ICHARM
Activity
Report

FY2016-2017

For the 3rd ICHARM Governing Board

On 14th February, 2018

International Centre for Water Hazard and Risk Management
under the auspices of UNESCO (ICHARM),
Public Works Research Institute (PWRI), Japan

Contents

１．Introduction

1.1 Research

1.1.1 Data collection, storage, sharing and statistics on water-related disasters

Interview surveys were conducted for residents and businesses in flood-affected areas. Data were collected and classified, and analysis was made to find out the inundation depth and the degree of damage, including the period of business interruption. ICHARM also assisted the Philippines in creating guidelines for effective data sharing of water-related disaster data, including damage to humans, houses, agricultural products and social infrastructure through the activities for developing a framework under the International Flood Initiative (IFI). Discussions have also started about data collection, storage and sharing using the Data Integration and Analysis System (DIAS). In addition, ICHARM developed and run an information delivery system on a trial basis for Sri Lanka in response to a recent flood disaster. Designed to operate on DIAS, the system automatically collects rainfall and other data, simulates heavy rain and other processes, and deliver information ready to be used by relevant organizations in Sri Lanka.

1.1.2 Risk assessment on water-related disasters

Research was conducted for holistic prediction and analysis of flood events including all processes from rainfall to runoff to flooding. For more reliable rainfall data, a method was developed to correct satellite rainfall using ground rainfall and to forecast heavy rainfall using the limited area ensemble approach. For runoff, Integrated Flood Analysis System (IFAS) and Rainfall-Runoff-Inundation (RRI) model were improved with more advanced functions, and WEB-RRI was newly developed. For more accurate forecasting of floods and inundation, the acoustic Doppler current profilers (ADCP) and satellites were introduced to observe sand waves and water bodies on the ground, and flood simulation was improved to incorporate observation results. More advanced inundation analysis became possible by considering the complex effect of water, sediment and driftwood. For drought analysis, Land data assimilation system of the University of Tokyo (LDAS-UT) was introduced to estimate soil moisture. For better water-related risk assessment, a damage function was proposed for Southeast Asian countries to estimate flood or drought damage to agricultural products.

1.1.3 Monitoring and prediction of changes in water-related disaster risk

ICHARM has been involved in efforts to assess the future impact of climate change by participating in the SOUSEI project and ADB projects. In those projects, ICHARM predicted changes in rainfall conditions by experimentally forecasting future climate using Global Climate Model (GCM) for representative river basins in Southeast Asian countries, and

evaluated flood and drought risks in the future.

1.1.4 Proposal, evaluation and application of policy ideas for water-related disaster risk reduction

The ICHARM-led side event of the 8th HELP meeting in October 2016 adopted the Jakarta Statement “Towards an interdisciplinary and transdisciplinary partnership to consolidate flood risk reduction and sustainable development”. The 3rd UN Special Thematic Session on Water and Disasters in July 2017 discussed coordinated efforts based on international alliance on water and disasters and further promotion of the international initiative in the field. According to these international consensuses, ICHARM assisted the Philippines, Sri Lanka, Myanmar and Pakistan in establishing a Platform on Water and Disaster to prepare policies for water-related disaster risk reduction. Furthermore, ICHARM provided technical assistance for Pakistan and Sri Lanka to develop a flood forecasting system in collaboration with the government of each country through UNESCO and other projects. ICHARM also supported Calumpit Municipality of Bulacan Province in the Pampanga River basin, the Philippines, in community-level flood risk contingency planning with residents and municipal personnel.

1.1.5 Support in constructing the applicability of water-related disaster management

Some local municipalities in Japan do not have adequate information on their river basins that helps residents with safe evacuation in case of flood. ICHARM provided technical assistance for such municipalities. For example, it developed a simple, effective method to visualize flood risk on a community basis and a portal site designed to be a one-stop information center for users to view all kinds of disaster-related information relevant for their communities. It also collected and categorized tense moments and lessons from past disaster cases and created a flood response training program for municipal personnel in charge of disaster management. Assistance was also provided for overseas countries. In Myanmar, ICHARM participated in an ADB project and conducted flood risk assessment for its three major cities and provided training on flood risk assessment for local experts of the Department of Meteorology and Hydrology (DMH).

1.2 Education and training

ICHARM provides educational and training programs that empower both individuals and organizations in disaster management. The programs are designed to effectively collaborate with research and networking activities at ICHARM to increase the synergy effect between students and ICHARM researchers, as well as their affiliations and ICHARM, in research and projects.

The main programs include: 1. One-year master's degree program, "Water-related Risk Management Course of Disaster Management Policy Program," conducted in collaboration with

National Graduate Institute for Policy Studies (GRIPS) and JICA; 2. Three-year doctoral degree program, “Disaster Management,” jointly conducted with GRIPS; 3. Short-term training programs held in Japan and overseas; 4. Follow-up Seminar held annually overseas for graduates and trainees; and 5. Short- and long-term internship programs. Short-term training programs conducted in the 2016-2017 period include the one-month ICHARM-JICA joint training “Capacity Development for Flood Risk Management with IFAS,” , and the International Summer Program for international students jointly conducted with the University of Tokyo, as well as other short-term training and workshops locally conducted in collaboration with JAXA, UNESCO and other international organizations.

The educational and training programs were also well managed in the 2016-2017 period. However, we have decided to be more exact in the application process of the master’s program, recognizing that it should accept more applicants who are expected to play a vital role in policy making and implementation in the future. We are also planning new training programs to meet increasingly growing interests of many countries in the development of water-related disaster policy in response to the Sendai Framework for Disaster Risk Reduction and SDGs.

1.3 Information networking

ICHARM continues promoting information networking. As a UNESCO category 2 center, it keeps close ties with each UNESCO-IHP (International Hydrological Programme) National Committee, other UNESCO category 2 centers, and UNESCO Chair. It also maintains cooperative relations with UN organizations such as UNISDR and WMO, and other international and regional organizations such as HELP and the Typhoon Committee.

As the IFI secretariat, ICHARM proposed the basic action plan of IFI at the October 2016 workshop in Jakarta, Indonesia and the January 2017 workshop in Tokyo. The plan was adopted as the Jakarta Statement by the member organizations. In July 2017, the Special Session on Science and Technology was held in the occasion of the 3rd UN Special Thematic Session on Water and Disasters in New York. The session discussed a broad range of issues including the IFI framework for establishing a Platform on Water and Disaster, a mechanism to promote international alliance on water and disasters, research foundation to promote investment and financing, and response efforts to water-related disasters. Many participants agreed the need for vitalizing the international initiative to tackle these challenges. In addition, ICHARM supported the establishment of a Platform on Water and Disaster in the Philippines, Myanmar, Pakistan and Sri Lanka.

During the 2016-2017 period, important international conferences were convened around the world, such as ICFM7 (7th International Conference on Flood Management) and the 3rd Asia-Pacific Water Summit. ICHARM participated in those conferences and hosted sessions and side events, which strengthened the relationships with other participants and organizations and

expanded the professional and organizational network.

２． Special topics

2.1 Session at the 3rd Asia-Pacific Water Summit

The Asia-Pacific Water Summit (APWS) targets top-level policy and decision makers, such as heads of national governments in the region. The primary objective of APWS is to create opportunity for the political leaders of the region to set out a course for sustainable development from a perspective of water and share concrete actions, solutions and innovations.

The 3rd Asia-Pacific Water Summit was held on December 11-12, 2017, in Yangon, Myanmar. On the afternoon of the first day, ICHARM co-hosted a session entitled “Water and Disasters in the Context of Climate Change - From the Mountains to the Islands -” with ICIMOD, SPC and HELP.

Asia-Pacific countries are closely related through water and its associated phenomena. While water supports Asia-Pacific lives, economies and ecosystems, water also brings hazards such as floods and droughts. Such hazards can be exacerbated by climate change, greatly affecting mountains, coasts and small islands in the region. The commonality and inter-connection of water issues in the Asia-Pacific region necessitates a holistic approach that is applicable to different parts of the region from mountains to islands.

In this regard, the session was a unique platform for the high-level leaders and representatives of Asia-Pacific states to meet together in order to discuss water-related disasters and environmental risks intensified by climate change, explore common challenges and solutions, and collaborate on the development of effective frameworks for action. The session was three-fold. The first part consisted of keynote speeches by high-level leaders including Dr. José Ramos-Horta, the senior minister of the Democratic Republic of Timor-Leste, who was the former president of East Timor and the Nobel Peace Prize laureate in 1996, and Mr. Keiichi Ishii, the minister of Land, Infrastructure, Transport and Tourism, Japan. In the second part, the representatives from seven countries in the Asia-Pacific region delivered a country presentation on water and disasters under the influence of climate change. The third part was dedicated to a panel discussion co-chaired by Director of ICHARM Toshio Koike and Dr. Kyaw Moe Oo, the director general of DMH, Myanmar.

On the afternoon of the second day, Chief Researcher of ICHARM Tetsuya Ikeda reported the outcomes of this session in the plenary meeting along with those of the other sessions. Finally, the Yangon Declaration was adopted at the closing plenary.

Prof. Koike, Director, ICHARM, the co-chair, and the panelists of Part 3

2.2 Education by Integrating Policy & Community of Practice and Science & Technology

"Transdisciplinary" means co-design and co-production in cooperation between scientists and stakeholders. This concept is proposed as a new approach of science & technology to social and other issues, based on a reflection that the world has not been successful in demonstrating concrete methodologies for solving earth environmental issues and reducing disaster damage despite increase in scientific knowledge and technology. Although the term promotes the new approach, it still connotes that scientists and stakeholders are different entities. Instead, the two parties should be considered as a single unit and a better capacity for handling knowledge and experience should be developed for both parties to closely help each other by moving back and forth between science & technology and policy & community of practice. In this effort, education should play a central role, and ICHARM has been supporting the effort by providing educational and training programs linking knowledge and experience.

Every year, over ten mid-career practitioners selected from various countries join the Disaster Management Policy program offered by ICHARM and GRIPS with a strong financial support from JICA.

There was a Malawian student who studied in this program from October 2016 to September 2017. Working at a national disaster management organization back home, he already had had basic knowledge and experience on socio-economic analysis and trans-boundary river management when he started the program. At GRIPS and ICHARM, he improved his socio-economic understanding, and began to learn a methodology for assessing climate change impact on floods. Then, he completed his research to incorporate assessment results in national and transboundary flood management policy plans. Fortunately, he had an opportunity for presenting his research at home just after his graduation. In response to his presentation, UNDP

decided to launch a new project based on his idea.

A Brazilian student was in the same program at the same time as the Malawian student, and he was from the National Department of Civil Protection and Defense. While studying at ICHARM, he worked on research aiming to apply the seven Global Targets, defined in the Sendai Framework, to disaster management in Brazil, proposing how to use these targets for achieving local disaster risk reduction. By overlaying the 26 climate model outputs from the Coupled Model Inter-comparison Project Phase 5 (CMIP5) on the spatial distribution of affected people by the floods and droughts during 2005-2015, he identified high risk area in both past and future and set priority for future disaster risk reduction countermeasures successfully.

His method can also be used by other countries, showing a very practical way to incorporate the Global Targets in planning local disaster risk reduction.

These two students are excellent examples of "skillful handlers of knowledge and experience" bridging between science & technology and policy & community of practice. It is critically important to train political and community leaders who can create societal benefits by learning science & technology and policy studies in one package. With a renewed commitment to this educational mission, ICHARM will step up our efforts to groom as many excellent social leaders as possible in collaboration with our great partners, GRIPS and JICA.

2.3 Emergency support for Sri Lanka after heavy rain disaster in May 2017

The rain started on May 24, 2017, over the southern and western regions of Sri Lanka. The rainfall exceeded 500mm in 12 hours between 9:00 p.m., May 25 and 9:00 a.m., May 26, which was equivalent to the rainfall of about 200-year return period. Due to this heavy rainfall, severe floods and landslides occurred in the Kalu and other river basins of the southern and western regions, resulting in devastating damage to lives and properties. According to the government report on June 3, the death toll reached 211 with 96 missing and 704,000 affected in some other ways.

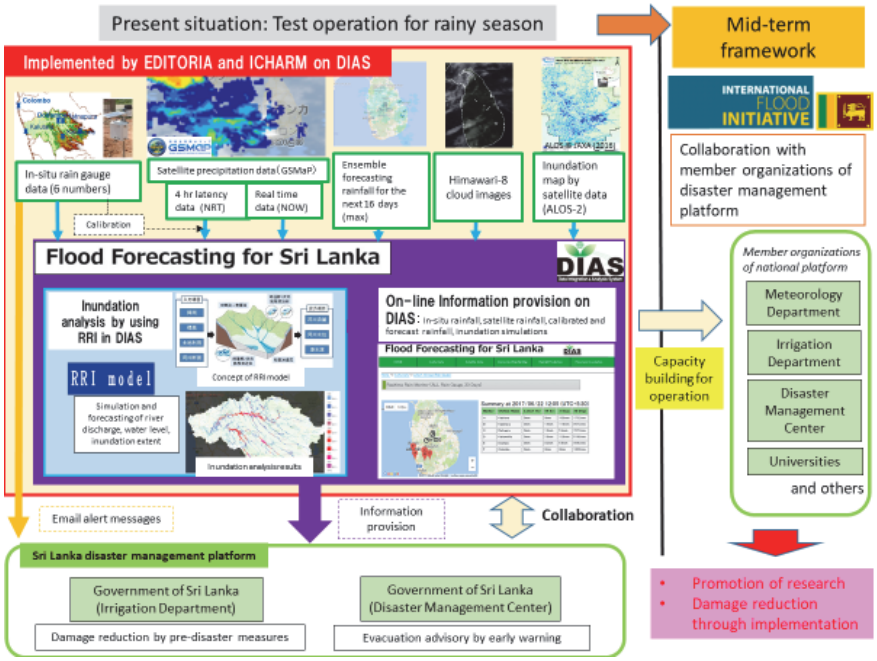
In response to the request from the Sri Lanka government, the Japanese government dispatched the Japan Disaster Relief Expert Team (the JDR Team) consisting of 10 technical experts in the fields of flood and sediment disaster to provide technical advice on effective measures for short-, mid-, and long-term flood and landslide control. After the investigation of affected areas and meetings with relevant ministries, organizations, and stakeholders of the Sri Lanka government, the JDR team compiled a report on the findings and future collaborations between the two governments and submitted it to the relevant ministries and government officials of Sri Lanka.

Since Sri Lanka anticipates more flood disasters in the future, Japan maximized its advanced science and technology to provide useful information that Sri Lanka needs for preventing

recurrent disasters and implementing effective emergency response. In response to this disaster, Earth Observation Data Integration and Fusion Research Initiative (EDITORIA) of the University of Tokyo and ICHARM cooperated to provide the following information for effective flood management by coupling meteorological and hydrological models developed by ICHARM with DIAS developed by EDITORIA.

- DIAS integrated ground and satellite precipitation data, rainfall forecasting data, results of flood inundation analysis and forecasting, and satellite observation data on cloud development, as well as ongoing floods and inundations. This information was provided in real time for the related organizations of the Sri Lanka government in time with the dispatch of the JDR Team, and has been provided since then.
- Hands-on-training and capacity development programs have been implemented for Sri Lankan experts to utilize these data and information properly and practically.

Through this support, Sri Lanka has been provided with various types of flood-related information based on the latest research findings. This information helps the government organizations of Sri Lanka to disseminate effective flood forecasts and early evacuation alerts, which should lead to human damage reduction and efficient emergency response efforts.



Outline of support for Sri Lanka

2.4 Field investigation and research on intensified flood and sediment disasters in recent years

In August 2016, heavy rainfall due to Typhoon No.10 (Lionrock) caused tremendous damage, particularly to areas along the Omoto River in Iwate Prefecture and tributaries of the Tokachi

river in Hokkaido. In the Omoto River basin occurred landslides and debris flows, which carried a large volume of sediment and countless driftwoods downstream; flooding and inundation occurred in low-lying areas along the valley. A total of 21 people were left missing or dead in this flood disaster, and houses, road and other infrastructure, farmland, and forests suffered significant damage from violent floodwaters. In July 2017, northern Kyusyu was hit by record heavy rainfall due to training thunderstorms. The extreme rainfall triggered numerous landslides and debris flows in the mountain areas of the Chikugo River's right-side tributaries, resulting in flooding and inundation with sediment and driftwoods in the lower reaches of the tributaries. This devastating disaster that occurred in Asakura city and its neighborhood was even worse than the Omoto disaster, leaving 41 people either dead or missing. Flood and sediment disasters, such as these, attributed to hazards from mountain rivers have been growing in numbers in recent years; heavy rain disaster in Kii Peninsula in 2011, heavy rain disaster in northern Kyusyu in 2012, heavy rain disaster in Izuohshima Island in 2013, and debris flow in Minamikiso and heavy rain disaster in Hiroshima both in 2014, just to name a few.

