, under the close supervision of the executing and implementing agencies, other departments of the government, and ADB.

### **C. Cost and Financing**

14. The Government has requested ADB to finance \$700,000 equivalent. The TA will be financed on a grant basis by the Japan Fund for Poverty Reduction and administered by ADB. The Government will provide counterpart support in the form of counterpart staff, office space and supplies and workshop venues. The cost estimates and financing plan are in Appendix 2.

### **D. Implementation Arrangements**

15. The Local Government Engineering Department (LGED) will be the executing agency, and the selected coastal towns will be the implementing agencies. The LGED will assign counterpart staff and ensure the provision of office space, furniture, equipment, and workshop venues by itself and/or with the selected coastal towns. The coastal towns will appoint TA coordinators and technical and counterpart staff to support TA consultants. Centrally, a steering committee will be headed by the secretary of Local Government Division of the Ministry of Local Government, Rural Development and Cooperatives and comprise senior officials from the Department of Environment, Economic Relations Division of the Ministry of Finance, Bangladesh Water Development Board, LGED, Department of Public Health Engineering, and local corporations of the selected coastal towns. Having the LGED as the executing agency is appropriate mainly because (i) the TA's geographical boundary will not be limited to the jurisdiction of one coastal town, requiring coordination with and support from other towns, and, (ii) while the TA is focused on the selected coastal towns, the methodology used and knowledge products developed, including adaptation options, are expected to be replicated in other areas of the country. A working committee will be established, chaired by the chief engineer of the LGED and with members from LGED local offices, the selected coastal towns, the Department of Public Health Engineering, and the Bangladesh Water Development Board. Resource persons and others may participate in the working committee as appropriate.

16. The first working committee meeting will be held no later than 2 weeks after the commencement of TA, and the working committee will meet at least once a month to ensure smooth coordination during TA implementation. The steering committee will meet when reports have been submitted by the TA consultants to discuss the progress of TA and provide guidance to the TA. As the TA is closely aligned with the BCCSAP, the steering committee is expected to serve as an important vehicle for widely disseminating TA progress and outputs among stakeholders.

17. The TA will be implemented over 10 months, from January to October 2012. Consulting services totaling 46 person-months will be required (9 person-months international and 37 person-months national). International expertise will be obtained in climate change adaptation and scenario assessment, mathematical modeling, and water sector planning. National consultants will have expertise in geographic information systems; hydraulic, salinity, and urban drainage modeling; water sector engineering; hydrogeology; social development and participation; urban planning; public health; and economic and financial management. International consultants will supervise and coordinate the work of national consultants. In addition to consulting services, resource persons may be invited to speak at workshops to provide the latest knowledge on climate change modeling and adaptation planning to key stakeholders and the consultants.

18. The consultants and resource persons will be engaged in accordance with ADB's Guidelines on the Use of Consultants (2010, as amended from time to time). ADB will engage consulting services for the TA in one package. The international consultants and national consultants will be recruited through a firm, using quality- and cost-based selection, with a quality–cost ratio of 80:20, and using simplified technical proposals. The resource persons will be recruited by single-source selection. Outline terms of reference for consultants and resource persons are in Appendix 3. Disbursements under the TA will be made in accordance with ADB's *Technical Assistance Disbursement Handbook* (2010, as amended from time to time).

19. The team of consultants will submit four major reports: (i) an inception report within 5 weeks after TA commencement, (ii) an interim report within 24 weeks, (iii) a draft final report within 40 weeks, and (iv) a final report 3 weeks after the final workshops organized in Dhaka and the selected coastal towns and the receipt of comments from the government and ADB on the draft final report.

20. Some equipment, such as computers and printers, will be procured under the TA using the shopping method in accordance with ADB Procurement Guidelines (2010, as amended from time to time). All equipment purchased under the TA will be handed over to the executing and implementing agencies after TA completion.

#### **IV. THE PRESIDENT'S DECISION**

21. The President, acting under the authority delegated by the Board, has approved ADB administering technical assistance not exceeding the equivalent of \$700,000 to the Government of Bangladesh, to be financed on a grant basis by the Japan Fund for Poverty Reduction, for Strengthening the Resilience of the Urban Water Supply, Drainage, and Sanitation to Climate Change in Coastal Towns, and hereby reports this action to the Board.

