

**TECHNICAL DEEP DIVE  
ON**

# **HYDROMET SERVICES**

**FOR EARLY WARNING**

SUMMARY REPORT



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# **TECHNICAL DEEP DIVE (TDD) ON HYDROMET SERVICES FOR EARLY WARNING**

SEPTEMBER 12-15, 2016

This TDD was jointly organized by the World Bank Disaster Risk Management Hub, Tokyo and the Tokyo Development Learning Center (TDLC), in partnership with the government of Japan (Ministry of Finance; Ministry of Land, Infrastructure, Transport and Tourism; Japan Meteorological Agency; Ministry of Internal Affairs and Communications; and the Japan International Cooperation Agency). The TDD also benefited greatly from contributions by the following: the Global Facility for Disaster Reduction and Recovery Hydromet Thematic Program, and the World Bank's Hydromet Community of Practice, the International Centre for Water Hazard and Risk Management; World Meteorological Organization; Australian Bureau of Meteorology; NHK ITEC; and NTT DoCoMo.

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# CONCEPT: THE TECHNICAL DEEP DIVE (TDD)

Technical Deep Dives bring together experts and practitioners through workshops, site visits, peer-to-peer knowledge sharing, and action planning. The objective is to provide specific support to World Bank clients and their projects by addressing thematic topics of high client demand. Typically, reference is drawn from Japan, which offers relevant experience and solutions for a wide range of topics. TDDs offer firsthand knowledge-exchange opportunities and enable developing countries to deepen their knowledge through intensive study tours and peer learning. Client demand is determined through a demand survey conducted by the World Bank. Demand is met by offering participants structured learning before they arrive in Japan, and by providing ongoing support to connect them to technical experts and best practices in close collaboration with the Bank's Communities of Practice (CoPs).

The TDDs have four core elements:

- **Challenge objective** which reflects the demand-driven nature of the program and involves problem solving and technical assistance, including expert consultation and expert visit to client nations
- **Knowledge development for operational development** which involves knowledge exchange, just-in-time assistance, and potential technical assistance for clients and World Bank task teams
- **Structured learning** which is delivered to clients and partners through e-learning courses and a package of selected knowledge-exchange instruments before, during, and after the TDD in Japan
- **Application to knowledge networks** which involves contributing relevant inputs to CoPs to support development of case studies and best-practice lessons and to diffuse knowledge to the broader community

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The report greatly benefited from the information and support provided by the government of Japan (Ministry of Finance; Ministry of Land, Infrastructure, Transport and Tourism; Japan Meteorological Agency; Ministry of Internal Affairs and Communications; and the Japan International Cooperation Agency). We are also grateful to the contributions of Global Facility for Disaster Reduction and Recovery Hydromet Thematic Program, and the World Bank's Hydromet Community of Practice, the International Centre for Water Hazard and Risk Management; World Meteorological Organization; Australian Bureau of Meteorology; NHK ITEC; and NTT DoCoMo.

We thank the participating officials and project task teams for their presentations, active involvement, and knowledge sharing.

# ACRONYMS AND ABBREVIATIONS

<b>AWS</b>	.....	Automatic weather station
<b>CoP</b>	.....	Community of Practice
<b>DRM</b>	.....	Disaster risk management
<b>EWS</b>	.....	Early warning systems
<b>EWBS</b>	.....	Early Warning Broadcasting System
<b>GFDRR</b>	.....	Global Facility for Disaster Reduction and Recovery
<b>ICHARM</b>	.....	International Center for Water Hazard and Risk Management
<b>ICT</b>	.....	Information and communications technology
<b>IFAS</b>	.....	Integrated Flood Analysis System
<b>JBP</b>	.....	Japan Bosai Platform
<b>JICA</b>	.....	Japan International Cooperation Agency
<b>JMA</b>	.....	Japan Meteorological Agency
<b>JWA</b>	.....	Japan Water Agency
<b>MIC</b>	.....	Ministry of Internal Affairs and Communications (Japan)
<b>MLIT</b>	.....	Ministry of Land, Infrastructure, Transport and Tourism (Japan)
<b>MOF</b>	.....	Ministry of Finance (Japan)
<b>NWP</b>	.....	Numerical Weather Prediction
<b>PIC</b>	.....	Pacific Island Country
<b>PPP</b>	.....	Public-private partnership
<b>PREP</b>	.....	Pacific Resilience Program
<b>PWRI</b>	.....	Public Works Research Institute
<b>RRI</b>	.....	Rainfall-Runoff-Inundation
<b>TDD</b>	.....	Technical Deep Dive
<b>TDLC</b>	.....	World Bank Tokyo Development Learning Center
<b>UNESCO</b>	.....	United Nations Educational, Scientific, and Cultural Organization
<b>WMO</b>	.....	World Meteorological Organization



# EXECUTIVE SUMMARY

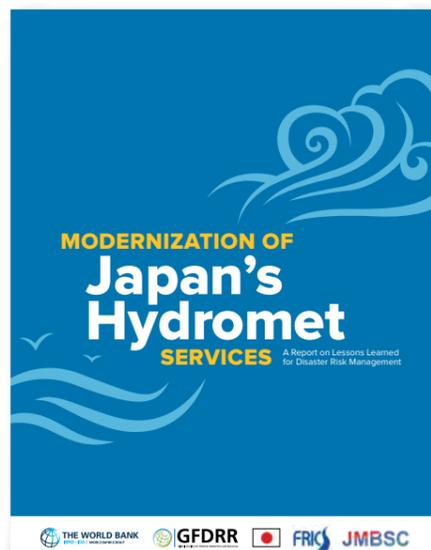
## Technical Deep Dive on Hydromet Services for Early Warning

The Technical Deep Dive (TDD) on Hydromet Services for Early Warning was held on September 12–15, 2016, in Tokyo, and brought together more than 40 officials from 11 developing countries, along with World Bank project teams and key experts from Japan and Australia. The Hydromet TDD extended knowledge-exchange opportunities to clients and World Bank staff from Afghanistan, Bhutan, Ethiopia, The Lao People's Democratic Republic, Honduras, Nicaragua, Pacific Island Countries (PICs), Sri Lanka, Uruguay, Vietnam, and Zambia.

The event allowed developing country clients to learn from Japan's approach to hydrological and meteorological (hydromet) hazards, specifically its ability to translate modern and sustainable weather, climate, and hydrological services into national hazard and climate risk management strategies. The TDD focused on finding solutions to key concerns identified by participant countries and aimed to inform countries' investments by bringing together experts and practitioners from hydrological, meteorological, and disaster risk management (DRM) agencies.

The Hydromet TDD was developed on the basis of the World Bank DRM Hub's Knowledge Program on Hydromet Services, particularly the 2016 report *Modernization of Japan's Hydromet Services: A Report on Lessons Learned for Disaster Risk Management*. The TDD also draws on the work of the Global Facility for

Disaster Reduction and Recovery (GFDRR) Hydromet Program. This program focuses on knowledge development and adaptation—through a series of targeted knowledge notes highlighting successful approaches to hydrological-meteorological disaster risk management—and on knowledge exchange and dissemination, including operational knowledge exchanges and public seminars.



## Participants' Profile and Challenges Faced

The countries participating in the TDD represented over 2 million people exposed to floods every year, 3 million people exposed to cyclone-strength winds, and 3 million people affected by drought. With the help of the World Bank and other development partners, these countries are making investments of around US\$1 billion to enhance their hydromet services. Participants reported facing one or more natural disaster events in the last two to three years—predominantly floods, droughts, and landslides. They noted that early warning systems (EWS) were deployed in 80 percent of these events, but that warnings were only effective in about 40 percent of these cases: the warning messages were often too late to be useful, had too narrow coverage in their outreach, and did not translate into action, including where natural hazards were unusually frequent or severe.

This TDD also observed participation from the two students of master's degree course in hydraulic engineering from Nagoya University, sponsored by JICA's PEACE Scholarship program.

INFORM Global Risk Index, 2016, <http://www.inform-index.org/>.

“

NAOKI YAMASHITA

Deputy Director of the Multilateral Development Banks  
Division at Japan's Ministry of Finance.

Japan has lessons learned from challenges faced in modernizing hydromet systems over the last 50 years. Indeed, the key of Japanese experiences is the collaboration among residents, businesses, and government.

They participated to learn about the various hydromet risks and how Japan uses its modern system to deploy early warning. They prepared a note at the end of the TDD describing their learnings and how those lessons could be applied to their country context in Afghanistan.

## Structure of the TDD

**Taking Japan's more than half a century of continuous hydromet service improvement as a key example, the TDD helped participating countries focus on advancing three main aspects of their hydromet services: (a) strengthening institutions, (b) modernizing systems, and (c) improving service delivery.**

### ✔ **Session I: Strengthening Institutions**

The session dealt with different models of coordination for early warning and data/information sharing, as well as with the role of legal and regulatory frameworks in streamlining hydromet services and EWS. The goal for client countries was to identify gaps in their institutional arrangements and determine how to potentially bridge them.

### ✔ **Session II: Modernizing Systems**

The session dealt with observing and forecasting systems to support hydromet services including EWS (such as currently available technology for hydromet observation/forecasting in Japan), strengthening of hydromet and EWS in the regional and global context, and managing modernization of systems.

### ✔ **Session III: Improving Service Delivery**

The session dealt with translating hazard information into actionable messages to

communities, determining how early warning messages can trigger action by end users, and reaching the last mile. It addressed challenges and opportunities, and the role of various stakeholders involved.

### ✔ **Discussion of past experiences to elicit key lessons learned**

The discussion dealt with recent and historical examples of successful and failed early warnings (in Japan, Australia, and client countries), identification of common prerequisites for successful early warning, identification of specific challenges, and components of EWS.

### ✔ **Site visits**

Participants visited Japan Meteorological Agency (JMA) headquarters, MLIT's Shimodate River Office and the Joso flood event area in Ibaraki prefecture where the Kinugawa river's bank burst, flooding the Joso city. They learned about how Japan prepares for, mitigates, and prevents hydromet risks and deploys EWS.

### ✔ **Action planning**

Participating countries engaged in peer-to-peer learning and formulated takeaways from the TDD that were applicable in their countries.

## Key Takeaways

**Participants reached the following conclusions in the course of their action planning discussions:**

✔ **Effective early warning and disaster management systems** are built on legal and regulatory frameworks that define clear responsibilities for hydromet and early warning services, and for the public and private stakeholders that provide them.

✔ **Investments in accurate data collection, archiving, analyzing, and sharing systems** are crucial. Accuracy is enhanced by integrating satellite data, ground-gauged data, global data, and precipitation radar systems. A comprehensive system should be developed that focuses on the entire value chain, from data collection and analysis to efficient service delivery.

✔ **Defining roles of different stakeholders**, such as governments, municipalities, media, and the private sector, is pivotal for effective EWS. Communication methods and channels should be based on how warning messages trigger actions by the end users. Messages from single authoritative voice through multiple routes are critical for reliable warning dissemination to end users.

✔ **Ongoing international initiatives that utilize globally available resources** can support agencies in developing countries in their efforts to modernize and improve hydromet services. Adopting and customizing free software such as ICHARM's Integrated Flood Analysis System (IFAS) and building regional collaboration are options for strengthening and judiciously implementing EWS.

✔ **Capacity building of the stakeholders**, through training and site visits, promotes well-coordinated, long-lasting, and effective EWS. Participants were specifically interested in training software management for flood risk modeling and EWS management, use of radars, EWS and information distribution channels, and coordination with local authorities.

# BACKGROUND ON HYDROMET SERVICES

## Hydromet Hazard Risks in Developing Countries

Hydrological and meteorological (hydromet) hazards—such as storms, floods, droughts, and heat and cold waves—are responsible for the greatest proportion of losses from adverse natural events globally. Between 1980 and 2011, they caused nearly 80 percent of disasters and over 50 percent of disaster-related deaths.

A lack of technical capacity and delivery capability makes providing effective hydromet services a key challenge for many developing countries. But well-prepared and well-resourced hydromet services could help these countries prepare for, mitigate, and recover from disasters. Such services minimize the disruptions caused by natural hazards by providing warnings to governments and communities in advance of events. They provide daily weather information, which can help prevent secondary disasters in environments where vulnerability and risk are high. And they can help guide reconstruction efforts after disaster strikes by developing resources such as flood hazard maps.

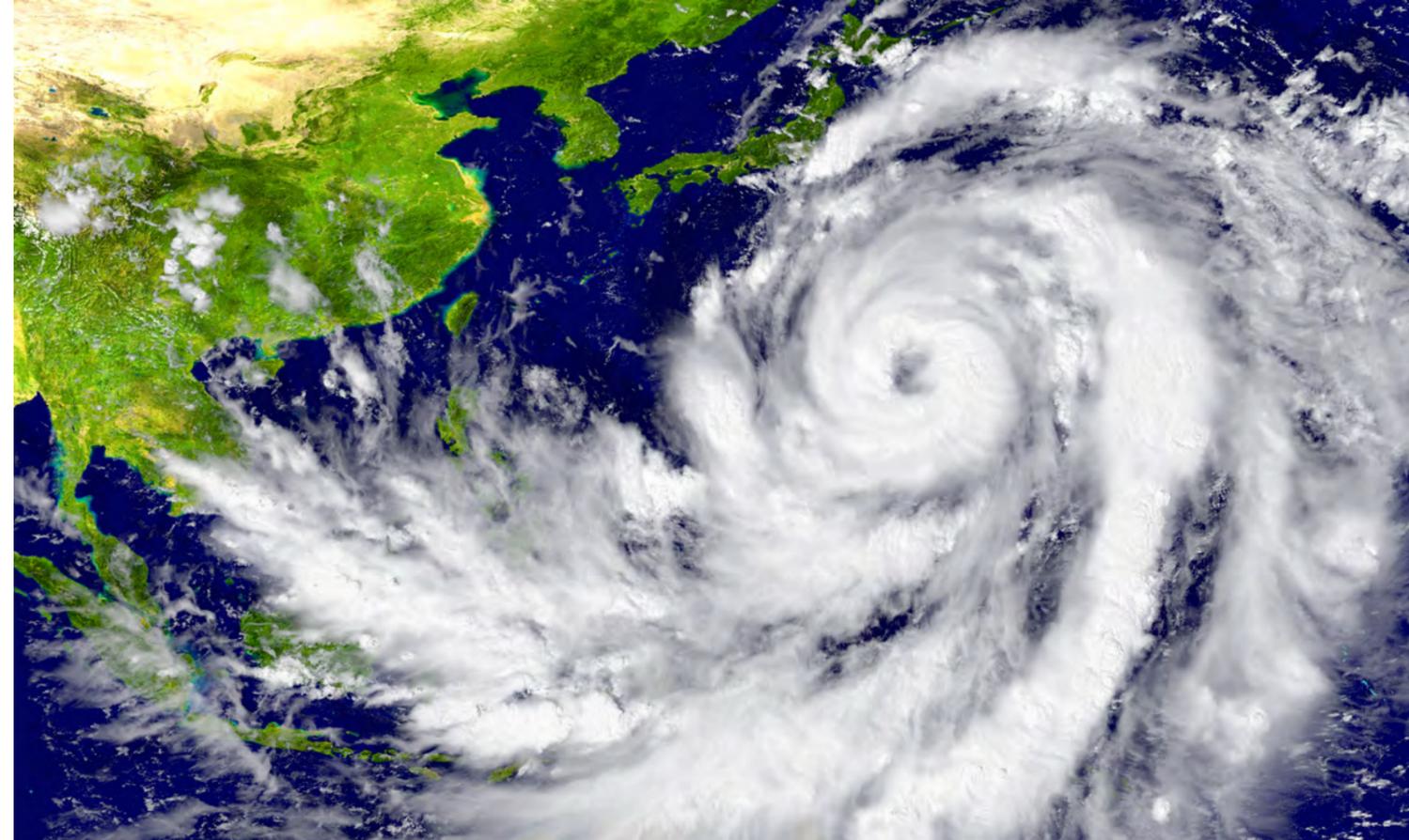
Client countries see a growing need to improve public weather services, invest in disaster related early warning systems, and strengthen information and decision support systems for climate dependent sectors, such as agriculture and water resources. The World Bank is increasingly providing operational and analytic support to hydromet modernization and development of climate products and services.

