



# Completion Report

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Project Number: 44164-001  
Technical Assistance Number: 8074  
June 2016

## Applying Remote Sensing Technology in River Basin Management

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TA Number, Country, and Name: TA 8074-REG: Applying Remote Sensing Technology in River Basin Management		Amount Approved: US\$2,000,000	
		Revised Amount: US\$2,000,000	
Executing Agency: ADB	Source of Funding: Japan Fund for Poverty Reduction	Amount Undisbursed: US\$545,595.39	Amount Utilized: US\$1,454,404.61
TA Approval Date: 27 April 2012	TA Signing Date: Not required	Fielding of First Consultants: 30 October 2012	TA Completion Date Original: 31 March 2014 Actual: 31 March 2015
			Account Closing Date Original: 31 March 2014 Actual: 1 June 2016

**Description:** Many countries in Asia and the Pacific have suffered from water-related disasters, such as floods. In order to mitigate damages and risks, under the purview of the TA, nonstructural measures such as monitoring and warning systems have been established by combining ground observations (rain and water-level gauges) and remote observations (radar rain gauge), thus improving prediction accuracy of extreme weather events and strengthening capacities of both governments and communities for pre- and post-disaster actions. However, there is still insufficient frequency and coverage of observation data, and inadequate dissemination of warnings to local communities. 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. Mobile phone use has rapidly spread in the region, facilitating transfer of real-time information. These technologies have the potential to improve the flood 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.

The TA was needed to assist target river basins in Bangladesh, the Philippines, and Viet Nam to improve monitoring and warning systems for flood risk management with reasonable cost and practical knowledge. ADB coordinated with the Flood Forecasting and Warning Centre of the Bangladesh Water Development Board, the Philippine Atmospheric, Geophysical and Astronomical Services Administration, and Viet Nam's Ministry of Natural Resources and Environment to carry out the TA activities. The specific agenda included (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.

**Expected Impact, Outcome, and Outputs:** The expected impact was reduction in losses from flooding events. The expected outcome was improved river basin management, including flood risk management using SBT and ICT in target countries. The expected outputs were (i) SBT and ICT applied for flood risk management, and (ii) selected staff able to apply SBT and ICT in river basin management. The TA design was relevant given the increasing occurrence of flooding in the river basin areas. SBT and ICT played a significant role for the monitoring and early warning systems in the target areas.

**Delivery of Inputs and Conduct of Activities:** The TA was executed by ADB and implemented by Japan Aerospace Exploration Agency (JAXA) with in-kind contribution of US\$648,440.<sup>1</sup> ADB engaged, as individual consultants in accordance with ADB's consulting services guidelines, a total of 32 person-months of international experts and 93 person-months of national consultants. The consultants' performance was satisfactory. The team organized 9 review missions for Bangladesh, 3 for the Philippines, and 8 for Viet Nam. The TA was extended twice from 31 March 2014 to 31 December 2014 and then to 31 March 2015. These extensions were necessary to cover the delay due to the lengthy internal approval process of the government of Viet Nam and to enable the target agencies and consultants to collect in-situ data in the 2014 flood season in all target countries to calibrate and validate the systems. The TA also purchased equipment for the three DMCs covered, in accordance with ADB's procurement guidelines. These equipment, composed of rain monitoring systems and SMS flood dissemination systems, have all been turned over to the governments. All required equipment has been purchased and TA activities carried out. Their total cost and that of the consulting contracts were less than what has been originally planned. Partner agencies were receptive of the models and approaches discussed during the workshops and training sessions. These activities were relevant in the operationalization of the flood monitoring and early warning systems. Overall performance of ADB as executing agency is satisfactory even with the change in project officer.

**Evaluation of Outputs and Achievement of Outcome:** The expected outputs, outcomes and the performance indicators outlined in the DMF were met. Key achievements are as follows:

**1. SBT and ICT applied for flood risk management.** The satellite-based rainfall data provided by JAXA was applied to flood forecasting models of the pilot rivers (Jamuna river in Bangladesh, Cagayan river in the Philippines, and Red-Thai river in Viet Nam). This improved the reliability and lead time of the forecast (e.g., from 3 days to 5 days in

<sup>1</sup> Signed Partnership Agreement between the Asian Development Bank and the Japan Aerospace Exploration Agency, July 2012.