Mountain rivers are typically characterized by fast rainfall runoff because their basins are often small and steep. In addition, once landslides and debris flows occur in mountains, flood flow is affected by these events, very often accompanied by sediment, driftwoods, and channel bed deformation, each of which can be a major hazard to communities in mountain areas. To prevent or mitigate damage from disasters involving complex factors and build disaster resilient communities, both hard and soft measures should be prepared and a system should be developed to maximize the measures for their intended purposes. To this end, efforts have been made from various sectors.

ICHARM has been part of the efforts, particularly focusing on the following topics that should be understood to take effective measures, based on field investigations, data analysis and numerical models.

1. Characterization of settlements in formation, topography and disaster damage
2. Prediction and assessment of hazards
   - Mechanism and forecasting of heavy rainfall events
   - Flood forecasting, rainfall runoff
   - Supply conditions of sediment and driftwood to river channels
   - Flood flow with sediment, driftwoods and bed deformation
3. Forecasting/warning and evacuation behavior, structure of a settlement

Research has been conducted on the topics listed above, and findings have been obtained on fundamental issues in disaster management such as: the relation of topographic characteristics and disaster damage characteristics, supply conditions of sediment and driftwood to lower reaches, assessment of flood flow with sediment, driftwoods and bed deformation, conditions of rainfall that triggers a disaster, and the effect of forecasting and warning on evacuation behavior.

These findings are important to plan practical measures for proper land use in areas along mountain rivers, river channel planning, and forecasting and warning for safe evacuation, for example. The findings are expected to contribute to not only disaster risk reduction in mountain

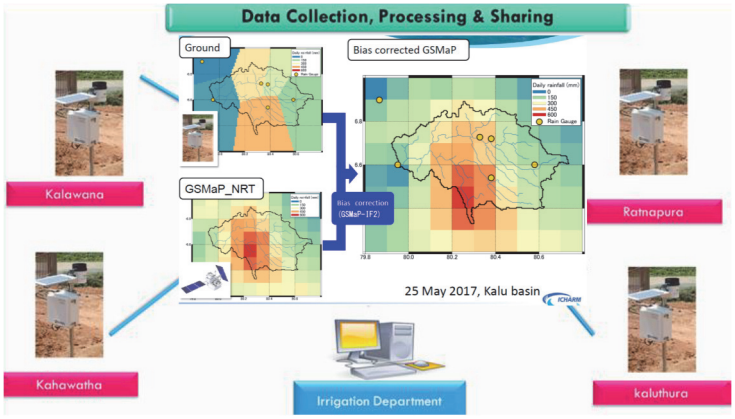
Debris flow fan formed in the upstream of Akatani river

river basins in Japan and overseas but also future international efforts to reduce disaster risks worldwide. Part of our research has been submitted to academic journals and already accepted for publication.

３． Research

3.1 Data collection, storage, sharing and statistics on water-related disasters

EDITORIA and ICHARM started providing real-time flood forecasts and other information for Sri Lanka on a trial basis when the country suffered tremendous damage from record heavy rainfall in May 2017. It was a joint effort by the two organizations taking advantage of their strengths; EDITORIA offered an advanced data processing system called DIAS while ICHARM offered expertise in flood monitoring and forecasting. To support Sri Lanka, ICHARM



Sri Lanka

The real-time system to collect ground rainfall data
and send the bias corrected GSMaP using the collected ground data.

developed a prototype online system on DIAS that collects hourly ground rainfall data from Sri Lanka, performs rainfall forecasting using the collected data, and delivers the results automatically.

3.2 Risk assessment on water-related disasters

3.2.1 Online release of RRI model

The RRI model, designed to perform rainfall-runoff analysis, runoff channel tracking, and flood and inundation analysis all at once, was released on the ICHARM website. This has made it possible to analyze the process of inundation over a large-scale river basin such as a low-lying delta. This model is also very user-friendly. Its graphical user interface allows the user to operate the setting and execution of various conditions and the display of analysis results very easily. All this can contribute to real-time flood and inundation forecasting, hazard mapping, evaluation of flood control measures such as dams and levees, and other purposes. RRI model has been applied to assess inundation risk in some Japanese municipalities, and as part of a flood inundation forecasting system in Thailand, Pakistan and some other overseas countries.

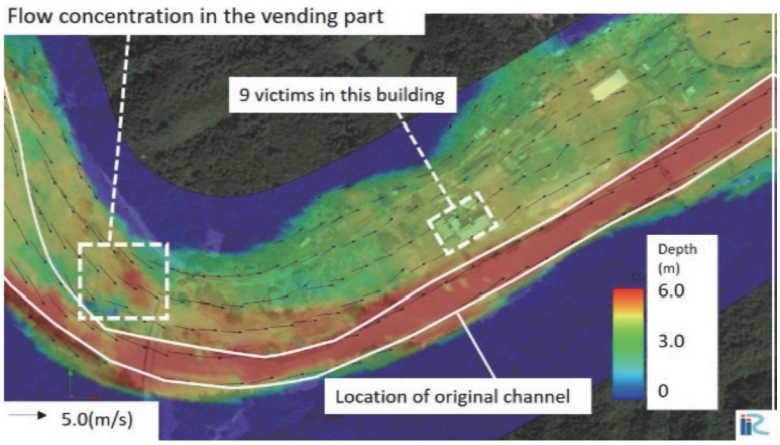
3.2.2 Development of a next-generation flood forecasting method using regional ensemble forecasting

Since heavy rainfall is hard to predict quantitatively, ICHARM employs limited area ensemble forecasting to predict heavy rainfall. This new approach predicts heavy rainfall stochastically based on multiple simulation results. We have also developed unique data-processing techniques to improve forecasting accuracy; for example, we apply the ensemble Kalman filter to process observed data before feeding them to a forecasting model. Forecasted rainfall is then evaluated for accuracy using a hydrologic runoff model. We have confirmed that it is possible to predict a flood event two or more days prior to its actual occurrence, from a study in which we conducted ensemble flood forecasting on several flood events in the last five years. We have also found that it is possible to predict flood discharge quantitatively at least a day before the actual event.

3.2.3 Analysis of flood flow with riverbed deformation in valley-bottom mountain rivers

In 2016, heavy rainfall due to Typhoon No.10 caused violent flood damage to areas along the Omoto River, which overflowed the river capacity and run through Iwaizumi Town, Iwate Prefecture, in northern Japan. ICHARM conducted field investigation, and the results suggested that because the Omoto River is a valley-bottom stream surrounded closely by mountains, a large volume of sediment and driftwood was easily supplied from the surrounding mountains to the stream and consequently compounded the disaster. Based on

this assumption, we conducted flood flow analysis considering a volume of sediment and driftwood supply conditions, and presented key considerations for planning effective river management of valley streams in mountains.



Characteristics of flood flow with riverbed deformation in mountainous valley-bottom streams the flood flow is concentrated on the bending parts of the valley, and is diverged toward the downstream of the sand bars.

3.2.4 Dissemination and improvement of IFAS

Many developing countries are affected by flood disasters repeatedly and suffer serious damage often with many victims either dead or missing. Despite this reality, they also face difficulty in developing and operating flood forecasting and early warning systems due to lack of hydraulic and hydrologic technology, observed data, and financial resources. To break through this situation, ICHARM launched a joint research project in 2004 with the Infrastructure Development Institute and nine other private consultant firms to develop a flood runoff analysis system, i.e., IFAS, that should be easy to operate and capable of practical flood forecasting. Even after the project ended, ICHARM has continued the improvement of IFAS by developing additional functions and upgrading GUI. IFAS is available for download free of charge from the ICHARM homepage.

IFAS is free software that supports easy operation of hydrologic runoff analysis with a user-friendly interface. The system uses topographical and land-use data which can be easily obtained free of charge from the Internet. It is also designed to acquire rainfall data needed for runoff simulation from different sources of ground observation, radar, and satellites; in particular, satellite data are obtainable worldwide. IFAS has been upgraded with additional modules for snowmelt and evapotranspiration to be a flood analysis model capable of incorporating a broad range of factors in calculation.

Because IFAS can perform flood forecasting and warning using satellite rainfall information, it is possible to predict floods in poorly-gauged river basins and international

rivers. It is now equipped with a function to correct satellite rainfall using ground rainfall. Its versatility has also enhanced by selectively combining different modules for snowmelt, evapotranspiration, and other factors to increase the applicability to different climate types.

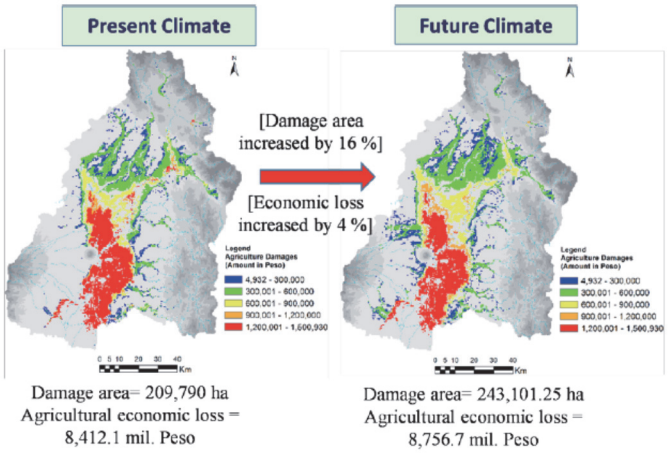
IFAS is used as a flood forecasting and warning system in several Asian countries. It is also used as a training tool, and more than 1,000 people in 50 countries have already taken some kind of training on IFAS. In Pakistan, in order to expand the coverage of the existing IFAS-based flood forecasting and warning system, local engineers have been independently working on the development of a local model of IFAS, which accelerates the localization of the system.

3.3 Monitoring and prediction of changes in water-related disaster risk

3.3.1 Completion of the Program for Risk Information on Climate Change (SOUSEI) and Report on Project Results

The SOUSEI program is a five-year research and development project conducted from 2012 to 2016, aiming at generating basic information required for managing various risks resulting from climate change. Assigned to “Development of Risk Assessment and Adaptation Strategies for Water-related Disaster in Asia” of Research Area D “Accurate Impact Assessment for Specific Tasks,” ICHARM conducted flood and drought risk assessment for three Asian river basins of Pampanga, Mekong and Solo. We also held meetings and workshops with government officials of Asian countries to promote the project and share the results.

On March 9, 2017, the FY2016 research results presentation meeting was held for each participating research group to present the results of their part of the project.



The example of the results of SOUSEI project
The comparison of flood damage assessment for a 100-year flood in the case of the worst scenario, which causes the largest flood area for the river basins of Pampanga

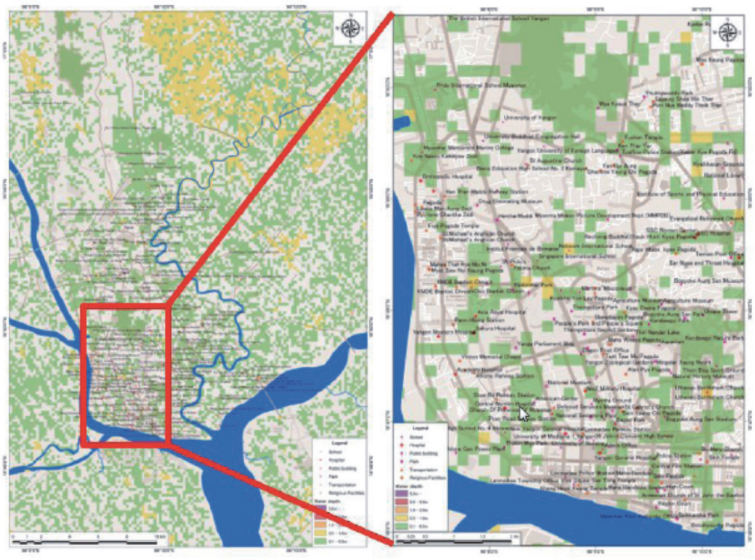
3.4 Proposal, evaluation and application of policy ideas for water-related disaster risk reduction

3.4.1 Completion of ADB project "TA-8456 Republic of the Union of Myanmar: Transformation of Urban Management"

An ADB project, "TA-8456 Republic of the Union of Myanmar: Transformation of Urban Management: Part II Flood Management," began in July 2014 and successfully ended in November 2016. ICHARM provided supervision throughout this project and submitted the final report to ADB. The project was conducted for the three major cities of Myanmar (Yangon, Mandalay and Mawlamyine) to develop human resources who are able to conduct flood risk assessment and flood management. The following activities were carried out in the project:

- Development of a flood inundation simulation model using the RRI model and creation of hazard maps for three cities
- Evaluation of flood damage risk using the flood inundation simulation (focusing on rice crop damage)
- Training on the development of a flood and storm-surge simulation model for local engineers of Department of Meteorology and Hydrology (DMH) and the Irrigation and Water Utilization Management Department (IWUMD)
- Proposal of a business plan for enhancing the capacity of DMH

Throughout the project, we held a number of meetings and workshops with the three cities and the government organizations in charge of water-related disaster risk management. Opinions collected from those meetings on hazard maps and flood risk assessment were reflected in each stage of the project, and the results were disseminated to the government organizations in Myanmar. The ICHARM project team also explained the project at the meetings with H.E. U Phyo Min Thein, the chief minister of the Yangon Region, on August 17, 2016, and with H.E. U Maung Maung Soe, the mayor of the Yangon City Development Committee, on August 19, 2016. When a flood disaster occurred in Myanmar by Cyclone Komen in August 2015 during the project implementation period, ICHARM instructed the trainees from the Myanmar government to independently prepare a flood inundation simulation model, hoping that the experience would help them gain confidence in continuing independent activities in the future. Since the project was also designed to produce future trainers, the trainees planned and conducted a workshop on the RRI model for junior officials at DMH after they finished all their training. This ADB project was specifically intended to assist Myanmar in the effort of water disaster risk reduction. However, as many Asian countries share the common issues concerning water-related disasters, we are hoping that the approach of this project will be widely used in Asia in the future.



Flood Hazard Map of Yangon 100-year flood (green (0.1-0.5 m), yellow (0.5-1.0m)) created in the ADB project.

3.4.2 UNESCO Pakistan Project

UNESCO and Badan Meteorologi, Klimatologi, dan Geofisika (BMKG) held the "International Partners Technical Meeting Year 2 Technical Assessment Workshop Strategic Strengthening of Flood Warning and Management Capacity of Pakistan" in Jakarta, Indonesia, on December 19-21, 2017, to report the progress of the Pakistan project, which consisted of the development of a flood prediction model for the Indus River and training on river observation using ADCP.

In response to the large flood in Pakistan in 2010, ICHARM participated in a UNESCO technical cooperative project conducted from 2012 to 2014, mainly developing a flood forecasting system for the Indus River basin (named Indus-IFAS), producing flood hazard maps, and carrying out capacity development programs for relevant government organizations in Pakistan. In the second phase starting in 2015, ICHARM has so far conducted several tasks including: the improvement of Indus-IFAS by integrating simulation for the Eastern Rivers, the development of a snowmelt module for the upper Indus River, the application of a new method for correcting satellite rainfall data, and the implementation of the training on river observation using ADCP.