1980 -2011

**80%**  
NATURAL DISASTERS  
WERE CAUSED BY  
HYDROMET HAZARDS

**50%**  
DIASTER RELATED  
DEATHS  
WERE CAUSED BY  
HYDROMET HAZARDS

The World Bank, GFDRR, Government of Japan (2012). The Sendai Report: Managing Disaster Risk for a Resilient Future.



## Japan's Experience in Managing Hydromet Risks

As a global leader in identifying, predicting, and managing the risks posed by hydrometeorological hazards, Japan has valuable experience and lessons to share with developing countries seeking to improve and modernize their hydromet services. The Japan Meteorological Agency (JMA), Japan's National Meteorological Service, began efforts to modernize its services in the early 1950s, when the modern Meteorological Service Act was enacted and the first operational weather radar and Numerical Weather Prediction model were introduced. Japan's National Hydrological Service, the Water and Disaster Management Bureau of the Ministry of Land, Infrastructure, Transport and Tourism (MLIT), was modernized as an integral part of flood management and water resources management.

The modern service that Japan now enjoys was established over several decades and with careful institutional and observational consideration on both the meteorological and

hydrological sides. Certain extreme events, such as the devastating 1959 Isewan Typhoon and the 2011 Great East Japan Earthquake and associated tsunami, were instrumental in shaping the service over time.

The resulting modern services were established in a series of long-term steps and include four key features: (a) issuance of warnings and countermeasures for natural hazards, (b) issuance of early flood warnings to assist in evacuation planning, (c) support for regional and other national meteorological and hydrological services with data and capacity development activities, and (d) institutional integration of hydrological services and river management.

Japan's experience offers some historical perspectives on lessons learned over a century of changes in legal and institutional arrangements, advances in technology, and responses to major natural disasters that can inform developing countries in their efforts to modernize their hydromet services. Especially for developing countries seeking modernization, the historical development of Japanese hydromet services can be seen as an exemplar for strengthening hydrological and meteorological services and enhancing early warning systems.

# OPENING AND WELCOME



## Mr. Naoki Yamashita

Deputy Director, Multilateral Development Banks Division,  
Ministry of Finance (MOF)

Japan faces frequent earthquakes, typhoons, and floods and has experienced some of the world's worst disasters, such as the 1995 Great Hanshin Awaji Earthquake and the 2011 Great East Japan Earthquake. September 1 is celebrated as Disaster Prevention Day to commemorate the 1923 Great Kanto Earthquake that killed 100,000 people.

The Japanese government has continuously sought to develop and implement best practices in disaster management. Japan has developed legal and regulatory frameworks that define clear roles for disaster risk management (DRM) agencies and stakeholders. Japan leads international efforts in DRM and has adopted the Sendai Framework for Disaster Risk Reduction 2015–2030 in an effort to create resilient societies that integrate all aspects of development.

The DRM Hub and World Bank Tokyo Development Learning Center (TDLC) collaborate with MOF in this effort. Hydromet-related disasters are increasing and need strategic management, in both developed and developing countries. This Technical Deep Dive (TDD) provides an opportunity to learn from Japan's modern hydromet systems, built over the last 50 years. The four-day TDD has been structured to share practices and experiences that will help to strengthen institutions, modernize systems, and improve delivery of hydromet services for early warning.

The TDD provides an opportunity for participants to learn and improve the decision-making process of their current or planned investments. It offers innovative ideas and approaches, new solutions to apply in projects back home, and opportunities to network with experts and colleagues, and knowledge and experience.



## Mr. Makoto Suwa

Senior DRM Specialist, World Bank

In the global context of weather, climate, and hydrological phenomena, DRM considerations are key, in part because of the impact of disasters on critical sectors like agriculture, energy, health, transport, and water resource management. DRM needs to be addressed from a multi-sector perspective that considers its multiple effects together in order to realize co-benefits and promote sustainable development.

Typhoon Vera (1959) was a turning point for hydromet services in Japan. It drew the attention of the government to hydromet risks and the need for advanced hydromet services, including early warning. An improved legal framework and technological advances were some of the initial efforts that significantly reduced the damages due to hydromet disasters. Cost-benefit analyses of investments in hydromet services establish that such services are cost-effective. At the same time, Japanese experience has shown that their impacts can be seen in a relatively short period of time.

With an increasing number of users accessing hydromet data, there is a need for long-term planning that addresses both current and expected future issues. As Japan's experience demonstrates, it is important to set up a system that allows different agencies to efficiently and regularly exchange hydromet data and information.

“

MAKOTO SUWA

Senior Disaster Risk Management Specialist, Global Facility for  
Disaster Reduction and Recovery (GFDRR), World Bank Group

The core of Japanese experience  
really comes down to collaboration:  
you need to work with  
governments, the private sector,  
nongovernmental organizations,  
and media. Hydromet agencies  
cannot do it alone.

The World Bank's support to hydromet services could trace back as old as 1978, but its portfolio has expanded in the last 5 to 10 years. Its focus has broadened and shifted to take in the entire value chain. It no longer seeks only to strengthen forecasting or observing systems but also works to improve delivery services, specialized services, and communication with end users as well as support users in accessing and translating data for usage. Working collaboratively and involving communities are the key elements for effective hydromet services.



## Mr. Kuniyuki Shida

Senior Program Manager for Regional Coordination, Development and Regional Activities Department, World Meteorological Organization (WMO)

The last two years have marked a critical period for the importance and relevance of global agreements that address natural disaster challenges, including the Paris Agreement (COP 21), Sendai Framework, and Sustainable Development Goals and SIDS ACCELERATED MODALITIES OF ACTION (S.A.M.O.A.) Pathway.

Among the WMO's organizational goals are seven strategic priorities to be implemented during the four-year period from 2016 to 2019 including disaster risk reduction (DRR), Global Framework for Climate Services (GFCS), WMO Integrated Global Observing System (WIGOS), aviation meteorological services and polar/high mountain regions. Assistance to its Members' capacity development is also a priority. WMO supports the Sendai Framework and contributes to the International Network of Multi-Hazard Early Warning Systems (In-MHEWS) and impact-oriented warnings as a means of furthering these development goals.

At regional and national levels, many WMO Member countries face the challenges of budget cuts and lack of technical know-how within the National Meteorological and Hydrological Services (NMHSs), which affect the quality of meteorological and hydrological services. WMO collaborates with the international/regional organizations and partners to assist its Member countries within the frameworks of Green Climate Fund, the Climate Risk Early Warning System (CREWS).

WMO initiated the dialogue with private sector to harmonize the services provided by NMHSs and the private sector. Prioritizing sustainable urban development, WMO has developed an integrated approach to urban issues based on atmospheric research, satellite observations, weather and climate services, and disaster risk reduction. Within GFCS, User Interface Platforms are being established for DRR, health, food security, water and Energy sectors.



# SESSION SUMMARIES

# PACIFIC

- **Current situation** In Tonga, the National Disaster Council within the Cabinet is the central agency for disaster management. Under the aegis of the council, disaster activities are performed by three committees: National Emergency Management Committee, National Emergency Operations Committee, and National Emergency Recovery Committee.
- **Common challenges** Challenges include weak institutional capacity to coordinate and implement DRM initiatives, lack of a modernized weather observation network, and weak last-mile communications, especially with the outer islands.
- **Learning from Japan** Areas of learning include access to high-resolution satellite data and modeling capabilities, training on impact forecasting and capacity building of forecasters, and better access to data as part of the multi-hazard warning platforms.

# ETHIOPIA

- **Current situation** Ethiopia is prone to droughts and floods. Initiative is being taken by the government to manage hydromet disaster risks. Improvements can be seen in system development for data monitoring, analysis and information generation, human capacity building and institutional integration, hydromet monitoring station network expansion and modernization, and quality forecasting.
- **Common challenges** Challenges include high cost of modern technologies, limited capacity in flood forecasting and EWS, weak coordination among stakeholders, inadequate data management, difficulty integrating data services with analytical tools, weak real-time data, and inadequate manpower capacity at all levels.
- **Learning from Japan** Areas of learning include risk modeling, database and data quality management, information generation and data dissemination systems, software and models application, monitoring mechanisms, technical and management coordination, and organizational improvements and capacity building at all levels.

# SRI LANKA

- **Current Situation** In Sri Lanka, disaster early warnings are disseminated through three agencies, the Department of Meteorology (for cyclones, rainfall, tsunami, and lightning), Irrigation Department (for riverine floods), and National Building Research Organization (for landslides).
- **Challenges** Challenges include lack of budgets for modernized systems, inadequacy and weak capacity of staff, issues of data sharing and integration with available systems, and lack of coordination among authorities.
- **Learning from Japan** Areas of learning include access to new technology and models (Doppler radar/QPF, distributed hydrological models) and efficient use of real-time data from the available network.

# SESSION I. STRENGTHENING INSTITUTIONS

## Key Institutional Considerations for Effective Early Warning Systems (EWS)



### Mr. Tomoyuki Okada

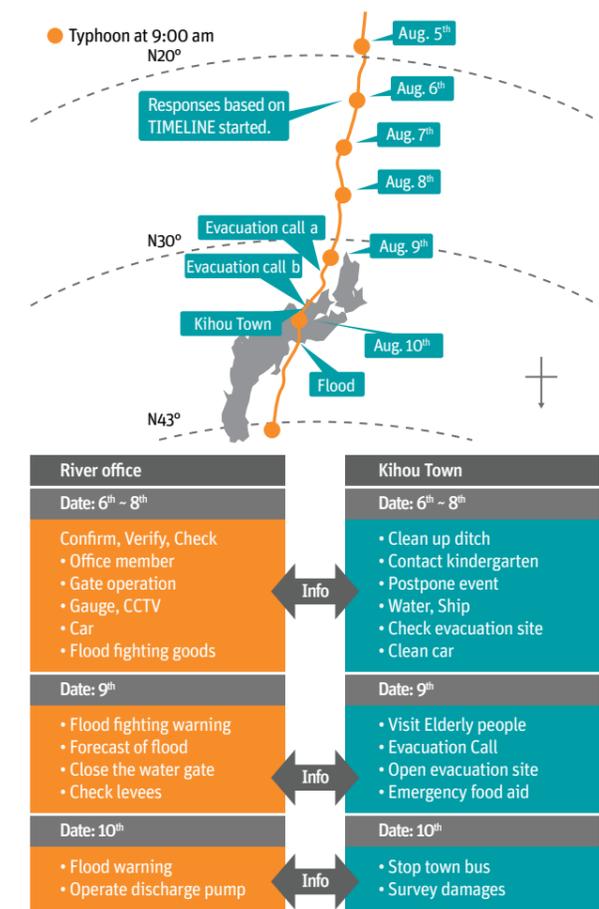
Director for International Coordination of River Engineering, River Planning Division, Water and Disaster Management Bureau, MLIT

Japan has long-established river administration and meteorological services, and it has continually improved disaster information delivery over the last 100 years. The DRM system in Japan is advanced and effectively mitigates the impacts of disasters. MLIT is Japan's primary authority for DRM, including risk preparedness, reduction, and response. Other ministries and agencies under the Cabinet Office work with MLIT in that role. Within MLIT, agencies like the Geospatial Information Authority of Japan, JMA, and National Institute for Land and Infrastructure Management are appointed to perform the various tasks pertaining to DRM. They all work in coordination and have designated responsibilities that allow them to tackle the gamut of risks.

Under the Meteorological Service Act of 1952, JMA is the designated single voice for deploying early warnings. In support of this arrangement, the Flood Fighting Act authorizes

MLIT and prefectural governments to designate inundation zones, disseminate forecasts, identify the location of evacuation sites, assist people in need, and provide flood hazard maps. MLIT disseminates flood warnings and forecasts for large rivers, in coordination with JMA. MLIT has eight regional bureaus (with local river offices) under its jurisdiction, and each has an established control center. The mission of the control centers is to (a) collect disaster information, (b) conduct surveillance of disaster damages, (c) disseminate disaster information to the Cabinet Office, other ministries, media, and the public, and (d) take emergency response measures. Various types of flood warnings are issued by MLIT and JMA, including stand-by, preparation, start operation, instruction, and disband. Japan's modernized system includes a rainfall radar system (C-Band radar and XRAIN) and promotes effective early warning.

Figure 1. MLIT's Flood Warnings and Response, Case of Typhoon 11 (2014).