**DESIGN AND MONITORING FRAMEWORK**

<b>Design Summary</b>	<b>Performance Targets and Indicators with Baselines</b>	<b>Data Sources and Reporting Mechanisms</b>	<b>Assumptions and Risks</b>
<b>Impact</b> Improved design of urban infrastructure projects in coastal towns	Projects submitted for PPCR and ADB funding in 2013	ADB's country operations business plan	<b>Assumptions</b> Project programmed for ADB investment by end of TA implementation
<b>Outcome</b> Strengthened capacity in the Government of Bangladesh to develop climate-resilient urban water, drainage, and sanitation projects in coastal towns	Prioritized adaptation options taken up by planned investment projects in coastal towns in 2013	Annual report of LGED	<b>Assumption</b> Low turnover of trained government staff  <b>Risks</b> Climate change impacts more severe than expected Government not prioritizing adaptation options in its investment plans
<b>Outputs</b> 1. Climate change adaptation options, both structural and nonstructural, identified for urban water, drainage, and sanitation projects in coastal towns  2. Capacity-building programs on climate change resilience for key stakeholders implemented  3. Workshops organized for sharing information and raising awareness	About 6 options for climate change adaptation presented to the government in May 2012  About 20 key staff members of the executing and implementing agencies trained and knowledgeable on climate change risks by December 2012  Three workshops organized with wide and active participation by more than 150 stakeholders in 2012	Final TA report prepared by ADB consultants  TA reports LGED newsletter  Stakeholder responses to surveys, workshops, and capacity-building programs compiled by TA consultants	<b>Assumption</b> Appropriate and timely participation of and consultation with key stakeholders

<b>Activities with Milestones</b>	<b>Inputs</b>
1. Climate change adaptation options, both structural and nonstructural, identified for urban water, drainage, and sanitation projects in coastal towns (May 2012) 1.1 Collect data related to hydrometeorology, water salinity, and outputs of various modeling results and analyses in the target area. 1.2 Assess plausible climate change scenarios regarding sea level rise, increased intensity of rainfall and cyclones, storm surges, etc., for 2030 and 2050. 1.3 Assess impacts on urban water supply, drainage, and sanitation caused by climate change (August 2012) 1.4 Collect available data and review the status of existing structures and future plans for extending and upgrading urban water supply, drainage, and sanitation structures. 1.5 Collect socioeconomic data on population density, population trends, and damage caused by past extreme weather events and data related to physical characteristics such as topography, land use, and land subsidence. 1.6 Review land-use plans and policies and current local practices for coping with climate variability and extreme weather events, such as early warning systems and evacuation plans.	ADB \$700,000  Government provides counterpart staff, office space and supplies and workshop venues  9 person-months for international consultants  37 person-months for national consultants



Activities with Milestones	Inputs
<p>1.7 Simulate hydrology and determine flooding, salinity, and other impacts on urban water supply, drainage, and sanitation using climate change scenarios in 2.2.</p> <p>1.8 Prepare maps based on the assessment results using geographic information systems.</p> <p>1.9 Identify structural and other options (October 2012)</p> <p>1.10 On the basis of assessments 1.2 and 1.3, identify structural and nonstructural adaptation options for urban water supply, drainage, and sanitation.</p> <p>1.11 Make a preliminary assessment of the feasibility of each option with due consideration of effectiveness, urgency, associated benefits and costs, and social acceptability; identify the agencies responsible for implementation; and prioritize preferred options through a participatory approach.</p> <p>1.12 Integrate priority actions into the design of future ADB-assisted projects and other development projects and policy actions.</p> <p>2. Capacity-building programs on climate change resilience for key stakeholders implemented (December 2012)</p> <p>2.1 Strengthen the capacity and awareness of key stakeholders regarding climate change</p> <p>2.2 Provide recommendations for further capacity-building and awareness-raising programs.</p> <p>2.3 Extract lessons from TA implementation and provide recommendations for scaling up and replication in other areas in Bangladesh and possibly other countries as well.</p> <p>3. Workshops organized for sharing information and raising awareness (workshops in May and October 2012 and other suitable times)</p> <p>3.1 Plan and conduct training programs and workshops for awareness and developing skills to better adapt to climate change (workshops in May and October 2012 and other suitable times).</p>	

ADB = Asian Development Bank, LGED = Local Government Engineering Department, PPCR = Pilot Program for Climate Resilience, TA = technical assistance.