3.5 Support in constructing the applicability of water-related disaster management

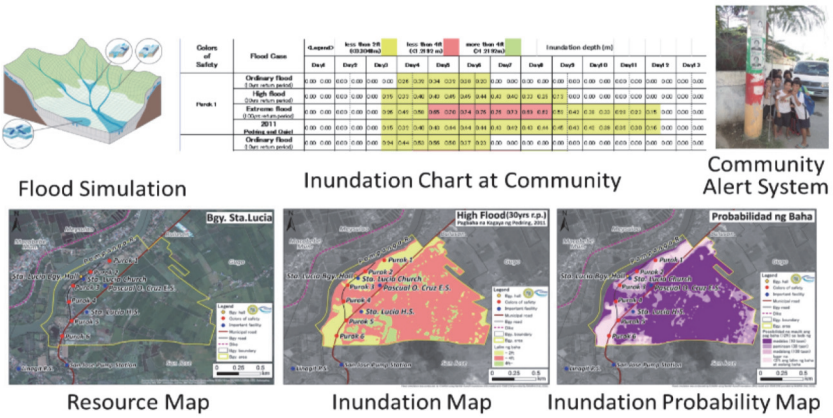
3.5.1 Research on flood risk assessment for river basins in mountains and information sharing

ICHARM is conducting research for municipalities in mountainous areas where little information is available to ensure residents' safe evacuation. The research aims to study the development of new flood risk indicators based on inundation simulation by using RRI model

and effective communication of information to residents. In this research, Aga Town of Niigata Prefecture located in the middle reach of the Agano River was selected as the study area. ICHARM proposed to the town an approach called “Flood Chart,” in which each community of the town was evaluated for total flood vulnerability based on different types of flood hazards from multiple perspectives. The results were further processed using cluster analysis for classifying the communities in several groups to find ones with high flood risk named “flood hot spot.” The key direction for devising a disaster management plan for each group of communities was also presented. In addition, ICHARM developed a portal site designed to be a one-stop information center useful not only at emergency but also in normal times for users to view all kinds of disaster-related information relevant for Aga residents. Currently, ICHARM and Aga Town are discussing the effective use of this portal site.

3.5.2 Support for Evidence-based Flood Contingency Planning

ICHARM conducted a technical assistance project from 2014 to 2016 to support Calumpit Municipality in community-level Evidence-Based Flood Contingency Planning based on the results of flood inundation simulation using the RRI model. Calumpit Municipality is part of Bulacan Province in the Pampanga River basin, one of the most flood-prone areas in Asia located on Luzon Island of the Philippines. In the flood inundation simulation using the RRI model, we created flood hazard maps and inundation progress charts for 29 communities of Calumpit, which showed chronological development of inundation, in collaboration with Philippine Atmospheric Geophysical and Astronomical Services Administration (PAGASA) and National Mapping and Resource Information Authority (NAMRIA). The maps and charts were provided to each community. We then held several meetings with the local communities to discuss how to ensure the user-friendliness of the maps and charts, and modified them by using icons, marks and colors that are easy for residents to understand. They were also translated into a local language, Tagalog. In February 2016, a workshop was



The Results of the research activity on community-level flood contingency planning in the Philippines

held, inviting officials in charge of disaster management from all communities, the city and the province, to share the procedures for this flood contingency planning with them. As the project had drawn a lot of local attention by then, the workshop was attended by over 100 participants. Mayor of Calumpit Jessie P. De Jesus specifically acknowledged ICHARM's commitment to this project, and awarded ICHARM with a certificate of appreciation. After the workshop in Calumpit, another workshop was held in Manila with state and provincial officials to disseminate the approach of this project to other parts of the country.

４．Training

4.1 Master's program: Water-related Risk Management Course of Disaster Management Policy Program

ICHARM provides a one-year M.Sc. program, "Water-related Risk Management Course of Disaster Management Policy Program (JICA Training Program: Training for Expert on Flood-Related Disaster Mitigation)", as a joint effort with JICA and GRIPS. This program is targeted at officials of administrative organizations and designed for them to obtain master's degree within a single year. In the first half of the course from October to March, the classes consist mostly of lectures; in the second half from April to the end, students work on research and graduation theses. In addition, several study trips are conducted during the program for students to visit dam, river and other management offices around Japan, where they can learn firsthand knowledge and experience in current flood management in Japan from experts of MLIT.

Between 2007 and 2015, the master's program of ICHARM graduated 97 students from 24 countries. In September 2016, the ninth batch of 13 students from 10 countries (Bangladesh, Brazil, Maldives, Myanmar, Nepal, Pakistan, the Philippines, Sri Lanka, East Timor, Zimbabwe), who entered the program in October 2015, graduated with a master's degree. In the following month, the tenth batch of 11 students from nine countries (Brazil, Malawi, Mozambique, Myanmar, Pakistan, Papua New Guinea, Philippine, East Timor, Vietnam) entered the program.

In September 2017, the tenth batch of 10 students from eight countries graduated, and in the following month, the eleventh batch of 14 students entered the program from 10 countries (Bangladesh, Brazil, Fiji, India, Nepal, Pakistan, Philippine, Sri Lanka, Tanzania, Vietnam).

In 2016, ICHARM in consultation with GRIPS and JICA started reviewing and finally revised the English language requirements and the application procedures, based on the realization that the program should accept more applicants who are expected to play a vital role in the future in making national policy on water-related disaster risk management. After that,

ICHARM informed of the revision relevant countries that are expected to send students to our educational program, with help from MLIT, JICA local offices and experts, high-ranking officials of government organizations who are familiar with ICHARM's research and networking activities. Furthermore, because there were always some applicants, in the past, who were late for submitting required documents, we strengthened communication between applicants and ICHARM to make sure that all the documents would be prepared in time for the screening process. Thanks to all these efforts, the number of applicants and the acceptance rate increased, and all successful applicants met the English language requirements.

Activities of Master Course (Hydraulic Model Experiment, Lecture, Site Visiting)

4.2 Doctoral program: Disaster Management

ICHARM started a doctoral program, "Disaster Management," in 2010 in collaboration with GRIPS to train experts who are capable of making policies on water-related disaster risk management and taking the leadership in implementing them. As of 2017, seven students completed the doctoral program.

In September 2016, the fourth batch of three students, Robin Kumar Biswas (Bangladesh), Md. Nasif Ahsan (Bangladesh), and Andrea Mariel Juarez Lucas (Guatemala), graduated with a doctoral degree in disaster management. In October, the seventh batch of students, Gul Amad Ali (Pakistan) and Islam Md Khairul (Bangladesh) entered the program. In October 2017, Amed Tanjir Saif (Bangladesh) joined the others as the eighth batch. In total, five doctoral students (two third-year, two second-year and one first-year students) are studying in the program.

Among the doctoral graduates, some have started a great carrier in the field of disaster management. One assumed a professor position back in his home country immediately after the graduation. Another continues research at a prominent national research institute in Japan (National Institute for Materials Science). Still another earned a position at the World Bank in

the Young Professional Program. Our dedication to capacity development is gradually taking shape as such individuals.

Diploma Awarded by GRIPS President

Graduated Ceremony in 2016 (3 Doctor Course Students, 13 Master Course Students)

4.3 Short-term training

4.3.1 JICA Short-term Training Program: Capacity Development for Flood Risk Management with IFAS

In the 2016-2017 period, ICHARM conducted the JICA training program, “Capacity Development for Flood Risk Management with IFAS,” twice from July 5 to July 29, 2016 and from July 4 to July 28, 2017. The training is targeted at three categories of experts in flood-vulnerable developing countries: meteorologists, river administrators, and disaster managers who are particularly in charge of residents’ evacuation. It is designed for those experts to learn about disaster management in general, including the outline of disaster prevention and evacuation plans, flood management technologies and past flood management efforts in Japan. The participants are also required to develop an action plan for local flood management of flood-vulnerable areas in their countries. These training activities aim to enhance individual flood-coping capacities and eventually to contribute to flood damage mitigation in their countries.

In the second year of this three-year training program starting in 2015, 18 people participated from Bhutan, Bosnia and Herzegovina, India, Kenya, Myanmar, Nigeria, the Philippines, and Sri Lanka. In 2017, the final year of this program, 10 people participated from Bosnia and Herzegovina, India, Kenya, Myanmar, the Philippines, and Sri Lanka.

They mainly learned how to operate the IFAS system along with additional training on the creation and use of disaster prevention maps (which was conducted in Tsuchiura City in 2016 and in Shimotsuma City in 2017) and a study trip to the Shinanogawa River, managed by the Hokuriku Regional Development Bureau. Through the training, they made a great improvement in operation of IFAS and RRI and also learned about disaster management currently practiced in Japan.

JICA Short-term Training Course (RRI model Exercise, PCM Exercise)

4.3.2 International summer program co-hosted with the University of Tokyo

An international summer program, “Sustainable Water Management in an Era of Big Data,” was held from July 25 to August 5, 2016. The summer program was jointly organized by ICHARM and the University of Tokyo and attended by 17 undergraduate and graduate students and junior experts from Japan, China, Indonesia, South Africa, Korea, Afghanistan, Taiwan, the Philippine, India, and Vietnam.

The program was designed for participants to increase understanding of sustainable water resources management and the importance of using big data while making the most of DIAS, developed in Japan. During the program, the participants learned about water issues, global water cycle, DIAS and GIS through lectures given by professors and researchers including the director of ICHARM. They also took a study trip to Shimokubo Dam in Tokyo’s neighboring prefecture Gunma and the Metropolitan Area Outer Underground Discharge Channel. On the last day, the participants were divided into groups to prepare a presentation. They analyzed a selected basin using various types of data such as topography and rainfall, and presented recommendations to solve problems.

4.3.3 IFAS and RRI training and workshops

In 2016 and 2017, training and workshops on IFAS and RRI were conducted both in Japan and overseas at various occasions.

On April 6-8, 2017, a workshop on the development of locally adjusted IFAS and RRI with a snowmelt module was held in Lahore, Pakistan, and on April 10-11, the same workshop was held in Islamabad. Both workshops were attended by local experts from Pakistan Meteorological Department (PMD), Pakistan Council of Research in Water Resources (PCRWR), governmental agencies in the agricultural sector, and universities in addition to personnel from local offices of UNESCO and JICA. High-ranking officials, two each from Pakistan and Afghanistan, were also invited to Japan from May 30 to June 6 in 2016 and from May 17 to 26 in 2017 to increase the understanding of flood forecasting using IFAS and other technologies and discuss the effective collaboration with Japan.

ICHARM has also been involved as a technical advisor in the SAFE project led by JAXA. On May 19-20, 2016, ICHARM provided Mekong River Commission (MRC) with bias correction training for GSMaP by means of IFAS as part of the SAFE project, “Deploying GSMaP for Decision Support in Transboundary Catchments in the Lower Mekong Basin.” On June 2, 2016, ICHARM organized another SAFE-related workshop and discussed flood forecasting using satellite rainfall information and its possible application in the decision making process, as well as issues arising while implementing the SAFE project. On August 22-24, it held another workshop at Kothmale International Training Institute (KITI) at Kothmale, Sri Lanka on RRI and a correction method for satellite rainfall data needed for the operation of a flood forecasting system installed for the Calganga River.

4.3.4 Support for Malaysia’s disaster management course

The Malaysia-Japan International Institute of Technology (MJIIT), an academic entity to provide Japanese-style engineering education in Malaysia, was officially launched in September 2011 as part of Universiti Teknologi Malaysia (UTM). The institute opened its fifth course on disaster risk management in September 2016, which is targeted at middle-ranking government officials in charge of disaster management. Japanese universities and research institutes formed a consortium to provide the institute with assistance in education, research, management and other areas, and ICHARM has been part of it, involved in planning the course and sending teaching staff. ICHARM staff has so far lectured about the basic concepts on flood flow and sediment transport.

4.4 Follow-up Seminar

ICHARM holds Follow-up Seminar once a year in a country of graduates from ICHARM educational and training programs to provide additional assistance and visit rivers and other

places with water-related problems. This annual meeting is a great opportunity for ICHARM to see how graduates are using knowledge and skills they learned at ICHARM and to learn actual issues they face in their practice, which are later used to improve ICHARM's training programs and enhance its research activities. From January 31 to February 2, 2017, the 2016 Follow-up Seminar was held at Manila, the Philippine, with 24 participants including officials from the Department of Public Works and Highways, the National Irrigation Administration, PAGASA, and the Department of Environment and Natural Resources and experts from ICHARM and JICA. The seminar consisted of presentations and discussions and a field trip to flood-prone areas in the Pampanga River basin. The 2017 Follow-up Seminar was held on December 12-13, 2017, in Yangon, Myanmar. A total of 28 people participated from DMH, Ministry of Transport and Communications; Directorate of Water Resources and Improvement of River Systems, Ministry of Transport and Communications; IWUMD, Ministry of Agriculture, Livestock and Irrigation; Relief and Resettlement Department, Ministry of Social Welfare, Relief and Resettlement; Yangon Institute of Technology; and JICA. The first day was spent for presentations and discussions, and the second day for a field trip to river structures in the Ayeyarwady River running through Yangon's neighboring Nya Dun City.

4.5 Internship

ICHARM offers an internship program, accepting interns from both Japan and overseas. In 2016, we accepted 10 interns: three from Kyungpook, Seoul and Yonsei universities of Korea, one from UNESCO-IHE, five from Jochi, Tsukuba, Nagoya, and Osaka City universities of Japan, and one from Kunming University of China. The interns from Jochi and Nagoya universities were overseas students from Kenya and Thailand. In 2017, seven interns studied at ICHARM: one from Erfurt University of Germany, one from UNESCO-IHE, one from Busan University of Korea, and four from Osaka Institute of Technology, Hiroshima, Nagoya, and Kyoto universities of Japan. The interns from Kyoto and Nagoya universities were overseas students from Afghanistan and the Philippines. The interns spent a week to several months at ICHARM studying hydraulic and hydrologic analysis, disaster risk analysis, or other subjects depending on their interest, with technical advice from ICHARM researchers.

５．Information networking

5.1 International Flood Initiative

5.1.1 Global activities

A new strategy and an action plan of IFI were approved at the UNESCO-IHP Intergovernmental Council held at the UNESCO headquarters in June 2016. Five key actions

were also identified by clearly defining supporting tools, focus areas and stakeholders. Based on the agreement of the intergovernmental council, the Jakarta Statement towards an interdisciplinary and transdisciplinary partnership to consolidate flood risk reduction and sustainable development was proposed at the side event of the 8th HELP meeting in Jakarta, Indonesia, in October 2016, and agreed on by the member organizations of IFI. The Jakarta Statement explains the current status of disaster risk reduction and sustainable development, and presents the direction and actions to take for the promotion of those two ultimate goals. This statement became the foundation of the project, based on which the global effort to establish Platforms on Water and Disaster has gotten underway. In July 2017, the 3rd UN Special Thematic Session on Water and Disasters was held at the UN headquarters in New York, and the director of ICHARM co-chaired the Special Session on Science and Technology. The session discussed a broad range of topics on water and disasters: a mechanism to promote international alliance on water and disasters, sediment disaster research, research foundation to promote investment and financing, response to multi-hazard disaster risk, as well as Platforms on Water and Disaster. Further promotion of the international initiatives was also proposed at the session. ICFM7 was held at Leeds University in Britain in September 2017. During the conference, the Special Session on IFI was organized and discussed the needs and activities for Platforms on Water and Disaster under the theme of "Towards Strengthening Flood Resilience under the Three Key Global Agendas and the United Nations New Water Decade." As the session recognized common need for water-related disaster risk reduction in Africa, Latin America, Asia and the world and agreed on the role of IFI for that purpose, it was a particularly important occasion for IFI to confirm the potential of IFI's Platform project, which is currently being implemented in Asian countries, to expand as a global effort covering Africa and Latin America. During the conference, the ICFM special committee met and proposed that the IFI special session be a plenary session at ICFM8 in 2020, though held

Special Session on Science and Technology in The 3rd UN Special Thematic Session on Water and Disasters

as a parallel session at ICFM7. This shows high expectations of the global community towards IFI. In November 2017, The World Bosai Forum was held in Sendai, Japan. ICHARM organized a technical session, and the participants discussed academic issues related to Platforms on Water and Disaster from multiple perspectives of ICT, economy, community and dynamics, while the invited panelists from the Philippines, Sri Lanka, Pakistan and Brazil spoke about the present situation and efforts of their countries regarding water-related disasters and their management. In conclusion, the session agreed on the importance of science and technology in water-related disaster risk reduction, and contributed to laying the groundwork for diverse, well-coordinated risk reduction efforts on a global basis.