Source: Adapted from Tomoyuki Okada's presentation

# SESSION II. MODERNIZING SYSTEMS

## How Do Evolving Technology and Innovation Provide Options for EWS?



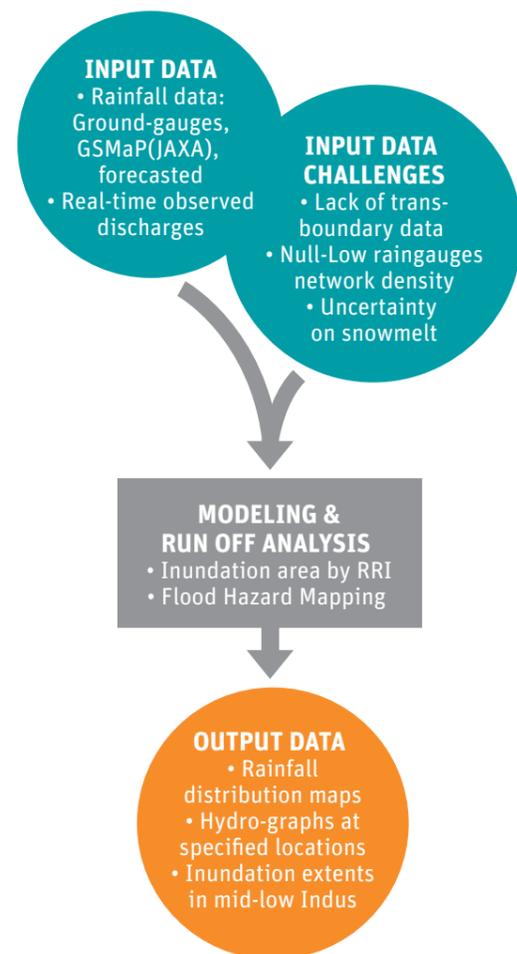
### Mr. Yoichi Iwami

Chief Researcher on Hydrology and Hydraulics, International Center for Water Hazard and Risk Management (ICHARM) under the auspices of UNESCO, Public Works Research Institute (PWRI), Japan

Flood risk management requires a comprehensive approach involving structural measures, land-use management, and nonstructural measures. In seeking to manage flood risk, developing countries often find themselves challenged by insufficient observed data, limited budgets, and inadequate capacity. They need modernized systems and strengthened institutions to address these issues and overcome challenges.

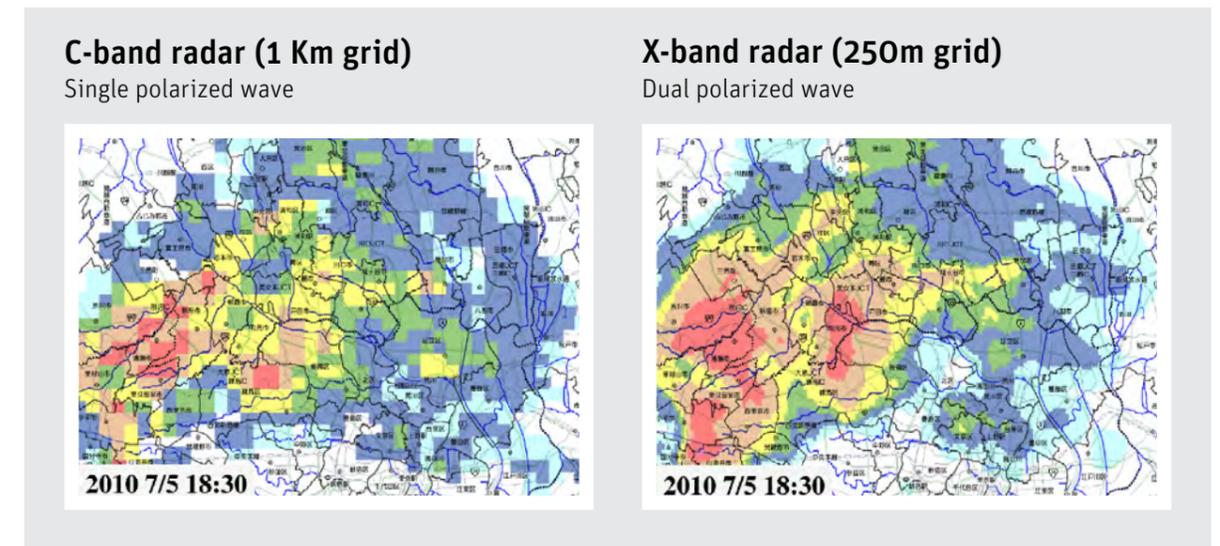
Developed using global data, ICHARM's Integrated Flood Analysis System (IFAS) and Rainfall Runoff-Inundation (RRI) models are useful tools for early warning flood simulation. Japan provides IFAS software at no cost to

Figure 2. Indus-IFAS applied to the UNESCO-Pakistan Project



Source: Adapted from Mr. Iwami's presentation

Figure 3. Precipitation Radar System (example of modernized systems)



countries in need; the software can be used with some prior training. Indus-IFAS is the localized version of the software used in Indus river basin, and many similar applications are used in other countries. ICHARM has the following suggestions for effective data collection:

- (a) a well-calibrated precipitation radar system is useful for a distributed hydrological flood forecasting model that can detect torrential rain in a small area (Figure 3);
- (b) satellite rainfall data need calibration with ground-gauged data; and
- (c) in situ data, along with global data from satellites, increase the accuracy of flood forecasting models.

Source: Yoichi Iwami, ICHARM

ICHARM was established in March 2006 with the mission to serve as the global center of excellence for water hazard and risk management. It is the secretariat of the International Flood Initiative, which was launched in 2005 as a joint collaboration between UNESCO (International Hydrological Programme), WMO, United Nations Office for Disaster Risk Reduction, United Nations University, International Association of Hydrological Sciences, and International Association of Hydro-Environment Engineering and Research.



### Mr. Mike Bergin

Regional Director,  
Australian Bureau of Meteorology

Australia supports end-to-end forecasting services, from research to decision making, ensuring improved safety and efficiency to its people (Figure 4). For forecasting services, it is crucial to communicate with end users and understand what they require—i.e., the value in forecast is its usefulness to the end user. Australia appoints forecasters who are intermediaries and facilitate communication between customers and the forecasting centers and services.

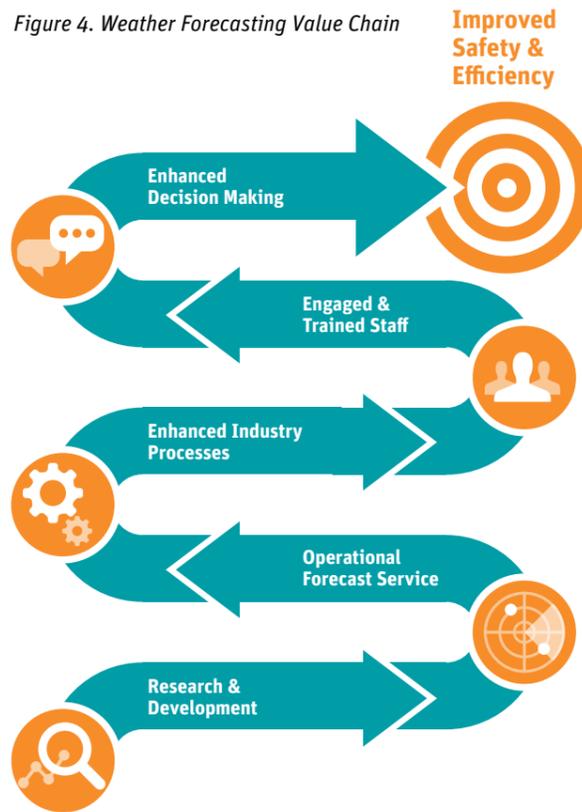
The Australian Bureau of Meteorology has set up automatic weather stations (AWSs) that provide weather information to many departments, especially agriculture. The AWS is a tiered network that provides layered information based on the needs and priorities of the users. This approach also helps in installing AWS at a relatively cheaper cost.

Surging mobile phone and Internet usage supports early warning dissemination by facilitating faster sharing of information on hydromet risks and disasters. Social media such as Twitter and Facebook are also great methods of disseminating information. It's been observed that the use of graphics for disseminating information on hydromet risks and warnings has a greater impact than use of simple text messages.

“

**MIKE BERGIN**  
Regional Director,  
Australian Bureau of Meteorology

In Australia, the hydromet agency comprises meteorologists, hydrologists, and climatologists who are not separated by departments but are looked up to as a team for mitigating risks.



Source: Adapted from Mr. Iwami's presentation

## SESSION III. IMPROVING SERVICE DELIVERY

### What Are the Critical Issues for Communicating Warning Messages



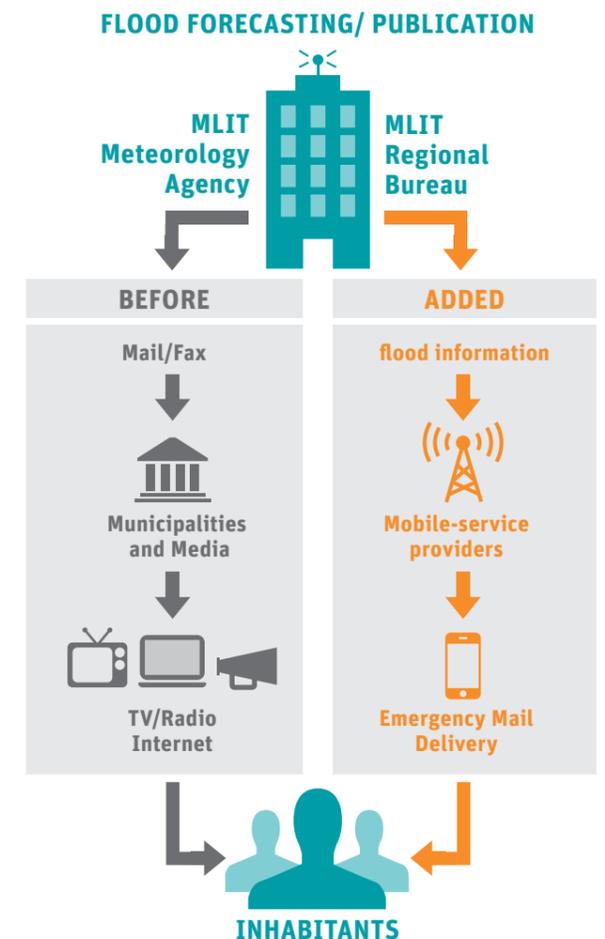
### Mr. Hirotsada Matsuki

MLIT  
Early Warning and Disaster Management in Japan

MLIT has increasingly recognized the importance of community engagement for flood risk management. As part of this effort, MLIT is promoting a new policy—"Rebuilding flood-conscious society". For this, MLIT, in cooperation with mobile service providers, introduced an emergency mail delivery system on September 5, 2016. The system directly delivers SMS messages/emails to mobile phones of the residents of the Kinugawa and Hijikawa River basins, informing them about water levels that may cause inundation. The Cable-One company started a "disaster channel" for the region (Takeo city, Ohmachi, Kohoku, and Shiroishi town) to broadcast real-time images of the river basin.

Source: Adapted from Mr. Iwami's presentation

Figure 5. Emergency mail delivery to push flood information



In order to provide additional information to the program, MLIT's Takeo River Office transmits the capture of real-time images from the river-monitoring camera. Communication with residents has also increased, and they are involved in various activities for flood risk management, including editing of the community hazard maps. MLIT river offices support schools' effort to educate children about flood fighting.



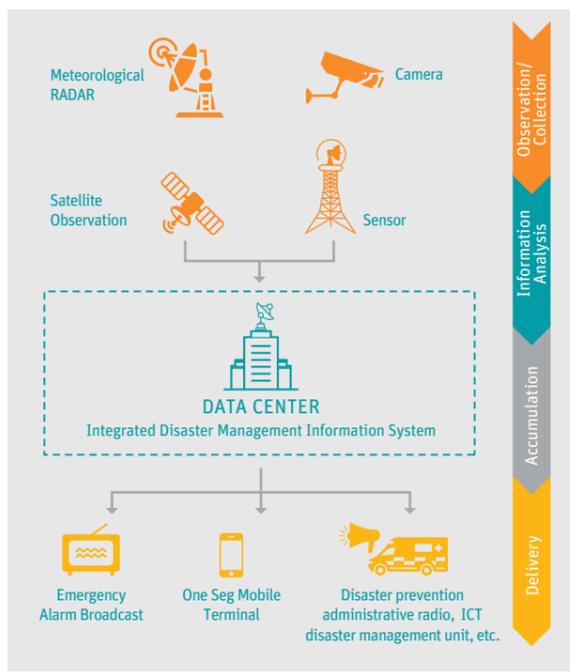
### Mr. Kazuhiro Wada

Ministry of Internal Affairs and Communication (MIC)

#### MIC's International Cooperation in the Field of ICT for Disaster Management

Information and communications technology (ICT) for disaster management involves four different stages—collection, information analysis, accumulation, and delivery. MIC cooperates at the international level in the field of ICT for disaster management, focusing on transmission of information within and between parties, including public organizations, residents, and mass media. MIC has established procedures for use of ICT in various stages of DRM, such as preparedness, mitigation, recovery, and response.

Figure 6. ICT for disaster risk management



Source: Adapted from Mr. Kazuhiro Wada's presentation



### Mr. Yasuji Sakaguchi

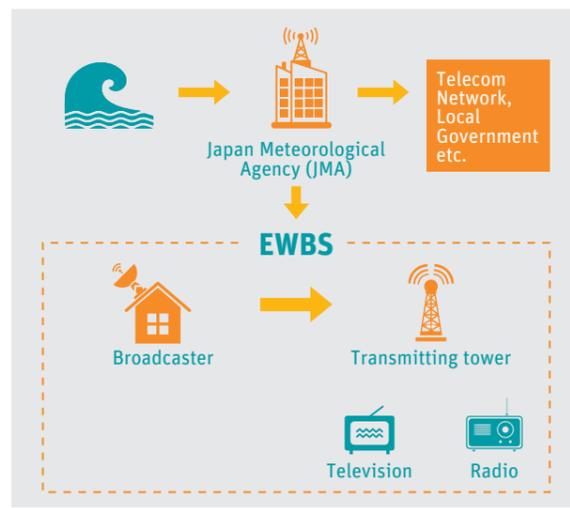
NHK ITEC

#### Advantages of Broadcasting in Disaster Reduction: Early Warning Broadcasting System (EWBS)

NHK ITEC shared a short video on early warning broadcasting for the tsunami on March 11, 2011. In Japan, broadcasting is the preferred method for deploying early warning. The Early Warning Broadcasting System (EWBS) not only is congestion free, but also allows robust transmission (wireless), with possible coverage to remote areas. In Japan, JMA is the single entity to issue early warnings except flood warnings, which are issued jointly with MLIT.

