Technical Assistance Report

Project Number: 51428-001
Knowledge and Support Technical Assistance (KSTA)
August 2018

People's Republic of China: Piloting Innovative Flash Flood Early Warning Systems in Selected River Basins

Asian Development Bank

CURRENCY EQUIVALENTS
(as of 31 July 2018)

Currency unit	–	yuan (CNY)
CNY1.00	=	$0.1467
$1.00	=	CNY6.8155

ABBREVIATIONS

ADB	–	Asian Development Bank
MEM	–	Ministry of Emergency Management
MWR	–	Ministry of Water Resources
PRC	–	People's Republic of China
TA	–	technical assistance
YREB	–	Yangtze River Economic Belt

NOTE

In this report, "$" refers to United States dollars.

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KNOWLEDGE AND SUPPORT TECHNICAL ASSISTANCE AT A GLANCE

1. Basic Data — **Project Number:** 51428-001

Project Name	Piloting Innovative Flash Flood Early Warning Systems in Selected River Basins	**Department/Division**	EARD/EAER
Nature of Activity	Policy Advice	**Executing Agency**	Ministry of Water Resources
Modality	Regular		
Country	China, People's Republic of		

2. Sector	**Subsector(s)**	**ADB Financing ($ million)**
✓ Agriculture, natural resources and rural development	Rural flood protection	0.12
	Rural water policy, institutional and capacity development	0.16
	Water-based natural resources management	0.12
	Total	**0.40**

3. Strategic Agenda	**Subcomponents**	**Climate Change Information**	
Inclusive economic growth (IEG)	Pillar 2: Access to economic opportunities, including jobs, made more inclusive	Climate Change impact on the Project	High
Environmentally sustainable growth (ESG)	Disaster risk management Global and regional transboundary environmental concerns		

4. Drivers of Change	**Components**	**Gender Equity and Mainstreaming**	
Governance and capacity development (GCD)	Institutional development	Some gender elements (SGE)	✓
Knowledge solutions (KNS)	Knowledge sharing activities Pilot-testing innovation and learning		

5. Poverty and SDG Targeting		**Location Impact**	
Geographic Targeting	No	Rural	High
Household Targeting	No	Urban	Low
SDG Targeting	Yes		
SDG Goals	SDG6, SDG11, SDG13		

6. Risk Categorization Low

7. Safeguard Categorization Safeguard Policy Statement does not apply

8. Financing

Modality and Sources	**Amount ($ million)**
ADB	**0.40**
Knowledge and Support technical assistance: Technical Assistance Special Fund	0.40
Cofinancing	**0.00**
None	0.00
Counterpart	**0.00**
None	0.00
Total	**0.40**

I. INTRODUCTION

1. The knowledge and support technical assistance (TA) will develop innovative technology for flash flood early warning systems and promote a community-based approach in flood risk management in selected river basins within the Yangtze River Economic Belt (YREB) in the People's Republic of China (PRC). The TA will assist the Ministry of Water Resources (MWR) in improving the coverage and the accuracy of flash flood early warning systems, as well as their applications, in urban and rural settings in the Yangtze River Basin and beyond.[1]

2. The MWR implemented the National Flash Flood Disaster Prevention Plan during 2010–2016 and is currently planning nationwide implementation of the activities related to the second phase while addressing the emerging challenges in flash flood risk mitigation.[2] The Government of the PRC requested TA from the Asian Development Bank (ADB) to improve the application, coverage, and accuracy of flash flood early warning systems in the YREB. The TA is included in ADB's country operations business plan, 2018–2020 for the PRC.[3]

II. ISSUES

3. The government has identified the YREB as one of the three key growth engines of the PRC's future economic development. The YREB comprises nine provinces (Anhui, Guizhou, Hubei, Hunan, Jiangsu, Jiangxi, Sichuan, Yunnan, and Zhejiang) and two centrally administered municipalities (Chongqing and Shanghai). It covers more than 2 million square kilometers along the Yangtze River—one-fifth of the country's total area. The YREB is the country's economic backbone, accounts for more than 40% of the PRC's total population, and contributes about 45% to the gross domestic product. The Yangtze River Basin has high biodiversity and provides 40% of the PRC's freshwater resources, serves as the source of drinking water for more than 400 million people, accounts for 20% of the total wetland areas in the PRC, and nurtures 60% of the total fishery resources across the country.