**COST ESTIMATES AND FINANCING PLAN**

(\$'000)

<b>Item</b>	<b>Total Cost</b>
<b>A. Japan Fund for Poverty Reduction<sup>a</sup></b>	
1. Consultants	
a. Remuneration and per diem	
i. International consultants	220
ii. National consultants	155
b. International and local travel	80
c. Reports and communications	30
2. Equipment <sup>b</sup>	20
3. Training, seminars, and conferences	
a. Facilitators	20
b. Training program	30
4. Surveys	70
5. Miscellaneous administration and support costs	10
6. Representative for contract negotiations	5
7. Contingencies	60
<b>Total</b>	<b>700</b>

<sup>a</sup> Administered by the Asian Development Bank.

<sup>b</sup> Computers, printers, photocopiers, and other office equipment will be handed over to the executing and implementing agencies after technical assistance completion.

Source: Asian Development Bank estimates.

## **OUTLINE TERMS OF REFERENCE FOR CONSULTANTS**

1. The technical assistance (TA) will require 46 person-months of consulting services (9 international and 37 national). Considering the rapid development of methodology and the knowledge base for assessing climate change scenarios and associated impacts, resource person(s) may be invited to speak in workshops and provide to participants the latest knowledge on climate change modeling and adaptation planning. The terms of reference of the consultants and resource persons will include the following.

### **A. Consultants**

#### **1. Specific Tasks of Consultants**

##### **a. Assessment of Climate Change Scenarios in Selected Coastal Towns**

2. Collect data related to hydrometeorology (river and sea levels, river flow, rainfall, cyclone frequency and intensity, storm surges, river and urban flooding, temperature, groundwater extraction, etc.), water salinity, and the outputs of various modeling results and analyses in the target area. Review and assess projections of future water withdrawal upstream. Utilize reliable secondary data as much as possible and, where such data are not available, take the direct measurements necessary to develop and calibrate models.

3. Assess plausible climate scenarios (sea level rise, increased intensity of rainfall and cyclones, storm surges, etc.) for 2030 and 2050. While analyzing the data and simulation results available, including the scenarios prepared in the fourth assessment report of the Intergovernmental Panel on Climate Change, make the best professional judgment in assessing future climate scenarios. Prepare at least two scenarios.

##### **b. Assessment of Impacts on the Water, Drainage, and Sanitation Caused by Climate Change**

4. Collect available data and review the status of existing structures and future plans for extending and/or upgrading water supply, drainage, sanitation, and sewerage structures. Data to be collected can include the type, location, and capacity of water supply, drainage, and wastewater-treatment assets; water service coverage; and coverage of sewage disposal and sanitation systems.

5. Collect available socioeconomic and physical data. Socioeconomic data to be collected include population density; population trends; the location of slums; damage caused by past extreme weather events; and those related to public health, such as the incidence of disease related to extreme weather events, such as waterborne diseases. Data to be collected on physical characteristics include topography, land use, and land subsidence. Collect historical and projected data and, where data are insufficient, take actual measurements as needed.

6. Review urban land-use plans and policies and current local practices for coping with climate variability and extreme weather events, such as early warning systems and evacuation planning.

7. Simulate the hydrology of urban watersheds and determine flooding, salinity, and other

impacts using climate scenarios identified for 2030 and 2050 in para. 3 above. Based on the modeling results regarding water availability, water salinity, extent of flooding, and location of sanitation, assess social and economic impacts on water supply, sanitation, and sewage and drainage systems, both qualitatively and quantitatively, including their public health implications and impacts on the poor. The results of model estimations for the calibration period will be cross checked with past data to justify and document the robustness of the models.

8. Prepare a digital map of the assessment results using geographic information system (GIS) technology. The GIS-based digital map will show flooded areas and duration, salinity intrusion, and other impacts of climate change under various model results.

### **c. Identification of Structural and Other Options**

9. On the bases of assessments in para. 7 above, identify structural and other adaptation options for strengthening resilience, focusing on water supply, drainage, and sanitation. Provide options on the bases of a review and analysis of international best practices and proposed potential adaptation interventions such as the implementation of protection measures, changes in land use, emergency response mechanisms, and strengthening the regulatory framework. Consider, for example, relocating the intake of the proposed water-treatment plant, assessing the abstracted volume of groundwater, optimizing the design of drainage systems, and selecting the location of sanitation facilities. Review groundwater and surface resources based on existing data.

