The Project for Capacity Development for Immediate Access and Effective Utilization of Satellite Information for Disaster Management in the ASEAN Region

Final Report

August 2016

Japan International Cooperation Agency

PASCO CORPORATION
CTI Engineering International Co., Ltd

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Group Photograph of Participants in First-year Training in Japan (February 2014)

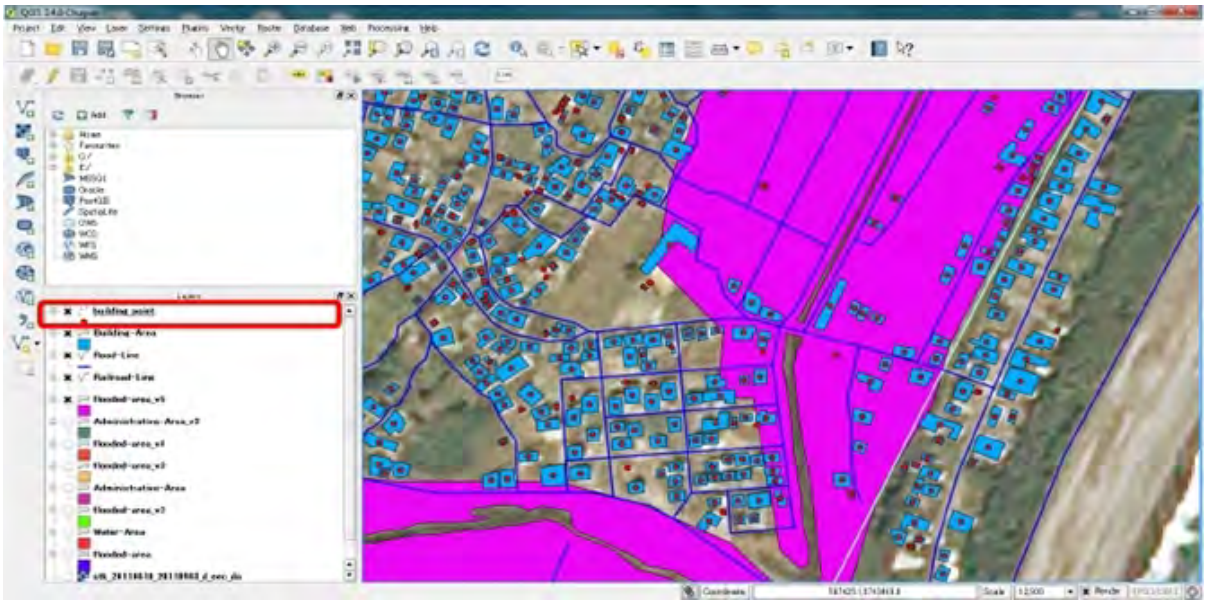

Image of Calculation of Numbers of Damaged Households and Victims Using Satellite Images and Statistical Information

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Abbreviations

Abbreviation	Description
AADMER	ASEAN Agreement on Disaster Management and Emergency Response
ACDM	ASEAN Committee on Disaster Management
ADRC	Asian Disaster Reduction Center
AHA Centre	ASEAN Coordination Centre for Humanitarian Assistance on Disaster Management
AIT	Asian Institute of Technology
ALOS	Advanced Land Observing Satellite
ALOS-2	Advanced Land Observing Satellite-2
ANGKASA	Malaysian Space Agency, Ministry of Science Technology and Innovation
APRSAF	Asia-Pacific Regional Space Agency Forum
ARSM	Malaysian Remote Sensing Agency, Ministry of Science Technology and Innovation
ARTSA	Asian Research and Training Center for Space Technology & Application
ASEAN	Association of South East Asian Nations
ATSB	Astronautic Technology Sdn. Bhd.(Malaysia)
BBWS	Balai Besar Wilayah Sungai (Basin Management Office) (Indonesia)
BIG	Geospatial Information Agency (Indonesia)
BMKG	Agency for Meteorology, Climatology and Geophysics (Indonesia)
BNPB	National Disaster Management Agency (Indonesia)
BPBD	Regional Disaster Management Agency (Indonesia)
BPBD DKI	Jakarta Regional Disaster Management Agency (Indonesia)
BPPT	The Agency for the Assessment and Application of Technology (Indonesia)
CRISP	Center for Remote Imaging, Sensing and Processing, National University of Singapore
CTII	CTI Engineering International Co., Ltd.
DAN	Data Analysis Node
DDMCC	Department of Disaster Management and Climate Change, Ministry of Natural Resources and Environment (Lao PDR)
DDMFSC	Department of Dyke Management Flood and Storm Control, Ministry of Agriculture and Rural Development (Vietnam)
DDPM	Department of Disaster Prevention and Mitigation, Ministry of Interior (Thailand)
DEM	Digital Elevation Model
DENR	Department of Environment and Natural Resources (Philippines)
DHRW	Department of Hydrology and River Works, Ministry of Water Resources and Meteorology (Cambodia)
DID	Department of Irrigation and Drainage, Ministry of Agriculture (Malaysia)
DMC	Disaster Management Center, Directorate of Water Resources, Ministry of Agriculture and Rural Development (Vietnam)

Abbreviation	Description
DMH	Department of Meteorology and Hydrology, Ministry of Agriculture and Forestry (Lao PDR)
DMH	Department of Meteorology and Hydrology, Ministry of Transport (Myanmar)
DNDPC	Department of Natural Disaster Prevention and Control, Minister of Agriculture and Rural Development (Vietnam)
DOM	Department of Meteorology, Ministry of Water Resources and Meteorology (Cambodia)
DOSMVN	Department of Survey and Mapping, Ministry of Natural Resources and Environment (Vietnam)
DPWH	Department of Public Works and Highway (Phillipines)
DSM	Digital Surface Model
DTM	Digital Terrain Model
DWR	Department of Water Resources, Ministry of Natural Resources and Environment (Thailand)
DWR	Department of Water Resources, Ministry of Natural Resources and Environment (Lao PDR)
DWRI	Directorate of Water Resources and Improvement of River System, Ministry of Transport and Communication (Myanmar)
DWRM	Department of Water Resource Management, Ministry of Agriculture and Rural Development (Vietnam)
EM-DAT	Emergency Disaster Database
EOC	Emergency Operations Center, Relief and Resettlement Department, Ministry of Social Welfare, Relief and Resettlement (Myanmar)
FA	Forestry Administration, Ministry of Agriculture, Forestry and Fisheries (Cambodia)
GD	Geography Department, General Department of Cadastre and Geography, Ministry of Land Management, Urban Planning & Construction (Cambodia)
GDEM	Global Digital Elevation Model
GISTDA	Geo-Informatics and Space Technology Development Agency, Ministry of Science and Technology (Thailand)
GLCF	Global Land Cover Facility
GSMaP	Global Satellite Mapping of Precipitation
HEC-RAS	Hydrologic Engineering Center's River Analysis System
ICHARM	International Centre for Water Hazard And Risk Management under the auspices of UNESCO
IDC	International Disaster Charter
IFAS	Integrated Flood Analysis System
IMHEN	Institute of Meteorology, Hydrology and Environment , Ministry of Natural Resources and Environment (Vietnam)
iRIC	International River Interface Cooperative

Abbreviation	Description
IWRM	Integrated Water Resource Management
JAXA	Japan Aerospace Exploration Agency
JICA	Japan International Cooperation Agency
JPT	Joint Project Team
JUPEM	Department of Survey and Mapping Malaysia, Ministry of Land and Cooperative Development
LAPAN	National Institute of Aeronautics and Space (Indonesia)
LDD	Land Development Department, Ministry of Agriculture and Cooperatives (Thailand)
LGU	Local Government Unit (Philippines)
MaCGDI	Malaysia Centre for Geospatial Data Infrastructure
MAFF	Ministry of Agriculture, Forestry and Fisheries (Cambodia)
MARD	Ministry of Agriculture and Rural Development (Vietnam)
MD	Meteorology Department, Ministry of Communications (Brunei)
MetMalaysia	Malaysian Meteorological Department, Ministry of Science Technology and Innovation
MGB	Mines and Geosciences Bureau, Department of Environment and Natural Resources (Philippines)
MIME	Ministry of Mines and Energy (Cambodia)
MIMU	Myanmar Information Management Unit
MLMUPC	Ministry of Land Management Urban Planning and Construction (Cambodia)
MMDA	Metropolitan Manila Development Authority, Office of the President (Philippines)
MO	Manila Observatory (Philippines)
MOECAF	Ministry of Environment and Conservation and Forestry (Myanmar)
MoNRE	Ministry of Natural Resources and Environment (Lao PDR)
MoNRE	Ministry of Natural Resources and Environment (Thailand)
MoNRE	Ministry of Natural Resources and Environment (Vietnam)
MOST	Ministry of Science and Technology (Lao PDR)
MOST	Ministry of Science and Technology (Myanmar)
MOST	Ministry of Science and Technology (Thailand)
MOWRAM	Ministry of Water Resources and Meteorology (Cambodia)
MRC	Mekong River Commission
MRSA	Malaysian Remote Sensing Agency
MSS	Meteorological Service Singapore, National Environment Agency, Ministry of the Environment and Water Resources
MT	Ministry of Transport (Myanmar)
NAHRIM	Nationa Hydraulic Institute of Malaysia
NAMRIA	National Mapping and Resource Information Authority, Department of Environment and Natural Resources (Philippines)
NASA	National Aeronautics and Space Administration (USA)

Abbreviation	Description
NCDM	National Committee for Disaster Management (Cambodia)
NCHMF	National Center for Hydro-Meteorological Forecasting (Vietnam)
NDMA	National Disaster Management Agency (Malaysia)
NDMC	National Disaster Management Centre, Ministry of Home Affairs (Brunei)
NDMO	National Disaster Management Office (Lao PDR)
NGD	National Geographic Department, Ministry of Home Affairs (Lao PDR)
NHMS	National Hydro-Meteorology Service, Ministry of Natural Resources and Environment (Vietnam)
NRE	Ministry of Natural Resources and Environment (Malaysia)
NREI	Natural Resources and Environment Institute, Ministry of Natural Resources and Environment (Lao PDR)
NRSD	National Remote Sensing Department, Ministry of Natural Resources and Environment (Vietnam)
OCD	Office of Civil Defense, Department of National Defense (Philippines)
PAGASA	Philippine Atmospheric, Geophysical and Astronomical Services Administration, Department of Science and Technology
PASCO	PASCO Corporation
PDNA	Post Disaster Needs Assessment
PHIVOLCS	Philippine Institute of Volcanology and Seismology, Department of Science and Technology
PPP	Public–Private Partnership
PU	Ministry of Public Works (Indonesia)
PUB	Public Utilities Board, Ministry of the Environment and Water Resources (Singapore)
PUSAIR	Research Center for Water Resources (Indonesia)
PWD	Public Works Department, Ministry of Development (Brunei)
PWD/JKR	Malaysia Public Works Department, Ministry of Works
RBC	River Basin Committee (Lao PDR)
RESTEC	Remote Sensing Technology Center of Japan
RID	Royal Irrigation Department, Ministry of Agriculture and Cooperatives (Thailand)
RRD	Relief and Resettlement Department, Ministry of Social Welfare, Relief and Resettlement (Myanmar)
RSC	Remote Sensing Center, Natural Resources and Environment Institute, Ministry of Natural Resources and Environment (Lao PDR)
RTSD	Royal Thai Survey Department
SA	Sentinel Asia
SAR	Synthetic Aperture Radar
SCDF	Singapore Civil Defence Force
SD	Survey Department, Ministry of Development (Brunei)
SD	Survey Department, Ministry of Environmental Conservation and Forestry (Myanmar)

