Technical Assistance Report

Project Number: 44164
Regional—Capacity Development Technical Assistance (R–CDTA)
March 2012

Applying Remote Sensing Technology in River Basin Management

(Financed by the Japan Fund for Poverty Reduction)

Asian Development Bank

ABBREVIATIONS

ADB	–	Asian Development Bank
BWDB	–	Bangladesh Water Development Board
DMC	–	developing member country
ICT	–	information and communication technology
JAXA	–	Japan Aerospace Exploration Agency
MONRE	–	Ministry of Natural Resources and Environment
PAGASA	–	Philippine Atmospheric, Geophysical and Astronomical Services Administration
SBT	–	space-based technology
TA	–	technical assistance

TECHNICAL ASSISTANCE CLASSIFICATION

Type	– Regional—Capacity development technical assistance (R–CDTA)
Targeting classification	– General intervention
Sector (subsector)	– Agriculture and natural resources (water-based natural resources management)
Themes	– **Social development**, economic growth, regional cooperation and integration, capacity development
Climate change	– Climate change adaptation
Location (impact)	– Rural (medium), urban (medium), national (high), regional (low)

NOTE

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

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I. INTRODUCTION

1. Many countries in Asia and the Pacific have suffered from water-related disasters, such as floods caused by typhoons and heavy rains, and sea-level rise. In addition, climate change and rapid economic development are predicted to amplify these negative impacts. As one of the most powerful nonstructural measures to guard against water-related disasters, monitoring and warning systems have been implemented in Asia and the Pacific by combining ground observations (rain gauge, water-level gauge) and remote observations (radar rain gauge); improving prediction accuracy of extreme weather events; and strengthening capacities of both governments and communities for pre- and post-disaster actions, including effective utilization of mass media for early warning and evacuation. However, there is still insufficient latency, frequency, and coverage of observation data; a lack of high spatial resolution of topographic and land usage information in hazardous areas; and inadequate dissemination of warnings to local communities.

2. Recently, space-based technology (SBT) and information and communication technology (ICT) have spread dramatically. For example, hourly global rainfall maps observed from satellites are provided via the internet about 4 hours after observation, and cellular phones have rapidly spread in the region.[1] These technologies have the potential to improve the monitoring and warning system because (i) satellites can cover a wider area than existing ground observation systems, and (ii) messages can be conveyed directly and simultaneously to citizens in hazardous areas. However, there are several factors which should be investigated and developed before incorporating SBT and ICT into the monitoring and warning system: (i) harmonizing existing SBT and ICT systems, (ii) making operational and maintenance costs sustainable, and (iii) providing adequate management capacities for SBT and ICT.

3. In July 2010, the Asian Development Bank (ADB) and the Japan Aerospace Exploration Agency (JAXA) signed a letter of intent to promote disaster management, climate change mitigation and adaptation, forest monitoring, and water resources management in Asia and the Pacific by using SBT, mainly in the field of remote sensing. Bangladesh, the Philippines, and Viet Nam have expressed interest in collaborating with ADB and JAXA in developing demonstration projects to improve monitoring and warning systems by incorporating SBT and ICT. Through the technical assistance (TA), these countries in partnership with ADB and JAXA hope to lay the foundation for subsequent feasibility studies of investment projects and for demonstrating associated best practices to leaders and practitioners. The TA received concept clearance from ADB Management in December 2010.[2]

II. ISSUES

4. Bangladesh, the Philippines, and Viet Nam are selected as pilot countries in the TA for the following reasons:

(i) They are among the countries most prone to water-related disasters. From 1988 to 2008, Bangladesh had the highest death toll from water-related disasters among developing member countries (DMCs), the Philippines had the fifth-highest toll, and Viet Nam the sixth.

[1] According to the International Telecommunication Union, the saturation level of cellular phones in 2008 was 27.9% in Bangladesh, 76.0% in the Philippines, and 86.9% in Viet Nam. In 2004, it was 1.9% in Bangladesh, 40.4% in the Philippines, and 6.0% in Viet Nam.

[2] The TA first appeared in the business opportunities section of ADB's website on 5 October 2011.

(ii) Mitigating natural disaster is stressed in the country partnership strategies and/or country operations business plans.
(iii) These countries have strong commitments to developing structural and nonstructural measures to mitigate water-related disasters.