4. Since 1980, the YREB has suffered more than $0.3 trillion in direct economic damage from recurring floods, accounting for 75% of total flood damage in the PRC. An important lesson learned from recent floods in the YREB is that the majority of flood damage does not come from the main stem river but from small- to moderate-sized river basins. In 2016, the YREB experienced fatal floods that led to $28 billion in economic damage and emergency declarations at more than 3,300 locations.[4] Of those, more than 3,200 were flash floods in small tributaries that were intensified by extreme rainfall events caused by global climatic changes.[5] Flash floods are common in the mountainous area of the PRC, which covers about two-thirds of the national territory with a population of 900 million people, of whom the majority are in the YREB. About 70% of total flood losses during 2000–2016 in the PRC were related to flash floods, which are spatially scattered and temporally variant.[6]

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[1] The TA first appeared in the business opportunities section of the ADB website on 22 June 2018.
[2] Ministry of Water Resources. 2017. *National Flash Flood Disaster Prevention Plan 2010–2016*. Beijing.
[3] ADB. 2018. *Country Operations Business Plan: People's Republic of China, 2018–2020*. Manila.
[4] The July 2016 flooding caused $28 billion in damage in the Yangtze River Basin and was the second most expensive natural disaster in the PRC's history (Aon Benfield. 2016. Worst Flooding Since 1998 Leaves $33bn Economic Toll in China, According to Aon Catastrophe Report. News release. 4 August).
[5] Ministry of Water Resources, Research Center on Flood and Drought Disaster Reduction. 2016. *Bulletins on 2016 National Flood Disasters*. Beijing.
[6] Ministry of Water Resources. 2017. *Flood Control, Drought Relief and Disaster Mitigation in China*. Beijing.

5. In 2006, the State Council of the PRC launched the National Flash Flood Disaster Prevention Plan, whose targets included strengthening monitoring and early warning systems and enhancing national and local preparedness and emergency response capacity. The government invested about CNY30 billion in national flash flood disaster prevention projects during 2010–2016. As a result, the average annual flash flood disaster-related fatalities dropped from 1,100 in 1990 to 400 in 2015. In 2017, the MWR issued the National Flood Disaster Prevention Project Implementation Plan, 2017–2020 to further consolidate the flash flood defense system by focusing on preventive, nonstructural measures.[7] To further reduce human casualties and economic loss from flash floods, the plan should additionally consider a variety of exposure and vulnerability factors, including land use changes, climate change, uncertainty of temporal and spatial distributions of flash floods, accuracy and localization of the early warning systems for emergency response, and community engagement.

6. In most of the previous flash flood events, excessive damage was attributed to the lack of spatial or temporal coverage of the available early warning systems and the gaps in the end-to-end early warning systems that should have involved the following six interactive elements: (i) risk knowledge, (ii) monitoring and data acquisition, (iii) forecasting and warning, (iv) dissemination and communication, (v) information type and reliability, and (vi) response capacity. While the PRC is pioneering flood preventive measures, forecasting and early warning systems in general are still at their primary stage of development. The challenges in establishing reliable flash flood early warning systems in the PRC are as follows: (i) the national flash flood disaster prevention plan is being implemented on a coarse spatial scale and has not yet been specialized for a large number of small river basins as well as scattered houses, villages, or towns in remote geographical settings; (ii) weather nowcasts (a report on current weather conditions) are becoming more detailed and accurate, but they have yet to be employed to increase the lead time in flood early warning; (iii) a large number of small basins are not being monitored by hydrological and meteorological stations, making it difficult to develop reliable localized flash flood early warning systems; (iv) flood forecasting does not take soil moisture and geophysical conditions, including consecutive rainfall events, into account; (v) self-help and mutual help conditions are yet to be promoted through awareness campaigns and capacity building activities in grassroots communities to improve the effectiveness of the early warning systems; (vi) institutional capacity in flood forecasting and early warning within local governments, as well as self-help, mutual help, and public help (mainly rescue operation conducted by authorities) conditions in grassroots communities, are not sufficient; and (vii) the elements of an end-to-end early warning system are yet to be integrated in the national program. Rapid socioeconomic development in the flash flood-prone areas urgently requires reliable flash flood forecasting and early warning systems and strong engagement of the local communities.