Abbreviation	Description
SLA	Singapore Land Authority, Ministry of Law
SOP	Standard Operating Procedure
SPOT	Satellite Pour l'Observation de la Terre
SRTM	Shuttle Radar Topography Mission
STI	Space Technology Institute, Vietnamese Academy Science and Technology
TMD	Thai Meteorological Department, Ministry of Transport and Communications
UBD/IBM	Universiti Brunei Darussalam / IBM Centre
UNDP	United Nations Development Programme
UNESCAP	Economic and Social Commission for Asia and the Pacific
UNSPIDER	United Nations Platform for Space-based Information for Disaster Management and Emergency Response
USAID	United States Agency for International Development
USGS	United States Geological Survey
VAST	Vietnamese Academy Science and Technology
VAWR	Vietnam Academy for Water Resources, Ministry of Agriculture and Rural Development
VINASARCOM	National Committee for Search and Rescue (Vietnam)

Chapter 1 Project Summary

1.1 Background and Objectives

The member countries of the Association of Southeast Asian Nations (ASEAN) worked towards ASEAN integration in 2015. In the disaster prevention sector, the ASEAN Committee for Disaster Management (ACDM) was established in 2003 based on the decision of the ASEAN Standing Committee. Later, following the Sumatra-Andaman Earthquake in 2004, the need for cross-border initiatives on disaster prevention was recognized and in 2005 the ASEAN Agreement on Disaster Management and Emergency Response (AADMER) was proposed and concluded to strengthen the disaster management systems in the region and promote the Hyogo Framework for Action.

Following discussions and coordination among the members, AADMER was ratified by all the ASEAN countries in 2009. The AADMER Working Group was adopted at the 15th ACDM meeting in 2010 and the ASEAN Coordinating Centre for Humanitarian Assistance on Disaster Management (AHA Centre), the base for AADMER activities, was established in Jakarta in phase 1 of the Work Program in November 2011. The AHA Centre receives equipment and technical support from Japan and New Zealand as well as the United States Agency for International Development (USAID).

Later, the Special ASEAN-Japan Ministerial Meeting was held on April 9th, 2011 and the ASEAN-Japan Foreign Ministers' Meeting was held on July 21st, 2011. It was reaffirmed through the meetings that ASEAN and Japan would cooperate in the field of disaster prevention and Japan declared its support for the AHA Centre. At the meetings, Japan put forward the concept of building an ASEAN disaster management network, and at the ASEAN-Japan Summit Meeting in November 2012, Japan proposed the concrete idea of a network "from outer space to rural communities." The Government of Japan promoted technical support for ASEAN in the area of technologies for utilization of satellite information in view of 1) the progress of utilization of satellite information and utilization technologies in Japan, and 2) the high degree of interest in ASEAN in utilization of satellite information for disaster prevention measures and disaster response.

Against such a background, the Japan International Cooperation Agency (JICA) and AHA Centre jointly launched the Project for Capacity Development for Immediate Access and Effective Utilization of Satellite Information for Disaster Management in the ASEAN Region (hereinafter, the Project) in August 2013 and implemented a technical training program in runoff analysis, inundation analysis and satellite image analysis using satellite information conducive to disaster mitigation, advance preparation and disaster emergency response to floods, the greatest common challenge facing ASEAN.

Skills acquired through training alone are not enough for practical utilization of satellite information. The utilizing organizations and cases/methods of utilization in disaster management must be defined as clearly as possible. After investigating ASEAN disasters, current disaster prevention measures and satellite information utilization trends through the Project, a satellite information utilization plan suited to the actual circumstances of each country was drafted.

1.2 Name of the Project

The Project for Capacity Development for Immediate Access and Effective Utilization of Satellite Information for Disaster Management in the ASEAN Region

1.3 Project Cooperation Period

August 2013 – June 2016

1.4 Implementation Agency and Cooperation Entities

1.4.1 Implementation Agency (ASEAN side)

ASEAN Coordinating Centre for Humanitarian Assistance on Disaster Management (AHA Centre)

1.4.2 Cooperation Entities of the ASEAN Member States

Brunei:	National Disaster Management Centre, Ministry of Home Affairs
Cambodia:	National Committee for Disaster Management, Office of the Council of Ministers, Royal Government of Cambodia
Indonesia:	National Disaster Management Agency
Lao PDR:	Disaster Management Division, Department of Social Welfare, Ministry of Labour and Social Welfare
Malaysia:	National Disaster Management Agency (Former National Security Council, Prime Minister's Department)
Myanmar:	Relief and Resettlement Department, Ministry of Social Welfare, Relief and Resettlement
Philippines:	National Disaster Risk Reduction and Management Council and Administrator, Office of Civil Defense
Singapore:	Singapore Civil Defence Force
Thailand:	Department of Disaster Prevention and Mitigation, Ministry of the Interior
Vietnam:	Department of Natural Disaster Prevention and Control, Ministry of Agriculture and Rural Development

1.4.3 Cooperation Entities (Japanese side)

- Japan Aerospace Exploration Agency (JAXA)
- International Centre for Water Hazard and Risk Management under the auspices of UNESCO (ICHARM)
- Hokkaido University

1.5 Project Purpose, etc.

Overall Goal

< For the entire ASEAN >

Solidify collaboration in the field of disaster management between ASEAN member states.

< For capacity development in conjunction with the utilization of satellite information >

Facilitate the utilization of satellite information for disaster prevention and emergency response in the ASEAN member states.

Project Purpose

< For the entire ASEAN >

Reinforce the network of officials in charge of disaster management centering on AHA Centre.

< For capacity development in conjunction with the utilization of satellite information >

Help participants from ASEAN member states learn how to use satellite information for disaster prevention and emergency response

Outcomes

< For the entire ASEAN >

AHA Centre will

- ascertain the development needs of disaster management authorities, especially those departments that utilize and apply satellite information, in the ASEAN member states.
- establish relations with resources necessary for implementing similar programs.

< For capacity development in conjunction with the utilization of satellite information >

Officials of disaster management authorities of the ASEAN member states and the staff of AHA Centre will

- acquire basic skills necessary for using satellite imagery.
- learn how to perform run-off analysis based on satellite imagery.
- learn how to perform inundation analysis based on satellite imagery.
- learn how to use satellite imagery for disaster response, risk assessment, and other relevant tasks.

1.6 Schedule

The Project was implemented according to the schedule shown in Figure 1-1.

First Year

ITEM	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR
Planning/Preparation												
Training								Image Analysis				
Observation Trip						Hydrology and Hydraulic Analysis						
Follow-up Survey								Indonesia		LaoPDR, Cambodia, Philippine, Myanmar		
Reporting etc				Inception Report					Vietnam		!st Year Report	

Second Year

ITEM	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR
Planning/Preparation												
Training					Image Analysis		Hydrology and Hydraulic Analysis					
Observation Trip												
Follow-up Survey		Singapore, Burunei					Indonesia	Thailand		Vietnam, LaoPDR		
Reporting etc	Work Plan										2nd Year Report	

Third Year

ITEM	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR
Planning/Preparation												
Training					Image An	Hydrology and Hydraulic Analysis						
Observation Trip												
Follow-up Survey				Malaysia, Cambodia				Philippine		Myanmar, Thailand		
Reporting etc	Work Plan											

Fourth Year

ITEM	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR
Planning/Preparation												
Training												
Observation Trip												
Follow-up Survey												
Reporting etc	3rd Year Report		DF/R, WS		F/R							

Figure 1-1 Project Implementation Schedule

1.7 Composition of Project Members and their Role/Duties

The composition of the Project members and allotted tasks are shown in Table 1-1.

Table 1-1 List of Project Members

Role	Name	Affiliation	Main Duties
Project leader/ application of satellite information and imagery *In the first and second years	Hiroshi Sato	PASCO CORPORATION	・ Overall management of the Project ・ Instructor for training in Jakarta (disaster response) ・ Participation in observation trips in Japan ・ Field surveys on the status of use of satellite information
Project leader/ application of satellite information and imagery (disaster response) *In the third year (until December 2015)	Hisashi Mori	PASCO CORPORATION	・ Overall management of the Project ・ Instructor for training in Jakarta (disaster response) ・ Field surveys on the status of use of satellite information
Project leader (replacement)/ application of satellite information and imagery (disaster response) *In the third year (from January 2016)	Kei Sato	PASCO CORPORATION	・ Overall management of the Project ・ Field surveys on the status of use of satellite information
Application of satellite information and imagery	Daisaku Kiyota	CTI Engineering International	・ Instructor for training in Jakarta (meteorology/flooding) ・ Participation in observation trips in Japan ・ Field surveys on the status of use of satellite information
Remote sensing/ acquisition and analysis of satellite information and imagery	Bhuwneshwar Prasad SAH	PASCO CORPORATION	・ Instructor for training in Jakarta (remote sensing)
Remote sensing/ acquisition and analysis of satellite information and imagery *In the third year	Takaya Ishizuka	PASCO CORPORATION	・ Instructor for training in Jakarta (remote sensing)
Training management/project coordination *In the first and second years	Yoko Tamura	PASCO CORPORATION	・ Management of training in Jakarta ・ Management of observation trips in Japan ・ Coordination of field surveys on the status of use of satellite information

Role	Name	Affiliation	Main Duties
Training management/project coordination *In the third year	Naoya Kanemoto	PASCO CORPORATION	・ Management of training in Jakarta ・ Management of observation trips in Japan ・ Overall project coordination
Training management/project coordination/ training instructor	Yuki Okajima	PASCO CORPORATION	・ Instructor for training in Jakarta (emergency image analysis)
Application of satellite information and imagery	Kazuhiro Nakamura	CTI Engineering International	・ Instructor for training in Jakarta (hydrology) ・ Coordination of field surveys on the status of use of satellite information
SAR (Synthetic Aperture Radar) data processing	Ryuichi Furuta	Remote Sensing Technology Center of Japan	・ Instructor for training in Jakarta (SAR data processing)
Hydrology and hydraulics analysis *In the second and third years	Daisuke Fujita	CTI Engineering International	・ Instructor for training in Jakarta (hydrology)
Training instructor (emergency image analysis/image interpretation) *In the second and third years	Shiori Kimura	PASCO CORPORATION	・ Instructor for training in Jakarta (emergency image analysis/ image interpretation)

1.8 Project Achievements and Outputs

1.8.1 Project Achievements

(1) Overall Preparations and Reports

Inception Report/Work Plan (First Year – Third Year)

An Inception Report (First Year) and Work Plan (Second Year and Third Year) were prepared in Japanese and English at the beginning of each year.