5. Bangladesh faces significant physical challenges due to its flat topography and location at the confluence of three major international rivers—the Brahmaputra, the Ganges, and the Meghna. Much of Bangladesh has adjusted itself to an annual wet season when 25% of its land area remains under water. Severe flooding, when about 60% of the country is flooded, occurs about every decade. Periodic natural disasters, including cyclones and tidal surges, and dry season droughts have severe impacts on agriculture, fisheries, and livelihoods of people living in affected areas. The Bangladesh Water Development Board (BWDB) under the Ministry of Water Resources is mandated to provide flood forecasting and is able to provide 3 days' lead time. The BWDB wishes to extend the flood warning lead time to 7 days by developing automatic ground observation data in Bangladesh territory, and collecting transboundary upstream satellite precipitation data, which is available via the internet. Each of these actions is expected to extend the flood warning lead time for 2 days.

6. The Philippines is prone to the impacts of water-related disasters. Between 1998 and 2007, 12,000 people perished, were injured, or went missing; around 49 million people were disaster affected; and total damage was estimated at P77 billion. The devastation from tropical cyclones and severe weather disturbances accounted for 92.5% of the total damage from natural disasters. These severe weather events caused significant damage to agriculture—a vital industry in the Philippines. The Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) is mandated to provide hydrological forecasts in the major basins of Agno, Bicol, Cagayan, and Pampanga. The National Disaster Risk Reduction and Management Council under the Department of National Defense is responsible for ensuring the protection and welfare of the people during disasters. Increasing prediction capability will assist poor and vulnerable communities in flood-prone areas make more informed and better planned decisions and, thereby, reduce loss of life and assets. In the Cagayan River basin, the regional office of PAGASA in Tuguegarao City receives hourly precipitation and water-level data from five ground observation stations along the river, and receives monitoring data of the Magat Dam operated by the National Irrigation Center Controls. The southwestern part of the upper basin is controlled by the Magat Dam, but the eastern part of the mountainous catchment area does not have any flood control infrastructure or ground observation stations. In 2010, the lower basin was flooded because of heavy rains in the eastern part of the basin.

7. More than 80% of Viet Nam's population is at risk of direct impacts from natural disasters. From 1997 to 2006, 7,500 people either died or went missing as a result of disasters, with total losses estimated at 1.5% of gross domestic product. It is realized that structural measures alone are not effective in some areas. The implementation plan of the National Strategy for Natural Disaster Prevention, Response, and Mitigation to 2020, approved by the prime minister in 2007, indicated that both nonstructural and structural measures are decisive forces in improving the adaptation and sustainable development capacities in the context of natural disaster. The Ministry of Natural Resources and Environment (MONRE) analyzes precipitation data gathered from rain gauges, meteorological radar, and satellites, and provides daily short-term hydrological forecasts for major rivers to the Central Committee for Flood and Storm Control and media during the rainy season (June to December). The Central Committee for Flood and Storm Control issues orders for specific flood prevention and mitigation measures to the Department of Agriculture and Rural Development in relevant provinces, and each provincial Department of Agriculture and Rural Development provides flood warnings to local governments

and citizens within its jurisdiction through local media. However, problems remain: (i) existing observatory devices cannot cover whole basins; and (ii) as it takes so long for MONRE to gather observatory data, local governments often do not have enough time for flood protection measures, especially for flash floods that occur frequently in the northern and the central regions of Viet Nam, e.g., in the Red-Thai Bin River basin.

8. The TA is needed to assist Bangladesh, the Philippines, and Viet Nam to improve monitoring and warning systems on flood risk management with reasonable cost and practical knowledge. The specific agenda includes (i) developing application methodologies for the use of SBT and ICT for flood risk management, (ii) developing strategies and programs for flood risk reduction by applying SBT and ICT, and (iii) developing capacity for SBT and ICT. The TA will also help DMCs in the region develop their capacity to fully benefit from the use of SBT and ICT in river basin management by providing additional technical support to ADB projects and surveys, and by disseminating knowledge and best practices.

III. THE PROPOSED TECHNICAL ASSISTANCE

A. Impact and Outcome

9. The impact of the TA will be reduction in losses from flooding events. The outcome of the TA will be improved river basin management including flood risk management using SBT and ICT in target countries. The design and monitoring framework is in Appendix 1.

B. Methodology and Key Activities

10. The project activities will be organized two outputs to achieve the outlined outcome: (i) SBT and ICT applied for flood risk management, and (ii) selected staff able to apply SBT and ICT in river basin management.