7. Considering the PRC's large and scattered mountain population, the government is yet to expand its flash flood early warning systems for each village to receive and respond to reliable early flood warnings. To promote nationwide end-to-end flash flood early warning systems, the government needs to develop an effective system incorporating the six interactive elements (para. 6) and pilot-test the system in selected river basins. The TA supports government efforts to strengthen the flash flood early warning systems and will pilot-test the best practices in (i) one community in the Kongmu River watershed, with a population of 109,580, in Xinyu City, Jiangxi Province; and (ii) two communities in the Laoguan River watershed, with a population of 76,000, in Xixia County, Henan Province. The pilot river basins

[7] Ministry of Water Resources. 2017. *National Flash Flood Disaster Prevention Plan 2017–2020*. Beijing.

represent the small river basins in the middle reach of the YREB, are highly exposed to flash floods, and were severely affected by the flash floods in 2016.

8. The TA will foster synergies in refining the national flash flood disaster prevention plan and promoting ecological civilization, with explicit targets in the PRC's 13th Five-Year Plan, 2016–2020.[8] As part of the rural revitalization objective set by the government to enhance livelihoods and attract investments in rural areas, the MWR will promote public security by establishing end-to-end flash flood early warning systems and by supporting local governments in planning and implementing flood mitigation measures. The TA will demonstrate the new benchmarks in implementing policies, strategies, and action plans in the YREB.

9. The TA builds on previous ADB engagements in water sector reform in the PRC.[9] ADB has put knowledge at the center of its operations in the PRC by (i) helping translate innovative ideas into actual projects and programs for implementation; (ii) supporting transformative and demonstrative projects and programs; and (iii) supporting institutional reform efforts. ADB's country partnership strategy, 2016–2020 for the PRC calls for managing climate change and the environment, fostering knowledge cooperation, and supporting institutional and governance reform.[10] The TA is consistent with ADB's Water Operational Plan, 2011–2020, which emphasizes integrated water resources management and climate change adaptation.[11] The government and ADB are proposing a strategic framework to support green development, with an emphasis on ecological conservation through environmental protection and rehabilitation of the YREB (footnote 9). Support for climate change adaptation and water-induced disaster risk management, particularly in the successful implementation of the flash flood early warning systems, will serve as an anchor for future engagement in water sector development and inclusion in the PRC.

III. THE TECHNICAL ASSISTANCE

A. Impact and Outcome

10. The TA is aligned with the following impact: flood risk management in the YREB improved.[12] The TA will have the following outcome: flash flood preparedness and emergency response in the YREB enhanced.[13]

B. Outputs, Methods, and Activities

11. **Output 1: Real-time flash flood early warning systems in selected river basins piloted.** This output will include (i) upgrading existing telemetric rainfall and water-level observation stations, including programming for hydrological threshold value and message texting capacity in each station, and networking of observation stations and communication channels; (ii) improving hydrological forecasts and early warning calibration, including

[8] Ecological civilization is the final goal of environmental reform within a given society. Government of the PRC. 2015. *The 13th Five-Year Plan for Economic and Social Development of the People's Republic of China, 2016–2020*. Manila.

[9] ADB. 2017. *Technical Assistance to the People's Republic of China for Preparing Yangtze River Economic Belt Projects*. Manila (TA 9311-PRC).

[10] ADB. 2016. *Country Partnership Strategy: Transforming Partnership: People's Republic of China and Asian Development Bank, 2016–2020*. Manila.

[11] ADB. 2011. *Water Operational Plan, 2011–2020*. Manila.

[12] Government of the PRC, National Development and Reform Commission. 2016. *Yangtze River Economic Belt Development Plan, 2016–2030*. Beijing.