5.1.2 Regional activities in Asia

As the secretariat of IFI, ICHARM has been actively promoting disaster risk reduction in the Asian region. It organized a side event, "Implementation Planning Workshop on IFI in Asia-Pacific," at the 9th GEOSS Asia-Pacific Symposium in Tokyo, Japan, in January 2017, inviting participants from relevant national organizations of Indonesia, Malaysia, Myanmar, the Philippines, Pakistan, and Sri Lanka. The workshop was successful in forming a consensus on the importance of establishing Platforms on Water and Disaster and was a great start to take concrete actions for implementing the idea. ICHARM also hosted a session at the 10th GEOSS Asia-Pacific Symposium in Hanoi, Vietnam, in September 2017. During this symposium, it also arranged a separate meeting with the participants from the Philippines and Myanmar to accelerate the process of establishing a Platform on Water and Disaster in each country. ICHARM promoted IFI's activities by taking advantage of other occasions including a UNESCO special session at AOGS2017 in Singapore in August 2017 and APAN44 in Dalian, China, in 2017.

Implementation Planning Workshop on International Flood Initiative (IFI) in Asia-Pacific

5.1.3 Activities in each country

After the IFI workshop in Tokyo in January 2017, the projects for establishing Platforms on Water and Disaster started in the Philippines, Sri Lanka, Myanmar and Pakistan. In the Philippines, the Coordinating Meeting on establishing a Platform on Water and Disaster was organized twice in March and June 2017. Another meeting was arranged with Philippine experts when they participated in the 10th GEOSS Asia-Pacific Symposium in September 2017 to step up preparation for the establishment of a Platform on Water and Disaster. In the case of Sri Lanka, ICHARM supported their emergency response efforts during the flood and sediment disaster in May 2017. In August, a meeting was arranged to coordinate relevant organizations towards the establishment of a Platform on Water and Disaster. In Myanmar, high-level meetings with bureau chief class officials were held twice in Nay Pyi Taw in May and November 2017. Another meeting was arranged with Myanmar experts when they participated in the 10th GEOSS Asia-Pacific Symposium. In Pakistan, a meeting was held in March 2017 to discuss the establishment of a Platform on Water and Disaster, and the country is now working towards the plan.

5.2 Contribution to the world community

ICHARM has committed to disseminate research findings and increase its international presence at various occasions by hosting international conferences, organizing sessions at international conferences hosted by overseas institutions, and making presentations as invited speakers. Since major activities related to IFI are described in section 5.1, the following outlines other major activities.

5.2.1 Contribution to UNESCO-IHP

As a UNESCO category 2 center, ICHARM has been contributing to UNESCO-IHP at national, regional and international levels. On June 13-17, 2016, ICHARM sent a party of researchers led by the director of ICHARM to the 22nd UNESCO-IHP Intergovernmental Council. It also sent researchers to other IHP-related conferences to speak about its activities and exchange views and ideas with other participants, including: a workshop, "Fostering Collaboration between UNESCO in the Field and Networks towards the 2030 Agenda," on July 21-24, 2016, in Bali, Indonesia, held jointly with the UNESCO Man and the Biosphere Program and IHP; regional workshops held on July 10-11, 2017, in Langkawi, Malaysia, and on November 29-30 in Penang, Malaysia; and the UNESCO-IHP Southeast Asia-Pacific Regional Steering Committee (UNESCO-IHP RSC-SEAP) and a joint symposium organized by UNESCO-IHP RSC-SEAP and UNESCO JASTIP on November 13-16, 2017. In addition, as a member of the IHP session of the Natural Science Subcommittee of the Japanese National Commission for UNESCO, ICHARM reports on its activities on a regular basis and

supports the operation of the session.

5.2.2 Contribution to hydrology on a global basis

As its establishment is closely related to issues of hydrology, the field is one of the important research areas for ICHARM. For this reason, it continues participating in research projects and international workshops on hydrology to exchange views and ideas with other organizations.

5.2.2.1 Contribution to Sentinel Asia

Sentinel Asia is an initiative underpinned by the Asia-Pacific Regional Space Agency Forum (APRSAF) to support the application of GIS and satellite observation technology to disaster risk reduction in the Asia-Pacific region.

ICHARM contributes to this initiative by sending the chief researcher of the Water Disaster Team to serve as a co-chair of the Flood Working Group (later renamed the Water Disaster Working Group) and sharing research findings with member organizations. We also join discussions on emergency satellite observation in case of flooding in the Asian region and the use of satellite observation for disaster management purposes.

5.2.2.2 Participation in the 15th WMO Commission for Hydrology

The 15th WMO Commission for Hydrology (CHy-15) was held December 7-13, 2016, and four ICHARM researchers including the director participated as the representatives of Japan. At the meeting, they explained the activities of ICHARM ranging from the development of IFAS and RRI to educational and training programs. As a result, ICHARM's contribution to WMO CHy was officially recognized, and clearly included in the committee report.

5.2.3 Contribution to disaster prevention in the world

ICHARM also contributes to disaster prevent worldwide through international conferences.

5.2.3.1 Participation in Global Platform for Disaster Risk Reduction

Researchers of ICHARM including the director participated in the Global Platform for Disaster Risk Reduction, held in Cancun, Mexico, on May 22-26, 2017. The Global Platform, held biennially since 2007, is a forum that is officially recognized by the United Nations General Assembly to provide advice for global efforts in disaster risk reduction and monitor the progress in the efforts. Since the meeting was the first one after the 3rd UN World Conference on Disaster Risk Reduction held in Sendai in 2015, the participants engaged in active discussions based on outcomes of the 2015 conference, regarding the implementation of the Global Targets for disaster risk reduction set according to the Sendai Framework, for example.

5.2.3.2 Participation in the Open-ended Intergovernmental Expert Working Group on indicators and terminology relating to disaster risk reduction

Official and informal meetings of the Open-ended Intergovernmental Expert Working Group (OIEWG) on the indicators and terminology of the Sendai Framework were convened by UNISDR, and the chief researcher of the Risk Management Team of ICHARM was sent to join discussions as an expert from Japan. The meetings were held to form consensus on indicators and terminology for worldwide use to measure the progress in the achievement of the seven Global Targets defined in the Sendai Framework, before submitting the proposal for adoption by the UN General Assembly. The indicators and terminology agreed by the OIEWG were reported to the UN General Assembly and adopted on February 2, 2017.

5.2.3.3 Global Forum on Science and Technology for Disaster Resilience 2017

The “International Conference on Science and Technology for Sustainability -Global Forum on Science and Technology for Disaster Resilience 2017-” was held in Tokyo on November 23-25, 2017. The purpose of the conference was to develop an action plan for the implementation of the four Priority for Actions stated in the Sendai Framework by integrating the fields of science and technology related to disaster risk reduction and uniting science and technology with other stakeholders such as politicians, administrators, and private corporations. It was organized by six entities including the Science Council of Japan and UNISDR, and ICHARM also participated in planning and operation.

Global Forum on Science and Technology for Disaster Resilience 2017

5.2.4 Global Earth Observation System of Systems Asian Water Cycle Symposium 2016

Based on recognition of the commonality in water-related issues and socio-economic needs in the Asia-Pacific region, a well-coordinated regional challenge, Global Earth Observation System of Systems Asian Water Cycle Initiative (GEOSS/AWCI), has been organized in cooperation among 18 countries in Asia since 2005. It focuses on convergence and harmonization of observation activities, interoperability arrangements for observed data and collected information, effective and comprehensive data management, and capacity building of the participating countries as the most functional element. Demonstrative approaches in cooperation between global observations and local applications, between research communities and operational sectors, and/or among different socio benefit areas can solve various problems and lead to realize societal benefits.

ICHARM co-hosted the Asia Water Cycle Symposium 2016 with the University of Tokyo with the support of MLIT on March 1-2, 2016 in Tokyo, Japan. Part of the symposium was held in commemoration of ICHARM's 10th anniversary. Graduates of its educational programs were invited to discuss issues on capacity development for further improvement of the training programs. In addition, since ICHARM is the secretariat for IFI, the symposium also included an event to discuss a new framework which IFI has been promoting recently for flood risk reduction. ICHARM also coordinated a sub-session on flood early warning systems and flood disaster risk reduction. The symposium gathered roughly 170 participants including about 40 from overseas organizations. The participants agreed on promoting a "spiral-up" framework, in which disaster risk reduction efforts will be enhanced by maximizing the power of science and technology coupled with practicing holistic disaster prevention, mainstreaming disaster prevention, and encouraging sustainable development. The

Asian Water Cycle Symposium 2016

symposium was also a good opportunity for ICHARM to share research results and findings with Japanese and international experts.

5.2.5 Invited lectures by overseas organizations and universities

ICHARM researchers, including the director, the research and training advisor, chief and senior researchers and research specialists, were invited by overseas organizations and universities to give lectures and presentations or join discussions as a panelist on flood forecasting technology, flood forecasting and warning, and hydrological models. Such organizations and universities include the World Bank, the Asia Institute of Technology, Technische Universitat Berlin of Egypt, and the MJIIT, for example.

5.3 Contribution to the Typhoon Committee

The Typhoon Committee is an intergovernmental community jointly organized in 1968 by ESCAP and WMO to promote and coordinate the development and implementation of plans to minimize human and physical damage caused by typhoons in the Asia-Pacific region. The member countries are composed of governmental organizations of 14 nations and territories in East and Southeast Asia. The committee consists of four Working Groups of Meteorology, Hydrology, Disaster Risk Reduction, and Training and Research, each of which works on its projects independently. Integrated Workshops and Annual Sessions are also held periodically. Currently, a chief researcher of ICHARM assumes the chair of the Working Group of Hydrology, taking the initiative in the “Flash Flood Risk Information for Local Resilience” project starting in 2017 with the start-up team of member countries. The following lists the meetings related to the Typhoon Committee held in the 2016-2017 period:

- The 11th Annual Meeting of Working Group of Disaster Risk Reduction and the Advisory Working Group (Ulsan, Korea; May 24-26, 2016)
- The 5th Annual Meeting of Working Group of Hydrology (Seoul, Korea; September 5-7, 2016)
- The 11th Annual Integrated Workshop (Cebu, Philippines; October 24-28, 2016)
- The 49th Annual Session (Yokohama, Japan; February 21-24, 2017)
- The 12th Annual Meeting of Working Group of Disaster Risk Reduction and the Advisory Working Group (Ulsan, Korea; May 31-June 1, 2017)
- The 6th Annual Meeting of Working Group of Hydrology (Seoul, Korea; September 25-27, 2017)
- The 12th Annual Integrated Workshop (Cheju Island, Korea; October 29-November 3, 2017)

Among the meetings, the 49th Annual Session of the Typhoon Committee was convened in Japan, gathering about 100 participants from 13 countries and territories (Japan, United States,

Korea, China, Hong Kong, Singapore, Macau, Malaysia, the Philippines, Vietnam, Thailand, Laos, and Cambodia) and international organizations (WMO, ESCAP, JICA, ADRC, etc.). The session consisted of technical presentations, reports on activity and budget plans from the Working Groups of Meteorology, Hydrology, and Disaster Risk Reduction, and discussions on other issues including the management of the Typhoon Committee. All those were compiled in the final report and approved by the session. The items approved by the session include: 1) MLIT of Japan will strengthens support for the Typhoon Committee through IFI and JICA; 2) The chair for the Working Group of Hydrology will continue to be assumed by Chief Researcher Tokunaga; 3) The "Flash Flood Risk Information for Local Resilience" project, proposed by Japan, will be implemented during the 2017-2019 period. Other meetings took place outside the Annual Session. The members of the Working Group of Hydrology met with its former chairs. Bilateral meetings were held between Korea and ICHARM and between Thailand and ICHARM. In the meantime, the 12th Integrated Workshop proposed that the 7th Annual Meeting of Working Group of Hydrology be held in Japan, which should be approved at the Annual Session scheduled in late February 2018.

Presentation by Director Koike at ESCAP/WMO Typhoon Committee 49th Annual Session

5.4 Leading the International Atomic Energy Agency (IAEA)/Regional Cooperative Agreement (RCA) RAS/7/030 Project on "Assessing Deep Groundwater Resources for Sustainable Management through Utilization of Isotopic Techniques" in Japan

Based upon the request from Japanese Ministry of Foreign Affairs (MOFA), ICHARM leads the IAEA/RCA RAS/7/030 Project in Japan and contributes to the implementation of the RAS/7/030 Project in other 19 Asia-Pacific region countries by assigning a research specialist as one of the national project coordinators/representatives of Japan for the following purposes:

- Conducting training to participants from the RCA member countries for the sustainable management of groundwater resources on the basis of comprehensive assessment using

integration of isotopic, hydrogeological and chemical techniques;

- Providing expert advice for specific study areas of the RCA member countries by answering questions of groundwater resource, recharge mechanism, age and volumes;
- Promoting application of isotope techniques in Japan to characterize water cycle in subsurface and surface water components;
- Contributing to the research development of new numerical modeling technology and preparation of the next 3-year IAEA/RCA Projects for reducing water-related disasters of droughts and floods.

In 2016, the research specialist of ICHARM was given a role of lecturer and expert in the 1st Regional Training Course (RTC) of the IAEA/RCA RAS/7/030 project held in Xian, China, on November 14-25, 2016, with 28 participants from 16 IAEA/RCA member countries of the Asia-Pacific Region.

In 2017, the research specialist was again given a role of co-lecturer and expert in the 2nd RTC of the IAEA/RCA RAS/7/030 project in Sydney, Australia, on August 14-18, 2017, with 25 participants from 16 IAEA/RCA member countries.

He also represented Japan in the IAEA/RCA Mid-Term Progress Review Meeting of the project RAS/7/030 held in Colombo, Sri Lanka, on November 6-10, 2017 and contributed to the preparation of the next 3-year IAEA/RCA Project, which is planned to start from 2020 focusing on groundwater pollution due to anthropogenic activities and climate change.

5.5 Visitors

ICHARM welcomed many visitors from around the world during the 2016-2017 period, and discussed various issues and shared information on our activities and theirs.

The following outlines some of the main visitors.

5.5.1 Minister of Water Resources of Bihar State, India

On December 20, 2016, H. E. Mr. Rajeev Ranjan Singh, the minister of Water Resources of Bihar State, India, visited ICHARM with four other officials to learn flood risk management including early warning systems and flood forecasting for mitigating flood damage in their state. They stressed the need for advanced technologies, particularly advanced flood models, as well as real-time flood forecasting systems, using ensemble rainfall and flood forecasts.

5.5.2 President of the 38th session of the UNESCO General Conference

Mr. Stanley Mutumba Simataa, the president of the 38th session of the UNESCO General Conference, visited ICHARM on May 15, 2017, as part of his working visit upon the invitation by the Minister for Foreign Affairs of Japan. President Simataa is also the deputy

minister of Information and Communication Technology, the Republic of Namibia. After a courtesy call on PWRI President Kazuhiro Nishikawa, the president received presentations on ICHARM's activities by the director and other researchers. He had a brief meeting with doctoral and master's students of ICHARM, and delivered a speech, stressing that it is important to prepare for water-related disasters such as floods and the impact of climate change, as the world has been seriously concerned about them.