The Inception Report and Work Plan showed the policy for implementation of the work in the year concerned, the implementation method, work content, work flow chart, work schedule, personnel plan, etc. They were submitted to the AHA Centre for comments which were appropriately reflected and consent obtained before the approval of JICA was obtained for finalization. The work in the year concerned was undertaken based on the Inception Report and Work Plan.

Annual Report (First Year – Third Year)

The results of training and field surveys in each year were reviewed and the outputs and issues for subsequent years summarized. The summarized results were reflected in the plans for subsequent years and improvements made. The report for the third year summarized the entire Project.

Draft Final Report/Final Report (Third Year)

A Draft Final Report summarizing the activities and outputs of the Project was prepared. The Draft

Final Report was explained to JICA, the AHA Centre and concerned parties and a Final Report incorporating feedback was prepared.

Work Report (Third Year)

A Work Report was prepared and submitted to JICA upon completion of the Project.

Project Report (First Year – Third Year)

The activities and outputs of the Project were summarized in an A4 leaflet which was prepared in Japanese, English and seven official languages (Indonesian, Thai, Lao, Vietnamese, Khmer, Malay and Burmese) and distributed to the relevant organizations in each country. A Final Project Report was only prepared in Japanese and English, and it was submitted upon completation of the Project.

(2) Survey of Satellite Information Utilization in ASEAN and Preparation of Draft Utilization Plan

An interview survey was conducted of the disaster prevention agencies and organizations in each country to check their technical capacity, budget, obtainable satellite information, work-related needs and feasibility of utilization of satellite information. A draft satellite information utilization plan summarizing satellite information utilization methods and practical issues was then prepared.

The countries visited in each year are shown below. In the case of Indonesia, the interview survey of the relevant organizations was conducted by making use of the overseas training period.

Table 1-2 Countries Visited in each Year

Year	Country
First year (2013)	Cambodia, Lao PDR, Myanmar, Philippines, Vietnam, Indonesia
Second year (2014)	Lao PDR, Brunei, Vietnam, Singapore, Thailand, Indonesia
Third year (2015)	Malaysia, Myanmar, Philippines, Thailand, Cambodia

When making the country visits, JICA was consulted on grasping the state of disaster management in each country, organizing the content of the interview survey, selecting the destinations and scheduling the interviews. At this time, a point was made of having the responsible person or manager of the organization present. As well as conducting the interview survey on the items described above, during the visit an explanation was given to the person responsible or the manager concerning what could be done by utilizing satellite information.

The interview survey and preparation of the draft satellite information utilization plan are described in detail in Chapter 3.

(3) Overseas Training

Training was held in Jakarta, Indonesia twice each year for a total of six times. One training

focused mainly on programs related to flood prediction and flood and inundation analysis targeted at a proactive disaster response, while the other focused on programs related to satellite remote sensing targeted at emergency response in the event of disaster.

The maximum of two disaster management agency personnel from each ASEAN member country and two AHA Centre personnel were eligible to participate in the training. The most appropriate organizations were selected for the training on the basis of information obtained in the interview survey described in (2) and in view of the objectives of the Project. The cooperation entities in each country were also requested to send human resources who would be capable of maximizing the skills acquired through the training in their work.

When formulating the training plan, the objectives, training period and detailed program content were discussed with JAXA, ICHARM and Hokkaido University, the cooperation entities of the Project, with the aim of achieving the most effective training possible. The training plan was explained to the AHA Centre before the start of each year's training and their consent obtained.

At the preparation stage, discussions were held with instructors dispatched from JICA and other cooperation entities in Japan, individual programs were drafted, data and equipment for use on site were confirmed and materials were prepared. For the programs conducted by ICHARM and Hokkaido University, data on each country were collected and organized for use in lectures and practical training and other advance preparations were made.

During the training, time was set aside as appropriate for Q&A and the instructors, as the developers and providers of the analysis tools and satellite information, and the participants, as the future users, exchanged views on uncertain points, requests, etc. At the end of the training, the program content and operation method were reviewed and improvements were reflected in the subsequent year's training. In addition, a questionnaire was conducted of the participants at the end of the training and 3 months after the end of the training, and their level of interest, enthusiasm and understanding and their evaluation of the lectures and practical training were checked and used as feedback for improvements.

The details and outputs of the overseas training are described in Chapter 2.

(4) Observation Trip in Japan

An observation trip in Japan was made once during each year of the Project. The maximum of two disaster management agency personnel from each ASEAN member country and two AHA Centre personnel who had attended at least one of the overseas trainings were eligible to participate in the observation trips.

When selecting the destinations and reviewing the content of the observation trips, the program was designed to show examples of satellite information utilization systems in case of a disaster or emergency in Japan through observation and to allow each country to find issues related to emergency systems in time of disaster.

Q&A time was provided at the destinations as far as possible, and especially at ICHARM and JAXA, the developers and providers of analysis tools and satellite information, efforts were made to

enable the participants, as the future users, not only to listen to explanations from the facility visited, but also to express their opinions and requests

At the end of each year's trip, the participants and resource created and presented an action plan based on what they had observed. A questionnaire was also conducted to check their level of interest, enthusiasm and understanding the participants and their evaluation of the visits as feedback for future improvements.

The details and outputs of the observation trips in Japan are described in Chapter 2.

(5) Partnerships with Relevant Organizations

As the Project is part of the initiative for ASEAN regional disaster management cooperation, information was provided as needed to the AHA Centre, the platform for ASEAN disaster management cooperation, in the course of implementation of the Project to promote continuation and development of the Project outputs. More precisely, as described earlier, the annual Work Plan and training plan were explained in advance and consent obtained, and at the end of the year, an annual report on the activities and outputs for the year concerned was prepared and explained.

The ASEAN Secretariat and the Mission of Japan to ASEAN were invited to the first day of the overseas training and the reception, and activity reports were made as appropriate.

1.8.2 Outputs

(1) Outputs

Table 1-3 List of Outputs

Report Name	No. of Copies, etc.
Work Plan	3 copies in Japanese
Inception Report (IC/R)	120 copies in English, electronic data
First Year Report	3 copies in Japanese, 50 copies in English, electronic data
Second Year Report	3 copies in Japanese, 50 copies in English, electronic data
Third Year Report	3 copies in Japanese, 50 copies in English, electronic data
Draft Satellite Information Utilization Plan 1 copy per country, 10 countries	3 copies in Japanese per country, 10 copies in English per country, electronic data
Draft Final Report	10 copies in Japanese, 60 copies in English
Final Report	30 copies in Japanese, 60 copies in English, 60 CD-R

(2) Other Reports

Table 1-4 List of Reports

Report Name	Remarks
Overseas Training Report	In Japanese and English Twice a year for 3 years
Japan Observation Trip Report	In Japanese and English Once a year for 3 years
Overseas Training Questionnaire Results	In Japanese Twice a year for 3 years
Japan Observation Trip Questionnaire Results	In Japanese Once a year for 3 years
Project Report	In Japanese, English and 7 official languages Once a year for 3 years In Japanese, English for the final year

1.9 Project Outputs

1.9.1 ASEAN Initiatives

The efforts of ASEAN countries to proactively utilize satellite information in future are important, but in some cases, for example training, ASEAN-wide activities may be more efficient. The AHA Centre must, therefore, take the lead in assessing and appropriately responding to the needs of each country on a routine basis. For this reason, the building of a relationship with resources, establishment of a training base and strengthening of the network of officers in charge of disaster management in each country are essential. Through the Project, a relationship was built with the instructors, observation visit destinations and other resources necessary for implementation of training related to promotion of satellite information utilization, and lecture materials and teaching aids were developed and supplied to the AHA Centre. As satellite-related technologies and analysis techniques are evolving on a daily basis, the content of the training must be kept updated and improved, but it will be very useful when the AHA Centre comes to initiate similar programs in future.

The broad network of disaster management officers was strengthened by the training over the three years. The strengthening of network centered around the AHA Centre is hoped for. In order to strengthen such network, it is vital to increase the number of trainings in which the AHA Centre is involved at the planning stage as much as possible and for the AHA Centre itself to implement the trainings.

1.9.2 Capacity Building Initiatives in Satellite Information Utilization

Through the Project, a total of 170 participants from the ASEAN region participated in the training in Indonesia and the observation tour in Japan and acquired the necessary knowledge and skills for satellite

information utilization.

The training in Indonesia was divided into two, training in acquisition and analysis of satellite images for the monitoring of damage status and training in satellite information utilization for flood analysis. The participants studied cases in each field, learned the basics and also performed analysis themselves using actual data. As the participants on the training programs implemented in the Project basically used satellite images and software that can be obtained free in their own countries, it is hoped that they will continue their training and promote satellite image utilization in their actual work by referring to the lecture materials and manuals.

On the observation trip in Japan, the participants visited various organizations representing diverse standpoints, such as government agencies, local governments, private companies and research institutions, and learned about their respective roles and activities and how they utilize satellite information in the area of disaster prevention. It was evident from the action plans created by the participants and questionnaire results that, through the training, the participants had gained an awareness of the various issues in their own countries and the need for an emergency system based on organizational cooperation at various levels in times of disaster. In particular, they expressed the views that collaboration between government agencies and local governments was needed and public-private partnership (PPP) was vital to realize smooth disaster prevention activities and precise emergency response. These cannot be realized immediately, but the very fact that the participants were aware of the issues was a major step forward. In addition, there was a lively exchange of questions and answers about the micro satellites being developed and launched by the private sector and universities, and views were expressed on the growing desire of each country to have its own satellite for the monitoring of damage status.

In a move towards capacity building and promotion of satellite information utilization, the issues facing formulation and realization of utilization plans based on the current situation in each country were summarized and distributed to the relevant organizations. It is hoped that in future each country will take steps to make the most of the techniques and experience gained through the Project.

Chapter 2 Overseas Training and Observation Trip in Japan

2.1 Training in Obtaining and Analyzing Satellite Images for the Monitoring of Damage Status

2.1.1 Training Overview

(1) Name of Training

Training Program on Capacity Development for Immediate Access and Effective Utilization of Satellite Information for Disaster Management: Satellite Data Characteristics, Way of Data Acquisition, and Utilization for Post Disaster

(2) Objectives

To help participants acquire the knowledge and technology needed to make an emergency response, mainly to flood disaster, as shown below.

- Features of satellite data and how to obtain the data
- Application of satellite information in assessing needs following a disaster

(3) Training Period

First Year (FY2013):November 11 - 20, 2013
Second Year (FY2014): August 18 - 29, 2014
Third Year (FY2015): August 3 - 14, 2015

(4) Location

Same location for three years: Sari Pan Pacific Hotel, Jakarta, Indonesia

(5) Instructors

- Japan Aerospace Exploration Agency (JAXA)
- Remote Sensing Technology Center of Japan (RESTEC)
- Asian Institute of Technology (AIT)
- PASCO Corporation (PASCO)
- CTI Engineering International Co., Ltd. (CTII)

(6) Qualifications to Receive Training Program

- The person should have practical experience of being responsible for disaster management or should be an expert in the field of remote sensing.
- The person should have more than two years' experience working in the above area.
- The person should belong to a disaster management institution that currently utilizes, or is planning to utilize, satellite information.
- The person should be a graduate of a four-year university/college course, or should have a comparable qualification.
- The person should be able to read and write English without difficulty.