11. **SBT and ICT applied for flood risk management.** The TA will support the development of SBT and ICT application methodologies for flood risk management in Bangladesh, the Philippines, and Viet Nam. Target agencies will be assisted with advisory services and financial support in formulating and implementing the following: (i) extending flood warning lead times by 1–2 days in Bangladesh by collecting precipitation data publicly available from satellites and ground observation systems; (ii) developing existing flood analysis models in the Red-Thai Bin River basin in Viet Nam by collecting satellites precipitation data; (iii) developing a system in the Cagayan River basin in the Philippines to provide satellite-based precipitation data and transfer it to the existing flood analysis model; and (iv) developing flood warning dissemination and disaster monitoring systems using web-based geographic information systems and cellular phones in Bangladesh and Viet Nam. All systems will be evaluated through trials.

12. To support implementation of the methodology outlined in para. 11, the TA will assess and prepare strategies, guidelines, and programs for flood risk reduction applying SBT and ICT in Bangladesh, the Philippines, and Viet Nam. The TA output is expected to provide a basis for the agencies (through the governments) to seek further ADB assistance in terms of infrastructure, management systems, associated policy, and institutional development.

13. **Selected staff able to apply SBT and ICT in river basin management.** The TA will strengthen staff capacities of target agencies and stakeholders in Bangladesh, the Philippines, and Viet Nam for applying SBT and ICT to flood risk management in a sustainable manner,

optimizing existing human and technical resources and experience in target agencies. Expected training programs are (i) the development or upgrade of flood analysis models using SBT and ICT, including harmonization with existing systems, and socioeconomic and topographical data management; (ii) satellite data processing, validation, and analysis; (iii) web-based geographic information systems; and (iv) dissemination of warnings to local communities by cellular phone. The specific activities will be developed in further information collection and consultation sessions with target agencies.

14. The TA will help DMCs develop their capacity to fully benefit from the use of SBT and ICT in river basin management by providing additional technical support to ADB projects and surveys. Possible technical support consists of developing their capacities for (i) detecting affected areas after water-related disasters, (ii) creating cost-effective and high-accuracy hazard maps, and (iii) monitoring land use in urban areas and/or mountainous areas including glaciers.

15. The TA will support dissemination of knowledge and practices on SBT and ICT with DMCs and development partners in the region through regional workshops. The regional SBT requirements that will be reflected in satellite development programs of Asian space agencies will also be specified in the regional workshops.

C. Cost and Financing

16. The TA is estimated to cost $2,648,435, of which $2 million will be financed on a grant basis by the Japan Fund for Poverty Reduction, and administered by ADB. JAXA will contribute a total of $648,435 equivalent in-kind contribution on counterpart personnel cost, technical fees, and administration services. The cost estimates and financing plan are in Appendix 2.

D. Implementation Arrangements

17. ADB, through the Sustainable Infrastructure Division of its Regional and Sustainable Development Department, will be the executing agency. The division will collaborate with the ADB's Water Community of Practice, regional departments, and resident missions concerned. Team members from regional departments will coordinate implementation of in-country TA activities. JAXA will be the implementing agency, in accordance with the letters of intent between ADB and JAXA. In accordance with the partnership agreement which ADB and JAXA will conclude for their collaboration under the TA, JAXA will provide its services on an in-kind basis, and ADB will provide advance(s) to JAXA for travel costs of JAXA staff members, and equipment and surveys procured by JAXA. Such advance(s) should be liquidated in accordance with ADB's *Technical Assistance Disbursement Handbook* (2010, as amended from time to time). JAXA will submit (i) semiannual financial statements accounting for the use of TA funds administered by it as advance(s), and (ii) an audited annual report for use of such funds. Throughout the implementation of the TA, JAXA will support ADB to manage and direct consultants in order to achieve expected outputs, and provide technical inputs for creating digital surface models and calibrated precipitation data from remote sensing data by collaborating closely with ADB headquarters, resident missions, and target agencies. The funding and implementation of the TA are subject to (i) signing of the partnership agreement between ADB and JAXA, (ii) receipt by ADB of no-objection letters from the governments of the three pilot countries, and (iii) approval by ADB of a detailed work program for each component. The TA will be implemented over 24 months, from April 2012 to March 2014.

18. Target agencies will include the BWDB in Bangladesh, PAGASA in the Philippines, and the MONRE in Viet Nam. The target agencies in the three pilot countries will assign TA project

directors from among senior staff to supervise and coordinate TA in-country activities and to participate in the regional workshops. Close coordination will be essential with related government agencies including space agencies, stakeholders, ADB, JAXA, and consultants to ensure synergy of activities and value addition to outcomes through regular joint meetings organized by the target agencies.