It provides information to broadcasters, who in turn deploy the warning to end users. EWBS follows "simple protocol" technical standards to issue the emergency warning rapidly and reliably to all users at once. Japan's experience of a stable and reliable broadcasting network has been introduced to other countries as well, including Peru, Chile, the Philippines, and Ecuador.

Figure 7. Flow of early warning information, Japan



Source: Adapted from Mr. Yasuji Sakaguchi's presentation



### Mr. Naoki Kato

NTT DOCOMO

#### DOCOMO Area Mail Service

In 2007, as a part of its mission to improve safety and security, the mobile phone service provider NTT DOCOMO started the early warning service "Area Mail."

The service provides disaster early warnings and evacuation information to all DOCOMO mobile phones in the designated area. Interestingly, Area Mail does not require registration, and everyone in the area, including commuters and travelers, can receive the early warning messages.

Area Mail essentially sends out three types of notifications—earthquake early warning, tsunami warning, and disaster/evacuation information. At the time of the service launch, DOCOMO was the only service provider participating, but the service is now provided by many carriers. On September 5, 2016, NTT DOCOMO (in association with MLIT) also began disseminating flood information. Flood information now is being disseminated for the municipalities of the Kinugawa and Hijikawa River basins (Joso City, Ibaraki and Ozu City, Ehime). The service is likely to be expanded gradually.

Figure 8. NTT DOCOMO started the early warning service "Area Mail"



Source: Adapted from Mr. Naoki Kato's presentation

# Highlights from Client Engagement including Main Challenges

## PACIFIC

- Tropical cyclones
- Lack of coordination and communication among governments of outer islands
- Rapid urbanization, lack of planning, and climate change
- Need of radar system on many islands

## HONDURAS / NICARAGUA / URUGUAY

- Limited use of existent radar equipment (Nicaragua and Honduras)
- No access to radar data (Uruguay)
- Inability to access global data
- Lack of forecasting capacity and funds (Nicaragua)



## ZAMBIA

- Droughts
- Inadequate forecasting services and warning dissemination, lack of coordination between technical services
- Need to disseminate information in understandable language
- Need to use sustainable technologies

## ETHIOPIA

- Drought, Flash floods
- Weak flow of information among agencies and low capacity to manage flood risk
- Lack of funds and limited technical capabilities
- Need for international support

## AFGHANISTAN

- Drought, floods, landslides, storms
- Security concerns
- Inadequate EWS and organizational capacities, absence of tools and systems
- Need to expand station network and collaborate on EWS



## BHUTAN

- Floods
- Lack of technology for forecasting and early warning
- Lack of coordination between agencies
- Need observation network and access to global data

## SRI LANKA

- Floods, landslides
- Lack of coordination between agencies leading to ineffective EWS (in spite of timely dissemination of information)
- Need to establish telemetry system (station itself and information dissemination to user) and radar system

## LAO PDR

- Flash floods
- Lack of data, inadequate EWS, lack of coordination between agencies
- Need to improve analysis, interpretation and use of weather-related data for forecasting

## VIETNAM

- Floods, typhoons
- Multiplicity of involved organizations, lack of coordination
- Lack of unified hydromet operations and inadequate financing
- Need to acquire improved software and high-processing-capacity computers to analyze satellite data





## SITE VISITS

# Japan Meteorological Agency Headquarters

Participants visited JMA headquarters to understand the scope of JMA activities and how it performs the early warning operation. Established under the Meteorological Service Act of 1952, JMA's objective is to establish observation networks; to issue warnings, forecasts, and other bulletins; and to promote private weather businesses, in part by establishing a certified weather forecaster system. The agency's core mission is fourfold:

- 1) Preventing and mitigating natural disasters
- 2) Securing traffic safety
- 3) Promoting international cooperation
- 4) Fostering development and growth of industries

Participants visited the four observation centers of JMA—the Observation System Operation Center, Weather Forecasting Center, Marine Forecasting Center, and Seismology and Volcanology Operational Center—in separate groups

### OBSERVATION SYSTEM OPERATION CENTER

✔ Controls and monitors observation systems for surface, upper-air, weather radar, civil aviation, and geostationary satellite.

✔ JMA launched Himawari-8, a multi-band, high-resolution, and high-frequency satellite, on October 7, 2014 followed by Himawari-9 on November 2, 2016 which is currently in the stand-by mode until it will succeed Himwari-8 in 2022.

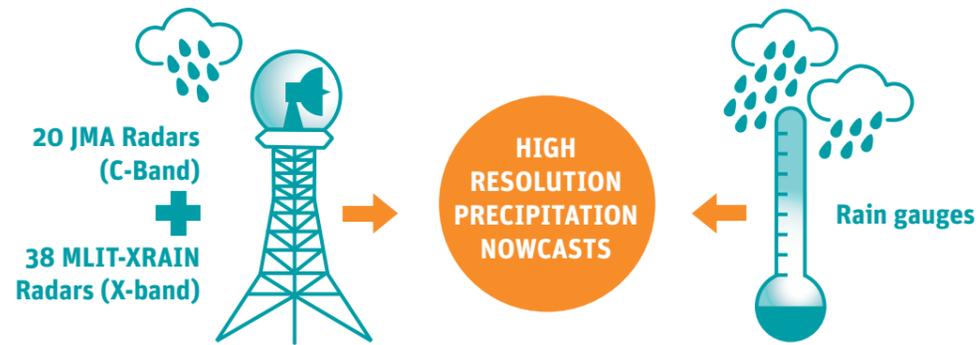
✔ JMA uses a C-band Doppler radar network consisting of 20 radars (range of 400 km radius) to observe precipitation.

✔ The automated weather station AMeDAS has about 1,300 stations for collecting data in real time and monitoring weather, including rainfall.

✔ Its High-Resolution Precipitation Nowcasts (Figure 7), predict short-range precipitation intensity with a spatial resolution of 250 m, up to 30 minutes ahead.

**JMA** has four technical departments or observation centers at its headquarters. Field offices are under six regional headquarters which comprise 50 local meteorological offices, two weather stations, four aviation weather service centers, and six aviation weather stations. The local meteorological offices is responsible for issuing bulletins on weather disaster reduction, including warnings and advisories for the designated prefecture. JMA also has five auxiliary organs - Meteorological Research Institute, Meteorological Satellite Center, Aerological Observatory, Magnetic Observatory, and Meteorological College.

Figure 9. High-Resolution Precipitation Nowcasts



### WEATHER FORECASTING CENTER

The Weather Forecasting Center forecasts and provides information on severe weather preparedness for emergency warnings, warnings, and advisories. It also works as a national forecasting center providing instructions and indications for regional and local offices. The center also analyzes and forecasts tropical cyclone, tracks typhoons, and provides marine warnings and forecasts and aviation weather services.

### MARINE FORECASTING SERVICE

The Marine Forecasting Service is under the Office of Marine Prediction. The main tasks of the office are to monitor tides (sea level) and storm surges, ocean waves, sea ice, sea temperatures, and ocean currents. Wave information is useful in reducing disaster risk for (a) shipping and fisheries industries, (b) people living

in coastal areas, (c) development of coastal marine structures, and (d) marine leisure. Wave observations are made using various tools (ships, radar, buoys, and satellites) and inform hazard predictions.

### SEISMOLOGY AND VOLCANOLOGY OPERATIONAL CENTER

For earthquakes and tsunami, an Early Earthquake Warning is issued within seconds of occurrence of earthquake. Early Warnings are issued automatically, and they provide advance notice of strong motion. Within around three minutes later JMA issues a tsunami warning advisory, and updates information, based on prediction and latest situation. In Japan, 47 out of 110 active volcanoes are under intensive observation. There are four Volcanic Observation and Warning Centers in Japan. The Tokyo Center is in charge of 18 volcanoes, including Mount Asama and Mount Ontake.

Source: Adapted from Mr. Iwami's presentation

## Shimodate River Office

The site visit to the Shimodate River Office was led by Mr. Katsuo Ito, Shimodate River Office, Kanto Regional Development Bureau, MLIT. The objective of the visit was to allow participants to understand both normal and extraordinary operations at river management offices, particularly before, during, and after an expected major hydrometeorological event. The site visit included a tour of the facilities and discussion with officials in the areas where residents had received a flood warning. Participants also visited nearby flood-fighting corps.

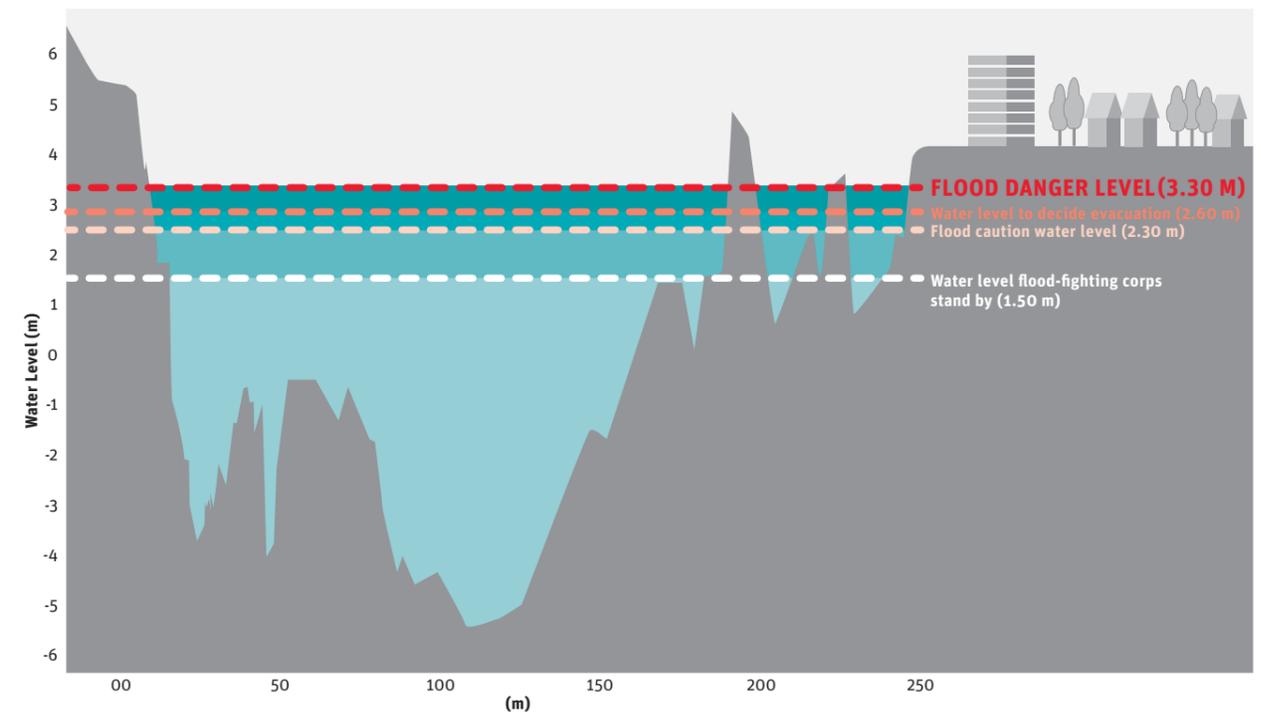
Within the Shimodate River Office jurisdiction, water-level observation stations are installed at four points in the Kinugawa River and four points in the Kokaigawa River, with flood-

fighting warning zones designated for each area. Observation data from the Kinugawa River is shown in Figure 10.

The observation system is a five-level danger advisory system, where each level signifies the danger intensity. When the water level reaches mark 2, the city governments are informed; at level 3 the mayor issues an advisory and at level 4 a warning. Advisories are issued through faxes, websites and Internet, and mobile phones.

The Shimodate River Office arranged for participants to visit the site of the levee break, where large-scale flooding had occurred, to gain a first-hand understanding of such events.

Figure 10. Record of water-level observations in the Kinugawa River (Sanuki point)



Source: Kanto Regional Development Bureau, MLIT

# Visiting the Areas affected by the Joso City Floods (September 2015)

On Wednesday, September 9, 2015, Severe Tropical Storm Etau made landfall in Aichi prefecture near the center of Japan's main island. As it proceeded northward, the storm produced heavy rainfalls of more than 300 mm in much of eastern Japan during September 6-11 (Figure 11). In Nikko, in Tochigi Prefecture, 551 mm of precipitation fell in a 24-hour period starting at 6:30 on September 9 – the highest level on record since 1975 and an amount only expected to occur 1 time in a period of 100 years or more, based on current models.

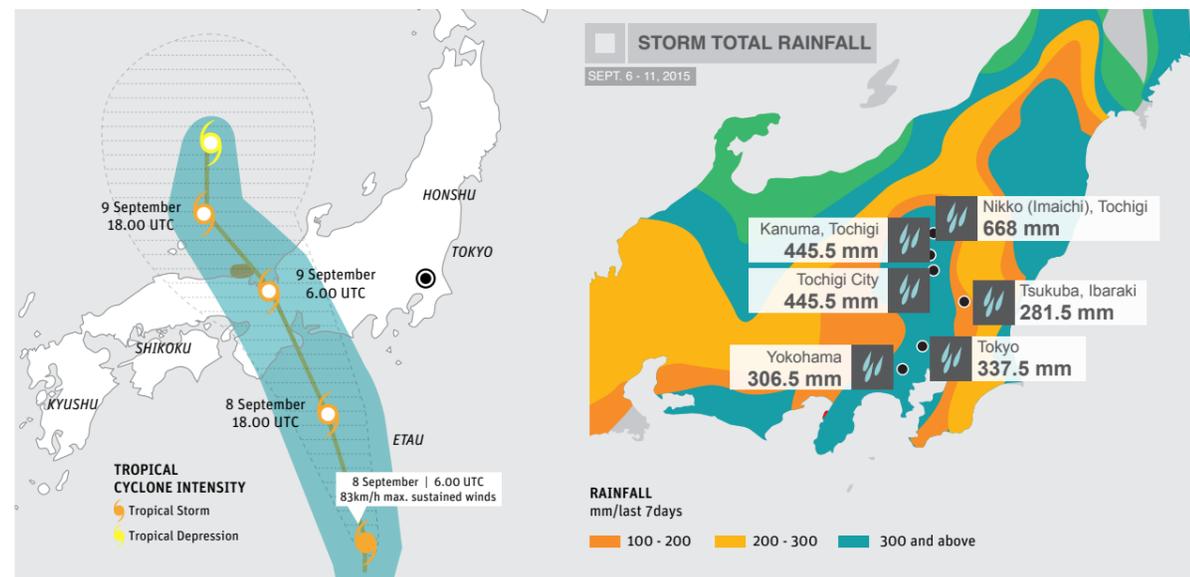
By mid-day on September 9, the rainfall in upstream areas of the Kinugawa River basin had begun to cause increasing water levels downstream. Joso City in the Ibaraki Prefecture saw water levels on the Kinugawa River surpass the 1.1-meter warning level at 22:30 that night.