(7) Participants

56 participants from 10 ASEAN countries and the AHA Centre participated over the three years. The number of participants from each country/organization in each year is shown in Table 2-1. A list of participants is attached in the appendix.

Table 2-1 Number of Participants in Training in Obtaining and Analyzing Satellite Information for the Monitoring of Damage Status

Country/Organization	2013	2014	2015	Total
Brunei	**0**	**3**	**0**	**3**
Public Works Department (PWD), Ministry of Development	0	2	0	2
Survey Department (SD), Ministry of Development	0	1	0	1
Cambodia	**2**	**2**	**2**	**6**
National Committee for Disaster Management (NCDM)	2	2	2	6
Indonesia	**2**	**2**	**2**	**6**
Jakarta Regional Disaster Management Agency (BPBD Jakarta)	1	2	0	3
National Disaster Management Agency (BNPB)	1	0	2	3
Lao PDR	**2**	**2**	**2**	**6**
Ministry of Science and Technology (MOST)	0	1	0	1
National Disaster Management Office (NDMO)	2	1	0	3
Ministry of Natural Resource and Environment (MoNRE)	0	0	2	2
Malaysia	**3**	**2**	**2**	**7**
Malaysian Remote Sensing Agency (MRSA)	0	0	1	1
National Security Council, Prime Minister's Department	1	1	1	3
Malaysia Centre for Geospatial Data Infrastructure (MaCGDI), Ministry of Natural Resources and Environment (NRE)	1	0	0	1
Department of Irrigation and Drainage (DID), Ministry of Natural Resources and Environment (NRE)	1	0	0	1
Public Works Department (JKR)	0	1	0	1

Country/Organization	2013	2014	2015	Total
Myanmar	**2**	**2**	**2**	**6**
Relief and Resettlement Department (RRD)	2	1	2	5
Department of Meteorology and Hydrology (DMH), Ministry of Transportation [at that time]	0	1	0	1
Philippines	**2**	**2**	**2**	**6**
Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA)	1	1	1	3
The National Mapping and Resource Information Authority (NAMRIA)	0	1	0	1
Office of Civil Defense (OCD)	1	0	0	1
Mines and Geosciences Bureau (MGB)	0	0	1	1
Singapore	**1**	**0**	**1**	**2**
Singapore Civil Defence Force (SCDF)	1	0	1	2
Thailand	**2**	**2**	**2**	**6**
Ministry of Interior, Department of Disaster Prevention and Mitigation (DDPM)	2	2	2	6
Vietnam	**2**	**2**	**2**	**6**
Department of Dyke Management and Flood, Storm Control (DDMFSC)	2	1	0	3
Ministry of Agriculture and Rural Development (MARD)	0	0	2	2
Disaster Management Center (DMC)	0	1	0	1
AHA Centre	**1**	**1**	**0**	**2**
ASEAN Coordinating Centre for Humanitarian Assistance on disaster management (AHA Centre)	1	1	0	2
Total	**19**	**20**	**17**	**56**

2.1.2 Formulation of Training Plan

The training plan was formulated taking the following items into consideration, based on the project purpose and the expected outputs for the Project.

Utilization of Japanese Satellites

In order to demonstrate the advantages and usefulness of the satellites operated by Japan, as much as possible the training was carried out using and analyzing images obtained from the Advanced Land Observing Satellite-2(ALOS-2), which uses the L-band, which is a wavelength unique to Japan, when using satellite images in the lectures or practical work within the training.

Utilization of the Disaster Prevention Network Promoted by Japan

Japan leads the framework of Sentinel Asia (SA) in the Asia-Pacific Regional Space Agency

Forum (APRSAF). In particular SA is an important source of satellite images, in particular for countries that do not have satellites or receiving stations for satellite information or countries that are unable to sufficiently provide budget for procurement of satellite images. Therefore during the training the role of SA and an overview of the specific method of requesting images were explained.

Satellite Image analysis using Free Software

The participants from each country are expected to utilize what they have acquired in the training in their work back in their own country after the training, as well as explaining to their superiors and colleagues the methods of operation and methods of use, so the software used in the training was open source software that can be easily obtained by anyone. Specifically, NEST (Next ESA SAR Toolbox) and PALSAR ReMap were used for displaying and analyzing SAR images, and ImageJ and QGIS were used for displaying images and other spatial information and for preparing Post Disaster Needs Assessment (PDNA).

Dealing With Remote Sensing Beginners

It was envisaged that the technical level and work experience of the participants would be varied, and would include beginners to remote-sensing, so the program included basic lectures on remote-sensing.

Preparation of Operation Manuals

Operation manuals were prepared so that the participants from each country would be able to analyze satellite images on their own after returning to their own country. The contents were revised as appropriate in the second and third years, based on the status of the participants during the training and the results of questionnaires carried out after the training.

Configuration of Programs in Accordance with the Present Status in Each Country

In order to carry out training that could be practically used based on the present status in each country, in the case of countries for which this preparation was possible the training was carried out using satellite images of their country and other information.

Characteristics of the Utilization of Satellite Information and Awareness of Limitations

Satellite information has various advantages compared with terrestrial observation, but it also has restrictions. Satellite information does not necessarily contribute to solving all of the problems of disaster prevention activities, and this point was sufficiently made so that the participants did not misunderstand it. In particular, by understanding and utilizing the characteristics of satellite information, planar information can be collected that would be difficult to obtain by terrestrial observation alone. On the other hand, the quality of the disaster information that can be extracted varies depending on the timing and method of image taking, so it was clearly conveyed that satellite information is just complementary to terrestrial observation. Also during the training, opportunities were provided to deepen their understanding of the characteristics of satellite images and to

experience the limitations of satellite images, by going outdoors and viewing the actual locations that appear in satellite images.

Besides the above, during the training attention was focused on the following points. In particular, in the second and third years the content of the program and the methods of operation were improved based on the status of absorption of the lectures by the participants in the previous years and the results of questionnaires.

- In the ASEAN region, frequently imaging with an optical satellite is difficult due to the effect of weather, etc., so the lectures and practical training on analysis using SAR images were enhanced.
- In order to deepen understanding of SAR images and to improve the interpretation capability, field surveys were included in the program as it was considered that even remote-sensing engineers would have little experience in this.
- Sufficient practical time was provided for methods of extracting changes using images before and after a disaster, which is a very versatile analysis technique.
- Sufficient practical training time was provided in order to acquire methods of preparing information, which has high added value for contribution to PDNA.
- Participation was encouraged from not only organizations engaged in disaster prevention, but also those that are likely to provide an analysis service during an actual response to a disaster, such as organizations involved in space, remote-sensing, spatial information, etc.

2.1.3 Training Content

The program shown in Table 2-2 was implemented in the training. Outline of the lectures and practical training is attached in the appendix.

Table 2-2 Training Program (image analysis)

A: Method to receive satellite data and images
A-1: Introduction to SA, practical training in the method of requesting emergency images
A-2: Examples of utilization of satellite data
A-3: Basic Principles of Optical and SAR
A-4: Visualization of optical images and analysis training
A-5: Visualization of SAR images and analysis training
A-6: Examples of utilization of SA and the International Disaster Charter
B: Analysis of disaster extent and disaster status using SAR images
B-1: Utilization and obtaining method of commercial satellite images
B-2: Method of interpretation of SAR images and field surveys for interpretation
B-3: Overview and practice on preparation of emergency flooding maps using SAR

images before and after the disaster B-4: Overview and practical training in PDNA using satellite images
C: Observation Trip
C-1: AHA Centre C-2: Disaster Management Agency

2.1.4 Outputs of Training

(1) Acquisition of Basic Skills in Use of Satellite Images

As a result of this training, the participants learned basic knowledge of satellite images, methods of obtaining satellite images, methods of reading satellite images, and basic skills in the use of satellite images, etc. Among the participants were beginners in the use of satellite images, so the training included basic knowledge of earth observation satellites and digital images.

In the lectures regarding earth observation satellites, the participants learned not only the main characteristics of satellites, but also the orbits of satellites, image taking methods, image taking mechanisms, etc. In this way, it is considered that the understanding of the participants was deepened regarding restrictions in timing of image taking, that it is not possible to take images immediately after requesting images, the existence of spatial errors and noise on images, etc. Also, the participants learned the most basic items in terms of use of images, such as resolution, bands, color adjustments, etc., using illustrations and actual images. In particular because interpretation of SAR images, which are expected to be used more and more in the future, is more difficult than interpretation of optical images, the differences from the method of viewing optical images was confirmed by comparison with actual images, and in addition the methods of viewing objects such as roads, buildings, water areas, etc. on SAR images was confirmed by comparison with the actual objects on site.

From the above, it can be concluded that the participants acquired the basic skills in the use of satellite images, including points to note during use and the reasons for these points.

(2) Acquisition of Methods of Use of Satellite Images, and Methods of Use in Risk Evaluation, etc.

In addition to the above, from the lectures and practical training, the participants learned examples of the use of satellite images for various types of disasters besides flooding, methods of obtaining satellite images when a disaster occurs, methods of interpreting the extent of the disaster using satellite images, and risk evaluation.

In the lectures of the examples of use of satellite images, the procedure from occurrence of the disaster to providing the outputs was described in detail in accordance with the timeline, so it is considered that even the participants that had not yet actually used satellite images could grasp the specific images.

Regarding SA, which is the important source of satellite images when a disaster occurs, the participants practiced the procedure from request of images to downloading the data using an actual

site. In addition, the participants themselves carried out preparation of emergency flooding maps using satellite images, and PDNA using actual satellite images and software.

According to the results of a questionnaire carried out 3 months after the training, virtually all the participants replied that they had reported the content of the training to their superiors, and, that they had reviewed what they had learned during training. Therefore it can be concluded that the participants undertook their training with a high level of awareness, and recognition of its usefulness. A certain level of experience and training is necessary to acquire the skills of analysis and interpretation of satellite images. It cannot be said that in this limited training period, the methods of using satellite images for disaster response and risk evaluation were completely mastered, but it is considered that the basic methods necessary for use have been acquired. In this training basically satellite images and software that can be obtained by the participants free of charge in their own country were used, so it is expected that their training will continue in their actual work by referring to the lecture documents and manuals.

2.2 Training in Utilization of Satellite Information for Flood Analysis

2.2.1 Training Overview

(1) Name of Training

Training Program on Capacity Development for Immediate Access and Effective Utilization of Satellite Information for Disaster Management: Utilization of Satellite Data for Flood Analysis

(2) Objectives

The participants acquire the knowledge and techniques regarding planning and early warning of flood disaster management.