Visit by Mr. Stanley Mutumba Simataa,
President of the 38th session of the General Conference, UNESCO

Date	Visitors & Affiliations	No. of Visitors	Purpose
April 11-12, 2016	Dr. Cecilia Tortajada, Senior Research Fellow, National University of Singapore (former President of IWRA), JICA staff	3	Site visit and research meeting with ICHARM researchers and students
May 23, 2016	Dr. Min Kyung Jin, Vice President and Chief of the Research Office, etc., i-WSSM (Korea)	3	Meeting on possible mutual collaboration as UNESCO centres
July 6, 2016	College students from Indonesia, Malaysia, Taiwan and Oyama College of the National Institute of Technology	Approx. 30	Receive lectures
July 20, 2016	Dr. Lal Samarakoon, Executive Director, etc., GeoInformatics Center of the Asian Institute of Technology	3	Discussion on collaboration in the development and effective use of remote sensing technologies and hydrological models
July 27, 2016	Mr. Song Dexiong, Executive Deputy Director, IKCEST, Institute of Geographic Sciences and Natural Resources Research (China)	4	Meeting on possible mutual collaboration as UNESCO centres
August 29, 2016	Mr. Ericson A. Alcovendaz, City Administrator, and officials from Manila City, the Philippines	9	Gather information on projects and research achievements in disaster prevention and mitigation

September 16, 2016	Experts from around the world involved in the World Bank's projects	12	Presentation and discussion on applications about IFAS and RRI model
October 24, 2016	Dr. Win Win Zin, Associate Professor, Yangon Technological University (Myanmar), master's course students from the University of Tokyo	7	Discussion on ICHARM's activities related to Myanmar
November 7, 2016	Md. Mahfuzur Rahman, Additional Director General, etc., the Bangladesh Water Development Board	3	Meeting to strengthen mutual research cooperation
November 9, 2016	Associate Professor Motoyoshi Kobayashi and international graduate students studying Life and Environmental Sciences, University of Tsukuba	35	Receive lectures and lab tour
December 20, 2016	H. E. Mr. Rajeev Ranjan Singh, Minister of Water Resources of Bihar State, India, etc.	5	To learn flood risk management
February 20, 2017	Dr. Hyo Seob CHO, Director of Water Resources Information Center, etc., Han River Flood Control Office (Korean delegations to Typhoon Committee)	3	Discussion on activities of Typhoon Committee
March 20, 2017	Prof. Felino P. Lansigan, University of the Philippines, Los Baños, etc.	4	Discussion on research and educational activities
April 22, 2017	Professor Ali Akbar, Vice Chancellor, etc., Bangladesh Agricultural University	2	Meeting to explore possible research collaborations
May 15, 2017	Mr. Stanley Mutumba Simataa, President of the 38th session of the General Conference, UNESCO, MOFA	3	Courtesy call on PWRI, etc. as a working visit upon the invitation by the Minister for Foreign Affairs
June 27, 2017	Bereniz Castaneda Talavera, Director, Innovation & Competitiveness, Agencia Espacial Mexicana (AEXA)	8	Research on flood forecasting using GSMaP, as a part of JICA program
August 9, 2017	Dr. KE Seetha Ram, Senior Capacity Building and Training Specialist, Asian Development Bank Institute (ADBI)	1	Meeting on ICHARM's training & capacity building activities
August 10, 2017	Mohammad Reza MEMARIAN, Head of Geotechnical and Strength of Material Center of Tehran Municipality, Iran	8	Training and capacity building by visiting important infrastructures in Japan and research institutes, etc.
December 20, 2017	Water Institution for Sustainability (WIS)(Thailand)	14	Research on the analysis methods and risk management methods on water-related disasters
December 22, 2017	Mr. Seok Kwan-Soo, Programme Manager, etc., i-WSSM (Korea)	3	Meeting on training and education

6. Local practices

ICHARM conducts various projects of local practices in rivers and floodplains of Japan and other countries such as Nepal, Pakistan, Bangladesh, Myanmar and the Philippines. Those projects can be categorized into three types: 1) field investigations and data collection mainly for hazard research; 2) research activities for disaster risk reduction and the development of resilient communities; 3) capacity development and technology transfer. The following three sections outline each category with concrete examples.

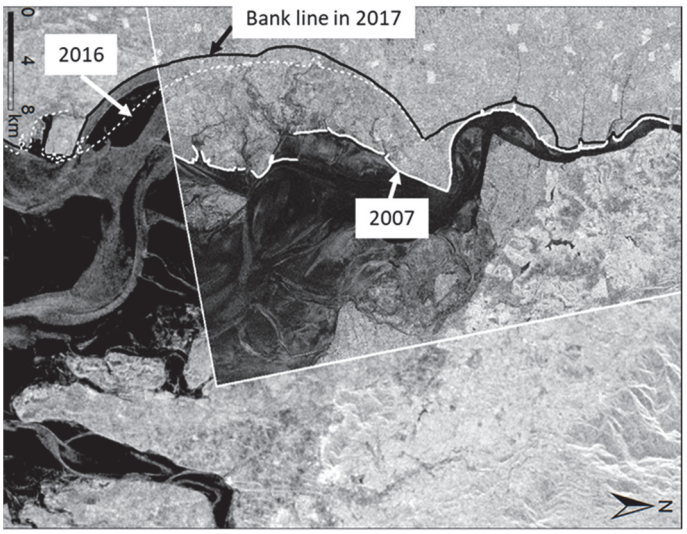
6.1 Field investigation and data collection

ICHARM conducted field investigation for the Omoto River of Iwate Prefecture and the Akatani River of Fukuoka Prefecture, both in Japan, whose basins suffered damage from a flood disaster during the 2016-2017 period. We investigated post-disaster conditions of the affected areas for further progress in the study of hazards. We also collected data needed to test the validity of existing hazard forecasting and evaluation methods and make improvements as necessary.

ICHARM also conducted field investigation in the West Rapti River of Nepal, and found the longitudinal sediment sorting in a short river reach, which contributes to a rapid transition from a gravel bed river to a sand bed river. Since this type of longitudinal sediment sorting has been rarely reported in Japan, the phenomenon has limited practical significance domestically. However, theorizing the phenomenon is crucially important in sediment transport mechanics, and the success in doing so will make enormous strides in sediment transport research. ICHARM continues the investigation on the West Rapti River in this respect, collecting data related to the longitudinal sediment sorting and working on the development of a numerical model for the assessment of this phenomenon.

In Bangladesh, large rivers such as the Brahmaputra River pose a serious threat to the livelihood of local communities, causing bank erosion and channel changes. The river banks consist of clay, silt and fine sand, and channel changes accompanying bank erosion result from imbalance of suspended sediment transport. In Myanmar, too, the river banks around the estuary of the Sittaung River are experiencing considerable erosion and local communities are in great danger. The river banks in this area are composed of cohesive material, and parts of them undergo an erosion of about 2,000 m per year due to river flow, tidal flow and bore. The channel changes and bank erosion in the two countries is very rare cases both in Japan and other countries. In the face of immediate danger, both countries hope for technical assistance to prevent the phenomenon from worsening; however, it is also true that both countries are hardly equipped with river engineering and methods for forecasting and evaluating sediment transport and channel changes. In these circumstances, ICHARM has conducted river erosion

investigation in the Brahmaputra and Sittaung rivers. In particular, river flow and suspended sediment have also been observed in the Brahmaputra River. Based on the results of these



Changes in bank line around the estuary of the Sittaung River in Myanmar

investigations and data collected on sediment transport, we are trying to characterize the channel changes observed in the study areas and develop a numerical model to evaluate river changes.

6.2 Research activities for disaster risk reduction

A large part of Joso City in Ibaraki Prefecture was inundated when the Kinugawa River breached the river bank in September 2015. As part of the effort to build a community that are more resilient to disasters, ICHARM conducted an interview survey, asking businesses and residents questions about preparation for floods and response in the face of inundation. Through this survey, we tried to find the city's current level of disaster resilience by looking into the relationship between preparation and flood impact, the time needed to return to the business and livelihood before the disaster, as well as other factors. Based on the results, we discussed actions needed to strengthen the resilience of the community.

ICHARM also conducted an interview survey in Calumpit of Bulacan Province in the Philippines. Calumpit is a small city with a population of about 100,000 in the Pampanga River basin of Luson Island, lying to the northwest of Manila. Local residents were asked questions about how they acted during a 2011 typhoon named Pedring, which caused the worst flood in history. A workshop was also held to support the community in the development of a flood contingency plan. In the workshop, they discussed how to prepare for and respond to future floods as a community, based on RRI-based inundation simulations.

Workshop for flood contingency planning at Calumpit, Philippines

6.3 Capacity development and technology transfer

Data on flow discharge and sediment transport are extremely important for river management. However, such data are not available in many developing countries; if available, they often lack temporal and spatial continuity and their quality cannot necessarily be guaranteed. As an effort to solve this problem, ICHARM provided on-site training in the Indus River for local engineers of Pakistan to learn how to collect basic data properly by instructing flow velocity measurement using ultrasonic waves from a manned or unmanned boat, suspended sediment concentration measurement, and river bed height measurement simultaneously.

Since there are no rivers in Japan having river morphology similar to that of the Indus River, the data collected through the training are also very valuable for the progress in fine-sediment transport research.

A researcher of ICHARM (front, left) answers questions about ADCP asked by a training participant.

7． Public relations and other important activities

7.1 ICHARM 10th anniversary publication

"ICHARM 10th Anniversary" was published in March 2016 to celebrate the occasion while reflecting on its decade of achievements and envisaging the way forward. The volume includes the forewords from the director-general of UNESCO, the minister of Land, Infrastructure, Transport and Tourism, and other important figures in the field, messages from the chair of UNESCO-IHP and others, as well as in-depth descriptions of activities of ICHARM and related documents and lists of many kinds.

ICHARM 10th Anniversary

7.2 Awards

The following lists the awards received by researchers of ICHARM for their quality research, presentations and academic papers in the 2016-2017 period.

7.2.1 Institute of Social Safety Science 2015 Best Paper Award

Recipients: Miho Ohara, Naoko Nagumo, Badri Bhakta Shrestha, and Hisaya Sawano

Paper: Study on Basic Flood Risk Assessment Method in Asian Flood Prone Area with Limited Regional Data -Case Study in Pampanga River Basin, Philippines-, Journal of Social Safety Science, No.27, p.225-235, 2015. (in Japanese)

7.2.2 Institute of Social Safety Science 2015 Best Presentation Award

Recipient: Naoko Nagumo, Miho Ohara, Hisaya Sawano, Hiroko Koumoto, and Satoshi Tanaka

Presentation: Geographical Characteristics of Flood Occurred in Joso City Ibaraki Prefecture in September 2015, Proceedings of the Annual Conference of the Institute of Social Safety Science, No.37, p.69-72, 2015. (in Japanese)

7.2.3 Hokkaido Regional Development Bureau Director's Award

(for the presentation at the 60th annual conference on technological research for the development of the Hokkaido region on February 13-16, 2017)

Recipients: Tadashi Sato (River Management Section, Development and Construction Department, Sapporo City), Atsuhiro Yorozuya (River and Dam Hydraulic Engineering Research Team, Hydraulic Engineering Research Group, PWRI), and Masahiro Hashiba (Fukuda Hydrologic Center)

Presentation: Applicability of particle image velocimetry to the upper Sorachi River during Typhoon No.10 in 2016 –Advanced discharge observation for large-scale flooding (part 2) – (in Japanese)

7.2.4 2016 Hydroscience and Hydraulic Engineering Paper Encouragement Award

Recipient: Shun Kudo (Hydrologic Engineering Research Team, Hydraulic Engineering Research Group, PWRI)

Paper: Influence Analysis of Observed River Channel Conditions on Inundation Process in Lower Mekong River Basin

Co-authors: Atsuhiro Yorozuya (Hydrologic Engineering Research Team, Hydraulic Engineering Research Group, PWRI); E.D.P Perera, Hiroshi Koseki, Yoichi Iwami (ICHARM); Makoto Nakatsugawa (Division of Engineering, Muroran Institute of Technology)

7.2.5 Common MP Contribution Award

Recipient: Yoshito Kikumori

Reason: His long-term contribution to the Common Modeling Platform for water-material circulation analysis (Common MP)

7.2.6 The 19th Infrastructure Technology Development Award

Recipient: ICHARM

Technology: Integrated Flood Analysis System (IFAS)

7.2.7 Letter of appreciation from the President of JICA and the Minister for Foreign Affairs

Recipient: Mohamed Rasmy Abdul Wahid

Reason: His professional contribution as a member of the Japan Disaster Relief Expert Team in Sri Lanka in response to extremely severe rainfall and flooding

ICHARM has its own prize, “ICHARM BEST PAPER AWARD,” mainly to encourage young researchers at ICHARM. Every year, the selection committee selects and examines papers of ICHARM researchers published in international journals for creativity and relevancy in terms of water-related disaster risk reduction, and finally decides the best paper for the prize.

7.3 ICHARM Open day

ICHARM held the annual “ICHARM Open Day” on April 22, 2016, and April 21, 2017, as a part of the open house event of PWRI during the Tsukuba Science & Technology Week every April.

Foreign researchers and master’s and doctoral students of ICHARM cooperated in preparation for this event. Students and teachers from local schools, the Ibaraki Prefectural Takezono High School and the Ibaraki Prefectural Namiki Secondary School, were invited to enjoy this unique occasion.

The first half of the event consisted of a short lecture and presentation on water issues with a Q&A session, while the second half contained poster presentations about countries of foreign researchers and graduate students including topics on water-related disasters. All communication took place in English.

ICHARM Open Day (April 21, 2017)

Date	Participants	Content
April 22, 2016	・69 students Takezono High School: 44 Namiki Secondary School: 25 ・5 teachers	・Greetings by Advisor Kuniyoshi Takeuchi ・Short lecture by Mahtab Mohammad Hosain, a PhD student, Bangladesh ・Poster presentation by ICHARM students from 12 countries
April 21, 2017	・57 students Takezono High School: 40 Namiki Secondary School: 17 ・6 teachers	・Greetings by Director Toshio Koike ・Short lecture by Gul Ahamad Ali, a PhD student, on Water Management and Flood Disasters in Pakistan ・Poster presentation by ICHARM students from 9 countries

7.4 Newsletters and website

ICHARM Newsletter has been published four times a year since March 2006 to publicize its activities of research, education and training, and local practice projects, as well as a list of published papers. During the 2016-2017 period, the newsletter was published eight times from No. 40 to No. 47. The number of subscribers has reached about 4,230.

ICHARM homepage has gone through a great renewal. A new section, “What’s New,” has been added to show the progress in research and projects in addition to the latest information and notifications of upcoming events.


Newsletter
Volume 12 No. 3
Issue No. 46
October 2017
ICHARM
International Centre for Water Hazard and Risk Management under the auspices of UNESCO
Message from Director
Policy & Community of Practice and Science & Technology

ICHARM Newsletter No. 46

7.5 ICHARM R&D Seminars

ICHARM R&D Seminars are held on an irregular basis as an opportunity to keep up with the latest knowledge and information from domestic and international experts in the field of hydrology and water-related disasters. In the 2016-2017 period, five seminars were held as follows, inviting experts from Japan and overseas, and attracted many participants even outside ICHARM.

Dr. Srikantha Herath at 58th ICHARM R&D Seminar

No.	Date	Speaker	Affiliation	Title
56	July 21, 2016	Prof. Kelly M. Kibler	Assistant Professor, Water Resources Engineering, University of Central Florida	Flow alteration signatures of diversion hydropower: an analysis of 32 rivers in southwestern China
57	December 1, 2016	Yasutaka Wakatsuki	Associate Professor, College of Science, Ibaraki University	Incremental dynamical downscaling for probabilistic climate change projection and a dynamical approach for precipitation nowcast
58	December 1, 2016	Dr. Srikantha Herath	Senior Advisor, Ministry of Megapolis and Western Development, Government of Sri Lanka	Integrated Flood Control and Water Management in Colombo, Sri Lanka
59	February 15, 2018	Dr. Blanca JIMENEZ-CISNEROS	Director, Division of Water Sciences and Secretary of IHP, UNESCO	International Hydrological Programme (IHP) and future collaboration with UNESCO category II centres
60	February 15, 2018	Prof. Andras Szöllösi-Nagy	Chairperson, International Hydrological Programme (IHP) Intergovernmental Council, UNESCO	Water related issues in the world and expectation for ICHARM

7.6 Research Meeting

Research Meeting has been held roughly once a month since March 2008 for researchers to upgrade their research skills and perspectives and stimulate interaction with other researchers.

During the 2016-2017 period, the meeting was held 21 times as of December 2017.