Bangladesh), along with introduction of the satellite-rainfall data calibration system (in all pilot countries), new automatic rain gauges for calibration (Viet Nam and the Philippines), new automatic water level gauges (Viet Nam), and the new basin flood model (Viet Nam). The local flood inundation model was introduced to two pilot areas in Bangladesh, which improved the quality of flood forecasting in the area and the target agencies will continue its operation. The mobile phone SMS (Short Message Service) flood warning dissemination system and web-based geographic information system (WebGIS) introduced to the pilot areas realized smooth and effective information dissemination. Flood warning SMS messages were directly sent to citizens in Bangladesh, and to registered personnel in Viet Nam.

**2. Selected staff able to apply SBT and ICT in river basin management.** The series of training programs, such as WEB-GIS training, Systems training, Flood risk management training, to operate and maintain the developed systems were conducted for staff of target agencies in the pilot DMCs and relevant organizations. In Bangladesh and Viet Nam, flood evacuation drills were conducted in the pilot areas to demonstrate the effectiveness of the developed systems and the established coordination mechanisms among organizations working for flood warning, and to train local people to prepare for flood events when informed by SMS messages from the developed system. The RETA organized the first flood evacuation drill in Bangladesh. The policy guidelines to apply SBT and ICT for flood management were prepared for each country based on the cost-benefit analysis to introduce developed systems to flood-prone river basins in the respective country. The guidelines were shared with decision makers through workshops, with the objective of ensuring continued usage even after TA completion. Partner agencies and the pilot communities were satisfied with these outputs—learnings from the workshops are being applied in the overall flood monitoring systems in the target river basins.

The successful result of the TA was shared in various domestic and international meetings and workshops, which increased awareness and understanding of the effectiveness of SBT and ICT applications for flood management in the region. These include the final workshops in the DMCs covered and the final regional workshop in Manila. This was organized in February 2015 to share the achievement of the TA with the other DMCs in the region. Some new water projects have applied SBT and ICT such as satellite-based rainfall data not only for flood management but also for water resources management.<sup>2</sup>

**Overall Assessment and Rating:** Overall, the TA is rated successful as (i) the TA introduced effective and operational flood warning systems using SBT and ICT for target river basins and demonstrated its effectiveness, and (ii) staff of the target agencies and other relevant agencies enriched their capacities to apply SBT and ICT for flood management through training, workshop and evacuation drills. With the workshops and trainings conducted, partner agencies in the pilot DMCs have the technical capacity to continue the operationalization of the monitoring and early warning systems.

**Major Lessons:** While working with hydrologists and/or flood specialists within ADB was important to apply SBT and ICT for flood management, the coordination between agencies and specialists with different backgrounds in the pilot countries were challenging. Establishment of a smooth coordination mechanism took time due to sectionalism of organizations in pilot countries. A major lesson learned is that good institutional arrangements are necessary to realize the benefits of a system—it is not enough that the systems are technically robust. The TA also confirmed that while the flood models with satellite-based rainfall measurement is cost-effective, calibration using ground observation is still important. For instance, the rating (H-Q) curve, which indicates the relation between water level and water discharge, needs to be obtained at key points because the output of the flood model (discharge rate) needs to be converted to water level, on which the warnings are based. Determination of this curve requires the observation of water levels and discharge rates during the flood season; this takes time and costs a lot. Ground water level gauge is also needed to validate the result of the flood models. Although the flood models using satellite-based rainfall data is cost effective where the number of ground rain gauge station is limited, other cost factors need to be considered.

**Recommendations and Follow-Up Actions:** Flood models applying satellite rainfall data and SMS flood warning dissemination systems developed under the TA are more cost-effective than the conventional methods especially for river basins where there are less available ground observation data (insufficient number of ground rain gauges/international river basins) and where flood warning dissemination to the local citizens is not yet established. New ADB projects in the region can introduce these systems as part of flood management components. Expert support from regional departments will be required as the target agencies of the TA try to expand the application of these systems to other river basins based on the policy guidelines developed under the TA. Prospects of applying this technology in water resources management and flood management may also be explored further.

TA = technical assistance.

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<sup>2</sup> Examples of this would be TA 8647-TAJ: Water Resources Management in Pyanj River Basin and TA 8800-PAK: Balochistan Water Resources Development.