- Fundamentals of hydrology
- Characteristics and operation procedures of Integrated Flood Analysis System (IFAS)
- Characteristics and operation procedures of International River Interface Cooperative (iRIC), river flow and riverbed variation analysis software
- Run-off analysis and flood inundation analysis for the basin of participant’s country using IFAS and iRIC

(3) Training Period

First year (2013): September 9 - 20, 2013
Second year (2014): October 6 - 17, 2014
Third year (2015): September 28 - October 9, 2015

(4) Main Implementation Location

Same location for three years: Sari Pan Pacific Hotel, Jakarta, Indonesia

(5) Instructors

- ICHARM
- Hokkaido University
- Civil Engineering Research Institute for Cold Region
- U.S. Geological Survey (USGS)
- CTII

(6) Qualifications to Receive Training Program

- Person in charge of flood management or flood forecasting engineer or expert for hydrology
- More than 2 years' work experience in the field of above
- Person who work in disaster related organization which (will) utilize satellite information
- Person who graduated university or has equivalent qualification
- Person who can use English without difficulty

(7) Participants

55 participants from 10 ASEAN countries and the AHA Centre participated over the three years. The number of participants from each country/organization in each year is shown in Table 2-3. A list of participants is attached in the appendix.

Table 2-3 Number of Participants to the Training in Utilization of Satellite Information for Flood Analysis

Country/Organization	2013	2014	2015	Total
Brunei	**2**	**3**	**1**	**6**
Public Works Department (PWD), Ministry of Development	0	2	0	2
Survey Department (SD), Ministry of Development	0	1	1	2
National Disaster Management Centre (NDMC)	2	0	0	2
Cambodia	**2**	**2**	**2**	**6**
Ministry of Water Resources and Meteorology (MOWRAM)	0	2	0	2
National Committee for Disaster Management (NCDM)	2	0	2	4
Indonesia	**3**	**2**	**2**	**7**
Jakarta Regional Disaster Management Agency (BPBD Jakarta)	2	2	0	4
National Disaster Management Agency (BNPB)	1	0	2	3
Lao PDR	**1**	**2**	**2**	**5**
Disaster Management Division (DMD) *Former National Disaster Management Office (NDMO)	1	1	0	2
Ministry of Natural Resource and Environment (MoNRE)	0	1	2	3

Country/Organization	2013	2014	2015	Total
Malaysia	**1**	**2**	**2**	**5**
Malaysia Centre for Geospatial Data Infrastructure (MaCGDI), Ministry of Natural Resources and Environment (NRE)	1	0	0	1
Department of Irrigation and Drainage (DID), Ministry of Natural Resources and Environment (NRE)	0	1	1	2
National Hydraulic Research Institute of Malaysia (NAHRIM), Ministry of Natural Resources and Environment (NRE)	0	1	1	2
Myanmar	**2**	**2**	**2**	**6**
Relief and Resettlement Department (RRD)	2	1	1	4
Department of Meteorology and Hydrology (DMH), Ministry of Transportation [at that time]	0	1	1	2
Philippines	**2**	**2**	**2**	**6**
Department of Public Works and Highways (DPWH)	0	1	1	2
Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA)	1	1	1	3
Office of Civil Defense (OCD)	1	0	0	1
Singapore	**0**	**0**	**0**	**0**
Thailand	**2**	**2**	**2**	**6**
Ministry of Interior, Department of Disaster Prevention and Mitigation (DDPM)	2	2	2	6
Vietnam	**2**	**2**	**2**	**6**
Department of Dyke Management and Flood, Storm Control (DDMFSC)	2	1	0	3
Ministry of Agriculture and Rural Development (MARD)	0	0	1	1
National Centre for Hydro-Meteorological Forecasting (NCHMF)	0	0	1	1
Disaster Management Center (DMC)	0	1	0	1
AHA Centre	**1**	**1**	**0**	**2**
ASEAN Coordinating Centre for Humanitarian Assistance on disaster management (AHA Centre)	1	1	0	2
Total	**18**	**20**	**17**	**55**

2.2.2 Formulation of Training Plan

The training plan was formulated taking the following items into consideration, based on the project purpose and the expected outputs for the Project.

Utilization of Satellite Information (Topography, Rainfall) Possessed by Japan

In order to emphasize the advantages and usefulness of the artificial satellites possessed by Japan, when satellite information was used in lectures or practical exercises during the training, data measured using Japanese satellites was used as much as possible (ASTER Global Digital Elevation Model (GDEM), Global Stellite Mapping of Precipitation (GSMaP), etc.).

Dealing with Beginners to Hydrological and Hydraulic Analysis

One condition for participation in the training was the participant had to be engaged in work related to flooding. However it was envisaged that there would be differences in the technical level and work experience of the participants, so lectures on the basics of hydrology and hydraulics were included in the first half of the program, so that it would facilitate understanding of IFAS and iRIC.

Preparation of Operation Manuals

Care was taken to ensure that the distributed operation manuals were consistent with the content of the training, so that the participants could carry out flooding analysis by themselves after returning to their countries. The content was improved as appropriate in the second and third years, based on the status of the participants during training and the results of questionnaire surveys carried out after the training, etc.

Implementation of Training Using their Own Country's Data

In order to encourage the participants of each country to apply the analysis models to catchment areas in their own country, the training was carried out for actual catchment areas in countries that were capable of providing the rainfall and flow rate data necessary for the analysis (for example, Philippines, Lao PDR, etc.).

Explanation of Points Requiring Attention when Applying Satellite Information

Normally in developing countries the development of ground-based measurement facilities is delayed. Therefore the transfer to analysis technology utilizing satellite information is extremely useful as the first step for carrying out countermeasures against flooding. On the other hand, the accuracy of satellite information is inferior to the measured values obtained from ground-based measurement, so it is important in the future to develop the ground-based measurement facilities in each country for formulating countermeasures against flooding.

In this training, the merits and demerits of satellite information were clearly explained, and the necessity of ground-based rainfall measurement was explained.

Besides the above points, during the training attention was focused on the following points. In the second and third years the content of the program and the methods of operation were improved based on the status of absorption of the lectures by the participants in the previous years and the results of questionnaires.

- Participation from organizations that deal with hydrology and hydraulics in their day to day work, organizations that are responsible for structural measures, and organizations associated with flood prediction and warning was encouraged.
- The training was carried out so that it would be understood by all the participants, taking into consideration the knowledge and technical level of the participants in hydrology and hydraulics. Measures were taken for participants with a high technical level, such as dealing with them

individually, etc.

- Members from the Project Team that were expert in IFAS and iRIC were dispatched, so that the training would be smoothly implemented.
- Hardware measures such as preparation of spare personal computers, etc., were taken so that differences in progress due to differences in personal computer specification would not arise.
- An environment in which the internet connection could be restricted was prepared so that the participants could concentrate on the lectures.

2.2.3 Training Content

The program shown in Table 2-4 was implemented in the training. Outline of the lectures and practical training is attached in the appendix.

Table 2-4 Training Program (flooding analysis)

A:	Basics of hydrological and hydraulic analysis and models and applications of models to each country
A-1:	Explanation on basic runoff mechanism and water-related issues, including flooding etc.
A-2:	Utilization of hydrological and hydraulic analysis as flood countermeasures, including establishment of flood control plan, river improvement works and flood early warning system etc.
A-3:	Brief summary on IFAS and iRIC
B:	Utilization of Integrated Flood Analysis System, “IFAS” (Runoff model)
B-1:	Introduction, advantages and use cases of IFAS
B-2:	Hands-on training of IFAS using sample data
B-3:	Group-work and discussion using IFAS with actual local data from selected countries and its calibration
B-4:	Analysis results and presentation
C:	Utilization of iRIC (Hydraulic modeling platform)
C-1:	Introduction of iRIC, its preprocessor, postprocessor, and analysis examples
C-2:	Hands-on training of inundation analysis, river-bed evolution and rating curve creation by iRIC
C-3:	Introduction of various models (solver), including one to three dimensional flow regime analysis and riverbed evolution analysis.

2.2.4 Training Output

The training was divided into 3 sections: lectures on the fundamentals of hydrology and hydraulics, iRIC training and practice using satellite information, and IFAS training and practice. The participants learned the use of satellite information, basic techniques of hydrological and hydraulic analysis, and methods of application and use.

Through the basics of hydrology and hydraulics and the practical training, the participants learned the relationships between actual phenomena such as runoff and flooding and the model parameters. In this way it is considered that the understanding of what parameter is related to what natural phenomenon when

carrying out analysis using IFAS or iRIC was deepened.

Regarding the data necessary for analysis, it was confirmed that in many of the ASEAN countries there is insufficient measurement of rainfall, and the development of topographical data is delayed. It is considered that through the exercises the participants sufficiently understood the usefulness of satellite information under the circumstances where there is insufficient information.

2.3 Observation Trip in Japan

2.3.1 Training Overview

(1) Name of Training

Training Program on Capacity Development for Immediate Access and Effective Utilization of Satellite Information for Disaster Management: Observation Trip in Japan

(2) Objectives

- To introduce Japanese satellites and techniques of utilizing satellite information and the status of research in this field, in order to deepen their understanding of the training obtained overseas.
- By introducing the Japanese countermeasures against disasters and the links between organizations, in addition to the Japanese technology, to broaden the perspective of the participants so that they understand the position of the technology of use of satellite information within the various technologies, so that they can introduce satellite technology into disaster countermeasures in each of the ASEAN countries, and can carry out more practical investigations for their extension.

(3) Training Period

First Year (FY2013):	February 24 - March 7, 2014
Second Year (FY2014):	December 1 - 12, 2014
Third Year (FY2015):	November 30 - December 11, 2015

(4) Qualifications to Receive Training Program

- A participant must have experience of receiving “training in acquisition and analysis of satellite images for the monitoring of damage status” or “training in satellite information utilization for flood analysis” or equivalent work experience.

(5) Participants

59 participants from 10 ASEAN countries and the AHA Centre participated over the three years. The number of participants by country/institution and by year is shown in Table 2-5. A list of participants is attached in the appendix.

Table 2-5 Number of Participants in Observation Trips in Japan

Country/Organization	2013	2014	2015	Total
Brunei	**2**	**3**	**1**	**6**
Public Works Department (PWD), Ministry of Development	0	2	0	2
Survey Department (SD), Ministry of Development	0	1	1	2
National Disaster Management Centre (NDMC)	2	0	0	2
Cambodia	**2**	**2**	**2**	**6**
Ministry of Water Resources and Meteorology (MOWRAM)	0	1	0	1
National Committee for Disaster Management (NCDM)	2	1	2	5
Indonesia	**2**	**2**	**2**	**6**
Jakarta Regional Disaster Management Agency (BPBD Jakarta)	2	2	0	4
National Disaster Management Agency (BNPB)	0	0	2	2
Lao PDR	**2**	**2**	**1**	**5**
Disaster Management Division (DMD) *Former National Disaster Management Office (NDMO)	2	2	0	4
Ministry of Natural Resource and Environment (MoNRE)	0	0	1	1
Malaysia	**2**	**2**	**2**	**6**
National Security Council, Prime Minister's Department	0	1	1	2
Malaysia Centre for Geospatial Data Infrastructure (MaCGDI), Ministry of Natural Resources and Environment (NRE)	1	0	0	1
Department of Irrigation and Drainage (DID), Ministry of Natural Resources and Environment (NRE)	1	0	1	2
Department of Survey and Mapping Malaysia (JUPEM)	0	1	0	1
Myanmar	**2**	**2**	**2**	**6**
Relief and Resettlement Department (RRD)	2	1	1	4
Department of Meteorology and Hydrology (DMH), Ministry of Transportation [at that time]	0	1	1	2
Philippines	**2**	**2**	**2**	**6**
Department of Public Works and Highways (DPWH)	0	1	1	2
Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA)	1	1	0	2
Office of Civil Defense (OCD)	1	0	0	1
Mines and Geosciences Bureau (MGB)	0	0	1	1
Singapore	**1**	**0**	**1**	**2**
Singapore Civil Defence Force (SCDF)	1	0	1	2
Thailand	**2**	**2**	**2**	**6**
Ministry of Interior, Department of Disaster Prevention and Mitigation (DDPM)	2	2	2	6
Vietnam	**2**	**2**	**2**	**6**
Department of Dyke Management and Flood, Storm Control (DDMFSC)	2	1	0	3
Ministry of Agriculture and Rural Development (MARD)	0	0	2	2
Disaster Management Center (DMC)	0	1	0	1
AHA Centre	**2**	**2**	**0**	**4**
ASEAN Coordinating Centre for Humanitarian Assistance on disaster management (AHA Centre)	2	2	0	4
Total	**21**	**21**	**17**	**59**

2.3.2 Formulation of Observation Trip Plan

The observation trip plan was formulated taking the following into consideration, based on the project objectives and the expected results.