Number of Alumni of ICHARM training program

ANNEX 1

(as of January 2018)

Ph.D. Program "Disaster Management"

Country / Year	Afghanistan	Bangladesh	Bhutan	Bosnia-Herzegovina	Brazil	Cambodia	China	Colombia	El Salvador	Ethiopia	Djibouti	Fiji	Guatemala	India	Indonesia	Japan	Kenya	Laos	Malaysia	Malawi	Maldives	Mozambique	Myanmar	Nepal	Netherland	Nigeria	Pakistan	Papua New Guinea	Philippines	Republic of Albania	Serbia	Sri Lanka	Tajikistan	Tanzania	Thailand	Timor-Leste	Tunisia	Venezuela	Vietnam	Zimbabwe	Total	(Number of students conferred degree)
2010-2013																1																									1	1
2011-2014										1														1	1																3	1
2012-2015		1											1																												2	2
2013-2016		2											1																												3	3
2014-2017																								1															1		2	-
2015-2018		1																									1													2	-
2016-2019		1																									1													2	-
2017-2020		1																																						1	-
Total	**0**	**6**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**2**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**1**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**16**	**7**

Master's. Program "Water-related Disaster Management Course of Disaster Management Policy Program"

2007-2008		2					3							1		3								1					1												11	10
2008-2009		2					2			1					1									1											2							9	7
2009-2010		2					1			1					3	1								1					1			2			1						13	12
2010-2011		2					2	1					1		1									1	3		1														12	12
2011-2012		2					2					1			2										2		6		1			1					1		1		19	19
2012-2013		2						1											2					1	1		1			1	1	1						1			12	12
2013-2014		2					1		1								1							1				1		2			2					1			12	12
2014-2015		1						1				1		2			3							1				2					2									13	13
2015-2016		2			1																1			1	1			2		1			2				1			1	13	13
2016-2017					1															1		1	1				2	1	1							1			2		11	8
2017-2018		2			1							1		1											2		2		1			2		1						1		14	-
Total	**0**	**19**	**0**	**0**	**3**	**0**	**11**	**3**	**1**	**2**	**0**	**3**	**1**	**4**	**7**	**4**	**4**	**0**	**2**	**1**	**1**	**1**	**7**	**11**	**0**	**1**	**16**	**1**	**8**	**1**	**1**	**12**	**0**	**1**	**3**	**2**	**1**	**2**	**4**	**1**	**139**	**118**

JICA training program "Flood Hazard Mapping"

2004						2	2								2			3	2										2						2				1		16	
2005						2	2								2			2	2										3						1				2		16	
2006						2	2								2			2	2										2						2				2		16	
2007						2	2								3			2	3										2			1			3				2		20	
2008						1	2											2	2										1						1				1		10	
Total						**9**	**10**								**9**			**11**	**11**										**10**			**1**			**9**				**8**		**78**	

JICA training program "Local Emergency Operation Plan with Flood Hazard Map"

2009		1	1												2			1					1			1					1	1		1						10	
2010		1	2												2			1					1	1		1					1	1		1						12	
2011		1	2												2			2					1			1					1	1								11	
Total		**3**	**5**												**6**			**4**					**3**	**1**		**3**					**3**	**3**		**2**						**33**	

JICA training program "Capacity Development for Flood Risk Management with IFAS"

2012(A)		3															3								2			2						3						13	
2012(B)																																						7		7	
2013		3															3								2			3						2				3		16	
2014		3	3														3								3			3						3				2		20	
2015			1	2							1						2						4		2			4			2			2						20	
2016			2	1										1			4						2		2			4			2									18	
2017				1										1			2						2					2			2									10	
Total		**9**	**6**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**2**	**0**	**0**	**17**	**0**	**0**	**0**	**0**	**0**	**8**	**0**	**0**	**11**	**0**	**0**	**18**	**0**	**0**	**6**	**0**	**0**	**10**	**0**	**0**	**0**	**12**	**0**	**104**	

JICA training program "Capacity Development for Adaptation to Climate Change"

2010		**1**													**3**														**1**						**1**				**1**		**7**	

UN/ISDR Training course "Comprehensive Tsunami Disaster Prevention"

2008														**2**	**4**						**2**									**3**											**11**	

UNESCO Pakistan Project workshop

2012																											6														6	
2013																											5														5	
2016	2																										2														4	
2017	2																										2														4	
Total	**4**																										**15**														**19**	

Country / Year	Afghanistan	Bangladesh	Bhutan	Bosnia-Herzegovina	Brazil	Cambodia	China	Colombia	El Salvador	Ethiopia	Djibouti	Fiji	Guatemala	India	Indonesia	Japan	Kenya	Laos	Malaysia	Malawei	Maldives	Mozambique	Myanmar	Nepal	Netherland	Nigeria	Pakistan	Papua New Guinea	Philippines	Republic of Albania	Serbia	Sri Lanka	Tajikistan	Tanzania	Thailand	Timor-Leste	Tunisia	Venezuela	Vietnam	Zimbabwe	Total
Total	**4**	**38**	**11**	**4**	**3**	**9**	**21**	**3**	**1**	**3**	**1**	**3**	**3**	**8**	**29**	**5**	**21**	**15**	**13**	**1**	**3**	**1**	**18**	**14**	**1**	**12**	**36**	**1**	**37**	**1**	**1**	**25**	**3**	**1**	**25**	**2**	**1**	**3**	**25**	**1**	**407**

ANNEX 2

ICHARM Publication List (January 2016 ~ December 2017)

A. Peer Reviewed Papers

- Shun KUDO, Atsuhiro YOROZUYA, E.D.P PERERA, Hiroshi KOSEKI, Yoichi IWAMI and Makoto NAKATSUGAWA: Impact Analysis of Observed River Channel Condition on Inundation Process in Lower Mekong River Basin, Journal of Japan Society of Civil Engineers, Ser. B1 (Hydraulic Engineering), Vol.72, No.4, I_145-I_150, 2016 (in Japanese)
- Tomoki Ushiyama, Takahiro Sayama, and Yoichi Iwami: ENSEMBLE FLOOD FORECASTING OF AGANO RIVER FLOOD DURING NIIGATA-FUKUSHIMA TORRENTIAL RAINFALL IN JULY 2011, Journal of Japan Society of Civil Engineers, Ser. B1 (Hydraulic Engineering), Vo.72, pp. I_157-I_162, Mar. 2016 (in Japanese)
- Kwak Y, A Yorozuya, Y Iwami: Disaster Risk Reduction using Image Fusion of Optical and SAR Data Before and After Tsunami, IEEE Aerospace2016, IEEE, DOI: 978-1-4673-7676-1/16, March 2016
- Mamoru Miyamoto, Kazuhiro Matsumoto, Morimasa Tsuda, Yuzuru Yamakage, Yoichi Iwami, Hitoshi Yanami, and Hirokazu Anai: Calibration Considering Flood Forecasting Aptitudes for Hydrological Parameters of a Distributed Runoff Model: Annual Journal of Hydraulic Engineering, JSCE, Vol.60, I_175-180, 2016 (in Japanese)
- Kazuhiro Matsumoto, Miyamoto Mamoru, Yuzuru Yamakage, Morimasa Tsuda, Hitoshi Yanami, Hirokazu Anai and Yoichi Iwami: Parameter Identification to Estimate the Discharges of the Multiple Water Level Stations by Multi-objective Optimization: Annual Journal of Hydraulic Engineering, JSCE, Vol.60, I_169-174, 2016 (in Japanese)
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- Y. Sawada, H. Tsutsui, T. Koike, M. Rasmy, R. Seto: A Field Verification of an Algorithm for Retrieving Vegetation Water Content From Passive Microwave Observations, IEEE Transactions on Geoscience and Remote Sensing, vol.54, pp.2082-2095, April 2016
- Gusyev M.A., Gädeke A., Cullmann J., Magome J., Sugiura A., Sawano H. and K. Takeuchi: Connecting global- and local-scale flood risk assessment: a case study of the Rhine River basin flood hazard, Wiley, Journal of Flood Risk Management, DOI: 10.1111/jfr3.12243, May 2016
- Y. Kwak, J. Magome, A. Hasegawa, Y. Iwami: Global Flood Exposure Assessment under

Climate and Socio-economic Scenarios for Disaster Risk Reduction, Disaster Prevention Research Institute(DPRI), Kyoto University, ICWRER2016, Kyoto TERRSA, Japan, June 5-9, 2016

- Atsuhiro YOROZUYA, Manabu TSUKAHARA, Shun KUDO, Hiroshi KOSEKI, and Toshiharu FUETA: Development of Water-Level/Velocity Measuring Instrument with Radar Technique, Journal of Japan Society of Civil Engineers, Ser. G (Environmental Research), Vol.72, No.5, I_305-I_311, 2016 (in Japanese)
- Shun KUDO, Atsuhiro YOROZUYA, Hiroshi KOSEKI, Toshiharu FUETA and Makoto NAKATSUGAWA: Estimation of Discharge Considering River Bed Fluctuation during Flooding, Journal of Japan Society of Civil Engineers, Ser. G (Environmental Research), Vol.72, No.5, I_313-I_320, 2016 (in Japanese)
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- Y.Kwak, Park, J., Arifuzzaman, B., Iwami, Y., Amirul, Md., Kondoh, A.: Rapid Exposure Assessment of Nationwide River Flood for Disaster Risk Reduction, The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences (ISPRS Archives), doi:10.5194/isprs-archives-XLI-B8-1357-2016, 2016, pp.1357-1362, June 2016

- Toshio Koike, Kuniyoshi Takeuchi, Shinji Egashira: An Approach to Next-Generation Water Disaster Study – In Commemoration of the 10th Anniversary of the Establishment of ICHARM –, Journal of Disaster Research, Vol.11, pp.1031, December 2016
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- Tong Liu, Tsuyoshi Kinouchi, Javier Mendoza, Yoichi Iwami: Glacier Mass Balance and Catchment-Scale Water Balance in Bolivian Andes, Journal of Disaster Research, Vol.11, pp.1040-1051, December 2016
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- Robin K. Biswas, Atsuhiro Yorozuya, Shinji Egashira: Numerical Model for Bank Erosion in the Brahmaputra River, Journal of Disaster Research, Vol.11, pp.1073-1081, December 2016
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ANNEX 3

Appraisal of the ICHARM Work Plan adopted at Governing Board meeting on 3 March 2016

Category	Content	Activities and expected results in FY2016	Activities and expected results in FY2017	Self-assessment of achievements S…Excellent, more than planned A…Good, as planned B…Satisfactory, less than planned C…Poor, far less than planned	FY2016 (April 2016-March 2017) Achievements	FY2017 (April 2017-March 2018) Achievements
(i) Innovative research						
(a) Technology for constantly monitoring, storing and using disaster information						
Methods will be proposed for disaster data collection and basic database development with their practical applications. This should eventually lead to data analysis using a data integration and analysis system. A data correction method will be also proposed to be used in the process of building a database using global data and near-real time data from satellites. The effect of the disaster database including its use on disaster reduction will be evaluated quantitatively in model areas both in Japan and overseas.						
(i)-(a)-1. Research on simple methods for evaluating the socioeconomic effect of flood disasters	1. Develop a simple method for evaluating the socioeconomic effect of flood disasters	Develop a simple model for evaluating socioeconomic activities based on micro geodata (residential maps, etc.) and commercial data (phone numbers, shops, etc.) installed in a data integration and analysis system, and verify the model using official commercial statistics.	Develop a simple method for evaluating the impact of flood disasters on socioeconomic activities by selecting recent flood disaster cases and assessing the socioeconomic activities in the target basins from business transaction and bulk data. Verify the method by comparing the results with flood statistics, etc. for direct damage, and eventually estimate indirect damage.	①Overall evaluation [B] ②Publication [B] ③Scientific significance [A] ④Social significance [A] ⑤Dissemination [B]	Developed a simple method for evaluating the impact of flood disasters on socioeconomic activities, using private land transaction data, MLIT's Official Land Price and other sources. As to data to be archived in DIAS, analysis was performed only for usable data.	Proposed a simple method for evaluating the impact of flood disasters on socioeconomic activities, using micro geodata (e.g., residential maps) to be archived in DIAS and Gross Regional Product-related data collected by local municipalities.
	2. Among the developed simple methods for evaluating the socioeconomic impact of flood disasters, use a globally applicable method to estimate such impact at national and global levels.	Evaluate the socioeconomic impact of flood disasters by nation using a globally applicable portion of big data such as satellite images of nighttime light distribution in urban areas, energy consumption, etc.	Verify the estimated impact for nations and the world using global statistics published by UN and other organizations and national statistics. Develop a flood damage risk allocation model incorporating investment and insurance made by nations and other entities for flood management. The model development will be conducted for several Asia-Pacific nations as part of the IFI activities in the region.	①Overall evaluation [B] ②Publication [B] ③Scientific significance [A] ④Social significance [A] ⑤Dissemination [B]	Estimated disaster damage by identifying flooded areas based on satellite images and using basin asset data and historical flood damage data in order to preview the applicability of the simple flood damage evaluation method to overseas cases.	Identified flooded areas in a model basin of Indonesia, one of the IFI project countries, using satellite data, and presented the simple method for evaluating the socioeconomic impact of floods. Also discussed social costs such as investment and insurance.
(b) Support system for early warning capable of providing accurate information in a shorter period of time						
More advanced application of WRF, a regional atmospheric model, and further improvement of IFAS and RRI will be achieved. Using these advanced technologies, a method will be developed for more accurate real-time prediction of rainfall, runoff and inundation so as to ensure over 10 hours of lead time for evacuation in a wide area and dam discharges prior to rainfall. The developed method will be tested for applicability to river basins both in Japan and overseas with different conditions of data availability, climate and topography, and used to establish an early flood warning and system. A technology will be developed to evaluate water disaster hazards by using satellites and sediment hydraulic models.						
(i)-(b)-1. Research on technologies for more accurate real-time	Improve the accuracy of the flood inundation prediction model by	Study the dynamic wave method for practical use. Modify the GUI program to install the	Modify the program sources of IFAS and RRI for more accuracy. Study a feedback function that can	①Overall evaluation [S] ②Publication [S]	Developed a tool for RRI to calculate the direction and cross-sectional area of the stream	Added the snowmelt/icemelt function to IFAS. With FUJITSU, studied

	prediction of runoff and inundation by complementing insufficient data availability	upgrading the flood tracking method and introducing an automatic parameter optimization method	automatic parameter setting function in IFAS.	optimize parameters in real time during the operation of IFAS for flood prediction.	③Scientific significance [A] ④Social significance [S] ⑤Dissemination [S]	from the accurate elevation data of the national land (basic map information). With this tool, flood analysis with mesh sizes of 5 m and 10 m has become possible. Studied the use of the dynamic wave method for IFAS. Improved the data import function of IFAS. Developed the IFAS calibrator to select optimal parameters automatically.	parameter optimization and real-time optimum parameter estimation that uses a multi-purpose optimization algorism. Awarded the Infrastructure Technology Development Award for IFAS. Improved RRI to incorporate channel cross-sections and water levels at the downstream end in calculation. Studied the installation of the new function in RRI as the GUI function.
		Provide detailed information on the applicability of satellite rainfall data. Develop a basin-specific data correction method.	Verify satellite rainfall for accuracy. Study a data correction method based on the verification results and issues identified.	Verify the effect of the data correction method for accuracy improvement of satellite rainfall. Propose the developed data correction method.	①Overall evaluation [S] ②Publication [A] ③Scientific significance [A] ④Social significance [S] ⑤Dissemination [S]	Developed a satellite rainfall correction method using ground rainfall data in a joint research with JAXA, and produced GSMaP-IF2.	Tested the reliability of each satellite rainfall correction method used in Pakistan and Sri Lanka as part of the JAXA-SAFE project. Developed a system to collect hourly rainfall data from ground rainfall gauges in Sri Lanka and send ground data –corrected GSMaP back to the country in real time automatically.
		Improve the accuracy of the WRF model for heavy rainfall prediction using X- and C-band MP radars and the Ensemble Kalman filter.	Study the effective use of radar and other data to improve the accuracy of the WRF model for heavy rainfall prediction using the Ensemble Kalman filter.	Verify the method to improve the accuracy of the WRF model for heavy rainfall prediction using the Ensemble Kalman filter. Propose the developed method.	①Overall evaluation [A] ②Publication [A] ③Scientific significance [A] ④Social significance [S] ⑤Dissemination [A]	Studied rainfall forecasting using the ensemble Kalman filter equipped with WRF and developed an approach which calculates ensemble members and the rmse of radar rainfall and identifies members with the highest similarity. Assimilated GPS precipitable water after converting it from GPS precipitable water into relative humidity. Applied the developed approach to the 2015 Kanto heavy rain disaster and confirmed the generation of ensemble members that help forecast heavy rainfall with a lead time of about 24 hours.	Analyzed the 2017 Northern Kyushu heavy rainfall disasters using the developed approach, and found it difficult to predict the exact location of a heavy rainfall event though confirmed the generation of ensemble members that help forecast heavy rainfall with a lead time of about 24 hours. Instead, proposed a method that indicates the possible locations of heavy rainfall events by including the neighboring areas around the calculation result to protect human lives in a worst possible situation. Compared the ensemble members and radar rainfall and examined the forecasting score.
		Develop a method for predicting flood inundation		Conduct case studies in domestic and overseas basins to verify the	①Overall evaluation [S]	Developed a rainfall forecasting method using data provided by	Developed a DIAS-based automatic data calculation and