19. The TA will require 112 person-months of consulting services (32 person-months international and 80 person-months national [Appendix 3]) to implement the TA components in the three pilot countries. All consultants will be engaged by ADB in accordance with ADB's Guidelines on the Use of Consultants (2010, as amended from time to time). For the selection of a main consulting firm, the quality- and cost-based selection (90:10) method will be used because of the requirement for high-qualified technique, knowledge, and experience to achieve expected outputs, and the firm will be required to submit biodata technical proposals. For the selection of two consulting firms each in Bangladesh (18 person-months) and Viet Nam (10 person-months), consultants' qualifications selection will be used.[3] In addition, individual consultants specialized in remote sensing, ICT, capacity development, and hydrology will be engaged to incorporate sophisticated technologies into specific systems and capacities in the three pilot countries. The consultants will work under the overall supervision of ADB with the support of JAXA.

20. Any procurement under this TA will be in accordance with ADB's Procurement Guidelines (2010, as amended from time to time). A digital surface model obtained from satellites will be procured by JAXA from PASCO Corporation through the direct contracting method because (i) its proposed price is competitive and reasonable; and (ii) PASCO Corporation has considerable knowledge of the existing satellite systems and, therefore, has experience of exceptional worth for the assignment.[4] Disbursements under the TA will be made in accordance with ADB's *Technical Assistance Disbursement Handbook*. At the end of the TA, equipment purchased through the shopping method under the TA will be assigned to the agencies concerned in the DMCs.

IV. THE PRESIDENT'S RECOMMENDATION

21. The President recommends that the Board approve ADB administering technical assistance not exceeding the equivalent of $2,000,000 to be financed on a grant basis by the Japan Fund for Poverty Reduction for Applying Remote Sensing Technology in River Basin Management.

[3] Highly specialized expertise in cellular phone systems in Bangladesh and Viet Nam is required for the assignments, and only a few consultants, such as cellular phone companies in those countries, are expected to be qualified. Estimated contract value is $63,000 in Bangladesh and $35,000 in Viet Nam.

[4] PASCO Corporation was established in 1953 in Japan as an aerial survey company, and focuses on providing geospatial information by the integration of remote sensing and ubiquitous technology. Its capital is ¥8.76 billion as of 31 March 2011. It can provide a digital surface model obtained from satellites with an area of 100,000 square kilometers and vertical accuracy of 5 meters for $200,000.

DESIGN AND MONITORING FRAMEWORK

Design Summary	Performance Targets and Indicators with Baselines	Data Sources and Reporting Mechanisms	Assumptions and Risks
Impact Reduction in losses from flooding events	By 2020, annual economic losses from flood events in the three target countries reduced by 10% (1980-2010 baseline: $491 million) Accurate and cost-effective river basin management achieved in developing member countries (DMCs) (2010 baseline: none)	National statistics; water publications; sector reports of ADB, JAXA, and knowledge partners	**Assumption** Political will and commitment by all target countries to mitigate flood risks **Risk** Inadequate priority of investments for flood risk management
Outcome Improved river basin management including flood risk management using SBT and ICT in target countries	Flood risk management strategies and programs incorporating SBT and ICT prepared in three pilot countries (2011 baseline: none) At least one target organization in each pilot country has designed and implemented application of SBT and ICT (2011 baseline: none) Knowledge and practice in three pilot countries and other DMCs shared in the region (2011 baseline: none)	Strategies and programs of BWDB, PAGASA, and MONRE Reports of BWDB, PAGASA, and MONRE Reports of BWDB, PAGASA, and MONRE, ADB website and sector report	**Assumptions** Adequate technical and institutional capacities for river basin management applying SBT and ICT Financing for river basin management applying SBT and ICT **Risk** Insufficient interest, political will, financing, and collaboration with SBT and ICT stakeholders
Outputs 1. SBT and ICT applied for flood risk management	Three strategies and programs revised for flood risk management reflecting SBT and ICT (2011 baseline: none) Flood warning lead times extended to 5 days in Bangladesh (2010 baseline: 3 days) Existing flood analysis model in the Red-Thai Bin River basin in Viet Nam incorporate satellites precipitation data (2010 baseline: none) A system in the Cagayan	Strategies and programs of BWDB, PAGASA, and MONRE Reports of BWDB Reports of MONRE Reports of PAGASA	**Assumptions** Commitment of state policy decision makers to apply SBT and ICT for river basin management Stakeholder support to improve river basin management Sufficient participation by line departments and local government staff **Risks** Shortage of qualified staff available to participate in the TA