Japanese System for Using Satellite Information during a Disaster or Emergency

The program provided examples of use of satellite information during disasters or emergencies in Japan, so that the participants from each country have the opportunity to understand the necessity of an emergency system when a disaster occurs and the issues arising.

Use of Artificial Satellites Possessed by Japan

In order to emphasize the advantages and usefulness of the satellites operated by Japan, sites to visit were selected from various viewpoints such as the manufacture and operation of Japanese satellites, providing images, end users, etc.

Besides the content described above, attention was paid to the following points in the planning and implementation of the trip plan. In the second and third years in particular, the points to which attention was paid were increased and reviewed, on the basis of the observation status of the participants and the results of questionnaires in previous years.

- The selection of organizations that are deeply involved in disaster prevention, river and flood management, space development, space utilization and spatial information and that can be expected to present specific examples of their initiatives and cooperation with other organizations.
- The provision of practical opportunities to widen horizons, by integrating into the training three factors, *i.e.*, lectures held by the organizations visited, observation tours around exhibition rooms, operations rooms, etc., and experience gained through experiments and the use of testing facilities.
- In order to maximize the effectiveness of the training in the limited time scale of two weeks, the structuring of the training whereby in the first half the participants deepen their understanding of the overall picture of national-level disaster management policies and measures in Japan through visits to as many institutions involved in national disaster management policies as possible; and in the second half gain an understanding of specific technologies and research, regional and local initiatives and cooperation between the relevant organizations through visits to local governments, research institutes and private companies.
- A request to the organizations visited to not only introduce case studies and technologies but also explain how the current status was reached, the difficulties encountered and lessons learned, etc., to enable participants to obtain a more specific image.
- Due concern for participants' state of health, taking into account the fact that they are staying in a country where the weather and environment are different from what they are used to.

2.3.3 Sites Visited for Observation

During the three years, a total of 55 sites were visited for the purpose of observation, including government agencies, municipal offices, research institutes, disaster management facilities and business enterprises (33 sites when duplication is excluded). The sites visited are shown in Table 2-6.

.

Table 2-6 List of Sites Visited during Observation Trip in Japan

Organization Visited	FY		
	2013	2014	2015
Disaster Management, Cabinet Office, Government of Japan (CAO)	○	○	
Office of National Space Policy, Cabinet Office, Government of Japan (CAO)	○	○	
Water and Disaster Management Bureau, Ministry of Land, Infrastructure, Transport and Tourism, Japan (MLIT)	○	○	○
Geospatial Information Authority of Japan, Ministry of Land, Infrastructure, Transport and Tourism (MLIT)	○	○	
International Cooperation, Overseas Project Division, Policy Bureau, Ministry of Land, Infrastructure, Transport and Tourism, (MLIT)	○	○	
Arakawa-Karyu River Office, Kanto Regional Development Bureau, Ministry of Land, Infrastructure, Transport and Tourism (MLIT)	○	○	
Water Hazard Forecast Center, River Bureau, Kanto Regional Development Bureau, Ministry of Land, Infrastructure, Transport and Tourism (MLIT)	○	○	○
Japan Meteorological Agency	○	○	
Earth Observation Center, Satellite Application and Promotion Center, Japan Aerospace Exploration Agency (JAXA)			○
Tsukuba Space Center, Satellite Application and Promotion Center, Japan Aerospace Exploration Agency (JAXA)	○	○	
Disaster Management Support Systems Office, Satellite Application and Promotion Center, Japan Aerospace Exploration Agency (JAXA)	○	○	
Remote Sensing Technology Center of Japan (RESTEC)			○
Foundation of River & Basin Integrated Communications, Japan		○	○
Japan Center for Area Development Research			○
Asian Disaster Reduction Center (ADRC)	○	○	
International Centre for Water Hazard and Risk Management under the auspices of UNESCO (ICHARM)	○	○	
Disaster Prevention Center, Tokyo Metropolitan Government	○	○	
Tokyo Metropolitan Government			○
Neya River System Repair Works Office, Osaka			○
River Management Disaster Prevention Section, Wakayama Prefecture	○	○	
Wakayama City Municipal Government	○	○	
Tsunami/Storm Surge Disaster Prevention Station, Osaka			○
Ujigawa Open Laboratory, Disaster Prevention Research Institute Kyoto University	○		○
National Research Institute for Earth Science and Disaster Prevention	○		
Sumida River Super Levee			○
Hakojima Retarding Basin		○	
Disaster Reduction and Human Renovation Institution		○	
Inamura-no-Hi no Yakata Tsunami Educational Center	○	○	
Museum of the Metropolitan Area Outer Underground Discharge Channel			○
Japan Weather Association			○
NEC Corporation	○	○	
Mitsubishi Electric Corporation	○	○	○
Axelspace Corporation			○

2.3.4 Trip Results

(1) Awareness of Necessity of Emergency System when Disasters Occur and Issues Arising

The participants visited organizations with various standpoints, such as government agencies, local governments, private companies, research organizations, etc., and learned details of their roles and activities in disaster prevention activities. From the action plans prepared by the participants and the results of questionnaires, etc., it was found that the participants recognized through these visits the necessity for an emergency system that links organizations at various levels when a disaster occurs, and the various issues in their own countries. In particular, many participants stated that the links between government agencies and local governments were insufficient in their own countries, and through these visits they recognized its importance and the urgent need for initiatives in this respect in their own countries. In addition, many participants expressed strong interest in the contribution of private companies to Japan's disaster prevention activities. Such companies did not yet exist in their own countries, but they expressed the opinion that public-private partnership (PPP) will be essential in the future for detailed disaster prevention activities and emergency response.

Also in the action plans prepared in the third year for each phase of a disaster (on the first day the participants were divided into 3 groups, and each group was allocated one phase each), the participants recognized through the discussions within the groups for studying the plan that there were many common points in the issues in each country. Also in order to solve these issues it was considered that in addition to support from developed countries, it is essential that there be cross-border links and cooperation among the various ASEAN countries. Presentation materials of each group are attached in the appendix.

(2) Strengthening the Network of Officials Responsible for the Disaster Prevention Field

During the questions and answers at each visit, etc., the participants touched on the present status of and thinking behind disaster response in each country, and while traveling and during meals this exchange was deepened. In particular in the third year the participants were divided into 3 groups on the first day and on the final day each group made a presentation, so during rest time on the visits and during self-study time, the groups could be seen gathering for discussion, and on several occasions individual groups went out together. From this it is considered that the personal network of officials engaged in the disaster prevention field in each country has been strengthened.

Chapter 3 Formulation of Satellite Information Utilization Plan

3.1 Examination Method of Satellite Information Utilization Plan

3.1.1 Overview of Examination Method

To effectively utilize satellite information for disaster management in ASEAN countries, it is necessary to confirm the current status of disasters and the response taken by the concerned country, to define the functions, technical capacity and equipment of the agencies related to disaster prevention and space development, and to recognize which organizations can be expected to improve their disaster response capacity by effectively utilizing satellite information.

In the Project, necessary studies were conducted in accordance with the flowchart shown in Figure 3-1, and a draft satellite information utilization plan for ASEAN countries was formulated.

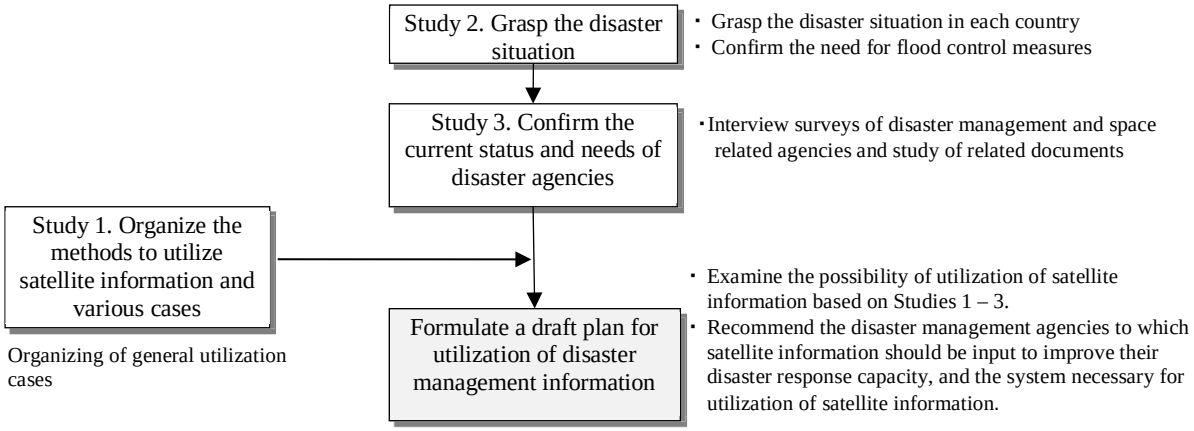
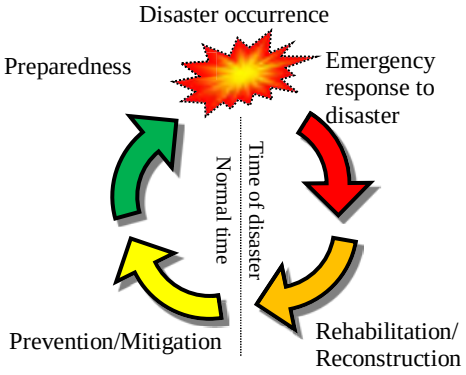


Figure 3-1 Flow of Studies and Examination for Proposal of Satellite Information Utilization Plan

3.1.2 Fields for Utilization of Satellite Information

In view of the characteristics of satellite information, satellite information can be utilized in two fields: Monitoring of the damage status (satellite images) and flood analysis (satellite images, Digital Elevetion Model (DEM), and satellite observation rainfall data). The flood analysis can be classified into two: “Disaster-time activities (flood forecast)” and “normal-time activities (establishment of flood control plan and creation of hazard maps).” These fields correspond to the phases of the



* Created based on the White Paper on Disaster Management 2004 and others.