		in real time with prediction uncertainty by using multiple rainfall prediction approaches.		improved model. Present the results of the case studies.	②Publication ［ A ］ ③Scientific significance ［ S ］ ④Social significance ［ S ］ ⑤Dissemination ［ S ］	Japan Meteorological Agency (JMA), a rainfall forecasting method using satellite rainfall data, or high-resolution rainfall simulation using WRF for each target area, and flood inundation could be forecasted by RRI using the forecasted rainfall.	distribution system to realize real-time rainfall and flood forecasting. Currently, forecasts are sent to Sri Lanka in real time.
	(i)-(b)-2. Development of technologies using satellites and sediment hydraulic models for assessing the impact of water disaster hazards	Develop a method for modifying DSM for the practical application of a sediment hydraulic model.	Study a DSM modification method using ground observation and the DSM obtained from satellite data.	Study a method for estimating river bed morphology. Modify DSM using the developed bed morphology estimation method.	①Overall evaluation ［ A ］ ②Publication ［ S ］ ③Scientific significance ［ A ］ ④Social significance ［ A ］ ⑤Dissemination ［ A ］	Calculated river width from satellite data and observed water depth and average river-bed height using ADCP. Proposed a method to convert resistance caused by sand waves generated during flooding into roughness coefficient using those measurements.	Removed noise of satellite data and modified DSM of flooding area. The precision of flood inundation analysis was improved by the method.
		Develop a flood damage risk mapping method that takes sediment hydraulic phenomena into account.	Conduct on-site observation and start studying sediment hydraulics and inundation analysis.	Test flood inundation analysis considering sediment hydraulic phenomena by applying the modified DSM.	①Overall evaluation ［ A ］ ②Publication ［ S ］ ③Scientific significance ［ S ］ ④Social significance ［ A ］ ⑤Dissemination ［ A ］	Applied a method to convert resistance caused by sand waves generated during flooding into roughness coefficient to the lower Mekong River and confirmed improvement in accuracy of flood simulation. For this achievement, Kudo et al. received the “Hydroscience and Hydraulic Engineering Paper Encouragement Prize” for their paper entitled "Influence Analysis of Observed River Channel Conditions on Inundation Process in Lower Mekong River Basin."	Reproduced floods in the Indus and other rivers, in addition to the lower Mekong River, using RRI with the method described in the left cell. Confirmed improvement of accuracy in flood simulation by comparing the simulation results with the actual flood extent from satellite images.
		Develop a method for mapping flood inundation risk in mountainous rivers.	Analyze factors and data needed for understanding flush floods in mountainous rivers.	Test flood inundation analysis including flush floods in mountainous rivers.	①Overall evaluation ［ A ］ ②Publication ［ A ］ ③Scientific significance ［ A ］ ④Social significance ［ S ］ ⑤Dissemination ［ A ］	Investigated the runoff phenomenon and other characteristics of the Omoto River, Iwate Prefecture of Japan. The investigation found that, unlike flooding caused by leveed rivers, runoff in mountainous rivers flows down the terrain where a river channel and land area are not clearly distinguishable.	Proposed a method for runoff calculation using RRI and rational method with simplified settings for the Omoto, the Kagetsu, and the Sayo rivers. Confirmed that the method is useful for cases prioritizing delivering timely evacuation information and ensuring sufficient lead time rather than for cases requiring accurate measurements such as water levels. Developed and tested a

							model reproducing a flood phenomenon involving water, sediment and driftwood, based on the results of the investigation about the Akatani River, Fukuoka Prefecture of Japan.
		Develop an inundation simulation method for wide areas in Asia and other regions by using a simple model.	N/A	Study a high-speed simulation model for wide areas using simplified continuous and motion equations for drift ice.	①Overall evaluation [A] ②Publication [A] ③Scientific significance [A] ④Social significance [S] ⑤Dissemination [S]	N/A	Developed GFiD2M, a global flood inundation depth 2-dimension model, which estimates potential flood inundation depth based on ground height relative to the breach point, assuming that floodwaters collect in low-lying areas near the breach point. Selected areas at high flood risk according to RCP8.5 and evaluated them for potential economic loss due to a flood. Validated the flooded area using satellite imagery. Held a workshop in Bangladesh at which the results presented draw strong attention from the national government.
(c) Assessment and planning technology for appropriate water resources management with insufficient information							
	A long-term water balance simulation technology will be developed to support optimal planning of water resources management both in Japan and overseas. This technology will offer a variety of functions to support highly technical dam operation integrating flood control and water use, water demand settings, soil moisture content settings based on satellite observation technology, application to a wide range of climate categories, input of highly detailed topographical, geological and other data.						
	(i)-(c)-1. Development of a simulation system to support integrated long-term water resources management under different natural and topographical conditions	Improve the capabilities of the system for integrated water resources management	Study and design module units to simulate highly technical dam operations, such as integrated dam operations and pre-releases, and water intake restrictions.	Develop a program for the module units to simulate highly technical dam operations, such as integrated dam operations and pre-releases, and water intake restrictions.	①Overall evaluation [A] ②Publication [A] ③Scientific significance [A] ④Social significance [S] ⑤Dissemination [S]	Developed WEB-DHM, a runoff analysis model incorporating dam operations, on DIAS.	Developed simulation technology for river runoff forecasting, capable of estimating in real time the spatial distribution of the basin water cycle incorporating snowfall, snowpack and snowmelt processes for improvement of dam operation for power generation purposes in the research project in which power companies participated.
		Study soil moisture content based on satellite data.	Study drought indices based on the estimation of soil moisture content from satellite observation.	Study the initial settings for models by using the estimated soil moisture content. Compare different models for	①Overall evaluation [A] ②Publication [A] ③Scientific significance	Estimated soil moisture in the Mekong River basin using satellite rainfall data corrected with ground rainfall data	Developed a method to estimate soil moisture from surface to underground by using soil moisture estimated from

			reproducibility.	[A] ④Social significance [S] ⑤Dissemination [A]	provided to LDAS-UT by JAXA and temperature, radiation, wind velocity, and relative humidity, all provided by NASA. Proposed a drought index and tested its viability in comparison with on past drought data.	assimilated satellite brightness temperature as the initial boundary condition, and tested the method for reproducibility.
	Improve the system applicability to rivers in Japan and overseas with different climate conditions.	Study coupling different models; e.g., RRI with advanced models of evapotranspiration and snowmelt.	Combine RRI and other models with evapotranspiration and snowmelt models. Test the combined models for applicability to different climate conditions.	①Overall evaluation [A] ②Publication [A] ③Scientific significance [A] ④Social significance [S] ⑤Dissemination [S]	Improved IFAS to calculate snowmelt by installing a function for calculating snowmelt using the Degree-Day method and the heat balance method and a function for importing snowmelt data collected from observation and other sources. Developed a WEB-RRI model capable of incorporating land surface evapotranspiration and snowmelt phenomenon.	Tested and examined the applicability of the WEB-RRI model developed last year to Japan's Kinugawa River (humid climate) and Oman's wadi (arid climate). Tested and examined the applicability of IFAS to Sudan's Gash wadi (arid climate) and the eastern tributaries of the Indus River, which need considering the influence of glaciers and snowpack.
(i)-(c)-2. Research on the creation of climate change risk information on natural disasters (MEXT program)	Assess water disaster risk in Asia. Create information on adaptation measures.	Develop hazard scenarios according to probabilities of exceedance under the present and future climates, based on the downscaled results from different RCP scenario experiments using a global climate model over Asian river basins. Develop a flood risk assessment model and a drought risk assessment model, both using local river basin scales. Then, calculate flood and drought risks under the present and future climates, and compare and assess the results for climate change impact with uncertainty. Arrange workshops to present the final results to local administrative bodies.	N/A	①Overall evaluation [S] ②Publication [S] ③Scientific significance [A] ④Social significance [S] ⑤Dissemination [S]	Assessed flood and drought risks based on RCP8.5 as part of the SOUSEI project in the Pampanga River (Philippines), the Solo River (Indonesia), the Chao Phraya River (Thailand), the Indus River (Pakistan), and the Mekong River. Reported the results to the government organizations related of each country at workshops and other occasions.	Japan's Ministry of Foreign Affairs produced a report entitled "Analysis and Proposal of Foreign Policies Regarding the Impact of Climate Change on Fragility in the Asia-Pacific Region - With focus on natural disasters in the Region," based on the findings from the SOUSEI project. The report has contributed significantly to discussions at home and abroad through the G7 working group on climate change and vulnerability.
(d) Technology for assessing the impact on local communities of water related disasters in flood plains and for evaluating the effect of investments in disaster risk reduction						
A disaster risk assessment method will be developed to evaluate "strength against fatal damage" and "resilience for speedy restoration". Indices will be proposed to help policy makers in Japan and overseas easily recognize local disaster risks and holistically evaluate the effect of investments on disaster risk reduction so that they can make informed investment decisions. A method will be proposed for building disaster resilient communities in Japan and overseas by using the developed risk indices.						
(i)-(d)-1. Research on a multifaceted water disaster risk assessment for	Propose a highly accurate and advanced method for multifaceted evaluation of	List aspects of disaster risk that requires more accurate and advanced evaluation.	Study a method for more accurate and advanced disaster risk evaluation.	①Overall evaluation [A] ②Publication	Conducted interviews with local residents about the restoration of businesses in Joso City, Ibaraki	Analyzed the interviews conducted last year, and conducted another interview

	worldwide use and a disaster resilient community building method based on the assessment	disaster risk			[A] ③Scientific significance [A] ④Social significance [A] ⑤Dissemination [A]	Prefecture, Japan, which suffered serious damage due to levee breach during the Kanto-Tohoku heavy rain in Sep. 2015, in order to identify issues on disaster risk assessment methods currently used in Japan.	survey with residents in Joso City about the restoration of their livelihoods. Compared the results from the interviews with those from existing risk assessment methods, and studied disaster risks and their assessment methods that need improvement in accuracy and function.
		Propose risk indices to holistically evaluate disaster risk reduction effect.	Sort existing risk assessment indices.	Study indices that can evaluate and present the effect of measures and investments on disaster risk reduction in an easy-to-understand manner.	①Overall evaluation [A] ②Publication [A] ③Scientific significance [A] ④Social significance [S] ⑤Dissemination [A]	Studied the viability of existing disaster risk assessment indices to holistically assess the effect of disaster prevention measures and investment on disaster risk reduction. Studied the relationship between inundation depth and rice production, which is one of the disaster risk assessment indices. Posted the Flood Disaster Prevention Index (FDPI) on the ICHARM website.	Studied required indices that can be used to assess the effect of disaster prevention measures and investment on disaster risk reduction in an easy-to-understand manner, based on the results from the interviews in Joso City and flood events in the Philippines. Conducted a case study in Brazil to adapt the global monitoring indices of the Sendai Framework for Disaster Risk Reduction to local level such as provinces, districts, municipalities and so on, and basin level.
		Propose a method for building disaster resilient communities in Japan and overseas by using the developed risk indices.	Sort existing methods for building disaster resilient communities.	Study a method for evaluating methods for building disaster resilient communities.	①Overall evaluation [A] ②Publication [A] ③Scientific significance [A] ④Social significance [A] ⑤Dissemination [A]	Reviewed existing domestic and overseas policies for disaster risk reduction and town planning in terms of building disaster resilient communities.	Studied the content and the expected outcome of existing domestic and overseas policies for disaster risk reduction and town planning in terms of building disaster resilient communities. Developed a database of past disasters, structural and non-structural policies and their issues in Japan and major countries in southeastern Asia.
(e) Technology for the effective use of water related disaster risk information to reduce disaster damage							
	An information system, as well as communication tools such as disaster response timeline tables, will be developed to support disaster management efforts by administrators and local residents to prevent or mitigate flood and sediment disasters. The effective use of such a system and tools will be proposed.						
	(i)-(e)-1. Research on a water disaster risk information delivery system to support local	Propose a method for identifying areas vulnerable to disasters (disaster hot spots) prior to	Study a method for characterizing areas vulnerable to flood and sediment disasters.	Verify the results of applicability tests of the method for characterizing areas vulnerable to flood and sediment disasters.	①Overall evaluation [A] ②Publication [A] ③Scientific significance	Proposed a new flood risk assessment method (named “Flood Chart”) designed to assess community-based flood	Tested the new methods, “Flood Chart” and “Flood Hotspot”, on Calumpit, the Philippines, for which RRI has already been

	disaster management efforts in areas with insufficient water disaster information	disasters.			[A] ④Social significance [A] ⑤Dissemination [A]	risk using RRI simulation results for several types of flood hazards with eight assessment indices. Developed a method to identify areas highly vulnerable to floods in each community as “Flood Hotspot”.	adjusted to local conditions, in order to check the applicability of the methods to overseas cases.
		Propose a method for forecasting the possibility of a water related disaster by community in real time before its occurrence.	Verify the reproducibility of the RRI model to reproduce inundation area in real time using forecasted rainfall as input.	Study the improvement of RRI’s reproducibility of inundation area and the optimal frequency for updating the reproduction of inundation area.	①Overall evaluation [A] ②Publication [A] ③Scientific significance [A] ④Social significance [A] ⑤Dissemination [A]	Added to RRI-GUI a new function to input radar rainfall information (XRAIN) provided by MLIT.	Developed a prototype of a real-time flood forecasting system using rainfall forecasts provided by JMA and river water-level forecasts provided by MLIT. Studied a method for real-time sediment disaster risk assessment, using a “Sediment Disaster Simulator” under development at ICHARM.
		Propose a Web-GIS water related disaster risk information delivery system that helps accumulate and share various types of disaster risk information and deliver evacuation information.	Sort requirements needed for a Web-GIS water related disaster risk information delivery system.	Develop a prototype of the Web-GIS water related disaster risk information delivery system	①Overall evaluation [A] ②Publication [A] ③Scientific significance [A] ④Social significance [A] ⑤Dissemination [A]	Conducted interview with Niigata Prefecture and Aga Town, and identified requirements and contents needed to develop an information sharing system.	Studied existing information sharing systems and analyzed strengths and weaknesses. Based on that, developed a prototype of a versatile information sharing system designed to provide disaster-related information for Aga’s disaster management office, fire department office, and residents.
		Propose the effective use of the Web-GIS information delivery system to stakeholders of local administrative bodies in Japan and overseas.	N/A	Study the effective use of the Web-GIS information delivery system by using its prototype.	①Overall evaluation [A] ②Publication [A] ③Scientific significance [A] ④Social significance [A] ⑤Dissemination [A]	N/A	Conducted an experiment to see how local information can be used to reduce disaster damage by means of the prototype information sharing system developed for Aga town.
	(i)-(e)-2. Research on risk forecasting simulation for floods caused by localized torrential rainfall and on a disaster response timeline	Propose a disaster response timeline	Study hazard scenarios used to develop a disaster response timeline.	Analyze the relationship between the hazard scenarios and possible behaviors in the face of the anticipated hazards.	①Overall evaluation [A] ②Publication [A] ③Scientific significance [A] ④Social significance [A] ⑤Dissemination [A]	Interviewed local businesses about their response to the flood event that occurred as a result of levee breaches due to the Kanto-Tohoku heavy rain in Sep. 2015 and heavily affected Joso City, Ibaraki Prefecture. Based on the results, studied a disaster response timeline suggesting	Interviewed local residents about their response to the flood event that occurred as a result of levee breaches due to the Kanto-Tohoku heavy rain in Sep. 2015 and heavily affected Joso City, Ibaraki Prefecture. Based on the results, studied a disaster response timeline suggesting

						actions that they should take before and after floodwaters reach the area. Developed an application to support the smooth execution of disaster response based on the instructions prepared in advance for the area around Kitasenju Station.	actions that they should take before and after being affected by a flood, including the restoration of houses and livelihoods. Applied the disaster response support tool developed for Kitasenju Station last year to the West Exit area of Yokohama Station.
		Propose a system for disaster response training.	Study an on-the-map training approach for administrators.	Study the content of disaster response training on the basis of the response process during a flood.	①Overall evaluation [A] ②Publication [A] ③Scientific significance [A] ④Social significance [A] ⑤Dissemination [A]	Studied reports published by local municipalities in Japan about their response to past flood disasters, and selected typical cases of tense moment in which disaster response was not carried out as planned due to ignorance or confusion among municipal personnel.	Sorted out references to improvement plans for the tense moments found in the municipal reports in last year's project. Among them, specifically selected those concerning personnel capacity development and studied training methods.
	(i)-(e)-3. Local practice using research results	ADB Myanmar project –risk assessment for urban management in Myanmar– (Yangon, Mandalay, Mawlamyine)	Develop a flood hazard map for each three target city and provide training on the operation of the RRI model, a storm-surge model, and an agricultural damage simulation model. Propose a business plan for the Department of Meteorology and Hydrology (DMH). Provide technical assistance for analyzing the 2015 flood. Sort and publish all project outcomes, and hold workshops for relevant organizations.	N/A	①Overall evaluation [S] ②Publication [S] ③Scientific significance [A] ④Social significance [S] ⑤Dissemination [S]	Completed flood hazard and storm surge hazard assessment and prepared flood hazard maps for Yangon, Mandalay and Mawlamyine and coastal flood hazard maps for Yangon and Mawlamyine. Completed flood damage assessment in Yangon, Mandalay and Mawlamyine areas. Conducted RRI Model and Storm Surge Model and Flood Disaster Risk Assessment Trainings for engineers of Department of Meteorology and Hydrology (DMH) and Irrigation and Water Utilization Management Department (IWUMD). Developed business plan for DMH. Organized Final Workshop on 23 May 2016 in Nay Pyi Taw. Organized a meeting to confirm Final Report on 18 October 2016 in Nay Pyi Taw. Submitted Final Report of the	Finalized Training Textbooks and submitted to ADB, DMH and other related organizations. Upload Final Report in ADB website.