Starting in the early morning of September 10, levee overflows were observed at 7 locations. By 12:50, a levee breach opened

near the Misakamachi area of Joso City, which eventually deteriorated a 200-meter section of levee. The flood damage from the overflows and breaches was extensive, with approximately 40 km<sup>2</sup> – one-third of Joso City – inundated and nearly 4,300 people requiring rescue, as well as several fatalities.

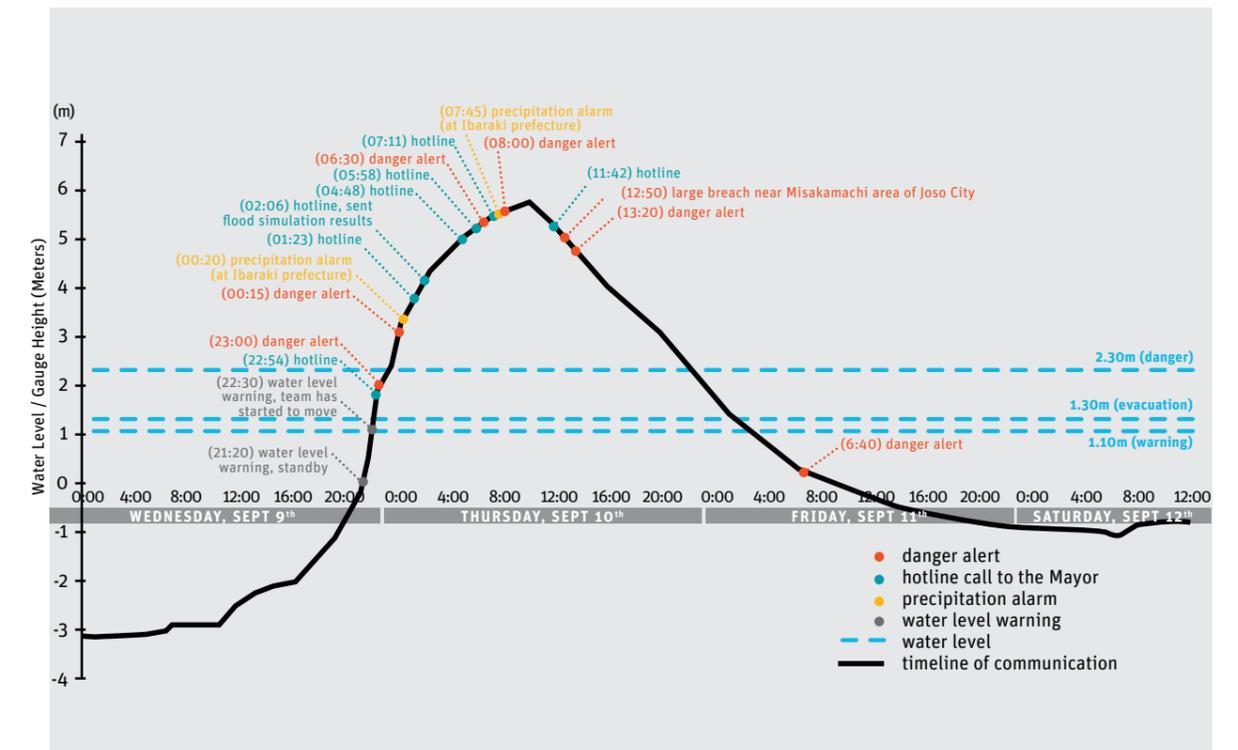
The figure 12 shows the water levels or gauge heights of the Kinugawa River from September 9-12, the reference flood stages and warning levels, and the flow of communication between the Shimodate River Office (MLIT) and the Joso City government. The director of the Shimodate River Office contacted the Mayor of Joso City several times on September 9-10 through a direct communication hotline, providing information about observed and predicted water levels, the expected risk of overflow and levee breach, and time and extent of inundation. Unfortunately, the mayor did not issue an evacuation warning prior to the major levee breach on September 10, citing confidence that the levee would hold despite the water levels.

Figure 11. Storm tracker and rainfall data for Tropical Storm Etau



Source: Adapted from information by JMA and European Commission Disaster Management (ECDM)

Figure 12. Water Levels at MLIT's Kawashima Water Level Observation Station and Flow of Emergency Information (Ibaraki Prefecture, Sept 9-12)



The process of emergency restoration began with the construction of a temporary levee, which was completed within five days. Notably, the entire reinforcement project was completed within two weeks. The temporary restoration of the levee relied on surplus materials on hand, which contributed to its rapid completion. Permanent levee construction took place from November 2015 to May 2016. In the wake of the levee breach and flooding, several initiatives were launched. MLIT established the Kinugawa River Levee Investigation Committee to identify the causes of the breach and review the information and actions taken, producing a full report describing the events in detail and setting out key recommendations for

improvement. To that end, the Government of Japan, Ibaraki Prefecture, and seven municipalities, including Joso City, have undertaken the Kinugawa River Emergency Response Project (Figure 13). The Project includes JPY 60 billion (US\$530 million) in structural investments to complete urgent and intensive river improvements to prevent future disasters, as well as nonstructural measures to promote appropriate evacuation through guidelines and training on timelines for evacuation orders, joint inspections of hazardous sites with officials, flood fighting response teams, and residents, publication of hazard maps, and development of a system for wide-area evacuation with relevant institutions.

Source: Adapted from MLIT's presentation

Figure 13. Elements of the Kinugawa Emergency Response Project



**KEY LEARNING POINTS FOR THE PARTICIPANTS**

Japanese officials were very candid in explaining and detailing the flood event, their response and lessons learned as a result. Through the site visit, participants observed the upgrading process of the levee and learned that various efforts are conducted by river management authority, local government and residents around major rivers to ensure last-mile connectivity and communication for early warning. This gave an opportunity to the clients to draw useful lessons that could be applied back in their home countries:

KEY LEARNING POINTS	
Consider structural measures to reduce disaster risk	Define responsibilities among key stakeholders
Carefully consider risk info and warning and the availability of the warning before, during, and after hazard events	
Focus on continuous improvement of structural and non-structural measures	



Source: Adapted from MLIT's presentation

# Summary of Action Planning Discussions

The participants discussed the range of challenges they face—institutional, legal, financial, technological, communication, structural, and nonstructural—in providing hydromet services. They also discussed the lessons learned from Japan and other participating countries. Table 1 summarizes the challenges countries face and those elements of the Japanese hydromet system they consider most important for promoting success in their own systems; more details are available in annex 1.

Table 1. Hydromet Challenges and Elements Needed for Successful Services in Client Countries

COUNTRY	CLIENT-IDENTIFIED CHALLENGES	TAKEAWAYS AND FOLLOW-UPS PLANNED/REQUESTED
<b>Afghanistan</b>	<ul style="list-style-type: none"> <li>Weak institutional mechanisms</li> </ul>	<ul style="list-style-type: none"> <li>Increased knowledge on modern technology used in Japan</li> <li>Best practices on efficient communication modalities and adequate capacity</li> <li>Follow-Up: Support from JMA in the strengthening of EWS</li> </ul>
<b>Bhutan</b>	<ul style="list-style-type: none"> <li>Lack of coordination between the responsible agencies</li> <li>Absence of national policy for hydromet</li> </ul>	<ul style="list-style-type: none"> <li>Increased knowledge on EWBS-style warning system</li> <li>Engagement with universities and education institutions for research and awareness raising</li> <li>Follow-Up: Collaborating with JMA in the strengthening of hydromet systems and services</li> </ul>
<b>Ethiopia</b>	<ul style="list-style-type: none"> <li>Lack of systematic and technology-supported integrated information systems and EWS</li> </ul>	<ul style="list-style-type: none"> <li>Increased knowledge on modern technology used in Japan including advanced EWS</li> <li>Follow-Up: Collaborating with JMA in the strengthening of hydromet systems and services</li> </ul>
<b>Honduras</b>	<ul style="list-style-type: none"> <li>EWS based only on meteorological data and limited forecasts and not on flood forecasting</li> </ul>	<ul style="list-style-type: none"> <li>Increased knowledge on defined roles and responsibilities for relevant agencies in Japan, including:                             <ul style="list-style-type: none"> <li>Efficient flood modeling and forecasting</li> <li>Efficient EWS with strengthened communication channels</li> </ul> </li> <li>Follow-Up: Collaborating with ICHARM on accessing rainfall run-off inundation (RRI) and flood models</li> </ul>

COUNTRY	CLIENT-IDENTIFIED CHALLENGES	TAKEAWAYS AND FOLLOW-UPS PLANNED/REQUESTED
<b>Lao PDR</b>	<ul style="list-style-type: none"> <li>Inadequate observation network</li> <li>Weak legal and institutional framework</li> <li>Lack of funds and resources</li> <li>Need for improved structural and nonstructural measures</li> </ul>	<ul style="list-style-type: none"> <li>Increased knowledge on clear institutional and implementation plans in Japan including:                             <ul style="list-style-type: none"> <li>Efficient flood management plans</li> <li>Enhanced institutional and human capacity</li> </ul> </li> </ul>
<b>Nicaragua</b>	<ul style="list-style-type: none"> <li>Lack of funds</li> <li>Very limited number of effective automatic EWS</li> <li>Limited modeling and forecasting experience</li> <li>Inadequate hydromet infrastructure (e.g., AWS, broadband Internet)</li> </ul>	<ul style="list-style-type: none"> <li>Increased knowledge on advanced technology and models, such as the Integrated Flood Analysis System (IFAS) and RRI</li> <li>Follow-Up: Collaborating with ICHARM on accessing rainfall run-off inundation and flood models</li> </ul>
<b>Pacific</b>	<ul style="list-style-type: none"> <li>Low-quality observation equipment</li> <li>Weak human and financial capacity</li> <li>Inadequate access to international weather and flood forecast models</li> <li>Weak communication and coordination within the island groups</li> </ul>	<ul style="list-style-type: none"> <li>Increased knowledge on hydromet tools and technologies in Japan including:                             <ul style="list-style-type: none"> <li>Capacity support of JMA</li> <li>Standard operating procedures for warnings and responses</li> </ul> </li> </ul>
<b>Sri Lanka</b>	<ul style="list-style-type: none"> <li>Inability to receive real-time and short-range quantitative precipitation forecasts for floods</li> <li>Weak early warning for landslides</li> </ul>	<ul style="list-style-type: none"> <li>Increased knowledge on use of digital data for forecasting in Japan including:                             <ul style="list-style-type: none"> <li>Adequate hydromet infrastructure</li> <li>Enhanced capacity of local meteorologists</li> </ul> </li> </ul>
<b>Uruguay</b>	<ul style="list-style-type: none"> <li>Limited knowledge and experience in hydrological forecasting</li> </ul>	<ul style="list-style-type: none"> <li>Increased knowledge on defined roles and responsibilities for relevant agencies related to hydromet and EWS in Japan including:                             <ul style="list-style-type: none"> <li>Enhanced hydromet models and use of advanced technology</li> <li>Effective evacuation planning</li> </ul> </li> </ul>
<b>Vietnam</b>	<ul style="list-style-type: none"> <li>Inadequate coverage of observational network and communication system</li> <li>Weak financial capacity</li> <li>Inaccurate short-range forecast for rainfall</li> </ul>	<ul style="list-style-type: none"> <li>Increased knowledge on the use of satellite and radar data for forecasting in Japan</li> <li>Follow-Up: Collaborating with ICHARM on accessing flood models</li> </ul>
<b>Zambia</b>	<ul style="list-style-type: none"> <li>Weak last-mile connectivity and EWS</li> <li>Weak forecasting systems for hydromet hazards</li> </ul>	<ul style="list-style-type: none"> <li>Increased knowledge on defined roles and responsibilities for relevant agencies related to hydromet and EWS in Japan including:                             <ul style="list-style-type: none"> <li>Adequate human capital and financial resources for hydromet services</li> <li>Customized solutions for hydromet services</li> </ul> </li> </ul>

# PUBLIC SEMINAR



The Hydromet TDD concluded with the 14th Disaster Risk Management Seminar, “Exploring Key Lessons Learned and Opportunities for Improved Forecasting and Early Warning in Developing Countries.” Organized by the World Bank Disaster Risk Management (DRM) Hub, Tokyo, in conjunction with the World Bank Tokyo Office, the seminar brought together experts and practitioners to share perspectives on meeting the serious challenge of hydromet risks. A part of the Hub’s Public Seminar series, this seminar presented the key lessons and solutions from the TDD, highlighted the effect of underinvestment in national hydromet services on public safety and assets, and called attention to solutions suggested by Japan’s experience.

The seminar drew lessons and discussed practices from Modernization of Japan’s Hydromet Services: A Report on Lessons Learned for Disaster Risk Management. This operational knowledge product, which captures key practices and techniques used in Japan, was produced by the World Bank Disaster Risk Management Hub, Tokyo, with support from the Government of Japan.

## The seminar set out:

- **Lessons learned from Japan and opportunities for improved forecasting and early warning in developing countries**

- **Challenges and status of natural disasters in Afghanistan and relevant lessons from the Hydromet TDD**

- **Key challenges of managing hydromet disasters in Bhutan and strategic plans for modernizing the national hydromet networks and infrastructures**

- **External support to help Ethiopia address problems with information generation and flow and with EWS (lack of systemization, poor integration, outdated technology)**

- **Holistic approach for strengthening climate information and early warning systems to support climate-resilient development in Honduras and Nicaragua**

# CONCLUSION

Climate change, land-use development patterns that do not take disaster risk into account, and other factors are drivers of hydrometeorological disaster risk. Effective hydromet systems and early warning systems can allow countries to safeguard lives and livelihoods while expanding economic opportunities. The Hydromet TDD demonstrated how Japan, a country subject to frequent natural hazards, continually improves and updates its legal and regulatory frameworks, technologies and systems, and learns and grows after every disaster. TDD participants were encouraged and informed by Japan’s experience in addressing disasters and its demonstrated proactivity in issuing timely and accurate warnings.