10. Make a preliminary assessment of the feasibility of each option, with due consideration of effectiveness, urgency, associated benefits and costs, and social acceptability and identify the agencies responsible for implementation. Analyze the pros and cons of each proposed intervention and prioritize preferred options through a participatory approach.

11. Integrate priority actions into the designs of future projects funded by the Asian Development Bank (ADB), in particular the Coastal Towns Infrastructure Improvement Project, and of other government development projects and policy actions. Assist in identifying other sources of funding for implementing priority actions.

### **d. Strengthening the Capacity and Awareness of Key Stakeholders Regarding Climate Change**

12. Plan and conduct training programs and workshops for key stakeholders to raise awareness of and develop skills for better adapting to climate change. Disseminate information on TA implementation to relevant central and local government departments and agencies, communities, the private sector, and development partners. To ensure effective participation, conduct workshops at least once in selected coastal towns and twice in Dhaka. Training programs will target mainly key central and local government officials to improve their capacity for assessing and responding to climate change impacts and risks.

13. Provide recommendations for further capacity-building and awareness-raising programs. Capacity-building programs undertaken during the TA will be evaluated, and future programs to be carried out during the implementation of priority actions will be prepared.

14. Extract lessons from TA implementation and provide recommendations for scaling up and replicating in other areas in Bangladesh and other countries. Assess the study approach, efficiency, output, and limitations.

## 2. Consultant Inputs and Reporting

15. The indicative expertise requirements of the consulting services are in Table A3.

**Table A3: Indicative Expertise Requirements**

Expertise	Person-Months
<b>A. International</b>	<b>9</b>
1. Climate change adaptation and scenario assessment specialist	5
2. Mathematical modeling expert	2
3. Water, sanitation, and drainage planning specialist	2
<b>B. National</b>	<b>37</b>
1. Geographic information system specialist	3
2. Hydraulic modeling expert	4
3. Urban water supply modeling expert	3
4. Urban drainage modeling expert	6
5. Water supply and sanitation engineer	4
6. Drainage and flood-control engineer	4
7. Hydro-geologist	3
8. Social development and participation specialist	3
9. Urban planner	3
10. Public health specialist	2
11. Economist and financial management specialist	2
<b>Total</b>	<b>46</b>

Source: Asian Development Bank estimates.

16. The consultants will assist the executing and implementing agencies in organizing workshops at least once in selected coastal towns and twice in Dhaka to ensure the effective participation of all key stakeholders and sufficient information dissemination, as well as raise public awareness. Resource persons may be invited to speak. Representatives of central and local government departments and agencies, communities, the private sector, and development partners will be invited to the workshops. In addition, focus group discussions will be undertaken as and when necessary to solicit the views of key stakeholders toward prioritizing various adaptation options. In addition to workshops, the consultants will plan, prepare, and conduct training programs for key central and local government personnel to strengthen their capacity to assess climate change impacts and risks and incorporate them into policy making, planning, and the design and implementation of projects and other interventions.

17. The consultants will submit (i) an inception report within 5 weeks from the start of TA, finalizing the approach, presenting a detailed work plan and implementation schedule for the TA, and identifying in detail the information and data required for the TA; (ii) an interim report within 24 weeks from the start of TA, presenting the climate change scenarios used and initial results of modeling, identifying preliminary structural and other options, and reporting on the progress and effectiveness of capacity-building programs; (iii) a draft final report within 40 weeks from the start of the TA, presenting refined modeling results, GIS-based maps of the assessment results, the feasibility of various options with the pros and cons of each option, and the results of capacity-building and awareness-raising programs, along with recommendations for future programs; and (iv) a final report 3 weeks after the final workshops organized in selected coastal towns and Dhaka and the receipt of comments on the draft final report from the government and ADB, satisfying all requirements of the TA.

### 3. Packaging Expert Requirements

18. ADB will engage the consultants in one package and use individual recruitment for any resource persons. The consultant firm will be joint firms or organizations, recruited using the quality- and cost-based method of selection with a standard quality–cost ratio of 80:20. A simplified technical proposal will be used in selecting a firm. Highly specialized expertise in climate change scenarios, impact assessment, and adaptation measures for water supply, drainage, and sanitation is required from the firm, and expressions of interest are to include (i) detailed information on the firm’s experience and qualifications relevant to the assignment, (ii) the firm’s background, and (iii) the proposed team leader and deputy team leader and their relevant experience. The team leader will be the international climate change adaptation specialist, and the deputy team leader will be the national urban drainage modeling specialist.