[13] The design and monitoring framework is in Appendix 1.

developing gauged and un-gauged basin-level rainfall runoff models and synchronizing localized early warning with the national flood forecast and early warning system; and (iii) using cutting-edge technology for early warning, including satellite-based weather forecasts, a geographic information system for flood response mapping, and an information and communication technology-based real-time decision support system to facilitate emergency response.

12. **Output 2: Capacity development for flash flood emergency response at local level enhanced.** This output will include (i) establishing community-based flash flood early warning systems, including developing the community organization and skills of the community members in the technical and nontechnical aspects of emergency response operations; and (ii) implementing institutional capacity development activities for local governments, including providing technical training on hydrological modeling and operation and maintenance of the early warning devices and equipment for emergency response operations at the community level.

13. **Output 3: Knowledge on flash flood early warning systems disseminated.** This output will include (i) organizing workshops and training programs to share knowledge and expertise on flash flood early warning systems; (ii) drafting policy recommendations for flash flood risk mitigation in the PRC; (iii) drafting an investment plan for the flash flood early warning systems in the YREB; and (iv) disseminating acquired lessons through knowledge products.

C. Cost and Financing

14. The TA is estimated to cost $500,000, of which $400,000 will be financed on a grant basis by ADB's Technical Assistance Special Fund (TASF-other sources). The key expenditure items are listed in Appendix 2. The government will provide counterpart support in the form of counterpart staff, necessary data, office space, and other administrative support.

D. Implementation Arrangements

15. ADB will administer the TA and will (i) recruit, supervise, and evaluate the TA consultants; (ii) organize a workshop in consultation with the executing agency; and (iii) provide staff to act as resource persons in the workshop and training programs. The MWR will be the executing agency and will establish a leading group, chaired by the director of the MWR's International Economic and Technical Cooperation and Exchange Center. The leading group will comprise members from the International Economic and Technical Cooperation and Exchange Center; Research Center on Flood and Drought Disaster Reduction; Department of International Cooperation, Science and Technology; and other relevant agencies under the MWR and other relevant ministries, some of which are being established by the government.[14] The leading group will be responsible for the overall planning, coordination, and supervision of TA implementation at the project locations. With the director of the Research Center on Flood and Drought Disaster Reduction as its head and with support from project officers and administrative staff, the TA management office will supervise (i) the TA activities to be carried out by the TA consultants; and (ii) day-to-day operations with ADB, consultants, related

[14] The Government of the PRC announced that the Ministry of Emergency (MEM) is currently being set up.The MEM will probably be responsible for compiling and implementing emergency management plans and for organizing rescue and relief for disasters and workplace accidents. TA implementation may need to be closely coordinated with the MEM. Detailed institutional setup and mandates, however, are not yet clear.

agencies, and local governments. The TA management office will also serve as the secretariat for the leading group.

16. The local governments and relevant agencies, mainly the water resources bureaus in Henan and Jiangxi provinces, will closely coordinate with one another during TA implementation. ADB with the help of executing agency will transfer the operation and maintenance responsibility of the developed systems from the executing agency to the local governments upon TA completion. The implementation arrangements are summarized in the table.

Implementation Arrangements

Aspects	Arrangements		
Indicative implementation period	September 2018–February 2020		
Executing agency	Ministry of Water Resources		
Consultants	To be selected and engaged by ADB		
	Individual consultant selection	19 person-months	$133,500
Procurement[a]	To be procured by the executing agency		
	Shopping	7 contracts	$92,000
Disbursement	The TA resources will be disbursed following ADB's *Technical Assistance Disbursement Handbook* (2010, as amended from time to time).		
Asset turnover or disposal arrangement upon TA completion	ADB will turn over equipment procured under the TA to the executing agency upon completion of the TA.		

ADB = Asian Development Bank, TA = technical assistance.
[a] Procurement Plan (accessible from the list of linked documents in Appendix 3).
Source: Asian Development Bank.