The TDD and the public seminar pointed to the need for key elements that are modeled in Japan’s hydromet services:

- **Institutional strengthening**, which entails interagency coordination and information/data sharing, operational procedures, and involvement of all relevant stakeholders, including communities and businesses

- **Modernization of systems**, which financially constrained countries can seek to achieve using data from global databases and platforms

- **Last-mile connectivity**, which involves dissemination of timely and accurate warning messages to end users

Participating countries with budgetary constraints are seeking economical options for obtaining hydromet data. The TDD facilitated their potential uptake of available solutions, such as WMO’s global data, ICHARM’s IFAS and RRI models, JMA’s Himawari-cast satellite data, and regional data sharing. Countries should take the initiative in customizing the data obtained, integrating the information into local data, and analyzing and validating the data for accuracy; this approach helps to ensure that there is a single voice from the government for early warning. For effective EWS, each country should develop standardized procedures that align institutional mechanisms, and should define roles and responsibilities of each stakeholder in order to enhance coordination and communication.

# FOLLOW-ON SUPPORT AND WAY FORWARD

World Bank clients and task teams are engaging the DRM Hub and TDLC for just-in-time operational support and are interacting with experts in Japan to enhance the quality of—and inform solutions for—their projects.

## Follow-On Support

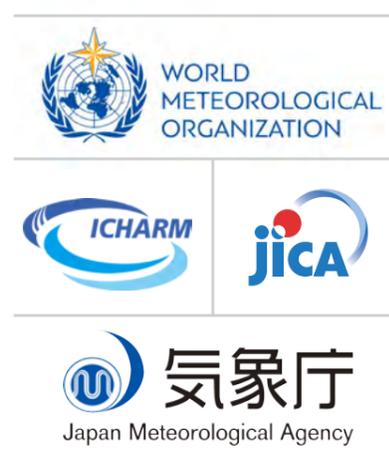
Clients from Afghanistan, Bhutan, Ethiopia, Honduras, Nicaragua, Pacific, and Uruguay visited JICA, ICHARM, JMA, and WMO offices to follow up on the presentations by these organizations and to gain a deeper understanding of their models. These client countries showed an interest in adapting and engaging Japanese expertise for their systems back home.

▪ **Pacific** The team expressed interest in collaborating on the Pacific Resilience Program (PREP), participating in the hydromet training programs that JICA offers in the Pacific to World Bank clients, and engaging in JICA’s flood master plan project in Fiji. The team member from Tonga attended JICA’s Himiwari-8 data training in Fiji (September 12–16, 2016).

▪ **Afghanistan, Ethiopia, Honduras, Nicaragua, and Uruguay** Client countries expressed interest in better understanding ICHARM’s free, open source flood risk models (IFAS and RRI), and they are looking for assistance in application of the risk models. The World Bank team in Tokyo is working in partnership with ICHARM to structure a follow-on workshop and potential knowledge product in response to client demand. Currently, Nicaraguan officials are working with the DRM Hub to explore collaborations around the flood risk identification tools from ICHARM.

▪ **Afghanistan, Bhutan, Ethiopia, and Pacific.** These client countries exchanged ideas on JMA’s potential support to the hydromet agenda and to their own projects, including observation network designs, models, and communication systems. Pacific countries plan to follow up on storm surge models and potentially collaborate with JMA on developing regional capacity through the Fiji Meteorological Service. Follow-up is required with the local Japanese Embassy and JICA country office on the potential participation of AMD staff in the JICA-JMA group training on meteorology.

Figure 14. Follow on support by Japanese experts



## Next Steps

Client countries identified the specific assistance they need from the World Bank in improving their hydromet services. Demand for technical assistance in capacity building was the highest, followed by hydromet services improvement. The figure below illustrates the order of requests from the participating client countries, which they need from the Bank and other donor agencies in improving their hydromet services.

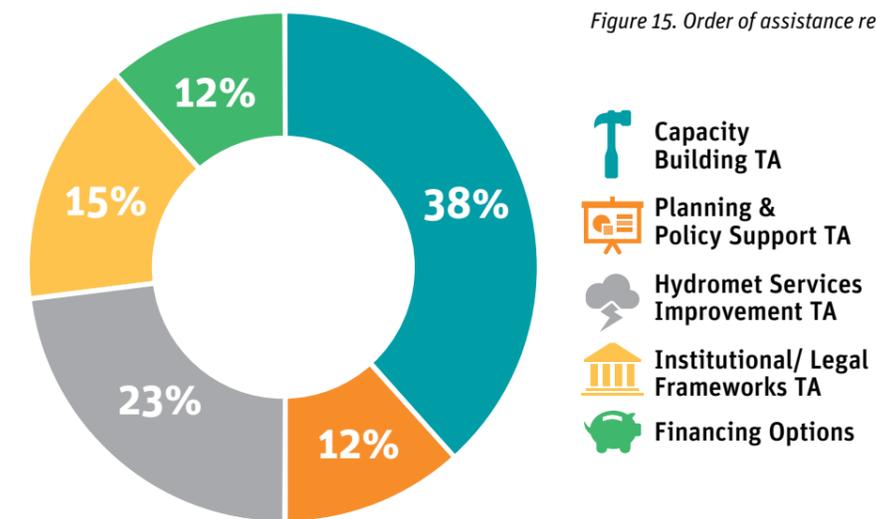


Figure 15. Order of assistance requests from the client countries

Details of the specific requests from each of the participating client countries are summarized in table 2 below.

Table 2. Client Countries’ Requests for Technical and Financial Assistance

	TECHNICAL ASSISTANCE				FINANCING OPTIONS
	CAPACITY BUILDING	PLANNING/ POLICY SUPPORT	HYDROMET SERVICES IMPROVEMENT	INSTITUTIONAL/ LEGAL FRAMEWORKS	
AFGHANISTAN	●		●		●
BHUTAN	●	●			●
ETHIOPIA	●		●	●	
HONDURAS	●	●			
LAO PDR	●	●	●		
NICARAGUA	●		●	●	
PACIFIC				●	
SRI LANKA	●				
URUGUAY	●			●	
VIETNAM	●		●		●
ZAMBIA	●		●		

## Annex 1. Agenda of TDD

### September 12, Monday

#### AM

8:50	Breakfast provided   at World Bank	10:30	Coffee Break
9:30	TDLC/DRM Hub, Tokyo	10:45	<b>Framing Presentation on Key Question 1: Strengthening Institutions: What are key institutional considerations for effective early warning systems?</b> (15 min. + 5 min. Q&A) Mr. Tomoyuki Okada, Director for International Coordination of River Engineering, River Planning Division, Water and Disaster Management Bureau, Ministry of Land, Infrastructure, Transport and Tourism, Government of Japan
9:30	<b>Introduction / Moderation</b> Mr. James (Jay) Newman, DRM Specialist, World Bank DRM Hub, Tokyo		
9:35	<b>Welcoming Remarks</b> Mr. Naoki Yamashita, Deputy Director, Multilateral Development Banks Division, Ministry of Finance, Government of Japan		
9:45	<b>Introduction to the Technical Deep Dive and Engagement Approach</b> Mr. Daniel Levine, Senior Officer, TDLC, World Bank	11:05	<b>Framing the Client's Challenge and Thinking Through the Question</b> Lightening Talks from 2–3 client countries (15 min.) • Afghanistan • Vietnam • Lao PDR Exchange of views in liberating format (Small group discussions) (20 min.) Facilitated Comments: • Mr. Tomoyuki Okada, MLIT • International Partners, World Bank staff (10 min.)
9:55	<b>Setting the Stage for Hydromet Services: Global Framework and Global Trends</b> (15 min.) Mr. Makoto Suwa, Senior DRM Specialist, GFDRR Hydromet Program, World Bank Mr. Kuniyuki Shida, Senior Program Manager for Regional Coordination, Development and Regional Activities Department, World Meteorological Organization	11:50	<b>Action Planning on Key Question 1 (Small groups of 4–6)</b> Activity Instruction (5 min.) Discussion and Action Planning (30 min.) Small Group Reporting—Representative from each group presents key points (15 min.)
10:10	<b>Visualization of Clients' Learning Objectives: Who Are We and What Are We Trying to Achieve?</b> Mr. Jay Newman Ms. Haruka Imoto, Knowledge Management Analyst, TDLC	12:40	
10:25		12:45	Lunch (Bento Box) at TDLC / DRM Hub
10:25	Group photo		

## September 13, Tuesday

### PM

13:25	Introduction	15:30	Small Group Reporting from Action Planning—Representative presents key points (15 min.)
13:30	<b>Framing Presentation on Key Question 2: Modernizing Systems: How do evolving technology and innovation provide options for Early Warning Systems (EWS)?</b> (15 min. + 5 min. Q&A) • Yoichi Iwami, Chief Researcher on Hydrology and Hydraulics, ICHARM, PWRI	15:45	Interactive session and feedback on learning needs from each country (1 hr.)
13:50	<b>Framing the Client’s Challenge and Thinking Through the Question</b> Lightening Talks from 2–3 client countries (25 min.) • Zambia • Bhutan • Honduras • Nicaragua • Uruguay Exchange of views in liberating format (Small group discussions) (20 min.) Facilitated Comments: • Mr. Yoichi Iwami, Chief Researcher on Hydrology and Hydraulics, ICHARM • Mr. Mike Bergin, Regional Director (Western Australia), Government Bureau of Meteorology, Australia	16:45	Wrap-up of Day 1 and Overview of Days 2–4 (15 min.)
14:40	<b>Action Planning on Key Question 2</b> (Small groups of 4–6) Activity Instruction (5 min.)	17:00	
15:10	Discussion and Action Planning (30 min.)	18:00	Reception and Dinner (TDLC/DRM Hub will take participants to restaurant)
15:10	Coffee Break	20:00	

### AM

8:50	Breakfast provided at World Bank TDLC/ DRM Hub, Tokyo	11:00	<b>Framing the Client’s Challenge and Thinking Through the Question</b> Lightening Talks from 2–3 countries (15 min.) • Ethiopia • Sri Lanka • Pacific Exchange of views in liberating format (Small group discussions) (15 min.) Facilitated Comments (10 min.) • Mr. Hirotada Matsuki, Director, International Affairs Office, River Planning Division, Water and Disaster Management Bureau, Ministry of Land, Infrastructure, Transport and Tourism, Japan • World Bank
9:30	<b>Recap of Key Questions 1 and 2 and Introduction to Question 3</b> - Participants • Moderated by Mr. Jay Newman	11:40	
10:00	<b>Framing Presentation on Key Question 3: Improving Service Delivery: What are critical issues for successfully communicating warning messages to users, including the general public?</b> • Mr. Hirotada Matsuki, Director, International Affairs Office, River Planning Division, Water and Disaster Management Bureau, Ministry of Land, Infrastructure, Transport and Tourism, Japan • Mr. Kazuhiro Wada, Assistant Director, International Cooperation, Global ICT Strategy Bureau, Ministry of Internal Affairs and Communications • Mr. Yasuji Sakaguchi, Senior Chief Engineer, NHK ITEC • Mr. Naoki Kato, Corporate Sales and Marketing Division, NTT DOCOMO	11:40	<b>Action Planning on Key Question 3</b> (Small groups of 4–6) Activity Instruction (5 min.) Discussion and Action Planning (30 min.) Small Group Reporting—Representative from each group presents key points (15 min.)
10:30	<b>Q&amp;A</b>	12:30	
10:45	Coffee Break	12:30	Lunch (Bento Box) at TDLC / DRM Hub

## September 13, Tuesday

PM

<p>13:30 Depart for JMA <b>JMA Headquarters (HQ) and Operations Center</b> Participants will visit JMA HQ to understand the scope of JMA's activities and its connections to early warning operations.</p> <p>14:00 <b>Outline of JMA Activities</b> (Presentation and Q&amp;A in Conference Room, 5th Floor – 5F)</p> <p>14:45 Tour (in 4 groups) of JMA HQ • Observation System Monitoring Center (3F) • Weather Forecasting Center (3F) • Marine Forecasting Center (3F) • Seismology and Volcanology Operational Center (2F)</p> <p>16:00</p>	<p>16:30 <b>Wrap-Up at World Bank Tokyo Office</b> Wrap-up of Day 2 and Overview of Days 3–4 (20 min.)</p> <p>17:30 <b>Reception with the Japan Bosai Platform (JBP)</b> Brief introduction of the activities and members of the JBP (Mr. Koji Arisawa) followed by networking reception • Mr. Koji Arisawa, JBP, and other participants from JBP</p> <p>18:30</p> <p>19:00 Dinner (TDL/DRM Hub will take participants to restaurant)</p>
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## September 14, Wednesday

AM

<p>6:00 Departure from hotel guided by staff</p> <p>6:30 Departure by bus (2 hr.+ bus ride)</p> <p>8:50 <b>Recap of Key Questions 1 and 2 and Introduction to Question 3</b> - Participants in the bus (2 buses) • Moderated by Mr. Jay Newman and Mr. Daniel Levine</p> <p>9:30</p> <p>9:30 <b>Shimodate River Office</b> The site visit aims to allow participants to understand normal and extraordinary operations at river management offices, particularly before, during, and after an expected major hydrometeorological event. The site visit is also expected to include a discussion with officials in areas where residents have received messages/warnings about an expected event and evacuation, as well as nearby flood-fighting corps.</p> <p>9:30 Arrival to the River Site 9:30 – 10:00 Site of Levee Break 10:00 – 10:20 Travel Time 10:20 – 10:50 Area where Large-Scale Flooding Occurred 10:50 – 11:20 Travel Time 11:20 – 12:00 Presentation about Nonstructural Measures at the Shimodate River Office</p> <p>12:00</p>
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PM

<p>15:00 Return to World Bank TDL/</p> <p>17:00 Wrap-up World Bank TDL/</p> <p>18:00</p> <p>18:30 Dinner (TDL/DRM Hub will take participants to restaurant)</p>
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**Lunch (Japanese garden)**