						project to ADB, DMH and other related organizations in December 2016. Prepared final version of Training Textbooks on RRI Model, Flood Disaster Risk Assessment and Storm Surge Model.	
	UNESCO Pakistan project Phase II	Improve Indus-IFAS with additional functions for snowmelt, several rainfall input types, and real-time GSMaP correction. Develop an IFAS model using global data for the eastern tributary basin of the Indus River. Participate in workshops and provide advice for training.	Test the Indus-IFAS with the additional functions and the expanded coverage including the eastern tributary basin of the Indus River.	①Overall evaluation ［ A ］ ②Publication ［ A ］ ③Scientific significance ［ A ］ ④Social significance ［ S ］ ⑤Dissemination ［ S ］	Improved Indus-IFAS by adding the snowmelt-icemelt function and the GSMaP-IF2 input function. Established the IFAS model of the eastern tributaries. Held and participated in various Indus-IFAS training opportunities including workshops, training programs, and teleconferences.	Confirmed that Indus-IFAS improves the reproducibility of flood peak by adding the snowmelt-icemelt function and applying MODIS 8-day data for the identification of the snowpack area. Held and participated in various Indus-IFAS training opportunities including workshops, training programs, and teleconferences. This project has been a very successful technical transfer project in that the Pakistan counterparts have started improving Indus-IFAS independently.
(ii) Effective Capacity Development							
(1) Foster the development of solution-oriented practitioners and Training-of-Trainers (TOT) instructors, with solid theoretical and engineering competence who will contribute effectively to the planning and practice of disaster management at any levels, from local to international.							
	(ii)-(1)-1. Nurture professionals who can train researchers and take leadership	Doctor Course “Disaster Management”	2-3 students (2014-2017)	2-3 students (2015-2018)	①Overall evaluation ［ A ］ ②Publication ［ A ］ ③Scientific significance ［ A ］ ④Social significance ［ A ］ ⑤Dissemination ［ A ］	Completed the program: Sep. 2016 Bangladesh: 2, Guatemala: 1 Enrolled in the program: Oct. 2016 Pakistan: 1, Bangladesh: 1 Note: 5 students were in the PhD course as of Oct. 2016, but one from Venezuela withdrew in late Mar. 2017.	Enrolled in the program: Oct. 2017 Bangladesh: 1 Note: 5 students are in the PhD course: Pakistan: 2, Bangladesh: 3
	(ii)-(1)-2. Development of the participant’s capacity to practically manage the problems and issues concerning water-related	Master Course “Water-related Disaster Management, Disaster Management Policy Program”	10-15 students from candidate countries: Bosnia Herzegovina, Brazil, Cambodia, Indonesia, Macedonia, Malawi, Mozambique, Myanmar,	10-15 students Candidate countries to be decided in consultation with JICA	①Overall evaluation ［ S ］ ②Publication ［ A ］ ③Scientific significance ［ A ］	Completed the program: Sep. 2016 13 students from 10 countries (Bangladesh, Brazil, Maldives, Myanmar, Nepal, Pakistan, Philippines, Sri Lanka,	Completed the program: Sep. 2017 8 students from 7 countries (Brazil, Malawi, Mozambique, Myanmar, Papua New Guinea, East Timor,

disasters in local levels		Papua New Guinea, Philippines, East Timor, Vietnam, Zimbabwe, Pakistan, etc.		④Social significance ［ A ］ ⑤Dissemination ［ A ］	East Timor, Zimbabwe) Enrolled in the program: Oct. 2016 9 students from 8 countries; 2 students from Pakistan on a special program	Vietnam). 2 students from Pakistan on a special program. Enrolled in the program: Oct. 2017 14 students from 10 countries Disseminated the contents of the Master Course and expected qualification of applicants, and made stricter of the acceptance conditions.
(ii)-(1)-3. Training to learn knowledge and technologies relevant to water-related disaster risk management for a period of several days or weeks	JICA training program “Flood Risk Management with IFAS” Phase II	14-22 students from candidate countries: Bhutan, Bosnia Herzegovina, Djibouti, India, Kenya, Myanmar, Nigeria, Philippines, Sri Lanka, Thailand, etc.	14-22 students Candidate countries to be decided in consultation with JICA	①Overall evaluation ［ A ］ ②Publication ［ A ］ ③Scientific significance ［ A ］ ④Social significance ［ A ］ ⑤Dissemination ［ A ］	Held training on July 3-30, 2016, for 18 participants from 8 countries (Bhutan, Bosnia and Herzegovina, India, Kenya, Myanmar, Nigeria, Philippines, Sri Lanka). They conducted flood simulation for each river basin using IFAS and RRI, and developed an action plan for the target river basin based on the simulation results.	Held training on July 3-28, 2017, for 10 participants from 6 countries (Bosnia and Herzegovina, India, Kenya, Myanmar, Philippines, Sri Lanka). They conducted flood simulation for a river basin using IFAS and RRI, and developed an action plan for the target river basin based on the simulation results.
	Capacity development program (summer program) with Tokyo University for international students	About 20 students	About 20 students	①Overall evaluation ［ A ］ ②Publication ［ A ］ ③Scientific significance ［ A ］ ④Social significance ［ A ］ ⑤Dissemination ［ A ］	Held a two-week workshop, “an Era of Big Data,” for 17 participants from 10 countries, who were mainly students selected from about 100 applicants from all over the world. They learned to come up with solutions for actual cases of water-related disasters.	N/A
	Follow-up seminars for ICHARM master’s program graduates and others.	Holding a follow-up seminar in a graduates’ country	Holding a follow-up seminar in a graduates’ country	①Overall evaluation ［ A ］ ②Publication ［ A ］ ③Scientific significance ［ A ］ ④Social significance ［ A ］ ⑤Dissemination ［ A ］	Held follow-up training in Manila, the Philippines, by mainly inviting master’s course graduates. Visited the Pampanga River basin with the graduates to see current flood prevention measures in place and discussed issues. Also visited a river selected by the graduates as posing a high flood risk to the area and gave advice.	Held follow-up training in Yangon, Myanmar, by mainly inviting master’s course graduates and IFAS short-term trainees. Visited the river management facilities of the Ayeyarwady River with the graduates and the trainees.
(2) Build a network of local experts and institutions equipped to address water-related risks with accumulated knowledge and applied skill both in research and practice, through trainings on occasion of international projects and education/training activities at ICHARM.						
(ii)-(2)-1. Follow up and encouragement for ex-trainees	Seminar in an ex-trainees’ country	- Make and maintain list of graduates - Implement internet networking - Organize follow-up seminars		①Overall evaluation ［ A ］ ②Publication	Updated the list of graduates by adding new graduates to strengthen the network.	Updated the list of graduates by adding new graduates to strengthen the network.

				[A] ③Scientific significance [A] ④Social significance [A] ⑤Dissemination [A]	In order to make networking graduates online, managing the Facebook page for ICHARM Alumni mainly led by Advisor Takeuchi and a PhD graduate.	In addition to the Facebook for ICHARM Alumni, started another Facebook page for ICHARM training courses in Oct. 2017 to provide snapshot of lectures and site visit.
(iii) Efficient Information Network						
(1) Accumulate, analyze and disseminate major water-related disaster records and experiences as the comprehensive knowledge center for practitioners.						
	(iii)-(1)-1. Accumulate disaster archives	Promote the collection of disaster information by demonstrating the effective use of such information	In collaboration with the University of Tokyo (and its DIAS project), Tohoku University and other organizations, develop a framework to promote the collection of disaster information through the effective use of such information; e.g., using big data to assess the socio-economic impact of flood disasters.	①Overall evaluation [A] ②Publication [A] ③Scientific significance [A] ④Social significance [A] ⑤Dissemination [A]	Promoted the integration and archiving the hazard data of water-related disasters using DIAS, operated and managed by the University of Tokyo. Discussed the collection of disaster damage data with Tohoku University.	Promoted the integration and archiving the hazard data of water-related disasters using DIAS. Particularly in Sri Lanka, collected rainfall and other data in real time and developed a framework to use such data in flood management on a national basis.
	(iii)-(1)-2. Collaboration	Promote collaboration with other organizations archiving water disaster information	-Collaboration for collecting reliable disaster information with UNESCO centers, international organizations (UNISDR, Red Cross, etc.), the University of Tokyo (and its DIAS project), Tohoku University and other entities. -Promotion of regional efforts in data archiving through International Flood Initiative (IFI)	①Overall evaluation [A] ②Publication [A] ③Scientific significance [A] ④Social significance [A] ⑤Dissemination [A]	Participated in meetings held by UNESCO centers and other international organizations, collected disaster-related information, and strengthened ties with other participating organizations. Participated meetings about IFI platform and developed a list of data on water and disasters with the Philippine government. Based on this list, discussed rules regarding the creation of metadata and the use of DIAS for data integration, archiving, use, and sharing.	Participated in meetings held by UNESCO centers and other international organizations, collected information on water-related disasters and international trends in disaster management, and strengthened ties with participating organizations. Assisted the Philippines in an initiative organizing a platform promoted by IFI; helped develop a list of necessary data and started integrating and archiving data into DIAS. Also, helped Myanmar and Pakistan implement the same project.
(2) Mainstream disaster risk reduction policy by facilitating active collaboration and communication within an influential global institutional network, such as the International Flood Initiative, and through dissemination of technical knowledge for water-related hazard and risk management						
	(iii)-(2)-1. Collaboration with relevant organizations	IFI secretariat	-Function as the secretariat in collaboration with the partners. -Develop and update the strategy in collaboration with relevant organizations. -Disseminate the activities such as International Conference on Flood Management (ICFM).	①Overall evaluation [S] ②Publication [A] ③Scientific significance [A] ④Social significance [A]	Provided services as the IFI secretariat by holding periodical teleconferences with IFI member organizations such as UNESCO, WMO, ICFM and IAHS and updating IFI's website. Held workshops coinciding with	Provided services as the IFI secretariat by holding periodical teleconferences with IFI member organizations such as UNESCO, WMO, ICFM and IAHS and updating IFI's website. Held workshops in collaboration

				⑤Dissemination ［　S　］	meetings of UNESCO-IHP Intergovernmental Council and HELP in collaboration with other organizations, and presented IFI activities at Budapest Water Summit 2016, COP 22, and the NARBO general conference (15 times in total).	with other organizations at the UN Special Thematic Session on Water and Disasters, GEOSS-AP, ICFM7, WBF, APWS, and other occasions, and presented IFI activities based on its new strategy at AOGS and other international conferences (15 times in total).
	Local efforts led by IFI	Coordinate a pilot project for monitoring flood management in the Asia-Pacific region, which will be launched as one of the efforts initiated by Sendai Framework in collaboration with Asian Water Cycle Initiative (AWCI) and Network of Asian River Basin Organizations (NARBO).	Coordinate a pilot project for monitoring flood management in the Asia-Pacific region.	①Overall evaluation ［　A　］ ②Publication ［　A　］ ③Scientific significance ［　A　］ ④Social significance ［　A　］ ⑤Dissemination ［　A　］	Held the IFI Action Plan workshop as a side event of GEOSS-AP・AWCI after the approval of the Jakarta Declaration at a side event of a HELP meeting. Held meetings to discuss the establishment of an IFI platform in countries that had participated in the IFI Action Plan workshop (Sri Lanka, Myanmar, Pakistan and the Philippines), and started the project.	Held meetings in Myanmar and Indonesia and discussed plans to establish an IFI platform. Held meetings in Sri Lanka for launching an IFI platform and now providing support for government agencies to implement Target Actions for better flood management.
	Typhoon Committee (TC)	Contribution to TC -Chair for the TC Working Group for Hydrology -Case study on the assessment of climate change impact in collaboration with member countries		①Overall evaluation ［　A　］ ②Publication ［　A　］ ③Scientific significance ［　A　］ ④Social significance ［　A　］ ⑤Dissemination ［　A　］	An ICHARM researcher chaired the Typhoon Committee's Working Group of Hydrology (WGH), and led 14 member countries to discuss water-related disasters and flood forecasting and study selected issues relevant to the members. Provided information about flood and flash-flood events in Japan, and proposed the 2017-2019 study plans for WGH (Flash flood risk information to increase disaster resilience of local communities), which was approved by the members.	An ICHARM researcher chaired WGH, and led 14 member countries to discuss water-related disasters and flood forecasting and study selected issues relevant to the members. Compiled disaster damage, policies, measures and issues collected by the member countries regarding the WGH 2017-2019 study plan, and introduced Japan's advanced disaster management policies and so on.
	(iii)-(2)-2. Synergy effects enhanced by alumni networking	Alumni networking	-Continue to update ICHARM Alumni list -Continue to keep in touch with ex-trainees by disseminating ICHARM newsletter, etc.	①Overall evaluation ［　A　］ ②Publication ［　A　］ ③Scientific significance ［　A　］ ④Social significance ［　A　］ ⑤Dissemination	Updated the ICHARM alumni list and used it when ICHARM researchers went on overseas business trips. Used SNS to network ICHARM alumni and facilitate the interaction among the alumni, as well as between ICHARM and	Updated the ICHARM alumni list and used it when ICHARM researchers went on overseas business trips. Used SNS to network ICHARM alumni and facilitate the interaction among the alumni, as well as between ICHARM and

			[A]	the alumni.	the alumni.
(iii)-(2)-3. Public relations	ICHARM website	Continue updating	①Overall evaluation [A] ②Publication [A] ③Scientific significance [A] ④Social significance [A] ⑤Dissemination [A]	Updated the website with latest information including newsletters and event notices. Published a commemorative book to celebrate ICHARM's 10-year anniversary with an extensive coverage of people, activities and events in the last decade. Posted the anniversary book on the website.	Updated the website with latest information including newsletters and event notices. Renewed the website. Updated the "What's New" section as frequently as possible with information on research and activities.
	ICHARM newsletter	Publish four times a year (January, April, July and October) with timely updates	①Overall evaluation [A] ②Publication [A] ③Scientific significance [A] ④Social significance [A] ⑤Dissemination [A]	Delivered a wide range of information about ICHARM's activity by publishing newsletters quarterly.	Delivered a wide range of information about ICHARM's activity by publishing newsletters quarterly. Reviewed the content and volume of the newsletter and collected readers' feedback for better readability.

Reference

- Sendai Framework for Disaster Risk Reduction 2015 – 2030 (Sendai Framework), United Nations, 18 March 2015
- Strategic Plan of the eighth phase of International Hydrological Programme (IHP-VIII, 2014-2021), UNESCO-IHP, 4-7 June 2012