17. **Consulting services.** The TA will require 1.5 person-months of international (flash flood management specialist) consulting inputs and 17.5 person-months of national (flood disaster risk mitigation specialist and team leader, flood forecasting and early warning specialist, and community-based disaster mitigation specialists) consulting inputs. The proposed positions require specialized terms of references, as flash flood modeling in un-gauged river basins, flash flood forecasting using hydrometeorological data, use of satellite-based information, and development of community-based early warning systems are still emerging issues in the PRC. Because it is difficult to find experts in different sectors related to localized flash flood early warning in a single consulting firm, ADB will engage the consultants through the individual consultant selection method following the ADB Procurement Policy (2017, as amended from time to time) and its associated project administration instructions and/or staff instructions.[15]

18. **ADB's procurement.** Procurement will follow the ADB Procurement Policy and Procurement Regulations for ADB Borrowers (2017, as amended from time to time).[16]

IV. THE PRESIDENT'S DECISION

19. The President, acting under the authority delegated by the Board, has approved the provision of technical assistance not exceeding the equivalent of $400,000 on a grant basis to the Government of the People's Republic of China for Piloting Innovative Flash Flood Early Warning Systems in Selected River Basins, and hereby reports this action to the Board.

[15] Terms of Reference for Consultants (accessible from the list of linked documents in Appendix 3).
[16] Procurement Plan (accessible from the list of linked documents in Appendix 3).

DESIGN AND MONITORING FRAMEWORK

Impact the TA is Aligned with Flood risk management in the YREB improved (Yangtze River Economic Belt Development Plan, 2016–2030)[a]			
Results Chain	**Performance Indicators with Targets and Baselines**	**Data Sources and Reporting Mechanisms**	**Risks**
Outcome Flash flood preparedness and emergency response in the YREB enhanced	By 2020: a. Localized flash flood early warning systems for isolated remote communities applied in the national flood risk management plan by the MWR (2018 baseline: not applicable) b. Experience gained from pilot study extended to the YREB (2017 baseline: not applicable)	a–b. MWR annual report and ADB review missions	Priority for flash flood early warning by governments in the YREB is not sustained.
Outputs 1. Real-time flash flood early warning systems in selected river basins piloted	By 2020: 1a. Two stand-alone automatic flash flood early warning systems developed in two pilot river basins (2018 baseline: 0) 1b. Pre-event and real-time decision support system to aid flash flood emergency response installed within local governments (2018 baseline: not applicable)	1a–b. Back-to-office reports of ADB missions, MWR reports on TA progress, and TA consultants' quarterly progress reports	Inter-sector cooperation and data sharing among key sectors is inadequate.
2. Capacity development for flash flood emergency response at local level enhanced	2a. Three communities in two pilot river basins organized in flash flood emergency response, with more than 40% female participation (2018 baseline: not applicable) 2b. Early warning communication system established in three communities (2018 baseline: not applicable) 2c. Three evacuation drills conducted in three pilot communities, with more than 40% female participation, using installed early warning systems (2018 baseline: 0)	2a–d. Back-to-office reports of ADB missions, MWR reports on TA progress, and TA consultants' quarterly progress report	

Results Chain	Performance Indicators with Targets and Baselines	Data Sources and Reporting Mechanisms	Risks
	2d. 20 technical staff of provincial and city governments in pilot project area reported skills improvement in flash flood early warning systems operation and maintenance (2018 baseline: 0)		
3. Knowledge on flash flood early warning systems disseminated	3a. Extension plan for applying flash flood early warning systems in the YREB developed (2018 baseline: not applicable) 3b. 29 senior provincial officials completed a flash flood early warning training workshop, of whom 20% are women (2018 baseline: 0) 3c. Guidelines on flash flood early warning systems drafted (2018 baseline: not applicable)	3a–c. Back-to-office reports of ADB missions and TA consultants' quarterly progress report	