## Annex 2. Expert Profiles

(Information is as of the time of the TDD)

### September 15, Thursday

#### AM

- 9:30 Breakfast at TDLC/DRM Hub
- 10:00 Stocktaking from Day 3 site visit: Multi-stakeholder dialogue (30 min.)
- 10:30 **Framing Presentation on Key Question 4: Key lessons learned from past experiences with early warning systems: What went well and what went wrong?** (25 min. + 5 min. Q&A)  
– International partners  
• Mr. Kuniyuki Shida, Senior Program Manager for Regional Coordination, Development and Regional Activities Department, World Meteorological Organization  
• Mr. Mike Bergin, Regional Director (Western Australia), Bureau of Meteorology, Australia
- 11:30 Action Plan Preparation: Country-Specific TDD Action Plan Development (Grouping by Clients and Task Team Leads)
- 12:15 Experts Available to Client Teams
- 12:15 Working Lunch (Bento Box) at TDLC / DRM Hub

#### PM

- 13:00 **Bringing It Home: How to Operationalize Key Takeaways** (10 min. talks)  
• Mr. Hiroshi Koide, Head, Office of International Affairs, JMA  
• Mr. Tatsuo Kunieda, Associate Director, Water Resources Engineering Department, Japan Water Agency
- 13:30 **Action Planning: Action Plan Pitch Session to Full TDD Panel** (5 min. presentation + 5 Q&A per client)  
Expert Panel Providing Feedback to Client Teams  
• Mr. Hiroshi Koide, Head, Office of International Affairs, JMA  
• Mr. Tatsuo Kunieda, Associate Director, Water Resources Engineering Department, Japan Water Agency  
• Mr. Satoru Mimura, Deputy Director General, and Group Director for DRR Group  
Global Environment Department and JICA Research Institute  
• World Bank Panelist
- 15:30 **Closing** – Francis Ghesquiere, Head of GFDRR
- 15:40 Conclusion and Wrap-Up
- 17:30 Dinner (TDLC/DRM Hub will take participants to restaurant)



**Naoki Yamashita**

Mr. Yamashita Deputy Director, Multilateral Development Banks Division, International Bureau, MOF. His previous position was Second Secretary with the Embassy of Japan in Thailand. In the course of his career he has worked with many government departments, including the National Tax Agency and Ministry of Agriculture, Forestry, and Fisheries. He holds a master's degree in public policy from Hokkaido University and the University of Southern California.



**Kuniyuki Shida**

Kuniyuki Shida worked at the Japan Meteorological Agency (JMA) for more than 20 years for the operational services including meteorological observations/forecasting, satellite meteorology and El Niño monitoring as well as international affairs related to the World Meteorological Organization (WMO) and development assistance to developing countries. In 2001, he joined the WMO Secretariat as the Programme Manager for Arab States, Asia and the Pacific for the management of projects for National Meteorological and Hydrological Services in the region. From 2004, he also supported the activities of the Regional Associations of WMO for Asia and the Pacific including the organization of conferences and meetings. He carried out the post-disaster assessments and provided assistance to countries affected by natural disasters. Since 2013, as the Senior Programme Manager for Regional Coordination, he has supported the activities of Regional Offices linking with administrative and technical departments of WMO.



**Tomoyuki Okada**

Tomoyuki Okada is the Director for International Coordination of River Engineering, River Planning Division, Water and Disaster Management Bureau, MLIT. He joined the Ministry of Construction (currently MLIT) in 1993 and has been working in the field of river and disaster management. He served as an attaché in the Economic Section of the Embassy of Japan in Vietnam for three years, was a professional officer in the WMO's Associated Programme on Flood Management, and later supervised, as a director, overall river administration in the Takeo River Office of MLIT. Before assuming his current position, he worked for the Japan Riverfront Research Center, a private organization conducting river-use planning.



**Yoichi Iwami**

Yoichi Iwami is Chief Researcher on Hydrology and Hydraulics, ICHARM, PWRI. His main areas of research include evaluation of flood and drought through hydrological observation and simulation, river planning processes with information sharing, and environment of rivers and reservoirs. Before assuming his position at ICHARM, he had a long career in the Ministry of Construction (now MLIT), and he also worked as the Director of Research (Environmental Impact Assessment of Dams) in the Water Resources Environment Center (Public Foundation) and as Head of the River Environment Research Division, National Institute of for Land and Infrastructure Management.



**Mike Bergin**

Mike Bergin has been the Regional Director of the Western Australia Bureau of Meteorology since 2007. Mike is responsible for all bureau operations in Western Australia, including observation networks (11 field stations, over 160 surface observation stations, and 13 radars) and weather forecasting and warning services for the state and eastern parts of the Indian Ocean, including commercial weather services. Mike has an extensive background in severe weather forecasting, with a focus on tropical cyclones; he has worked as a meteorologist in all of the bureau’s Tropical Forecasting Centres (Darwin, Brisbane, Perth and overseas). Mike worked with the Vanuatu Meteorological Service as Assistant Director from 1988 to 1992.



**Hirotada Matsuki**

Hirotada Matsuki is the Director of the International Affairs Office, River Planning Division, Water and Disaster Management Bureau, MLIT. He started his career in 1989 in the Saguri-gawa Dam Construction Office, and worked in river basin management under MLIT on Shikoku, Kyushu, and Okinawa islands. He worked overseas as the JICA expert in Lao PDR and Vietnam. He tackled riverbank erosion along the Mekong River and other rivers in Vietnam, and developed new design standards for riverbank protection using artificial groins and rivers’ natural powers.



**Kazuhiro Wada**

Kazuhiro Wada is the Assistant Director of International Cooperation at the Global ICT Strategy Bureau, MIC. His work helps to encourage international cooperation in and overseas deployment of ICT, mainly in Asia, the Middle East, and Africa.



**Yasuji Sakaguchi**

Yasuji Sakaguchi is the Chief Engineer in the International Department of NHK Integrated Technology. He graduated from Osaka University (Department of Communication, Faculty of Engineering). In 1989, he joined the Japan Broadcasting Corporation (NHK) and worked at regional stations in Kyoto and Osaka until 1995. In September 2009, he was appointed an advisor (a JICA expert) for implementation of digital broadcasting in Peru, where he worked for three years to facilitate implementation of digital TV utilizing the Japanese standard ISDB-T. He developed an EWBS standard suited to Latin America that included a superimposed closed caption function. In June 2015, he took over his current role with NHK.



**Naoki Kato**

Naoki Kato works in the Corporate Sales and Marketing Division of NTT DOCOMO, the company that leads Japan in providing disaster management services for smartphone and cell phones. Since joining the company in 2003, he has been involved in a range of projects, including developing a corporation system utilizing cell phones, training employees, and negotiating contracts with worldwide smartphone makers. He holds an undergraduate degree from the University of Electro-Communications and specializes in disaster prevention.

**Hiroshi Koide**

Hiroshi Koide is the Head of the Office of International Affairs, Planning Division, JMA. He started his career with JMA in 1990 and has held various positions in JMA offices since then. He earned an engineering degree from Kyoto University.

**Tatsuo Kunieda**

Tatsuo Kunieda is the Associate Director of the Water Resources Engineering Department at the Japan Water Agency. He has more than 20 years of experience in dam engineering. From 2006 to 2009, he served as Senior Advisor of River Management for the Basin Development Plan Programme, Mekong River Commission Secretariat; from 2010 to 2012, he developed the Bagmati River investment road map in Nepal; from 2010 until the present, he has served as a secretariat member of the Network of Asian River Basin Organizations (NARBO); from 2012 to 2013, he was Program Coordinator of Chaopraya flood management projects in the Thai Royal Irrigation Department; and from 2016 to the present, he is working to establish an earthquake response system in India.

**Satoru Mimura**

Satoru Mimura is the Deputy Director General and Group Director for the DRR Group of the Global Environment Department and JICA Research Institute. He has worked for JICA for more than 20 years and has extensive experience in global environment and disaster risk reduction in the Asia-Pacific region. Previously he worked for the Ministry of Environment of Japan as Deputy Director in charge of Sustainable Development. After the Great East Japan Earthquake and tsunami, he was seconded to Fukushima University to work in disaster restoration programs. He assumed his current position in April 2015. Concurrently, he serves as Senior Researcher of JICA Institute and as specially appointed professor at Fukushima University. He holds a bachelor of engineering degree from Tokyo University of Science and a master of arts from the Open University of Japan.

**Yusuke Amano**

Yusuke Amano is the Director of International Cooperation and Engineering for Infrastructure, MLIT. Before assuming his current position, he served as the Director, International Affairs Office, Water and Disaster Management Bureau, MLIT, since 2013. He has experience in the field of water resources management and disaster management. He also worked for JICA as Senior Advisor to the Director General and provided institutional and technical assistance to various international cooperation projects in the water and disaster reduction sectors.

**Toshio Koike**

Dr. Toshio Koike serves as Professor at the Department of Civil Engineering, School of Engineering, the University of Tokyo, as well as Director, ICHARM. He also works as Lead Scientist, CEOP projects of the World Climate Research Programme (WCRP); Co-Chair of the Architecture and Data Committee of the Group on Earth Observation (GEO), MEXT; and Chair of/ Advisor to river management related committees under MLIT. As hydrological and climate expert, Dr. Koike leads a number of national and international initiatives such as Asian Water Cycle Initiative (AWCI) with Global Earth Observation System of Systems (GEOSS), and Data Integration and Analysis System (DIAS). Some of the prominent awards he has recently won include: Group Achievement Award from NASA, and Awards for International Contribution and Academic Contribution Awards from Japan Society of Hydrology and Water Resources. Dr. Koike holds Bachelor, Master and Doctorate of Engineering from the University of Tokyo.

**Takuya Hosomi**

Mr. Takuya Hosomi is the Head of Management Division, Administration Department, Sapporo Regional Headquarters, JMA. Prior to this, during the time of Hydromet TDD, he was working as Senior Coordinator for International Cooperation, Office of International Affairs, Planning Division, Administration Department, JMA. He has been associated with JMA ever since he completed his bachelor's in science from Meteorological College in 1995.

**Luis Tineo**

Luis Tineo, a Venezuelan national, joined the World Bank in 1998. He is currently the Deputy Manager and Lead Operations Officer, GFDRR, World Bank Group. He has held various positions in the Private Sector Development Department, the Latin American and Caribbean Operations Services Department, and the Global Partnership on Output-Based Aid. He has extensive experience in infrastructure operations and has worked in different regions on portfolio management and evaluation as well as on the fiduciary and financing aspects of lending and nonlending instruments, including trust funds. A graduate in law, Mr. Tineo holds post-graduate degrees in project finance and commercial transactions. Prior to joining the GFDRR and the World Bank, he was General Counsel of Venezuela's Ministry of Planning and Finance.

**Makoto Suwa**

Makoto Suwa is a Senior DRM Specialist, GFDRR, World Bank. Specializing in hydromet, he leads and supports a wide range of GFDRR/World Bank activities and projects that aim to strengthen weather, climate, and hydrological services globally. Prior to joining GFDRR, Makoto worked for the World Meteorological Organization, at both its headquarters in Geneva and its Regional Office for Eastern and Southern Africa in Nairobi. He also taught at Kigali Institute of Science and Technology and Lycée de Kigali in Rwanda, and briefly worked for JICA's Office for Climate Change in Tokyo. Makoto holds a PhD in geosciences (climate science) from Princeton University and a master of environmental management degree from Duke University; his undergraduate degree is from the University of Tokyo.

**Toshihiro Sonoda**

Toshihiro Sonoda is a Senior DRM Specialist at the World Bank and a member of GFDRR's Hydromet Team. He has over 20 years of experience on water-related disaster management, including formulation of comprehensive flood and water resources management policy, implementation of integrated flood risk management through structural and nonstructural measures, supervision of flood and tsunami reduction infrastructure projects, and direction of emergency responses for water-related disasters. Prior to joining GFDRR, he was a program specialist with UNESCO and has contributed to JICA's Toward Mainstreaming Disaster Risk Reduction project as an external lead researcher. A Japanese national, Mr. Sonoda holds a bachelor's degree and master's degree in civil engineering from the University of Tokyo.

**Daniel (Dan) Levine**

Dan Levine is the Senior Operations Officer/Team Lead of the TDLC and manages the Tokyo-based operations and staff of the program. He has over 12 years of experience at the World Bank and International Finance Corporation dealing with finance and private sector development, knowledge and portfolio management, jobs and growth, and most recently infrastructure and urban development. Within the World Bank Group, Dan has developed a reputation for the application of knowledge in direct support of lending and analytical operations. He has conducted knowledge exchanges with clients and staff in China (Beijing), India (Chennai and Delhi), Sri Lanka (Colombo), Kenya (Mombasa), Singapore, and Austria (Vienna). In the private sector, Dan worked in government affairs, private equity, and management consulting. As a Wolcott Fellow, Dan obtained an MBA from the George Washington University.

**James (Jay) Newman**

James Newman is a DRM Specialist at the World Bank DRM Hub, Tokyo, where he leads the Hub's Knowledge Program and its engagements on urban resilience. Since joining the World Bank in 2013, he has worked at GFDRR and has supported World Bank projects and technical assistance in India, Nepal, South Africa, and Vietnam. Prior to joining GFDRR, he worked for the City of Baltimore, contributing to the city's 10-year financial plan and its CitiStat performance management program, also serving as Acting Deputy Procurement Agent. As an adjunct professor at University of Baltimore's master of public administration (MPA) program, he taught courses on statistics, urban management, and public policy. A United States national, Mr. Newman holds a master's degree in applied economics and public policy jointly from Georgetown University and Universidad Alberto Hurtado in Santiago, Chile, as well as a bachelor's degree in economics and Spanish from Washington University in St. Louis.

**Yuko Okazawa**

Yuko Okazawa is the Operations Officer of the TDLC. She received a master's degree in civil engineering from the University of Tokyo and worked as an Urban Planning Consultant at ALMEC Corporation before joining the Bank. She has worked in Vietnam, Indonesia, the Philippines, Thailand, Mongolia, and Japan. She has experience in urban development and transport planning and has extended technical assistance to nurture collaboration between cities in Japan and developing countries, and formulated urban planning and management manuals for training courses targeted at planning authorities in client countries. She recently earned her second master's degree in planning, growth, and regeneration at the Department of Land Economy, University of Cambridge.