19. The team leader will (i) lead the TA, (ii) prepare a task matrix for consultants and counterparts, (iii) supervise the inputs of the consultants and coordinate with the executing and implementing agencies and ADB, (iv) ensure the quality of consultants’ inputs, and (v) be responsible for delivering various outputs under the TA. A prospective team leader with experience in managing similar work, supervising national consultants in developing countries, and working with international development organizations will be given preference. As the number of person-months assigned to the team leader is rather short compared with the implementation period of the TA, which is expected to be 10 months, the other two international consultants will help supervise the work of national consultants under the guidance of the team leader. Close coordination among international consultants is required.

20. **Climate change adaptation and scenario assessment specialist and team leader** (5 person-months). The consultant will be an experienced international expert with qualifications and specialization in climate change adaptation in general and, in particular, in climate change scenarios and modeling. The expert should have broad, up-to-date technical knowledge of climate change impacts on water supply, including the assessment of climate scenarios and modeling exercises. Participation in the fourth assessment report of the Intergovernmental Panel on Climate Change is desirable. The specialist will (i) identify data and information that are needed for assessing climate change scenarios; (ii) assess climate change scenarios based on the available data and inputs; (iii) provide guidance and training on how to strengthen the capacity and raise the awareness of various stakeholders regarding climate change; (iv) identify and evaluate various adaptation options, in particular nonstructural ones, with reference to international best practices; and (v) ensure the integration of priority options into planned investment projects and other interventions.

21. **Mathematical modeling expert** (2 person-months). The consultant will be an experienced international expert with qualifications and specialization in mathematical modeling. The expert should have knowledge of climate change impacts on hydrology. The expert will (i) review existing mathematical models and provide concrete recommendations for further upgrading and calibration; (ii) develop new mathematical models as and when needed, mainly for urban water supply and urban drainage; (iii) verify the robustness of modeling results; (iv) provide guidance and training on how to strengthen the capacity and raise the awareness of various stakeholders regarding hydraulic modeling; (v) help interpret the modeling results for easy public understanding; and (vi) support the identification and evaluation of various adaptation options with reference to international best practices.

22. **Water sector planning specialist** (2 person-months). The consultant will be an experienced international expert with qualifications and specialization in planning water infrastructure, in particular urban water supply and urban drainage systems. The consultant should have an adequate technical background and detailed knowledge of various technological options. Experience in climate-proofing water infrastructure is highly desirable. The expert will (i) identify necessary data and information on water for impact assessment; (ii) assess the impacts of climate change on urban water supply, drainage, and sanitation; (iii) identify and evaluate various adaptation options, mainly from technical perspectives, with reference to international best practices; (iv) provide guidance and training on how to strengthen the capacity and raise the awareness of various stakeholders regarding urban water supply, drainage, and sanitation planning; and (v) ensure the integration of priority options into planned investment projects and other interventions.

23. **National consultants** (37 person-months). The deputy team leader will be designated from among the national consultants and will closely coordinate with and work under the supervision and guidance of the team leader. The deputy team leader will establish and maintain good coordination with the executing and implementing agencies, other relevant organizations, and ADB, as well as assist the team leader in ensuring high-quality work and submitting high-quality reports. All national consultants will perform their tasks under the close supervision of the deputy team leader and international consultants.

24. National consultants will be the following experts: GIS specialist, hydraulic modeling expert, urban water supply modeling expert, urban drainage modeling expert, water and sanitation engineer, hydro-geologist, social development and participation specialist, urban planner, public health specialist, and economist and financial management specialist. National consultants will initiate all the tasks in the terms of reference and prepare high-quality outputs so that the limited inputs from the international consultants will suffice to achieve the expected output at an international standard.

## **B. Resource Persons**

25. **Scope of services.** Make presentations to workshop participants to provide the latest knowledge on climate change modeling and adaptation planning, including international best practices. Subject to time availability, visit selected urban areas and reflect on-site findings in presentations.

26. **Qualification and experience.** Resource persons are expected to have strong research backgrounds at universities and research institutes, etc., and are required to possess the latest knowledge and understanding of climate change adaptation. It is expected that they will be lead or contributing authors of the Working Group II (Impacts, Adaptation, and Vulnerability) of the fourth assessment report of the Intergovernmental Panel on Climate Change and have participated as distinguished speakers in international conferences and seminars on climate change adaptation.