Design Summary	Performance Targets and Indicators with Baselines	Data Sources and Reporting Mechanisms	Assumptions and Risks
	River basin in the Philippines developed to provide satellite-based precipitation data (2010 baseline: none)		activities Availability of stakeholders to participate in consultation workshops
	Flood warning dissemination and disaster monitoring systems developed in Bangladesh and Viet Nam (2010 baseline: none)	Reports of the government of Bangladesh and Viet Nam	
2. Selected staff able to apply SBT and ICT in river basin management	Selected staff (M/F) in at least one target organization in each pilot country are able to use SBT and ICT in river basin management (2010 baseline: none)	Reports of BWDB, PAGASA, and MONRE, training programs reports, workshop reports	
	SBT and ICT incorporated in selected water projects (2010 baseline: none)	Project concept papers	

Activities with Milestones

1. SBT and ICT applied for flood risk management
1.1 Submission of strategies and programs for flood risk management to the three target countries (by 4Q 2013)
1.2 Conducting demonstration activities in the three pilot countries combining earth observation satellite data, web-based GIS, communication system, and existing systems (by 3Q 2013)

2. Selected staff able to apply SBT and ICT in river basin management
2.1 Conducting training programs (by 4Q 2012 and 1Q 2013)
2.2 Supporting ADB's water-releted projects benefit from SBT and ICT (by 4Q 2013)
2.3 Conducting regional workshops (by 1Q and 4Q 2013)

Inputs

Japan Fund for Poverty Reduction: ADB $2,000,000

Cost Item	Amount ($'000)
International consultants	512.00
National consultants	280.00
International and local travel	189.50
Reports and communications	20.00
Equipment	287.50
Workshops, training and seminars, and conferences	234.00
Surveys and studies	227.00
Miscellaneous administration and support costs	100.00
Contingencies	150.00

Japan Aerospace Exploration Agency (in-kind contribution on counterpart personnel cost, technical fees, and administration services) $648,435

ADB = Asian Development Bank, BWDB = Bangladesh Water Development Board, GIS = geographic information system, ICT = information and communication technology, JAXA = Japan Aerospace Exploration Agency, MONRE = Ministry of Natural Resources and Environment, PAGASA = Philippine Atmospheric, Geophysical and Astronomical Services Administration, SBT = space-based technology
Source: Asian Development Bank.

COST ESTIMATES AND FINANCING PLAN
($'000)

Item	Total Cost
A. Japan Fund for Poverty Reduction[a]	
1. Consultants	
a. Remuneration and per diem	
i. International consultants	512.00
ii. National consultants	280.00
b. International and local travel	189.50
c. Reports and communications	20.00
2. Equipment[b]	287.50
3. Workshops, training and seminars, and conferences[c]	234.00
4. Surveys and studies[d]	227.00
5. Miscellaneous administration and support costs	100.00
6. Contingencies	150.00
Subtotal (A)	**2,000.00**
B. Japan Aerospace Exploration Agency Financing	
1. In-kind contribution on counterpart personnel cost, technical fees, and administration services.	648.44
Subtotal (B)	**648.44**
Total	**2,648.44**

[a] Administered by the Asian Development Bank (ADB).
[b] Purchase of equipment (computers and rain gauges) to be administered by the Japan Aerospace Exploration Agency (JAXA).
[c] Including travel costs for ADB staff as resource persons, and travel costs for JAXA staff members ($34,000).
[d] Purchase of a digital surface model for surveys to be administered by JAXA ($200,000) and travel costs of JAXA staff ($27,000).

Sources: Asian Development Bank and Japan Aerospace Exploration Agency estimates.

OUTLINE TERMS OF REFERENCE FOR CONSULTANTS

1. The appendix provides a summary of the consulting services required during technical assistance (TA) implementation and the type of technical services and/or specialist inputs to be provided:

(i) main consultant (firm) to be recruited through quality- and cost-based selection (90:10), 21 person-months international and 31 person-months national;[1]
(ii) information and communication technology (ICT) consultant (firm) to be recruited through consultants' qualifications selection, 18 person-months;
(iii) ICT consultant (firm) to be recruited through consultants' qualifications selection, 10 person-months;
(iv) remote sensing specialists (individual), international, 9 person-months;
(v) ICT specialists (individual), international, 2 person-months;
(vi) capacity development specialists (individual), national, 14 person-months; and
(vii) hydrological specialists (individual), national, 7 person-months.

2. All consultants will be engaged by the Asian Development Bank (ADB) following ADB's Guidelines on the Use of Consultants (2010, as amended from time to time).