Figure 3-2 Disaster Management Cycle

Disaster Management Cycle.

- Monitoring of damage status (Emergency response to disaster)
- Flood forecast (Preparedness)
- Establishment of flood control plan and creation of hazard maps (Prevention/Mitigation)

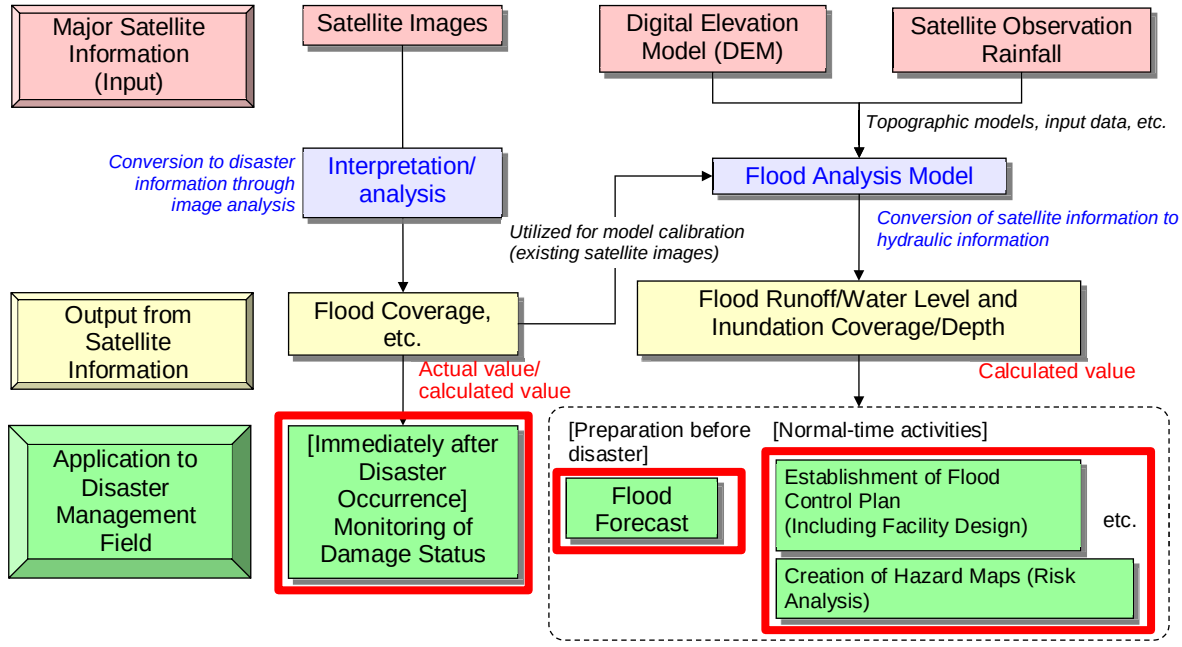


Figure 3-3 Example of Utilization in Disaster Prevention Activities

The draft satellite information utilization plan in the three fields listed above will be organized in this Project. The outlines of these fields are shown below.

1) Monitoring of Damage Status (Emergency Response)

For emergency response to disasters immediately after the occurrence of the disaster, it is important to monitor the damage status as early and properly as possible. Observation satellites can capture a wide area with one shot. Some sensors can take photographs regardless of weather and satellite images are an effective means of collecting disaster information in the event of flood occurrence in large river basins. Also, satellite images are effective in the monitoring of sediment disaster status including the identification of spots where landslides occurred and natural landslide dams were created.

2) Flood Forecast (Preparedness)

If adequate flood prevention facilities such as dams and levees are not provided, it is effective to promote the evacuation of residents by flood forecasting and warnings in order to mitigate the damage scale. For forecasting and warnings, flood forecasts are required. In large rivers in developing countries, the water level is observed in the upper and lower reaches to make flood

forecasts using water level correlation. However, flood forecasts using water level correlation are difficult in basins where there are no water level observation stations and in medium/small river basins where the time from rainfall to flood occurrence is short. In such basins, it is effective to conduct runoff analysis to forecast floods. In building the runoff analysis models, DEM data and satellite images (setting parameters for basins) can be utilized. Satellite observation rainfall data can also be utilized as input data.

3) Flood Control plans and Flood Hazard Maps (Prevention/Mitigation)
To improve flood control safety and mitigate the damage scale in the region, it is vital to formulate flood control plans which principally involve structural measures. In formulating the flood control plans, it is necessary to conduct runoff analysis and calculate the flow rate of rivers. For the runoff analysis, rainfall and topography data are required and topographic maps and rainfall data are usually used. However, for basins where such data are lacking, digital elevation model (DEM) data and satellite information including satellite observation rainfall data can be utilized. Further, satellite information can also be utilized in the preparation of flood hazard maps[1].

3.1.3 Satellite Information

There are various types of “Earth Observation Satellite” such as meterological satellite, marine observation satellite, earth resource exploration satellite, advanced earth observing satellite, geodetic satellite and others.

In this project, outlines of 1) satellite image including optical sensored and SAR image, 2) digital elevation model (DEM) and 3) satellite observed precipitation are described as satellite information for disaster management activitis. Table 3-1 shows the outline of the satellite information and the possible apprication.

[1] In Japan, inundation area forecast maps indicating the inundation coverage and depth are prepared by the national and local governments. Based on such information, the municipalities prepare hazard maps (at community level) by adding information on evacuation routes and evacuation shelters. The Hazard Maps as shown in the Project are handled in the form of inundation area forecast maps.

Table 3-1 The Outline of Satellite Information

No.	Satellite Information	Overview	Possible application to disaster prevention activities
1	Satellite Image	Satellite images are planar images of the surface of the earth, which are captured from the orbit of the earth observation satellites and consist of two types: (1) Satellite images captured on optical sensors in the wavelength ranges of visible light, near-infrared, intermediate-infrared, and thermal infrared and (2) Radar satellite images captured on microwave sensors in the microwave range. Whereas optical sensors cannot make observations in bad weather or at nighttime, microwave sensors can make observations in all weathers. The typical artificial satellites include Landsat, a satellite launched by the U.S.A., "SPOT" (Satellite Pour l'Observation de la Terre), an earth observation satellite launched by France, "Daichi" (Advanced Land Observing Satellite: ALOS), an earth observation satellite launched by Japan.	➢ The flood coverage can be extracted through interpretation and analysis of satellite images. Thus, the flood coverage can be monitored. Furthermore, calibration of flood analysis models is possible using the extracted flood coverage. ➢ The ground cover can be identified using images to monitor the land usage status. The parameters of hydrologic/hydraulic models can be set and the asset distribution in the urban areas, etc. can be monitored. ➢ An observation satellite periodically captures images of the surface of the earth from a fixed satellite orbit. The satellite images are appropriate for periodical and continuous disaster monitoring.
2	Digital Elevation Model （DEM）	Digital Elevation Model: DEM consists of Digital Surface Model : DSM which express the height of any geographic feature and Digital Terrain Model: DTM which express the height of ground. Satellite DEM data is basically a surface model and not ground elevation. Typical free DSMs are ASTER-GDEM and Shuttle Radar Topography Mission (SRTM). Japan Aerospace Exploration Agency : JAXA has also publish AW3D30 which is about 30m resolution DEM acquired by ALOS1 satellite free of charge since 2015. Many high resolution DEMs are subject to fees.	➢ Satellite acquired DEM can be utilized as topographic data for developing a grid-type run-off model and inundation model while DSM has to be modified as the high value express building hight. ➢ Satellite acquired DEM generally can not be utilized for detail analysis of the flood control facilities due to its resolution.
3	Satellite Observed Precipitation	Satellite observed precipitation is measured by SAR satellite. Typical free satellite observed precipitations are Global Satellite Mapping of Precipitation: GSMaP of JAXA and 3B42RT of National Aeronautics and Space Administration (NASA)	➢ Satellite observed precipitation can be used as input data for run-off analysis. ➢ There are certain observation errors and therefore those errors have to be calibrated by ground monitored data. ➢ Spatial resolution of the satellite observed data is low such as 10km to 30km and therefore, it is diffictlt to apply for small reiver basins. ➢ Tempral resolution of the satellite observed data is 1 hour for GSMaP and 3 hours for 3B42RT. Therefore, is is difficult to apply for the reiver basins with shorter arrival time than above.

3.1.4 Current Status Monitoring and Needs Survey Methods

To confirm the current status of the disaster characteristics and disaster management measures in each country and to define the need for utilization of satellite information, interview surveys of the disaster management-related agencies in each country were conducted. The list of the visited agencies is shown in the appendix.

3.2 Summary of Current Status of Each Country

The current status of each ASEAN country was acquired from information collection and exchange of opinions, Internet access and the above-mentioned interview surveys of individual disaster management experts and projects and training cooperation agencies. The situation for the entire ASEAN is summarized below. The document “Summary of Current Status of Satellite Information Utilization of Each Country” attached in the appendix describes the current status of each of the ASEAN countries.

(1) Status of Utilization of Satellite Images for Monitoring of Flood Damage Status

The utilization of satellite images for monitoring of the flood damage status, which can identify the damage status using planar images, is effective as an objective means of monitoring. However, the ASEAN countries are utilizing satellite images differently depending on whether or not they have a satellite-related agency, their own global observation satellite, or an allocated budget. Figure 3-4 is based on the ownerships and operation durations of the countries’ own earth observation satellites, satellite-related agencies’ capacities for analyzing satellite images and status of utilization of satellite images for monitoring of flood damage status. In this figure compiled by the Study Team according to its subjective recognition, the horizontal axis shows how much experience the ASEAN countries have in utilizing satellite images to monitor the disaster status. The vertical axis shows the ASEAN countries ordered by the number of victims of floods that occurred in 1985 to 2014 (EM-DAT The International Disaster Database (http://www.emdat.be/)).

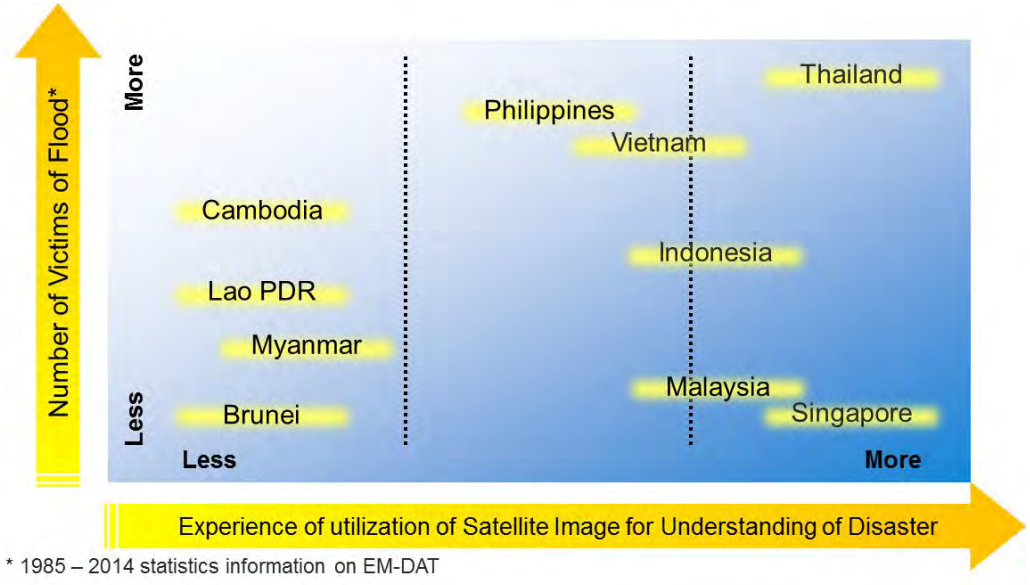


Figure 3-4 Status Quo of ASEAN Countries in Monitoring of Damage Status

Figure 3-4 shows that a country has made progress in utilizing satellite images to monitor the damage status if it has its own earth observation satellite or a space-related agency responsible for monitoring the damage status using satellite images and has a large number of victims of flood disasters. In contrast, a country that has a large number of victims but does not have its own earth observation satellite nor a space-related agency responsible for monitoring the damage status using satellite images will need support from surrounding countries that have their own earth observation satellites when flood damage occurs.