**Haruka Imoto**

Haruka Imoto joined the TDLC as a Knowledge Management Analyst. After receiving dual master's degrees—one in public policy and administration from the London School of Economics, the other in political science from L'Institut d'Etudes Politiques de Paris—Haruka has worked with cities in Europe, Japan, and other parts of Asia to promote sustainable urban policy and project implementation. Haruka worked for CHAdEMO Association in Paris to implement infrastructure for electric vehicles in Europe, and joined the Institute for Global Environmental Strategies (IGES) as a policy researcher focused on low-carbon and resilient cities. At IGES, she worked closely with the City of Yokohama to foster knowledge sharing and capacity building for greener and smarter cities. She was also active in communicating local municipalities' climate actions in the international arena, including at UNFCCC/COP (United Nations Framework Convention on Climate Change/Conference of the Parties).

**Naho Shibuya**

Naho is a DRM Specialist at the World Bank DRM Hub, Tokyo. She supports efforts to bridge global and Japanese knowledge, expertise, and technology with the World Bank's operations for mainstreaming DRM in developing countries. As a Chartered Water and Environmental Manager and a Chartered Environmentalist, Ms. Shibuya previously provided advisory services to multilateral and bilateral development agencies, commercial lenders, sponsors, contractors, and manufacturers in the Asia-Pacific region. Her sectoral experience includes thermal power and renewables, water and wastewater, aviation, metro, highways, ports, and urban planning, including experience with eco-smart cities and solid waste management. Ms. Shibuya holds a graduate degree from the Arizona State University and a master's degree in sustainability science from the University of Tokyo.

**Keiko Sakoda Kaneda**

Keiko Sakoda Kaneda is a DRM Specialist at the World Bank DRM Hub, Tokyo. She works on the technical assistance grant portfolio and supports efforts to mainstream DRM in various sectors by connecting relevant Japanese experience with the Bank's operational teams, beyond the traditional DRM community. She has nearly 10 years of operational experience in post-disaster/post-conflict reconstruction, disaster preparedness, climate change adaptation, and urban development. Prior to joining the Bank, she worked at the United Nations Development Programme and UN Habitat in Indonesia, the UN Refugee Agency in South Sudan, and JICA in Mongolia. Ms. Kaneda holds a master's degree in architectural engineering from the Kyoto Institute of Technology.

**Vibhu Jain**

Vibhu Jain is an Urban Specialist Consultant who supports two teams in Tokyo—one at the Global Infrastructure Facility and one at the DRM Hub. She holds a master's degree in urban regional planning and public policy. She has worked with the World Bank since 2012, first on urban development projects in the New Delhi office and now on DRM and infrastructure public-private partnerships (PPPs) in the Tokyo office. Before joining the World Bank, she worked with PricewaterhouseCoopers Ltd. and Deloitte Touche Tohmatsu. Much of her work has been on infrastructure sector projects, with a focus on project design, PPP transaction advisory, and implementation support. Currently, she works on integrated flood risk management, hydrometeorology, geohazard risks, and other related aspects of DRM. She also works on PPP in infrastructure and resilient infrastructure PPPs in Tokyo.

**Guillermo Siercke**

Guillermo A. Siercke, Disaster Risk Management Specialist, is a member of the Japan-World Bank Program for Mainstreaming Disaster Risk Management in Developing Countries. Prior to joining GFDRR, Guillermo worked with the South Asia and Latin America and the Caribbean teams on lending operations and technical assistance in disaster risk financing, and on modernization of hydromet services. He is a core member of the Hydromet, Climate Services, and Resilience Community of Practice. A Honduran national, Guillermo holds a Master's degree in Development Economics from Georgetown University.

**Iain Mitchell**

Iain Mitchell joined the World Bank TDLC in August 2004 to support videoconferencing and technical operations for distance learning seminars, SS knowledge-exchange seminars, and roundtable business meetings. After managing a wide variety of events over a 10-year period, Iain was remapped to ITSCU as a Senior IT Assistant, Engineering, where he was appointed the task team leader and system architect for the facility upgrade project involving renewal of all videoconference and multimedia equipment in the center. In his current position, Iain is responsible for technical operations and engineering support at TDLC, including videoconference bridging.

## Annex 3. List of Participants



**Asako Sato**

Asako Sato is a Knowledge Management Associate at the TDLC partnership. She started her career at the Asian Productivity Organization, where she organized training programs and study missions and worked with Japanese stakeholders in the industrial and environment sector to disseminate knowledge and provide technical assistance services to member countries in the Asia-Pacific region. She joined the Bank in July 2010 as a Senior Knowledge Management Assistant in the TDLC partnership, and is responsible for delivering TDLC blended learning programs and GDLN services, as well as coordinating videoconference/WebEx events and CoP administration.



**Tomoko Kobayashi**

Tomoko Kobayashi joined the TDLC in September 2015 as a Video Editor Associate. She edits videos for seminars, meetings, and presentations as well as for other video packages recorded at TDLC's Tokyo offices. She also supports studio operations and archiving video sources. She started her career at Bloomberg Television Tokyo, where she worked for 12 years editing financial program packages, executive interviews, and company promo videos, and she also has experience as a video librarian. She is currently learning web design at a Japanese web company.



**Mariko Tanaka**

Mariko Tanaka is a Communications Associate at TDLC. She has more than 10 years of communications background in multilateral and bilateral organizations. For over six years, she worked for the World Bank as a Communications Consultant in the Sustainable Development Network as well as in the Latin America and the Caribbean (LAC) Department, where she conducted communications analyses to understand outside perceptions of the World Bank. Mariko worked for Japan's Ministry of Foreign Affairs as Chief for World Bank Affairs and for JICA as a Research Assistant. Mariko holds a master's degree in international affairs and development from George Washington University.

Role	Country / Organization	First name	Last name	Title	Organization/ Government agency
Task team lead (TTL)	Afghanistan	Toru	Konishi	Senior Economist	World Bank
Client	Afghanistan	Mohammad Gul	Hamidi	Irrigation Restoration Development Project, Director	Ministry of Energy and Water (MEW)
Client	Afghanistan	Jamal Abdul Naser	Shokory	Meteorology Adviser to the Water Resource Department of MEW	MEW
TTL	Afghanistan	Sayed Sharifullah	Mashahid	Disaster Risk Management Specialist	World Bank
Client	Afghanistan	Najeebullah	Saraj	Hydrometeorology Expert	Afghanistan Meteorological Department
Observer student	Afghanistan	Fazlullah	Durrani	Hydrologist	Ministry of Energy and Water/Graduate School of Engineering and Science of Ryukyus University
Observer student	Afghanistan	Ahmad Shayeq	Azizi	Irrigation and Construction Engineer	Ministry of Energy and Water/Graduate School of Engineering of Nagoya University
TTL	Bhutan	Dechen	Tshering	Disaster Risk Management Specialist	World Bank
Client	Bhutan	Tshering	Wangchuk	Program Officer	Department of Disaster Management, Ministry of Home and Cultural Affairs
Client	Bhutan	Trashi	Namgyel	Engineer/Hydro-Met Officer	Department of Hydro-Met Service, Ministry of Economic Affairs
TTL	Ethiopia	Alemseged W Yohannes	Bedane	Consultant, Global Practice for Social, Urban and Rural Development and Resilience	World Bank
Client	Ethiopia	Abera	Kassa	Director	National Disaster Risk Management Commission
Client	Ethiopia	Kinfe	Hailemariam	Director, Electronic Stations and ICT	National Meteorology Agency
Client	Ethiopia	Semunesh	Gola	Director	Hydrology and Water Quality Directorate
TTL	Lao PDR	Zuzana	Stanton-Geddes	Operations Analyst	World Bank
Client	Lao PDR	Malabou	Baylatry	Deputy Head, Information and Public Relations Division	Ministry of Natural Resources and Environment

Role	Country / Organization	First name	Last name	Title	Organization/ Government agency
Client	Lao PDR	Khanmany	Khounphonh	Director General	Ministry of Natural Resources and Environment
TTL	Honduras/ Nicaragua	Ana	Campos Garcia	Senior Disaster Risk Management Specialist	World Bank
Client	Nicaragua	Federico Vladimir	Gutierrez Corea	Director, Geoinformation Systems	INETER (Nicaraguan Institute of Territorial Studies)
Client	Nicaragua	Alex Martin	Castellon Meyrat	Technical Advisor for Land Use Planning	INETER
Client	Honduras	Wendy Carolina	Rodriguez Molina	Head, Department of Research and Information	Water Resources Directorate-General, Ministry of Environment
Client	Honduras	Igor Arold	Giron	Meteorologist	CENAOS (COPECO)
TTL	Pacific	Michael	Bonte-Grapentin	Senior Disaster Risk Management Specialist	World Bank
Client	Pacific	Litea	Biukoto	PREP Project Manager,	Secretariat of the Pacific Community
Client	Pacific	Leveni	Aho	Director	National Emergency Management Office
TTL	Sri Lanka	Suranga	Kahandawa	Disaster Risk Management Specialist	World Bank
Client	Sri Lanka	Dulari	Fernando	Meteorologist	Department of Meteorology
Client	Sri Lanka	Shiromi	Weeraratne	Irrigation Engineer	Irrigation Department
TTL	Uruguay	Melanie Simone	Kappes	Disaster Risk Management Specialist	World Bank
Client	Uruguay	Carlos Federico	Baz Uriarte	General Secretary	INUMET (Instituto Uruguayo de Meteorología)
Client	Uruguay	Gimena Inés	Bentos Pereira Eguren	Civil Engineer	Service for Sanitation Studies and Projects
TTL	Vietnam	Nguyen	Dzung Huy	Disaster Risk Management Specialist	World Bank
Client	Vietnam	Nguyen	Nam Thanh	Deputy Director	Project Management Unit, National Hydro-Meteorological Service, Vietnam
Client	Vietnam	Nguyen	Hung Viet	Officer	Steering Center of Urban Flood Control Program in Ho Chi Minh City
TTL	Zambia	Shelley	McMillan	Senior Water Resources Specialist	World Bank
Client	Zambia	Jonathan	Kampata	Principal Water Resources Engineer	Ministry of Energy and Water Development
Client	Zambia	Brigadier	Libanda	Meteorologist	Zambia Meteorological Department

Role	Country / Organization	First name	Last name	Title	Organization/ Government agency
TDD partner	WMO	Kuniyuki	Shida	Senior Program Manager for Regional Coordination	WMO
TDD partner	Australia	Mike	Bergin	Regional Director	Bureau of Meteorology
TDD partner	MOF	Naoki	Yamashita	Deputy Director	Development Banks Division, International Bureau, MOF
TDD partner	JICA	Satoru	Mimura	Deputy Director General and Group Director for the DRR Group of the Global Environment Department and JICA Research Institute	Japan International Cooperation Agency
TDD partner	ICHARM, PWRI	Yoichi	Iwami	Chief Researcher on Hydrology and Hydraulics	ICHARM, PWRI
TDD partner	MLIT	Hirotsada	Matsuki	Director	International Affairs Office, River Planning Division, Water and Disaster Management Bureau, MLIT
TDD partner	MLIT	Tomoyuki	Okada	Director for International Coordination of River Engineering, River Planning Division	International Affairs Office, River Planning Division, Water and Disaster Management Bureau, MLIT
TDD partner	MLIT	Yusuke	Amano	Director	International Cooperation and Engineering for Infrastructure
TDD partner	JMA	Hiroshi	Koide	Head	Office of International Affairs, Planning Division, JMA
TDD partner	JMA	Takuya	Hosomi	Senior Coordinator	Office of International Affairs, Planning Division, JMA
TDD partner	JWA	Tatsuo	Kunieda	Associate Director	Water Resources Engineering Department, Japan Water Agency
TDD partner	NHK ITEC	Yasuji	Sakaguchi	Senior Chief Engineer	NHK ITEC
TDD partner	MIC	Kazuhiro	Wada	Assistant Director	International Cooperation Division, Global ICT Strategy Bureau, MIC
TDD partner	NTT DOCOMO	Naoki	Kato	Manager	Corporate Sales and Marketing Division, NTT DOCOMO
World Bank Group (WBG)	WBG	Francis	Ghesquiere	Head, GFDRR	GFDRR, Washington, DC
WBG	WBG	Luis	Tineo	Deputy Manager and Lead Operations Officer	GFDRR, Washington, DC

Role	Country / Organization	First name	Last name	Title	Organization/ Government agency
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WBG	WBG	Toshihiro	Sonoda	Senior Disaster Risk Management Specialist	GFDRR, Washington, DC
WBG	WBG	Makoto Suwa	Makoto Suwa	Senior Disaster Risk Management Specialist	GFDRR, Washington, DC
WBG	WBG	Daniel (Dan)	Levine	Senior Operations Officer	World Bank TDLC
WBG	WBG	Yuko	Okazawa	Operations Officer	World Bank TDLC
WBG	WBG	Haruka	Imoto	Knowledge Management Analyst	World Bank TDLC
WBG	WBG	Yukiko	Daikai	Program Assistant	World Bank TDLC
WBG	WBG	Iain	Mitchell	Technical Operations and Engineering Support	World Bank TDLC
WBG	WBG	Asako	Sato	Knowledge Management Consultant	World Bank TDLC
WBG	WBG	Mariko	Tanaka	Communication Consultant	World Bank TDLC
WBG	WBG	Tomoko	Kobayashi	Video Editor Consultant	World Bank TDLC
WBG	WBG	Naho	Shibuya	Disaster Risk Management Specialist	World Bank DRM HUB, Tokyo
WBG	WBG	Keiko	Sakoda Kaneda	Disaster Risk Management Specialist	World Bank DRM HUB, Tokyo
WBG	WBG	Jack	Campbell	Disaster Risk Management Specialist	GFDRR, Washington, DC
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The World Bank Disaster Risk Management Hub, Tokyo supports developing countries to mainstream DRM in national development planning and investment programs. As part of the Global Facility for Disaster Reduction and Recovery and in coordination with the World Bank Tokyo Office, the DRM Hub provides technical assistance grants and connects Japanese and global DRM expertise and solutions with World Bank teams and government officials. Over 37 countries have benefited from the Hub's technical assistance, knowledge, and capacity building activities. The DRM Hub was established in 2014 through the Japan-World Bank Program for Mainstreaming DRM in Developing Countries – a partnership between Japan's Ministry of Finance and the World Bank.