Table A3.1: Main Consultant (Firm)
(international, 21 person-months; national, 31 person-months)

Name (Input)	Qualifications	Tasks
International		
Team leader and project management specialist (4 person-months)	Master's degree or higher in civil engineering, space-based technology (SBT), or information and communication technology (ICT) More than 12 years of experience in the field of water-related disaster risk management (DRM), integrated water resources management (IWRM), remote sensing technology, ICT, and project management in Asia and the Pacific	(i) Perform as the general secretariat for the technical assistance (TA) steering committee; (ii) coordinate and supervise all consultant team members to ensure the quality of outputs; (iii) review existing projects and programs for flood risk management in Bangladesh, the Philippines, and Viet Nam, and reflect the necessary actions to the TA outputs; (iv) prepare implementation materials, monthly activity summaries, and reports (inception, midterm, draft final, and final); (v) support the Asian Development Bank and the Japan Aerospace Exploration Agency (JAXA) to compile outputs of other consultants; (vi) organize inception activities, all workshops, and trainings in the three countries; and (vii) consult with target agencies about the project components to assess their views.
System architecture specialist (4 person-months)	Bachelor's degree or higher in remote sensing technology, ICT, civil engineering, or a comparable discipline More than 8 years of experience in the field of earth observation satellite (EOS) data application, water-related DRM, IWRM, hydrology, and ICT in Asia and the Pacific	(i) Review existing flood risk management systems in the three pilot countries; (ii) define system requirement for the implementation of the TA's first component using SBT including the advanced land observation satellite (ALOS) digital surface model (DSM), the Global Satellite Mapping of Precipitation (GSMaP), and ICT; (iii) design and develop system architectures, including data and work flow based on system requirements defined in (ii); and (iv) contribute to developing an implementation plan and evaluate the accomplishment of the TA's first

[1] Given the need to ensure that a firm with the technical skills and program management experience is recruited by the Asian Development Bank, a heavier weight will be given to the technical merits of the proposals. Hence, the program management consultant will be selected using quality- and cost-based selection evaluation (90:10).

Name (Input)	Qualifications	Tasks
		component, including conducting the demonstration activity in the three pilot countries.
Remote sensing specialist 1 (RSS1) (5 person-months)	Master's degree or higher in remote sensing technology, earth science, or a comparable discipline (or bachelor's degree with more than 1 year experience in JAXA joint work for river basin management applying remote sensing) More than 5 years of experience in EOS data analysis of ALOS and GSMaP or its research, flood risk management, IWRM, and hydrology	(i) Define data processing and validation method for JAXA's EOS data and calibration method for GSMaP with ground-based observation data; (ii) install and operate a rain gauge in cooperation with counterpart organizations to calibrate and validate GSMaP with other ground observation data provided by them; (iii) process and validate JAXA's EOS data and calibrate GSMaP to ingest it into water-related DRM systems in the three countries; (iv) define system interface to ingest JAXA's EOS data, including ALOS DSM and GSMaP, into existing hydrological models for flood warning systems in the three countries; (v) develop documents for data processing, calibration, and validation for practitioners; and (vi) conduct training regarding EOS data processing, calibration, and validation in training programs.
Remote sensing specialist 2 (RSS2) (4 person-months)		(i) Design the system interface defined by RSS1 in Bangladesh and the Philippines; (ii) develop the system interface to convert the EOS data, including ALOS DSM and GSMaP, into the interface data in Bangladesh and the Philippines; (iii) develop documents of system interface and architecture for practitioners in Bangladesh and the Philippines; and (iv) conduct training regarding system interface and its architecture and operation in Bangladesh and the Philippines.
Flood risk management specialist (4 person-months)	Bachelor's degree or higher in civil engineering, flood risk management, remote sensing technology, ICT, or a comparable discipline More than 5 years of experience in planning and implementing strategies, guidelines, and programs for flood risk reduction applying SBT and ICT in Asia and the Pacific	(i) Define and implement the monitoring and evaluation methods to measure the results of the TA's first component; (ii) assess the financial and socioeconomic cost and impacts of applying SBT and ICT for flood risk reduction in the three countries, based on the outputs of (i); and (iii) develop strategies, guidelines, and programs for flood risk reduction applying SBT and ICT in the three countries based on the outputs of (i) and (ii).
National		
ICT specialist (11 person-months)	Bachelor's degree or higher in the field of ICT, geographic information systems (GISs), or a comparable discipline More than 5 years of experience in GIS development in Bangladesh and Viet Nam	(i) Develop software architecture, program, and test documents and quality control documents; (ii) develop web-based geographic information system (WebGIS) to visualize GSMaP, ground-based measurement data, EOS data, flood warning information, and map information in Bangladesh and Viet Nam; and (iii) collect necessary data from relevant agencies, and translate it for developed WebGIS.
Hydrological system specialist (6 person-months)	Master's degree or higher in remote sensing technology, earth science, or a comparable discipline More than 5 years of experience in hydrology, IWRM, flood risk management, earth science, and remote sensing in the Philippines	(i) Develop the system interface to convert the EOS data in the Philippines, including GSMaP, into the interface data; (ii) monitor and evaluate the value of interface data to the existing models; (iii) survey the existing ground-based measurement equipment, and develop a method to utilize ground-based measurement data with EOS data in the