Activities with Milestones

1. Real-time flash flood early warning systems in selected river basins piloted

1.1 Collect and review hydrological and meteorological data for the river basins (Q4 2018–Q1 2019)
1.2 Select strategic location for real-time hydrological monitoring stations (Q4 2018–Q1 2019)
1.3 Procure accessories to upgrade the existing weather observation stations (Q4 2018–Q1 2019)
1.4 Develop hydrological models for flash flood forecasting and calibrate them for local use (Q4 2018–Q1 2019)
1.5 Install and calibrate real-time hydrological monitoring stations (Q1 2019–Q3 2019)
1.6 Develop basin-specific early warning system using weather forecasts, real-time hydrological observation, flood hazard and emergency response mapping, and real-time decision support system (Q1 2019–Q3 2019)
1.7 Sign handover notes and agreement between the executing and implementing agencies and the local governments for operation and maintenance of the project-established systems (Q4 2019)

2. Capacity development for flash flood emergency response at local level enhanced

2.1 Field community mobilizers for raising awareness and organizing community groups in pilot communities (Q1 2019)
2.2 Form community-based flash flood early warning and emergency response organizations in three pilot communities (Q1 2019–Q2 2019)
2.3 Conduct awareness campaign in each pilot community (Q2 2019–Q3 2019)
2.4 Conduct community-based flash flood risk and response mapping (Q2 2019–Q3 2019)
2.5 Revise scientifically produced hazard, vulnerability, risk, and emergency response maps addressing each community's need (Q2 2019–Q3 2019)
2.6 Conduct flash flood warning information delivery drills using indoor radios or smartphones in each pilot community (Q3 2019–Q1 2020)
2.7 Conduct flash flood evacuation drills in each pilot community (Q3 2019–Q1 2020)
2.8 Conduct two training programs on flash flood early warning systems operation and maintenance for local government technical staff (Q4 2019–Q1 2020)

3. Knowledge on flash flood early warning systems disseminated
3.1 Organize a national workshop on flash flood early warning, involving local governments (Q2 2019)
3.2 Draft a technical note and policy recommendation on flash flood early warning (Q3 2019–Q1 2020)
3.3 Draft an investment plan for flash flood early warning systems development in the YREB (Q4 2019)
3.4 Publish lessons learned (Q4 2019–Q1 2020)
Inputs
ADB: $400,000 (TASF-other sources)
Note: The government will provide counterpart support in the form of counterpart staff, necessary data, office space, and other administrative support
Assumptions for Partner Financing
Not applicable

ADB = Asian Development Bank, MWR = Ministry of Water Resources, Q = quarter, TA = technical assistance, TASF = Technical Assistance Special Fund, YREB = Yangtze River Economic Belt.

[a] Government of the People's Republic of China, National Development and Reform Commission. 2016. *Yangtze River Economic Belt Development Plan, 2016–2030*. Beijing.

Source: Asian Development Bank.

COST ESTIMATES AND FINANCING PLAN
($'000)

Item				Amount
Asian Development Bank[a]				
1.	Consultants			
	a.	Remuneration and per diem		
		i.	International consultants	31.0
		ii.	National consultants	74.5
	b.	Out-of-pocket expenditures		
		i.	International and local travel	18.0
		ii.	Reports and communications	10.0
2.	Equipment[b]			92.0
3.	Surveys			83.0
4.	Training, seminars, workshops, forum, and conferences			50.0
5.	Miscellaneous administration and support costs[c]			20.0
6.	Contingencies			21.5
	Total			**400.0**

Note: The technical assistance (TA) is estimated to cost $500,000, of which contributions from the Asian Development Bank are presented in the table above. The government will provide counterpart support in the form of counterpart staff, necessary data, office space, and other administrative support. The value of government contribution is estimated to account for 20% of the total TA cost.

[a] Financed by the Asian Development Bank's Technical Assistance Special Fund (TASF-other sources).

[b] The executing agency will procure telemetric devices, early warning communication systems, computers, and printers. The Asian Development Bank will turn over equipment procured under the TA over to the executing agency upon completion of the TA activities.

[c] Miscellaneous administration and support costs include office supplies; and administration, logistics, interpretation, and translation costs.

Source: Asian Development Bank estimates.

LIST OF LINKED DOCUMENTS

http://www.adb.org/Documents/LinkedDocs/?id=51428-001-TAReport

1. Terms of Reference for Consultants
2. Procurement Plan