Name (Input)	Qualifications	Tasks
		Philippines; and (iv) support documents development by RSS1 and RSS2 for EOS data processing, calibration and validation, and system interface and its architecture for capacity development.
Monitoring and evaluation specialist (6 person-months)	Bachelor's degree or higher in civil engineering, remote sensing technology, ICT, project management, or a comparable discipline More than 5 years of experience in project management on flood risk management applying SBT and ICT in Asia and the Pacific	(i) Propose the monitoring and evaluation methods to measure the results of the TA's first component to flood risk management specialist, (ii) support implementing the monitoring and evaluation defined in (i), and (iii) collect necessary information to assess the financial and socioeconomic cost and impacts of applying SBT and ICT for flood risk reduction in the three pilot countries.
Capacity development specialist (8 person-months)	Doctorate in civil engineering, DRM, GIS, remote sensing technology, ICT, or a comparable discipline More than 10 years of experience in research, adult education, capacity development, or training in the Philippines	(i) Review current capacity of agencies and stakeholders in the Philippines, and assess the requirements of training programs; (ii) design and implement training programs in the Philippines; (iii) evaluate capacity development results by holding follow-up meetings in the Philippines; and (iv) provide inputs for the regional workshops in the TA's fifth component.

Source: Asian Development Bank.

Table A3.2: Information and Communication Technology Consultant (Firm)
(national, 18 person-months)

Name (Input)	Qualifications	Tasks
Information and communication technology (ICT) specialist 1 (10 person-months)	Bachelor's degree or higher in the field of ICT or a comparable discipline More than 5 years of experience in computer and information systems using short message services (SMSs) in Bangladesh	(i) Review existing regulations and systems on SMS in Bangladesh; (ii) develop software architecture, program and test documents, and quality control documents to achieve system requirement; (iii) develop an SMS-based flood warning/evacuation information dissemination system to related organizations and citizens in a selected area in Bangladesh; (iv) provide SMSs through the system developed in (iii); and (v) provide information on bills of cellular phones without personal data for the estimation of population of a selected area in Bangladesh.
ICT specialist 2 (8 person-months)	Bachelor's degree or higher in the field of ICT or a comparable discipline More than 3 years of experience in computer and information systems using SMSs in Bangladesh	(i) Support ICT specialist 1 to develop software architecture, program and test documents, and quality control documents; and (ii) support ICT specialist 1 to develop an SMS-based flood warning/evacuation information dissemination system to related organizations and citizens in a selected area in Bangladesh.

Source: Asian Development Bank.

Table A3.3: Information and Communication Technology Consultant (Firm)
(national, 10 person-months)

Name (Input)	Qualification	Task
Information and communication technology (ICT) specialist	Bachelor's degree or higher in the field of ICT or a comparable discipline	(i) Review existing regulations and systems on SMS in Viet Nam; (ii) develop software architecture, program and test documents, and quality control documents;

Name (Input)	Qualification	Task
1 (6 person-months)	More than 5 years of experience in ICT using short message services (SMSs) in Viet Nam	(iii) develop an SMS-based flood warning/evacuation information dissemination system to related organizations and citizens in a selected area in Viet Nam; and (iv) provide SMSs through the system developed in (iii).
ICT specialist 2 (4 person-months)	Bachelor's degree or higher in the field of ICT or a comparable discipline More than 3 years of experience in ICT using SMSs in Viet Nam	(i) Support ICT specialist 1 to develop software architecture, program and test documents, and quality control documents to achieve information system requirement; and (ii) support ICT specialist 1 to develop an SMS-based flood warning/evacuation information dissemination system to related organizations and citizens in a selected area in Viet Nam.

Source: Asian Development Bank.

Table A3.4: Individual Consultants

(international, 11 person-months; national, 21 person-months)

Name (Input)	Qualifications	Tasks	Deliverables
International			
Remote sensing specialist 1 (RSS1) (5 person-months)	Master's degree or higher in remote sensing technology, earth science, or a comparable discipline More than 5 years of experience in the field of EOS data analysis of ALOS and GSMaP or its research, flood risk management, IWRM, and hydrology	(i) Design and develop a system to convert GSMaP data into the interface data which can be ingested into existing flood risk management systems in Viet Nam, (ii) develop documents of the system interface and its architecture for practitioners in Viet Nam, and (iii) conduct training regarding the system interface and its architecture and operation in Viet Nam.	Final report Software of the developed system Documents of the system interface and its architecture
Remote sensing specialist 2 (RSS2) (4 person-months)	Master's degree or higher in remote sensing technology, earth science, or a comparable discipline More than 5 years of experience in the field of digital surface model (DSM) creation from satellite data or its correction	(i) Define the method for correction of ALOS DSM; (ii) prepare software running on Microsoft Windows for ALOS DSM correction, which can be used in developing member countries; (iii) correct ALOS DSM for a selected area in Bangladesh with participating agencies to assess its feasibility; (iv) develop documents for (i); and (v) conduct training regarding ALOS DSM correction in Bangladesh.	Final report Software and documents for correction of ALOS DSM Corrected data of ALOS DSM
Information and communication technology (ICT) specialists (2 person-months)	Master's degree or higher in ICT or a comparable discipline More than 5 years of experience in the field of information gathering and dissemination system utilizing short message service (SMS)	(i) Investigate advanced methods for information gathering and dissemination applicable to citizens by utilizing SMSs and for estimation of population in a selected area in Bangladesh from bills of cellular phones, (ii) develop reports on the outputs of (i), and (iii) conduct training regarding information gathering and dissemination utilizing SMSs in the three pilot countries.	Final report Report of investigation in task (i)
National			
Capacity development specialist 1 (7 person-months)	Doctorate in civil engineering, flood risk management, geographic information systems (GIS), remote sensing technology, ICT, or a comparable discipline	(i) Review current capacity of agencies and stakeholders in Bangladesh, and assess the requirement of training programs; (ii) design and implement training programs on flood analysis models by SBT and ICT, information sharing in	Final report Training programs

Name (Input)	Qualifications	Tasks	Deliverables
	More than 10 years of experience in the field of research, adult education, capacity development, or training in Bangladesh	web-based GIS, and warning dissemination over cellular phones; (iii) hold meetings with local community in Bangladesh to let the community understand the overview and general knowledge on dissemination of flood warning and evacuation information over cellular phones; (iv) evaluate capacity development results by holding follow-up meetings in Bangladesh; and (v) provide inputs for the regional workshops in the fifth component of the TA.	
Capacity development specialist 2 (7 person-months)	Doctorate in civil engineering, flood risk management, GIS, remote sensing technology, ICT, or a comparable discipline More than 10 years of experience in the field of research, adult education, capacity development, or training in Viet Nam	(i) Review current capacity of agencies and stakeholders in Viet Nam, and assess the requirement of training programs; (ii) design and implement training programs on flood analysis model by SBT and ICT, information sharing in web-based GIS, and warning dissemination over cellular phones; (iii) hold meetings with the local community in Viet Nam to let the community understand the overview and general knowledge on dissemination of flood warning and evacuation information over cellular phones; (iv) investigate the framework for effective information sharing of floods by GIS among related organizations in Viet Nam by making use of the outputs of ADB's TA.[a] (v) evaluate capacity development results by holding follow-up meetings in Viet Nam; and (vi) provide inputs to the TA's fifth component.	Final report Training programs
Hydrological specialists (7 person-months)	Master's degree or higher in remote sensing technology, earth science, or a comparable discipline More than 5 years of experience in the field of hydrology, integrated water resources management, flood risk management, earth science, and remote sensing in Bangladesh	(i) Improve existing flood risk management systems in the Bangladesh Water Development Board with EOS data, including ALOS, DSM, and GSMaP; (ii) evaluate the performance of the existing hydrological models in Bangladesh; (iii) survey the existing ground-based measurement equipment, and develop a method to utilize ground-based measurement data with EOS data in Bangladesh; and (iv) support documents development by RSS1 and RSS2 for data processing, calibration and validation, and system interface and its architecture for capacity development.	Final report Improved flood risk management systems in the Bangladesh Water Development Board

[a] Asian Development Bank. 2008. *Technical Assistance to the Socialist Republic of Viet Nam for Geo-Information Technology for Hazard Risk Assessment*. Manila (TA 7220-VIE).

Source: Asian Development Bank.