(2) Current Status of Flood Forecasting

Result of follow-up survey regarding current status of flood disaster management shows that there is no organization which utilizes satellite information (precipitation and topography) for conducting hydrological and hydraulic analysis.

Both Singapore and Malaysia are conducting flood control measures such as development of flood control plan, preparation of flood hazard map and development of flood early warning system by their own budget and efforts. The roles and the responsible organization regarding conduction of above activities are clearly defined in the two countries.

Brunei, Philippines, Thailand, Vietnam, and are also attempting to conduct flood control measures by their own budget and efforts, while the implementation is not sufficient yet. In addition, various donors have been supported for the implementation for those countries except for Brunei.

Cambodia, Indonesia Lao PDR, and Myanmar are attempting to conduct flood control measures with the support of donors for some part of their countries.

Singapore and Malaysia have sufficiently implement ground monitoring network for rainfall and water level. In Thailand and Malaysia, ground monitoring network have been implemented for main river basins, while its implementation in mountainous areas and other part of area is not sufficient. In

Philippines, ground monitoring network has been implementing rapidly but it takes more time to equip and operate sufficiently. In Indonesia, the system has been installed once but most of them are out of service due to the lack of maintenance. In Brunei, it is physically impossible to set up observation point at the upper stream where is covered by jungle with little accessible road. In Myanmar, Cambodia, and Laos, implementation of ground monitoring network is not sufficient as a whole.

Table 3-2 Current status of flood countermeasures with national budget by country

Country	Current status of flood countermeasures with national budget t		
	Flood management plan (by meteorological and hydrological analysis)	Risk evaluation (by meteorological and hydrological analysis)	Flood forecasting system
Indonesia	No	No	No
Cambodia	No	No	No
Brunei	Yes	No	No
Lao PDR	No	No	No
Malaysia	**Yes**	**Yes**	**Yes**
Myanmar	No	No	No
Philippines	No	**Yes**	No
Singapore	**Yes**	**Yes**	**Yes**
Thailand	**No**	**No**	**Yes**
Vietnam	Yes	No	No

3.3 Proposal on Satellite Information Utilization Plans

The proposal on satellite information utilization plans for ASEAN countries were drafted based on the present status of each country. The country-by-country proposal on utilization plans and efforts to realize the plans are summarized below according to disaster phase.

3.3.1 Brunei

Phase	Draft Utilization Plan	Efforts to Realize the Plan
Monitoring of Damage Status	[Survey Department, Ministry of Development: SD] ・Monitoring of disaster status utilizing satellite images [National Disaster Management Centre, Ministry of Home Affairs: NDMC] ・Use of the results of satellite image analysis by SD	・Satellite images are basically made available by SA, but if a request cannot be fulfilled by SA, it is necessary to examine the use of commercial satellites using the SD's image procurement budget. ・Geospatial information developed by SD is released on the GIS portal site, but it is desired to improve the joint use of data and the data dissemination method. ・There is a pressing need to formulate cross-organizational Standard Operating Procedure (SOP) for analysis and provision of analyzed results and make it known to the related agencies under the leadership of SD and NDMC. ・It is hoped to increase the number of analysis engineers at SD and continuously build up their capacity.
Flood forecasting	[NDMC] ・Utilization of satellite information in the area where meteorological observation stations have not installed in upper reach of the river basin. ・Construction of flood forecasting system utilizing analysis tool such as IFAS [University Brunei Darussalam /IBM Centre: UDB/IBM] ・Implementation of training for trainers who is involved in flood forecasting system construction utilizing satellite information.	・Although MD as well as NDMC are taking responsibility for the activities related to flood early warning, both MD and NDMC do not have sufficient skills and knowledges regarding conducting hydrological analysis yet. ・Therefore, it is necessary to establish the cooperative framework in which UDB/IBM, having developed own hydrological as well as hydraulic models in Brunei, gives long-term necessary training to MD and NDMC for conducting the following activity.
Flood management plan, hazard map	[Public Works Department, Ministry of Development: PWD] ・Utilization of satellite information in upper-jungle area ・Estimation of inundation area by using satellite information (precipitation and topography) and analysis tool such as IFAS and iRIC. [Universiti Brunei Darussalam/IBM Centre: UDB/IBM] ・Implementation of training for trainers in terms of risk evaluation (hazard analysis) by utilizing satellite information.	・PWD outsources formulation of flood control plan while no activity for preparing hazard map has been conducted. Therefore, the project team proposed PWD to conduct hazard assessment utilized the learned skills and knowledges through the project trainings. ・PWD does not have sufficient skills and knowledges regarding conducting hydrological and hydraulic analysis yet. Therefore, it is necessary to establish the cooperative framework in which UDB/IBM, having developed own hydrological as well as hydraulic models in Brunei, gives long-term necessary training to PWD.

3.3.2 Cambodia

Phase	Draft Utilization Plan	Efforts to Realize the Plan
Monitoring of Damage Status	[National Committee for Disaster Management: NCDM] ・ Monitoring of disaster status utilizing satellite images	・ As no budget is allocated for the purchase of satellite images, it is recommended to make positive use of SA. ・ It is hoped to realize the development of 1/25,000-scale topographic maps at an early stage. To cover the shortage of topographic maps, it is effective to utilize maps from open-sources such as OpenStreetMap. ・ It is recommended that NCDM undertakes analysis, but it does not have the technology to quickly analyze satellite images at present. So it is recommended to positively utilize the analysis services provided by SA. ・ It is necessary to prepare SOP for the analysis specifications and procedures.
Flood forecasting	[Department of Hydrology and River Works: DHRW] ・ Utilization of satellite information (precipitation and topography) in the area where the density of ground observation network is low. ・Construction of flood forecasting system by utilizing satellite information (precipitation and topography) and analysis tool such as IFAS. ・Implementation of training for trainers in terms of construction of flood forecasting system by utilizing satellite information.	・ Flood occurs and causes damages in the river basin with short flood arrival time and therefore, establishment of flood early warning system is necessary. ・ Although DHRW is responsible for flood early warning, DHRW still does not have sufficient skills and knowledges regarding conducting hydrological analysis. ・ Thus, it is necessary to establish long-term support system in which selected personnel of DHRW gives capacity enhancement activities to other DHRW in sustainable manners.
Flood management plan, hazard map	[Department of Meteorology: DOM] ・ Utilization of satellite information (precipitation and topography) in the area where the density of ground observation network is low. [DHRW】 ・Grasp of topographical situation and meteorological (precipitation) condition of the area disaster occurred by utilizing satellite topographical information and satellite images. Grasp of inundation-assumed area by utilizing satellite information (precipitation and topography) and analysis tool such as IFAS and iRIC. ・Implementation of training for trainers in terms of hazard analysis utilizing satellite information.	・ Attempt to utilize the free satellite information such as satellite images, DSM as well as rainfall data that can be download from the internet sites (e.g GLCF site of University of Maryland provides Landsat images, DSM and etc.) using the textbooks as well as reference materials which were supplied during the activities of the Project. 1) Grasp the topographical characteristics by using free GIS software (e.g., QGIS) and understanding of land covering situation by using free satellite images (e.g., LANDSAT from GLCF or images provided by SA during disaster) 2) Make a comparison between satellite precipitation (e.g., GSMaP) and DOM's precipitation data to verify the precision of satellite precipitation. ・ Conduct flood hazard analysis for the case of using ground monitoring station data as well as for the case of using satellite precipitation data and verify the analysis results. ・ Upon acknowledging the above verification, conduct flood hazard analysis in the area where the

Phase	Draft Utilization Plan	Efforts to Realize the Plan
		density of ground monitoring network is scarce. ・ Although DHRW is responsible for flood early warning, DHRW still does not have sufficient skills and knowledges regarding conducting hydrological analysis. ・ Thus, it is necessary to establish long-term support system in which selected personnel of DHRW gives capacity enhancement activities to other DHRW in sustainable manners.

3.3.3 Indonesia

Phase	Draft Utilization Plan	Efforts to Realize the Plan
Monitoring of Damage Status	[National Disaster Management Agency: BNPB], [Regional Disaster Management Agency: BPBD] ・ Understanding of satellite images [National Institute of Aeronautics and Space: LAPAN] ・ Providing support to the surrounding countries as SA's Data Analysis Node (DAN)	・ LAPAN has a tie-up with BNPB and BPBD, but it is necessary for BNPB and BPBD to deepen their understanding of satellite images. ・ LAPAN is registered as DAN, but the assistance in image analysis that it provided to other countries was insufficient. In particular, it is hoped that it will provide more active assistance to countries in which DAN is not fully functioning.
Flood forecasting	[BPBD] ・ Utilization of satellite information (precipitation and topography) in the area where the density of ground observation network is low. ・Construction of flood forecasting system by utilizing satellite information (precipitation and topography) and analysis tool such as IFAS. [Ministry of Public Works: PU] ・Implementation of training for trainers in terms of construction of flood forecasting system by utilizing satellite information.	・ Flood with short arrival time such as flash flood occurs and causes damages and therefore, establishment of flood early warning system is necessary. ・ As BPBD, disaster management organization, does not have enough skills and knowledges for conducting hydrological and hydraulic analysis, it is necessary to establish long-term support system in which PU which has skills and knowledges gives capacity enhancement activities to BPBD in sustainable manners.
Flood management plan, hazard map	[BPBD] ・ Utilization of satellite information (precipitation and topography) in the area where the density of ground observation network is low. ・Grasp of topographical situation and meteorological (precipitation) condition of the area disaster occurred by utilizing satellite information and satellite images. ・Grasp of inundation-assumed area by utilizing satellite information (precipitation and topography) and analysis tool such as IFAS and iRIC. [PU] ・Implementation of training for trainers in terms of hazard analysis by utilizing	・ Attempt to utilize the free satellite information such as satellite images, DSM as well as rainfall data that can be download from the internet sites (e.g GLCF site of University of Maryland provides Landsat images, DSM and etc.) using the textbooks as well as reference materials which were supplied during the activities of the Project. 1) Grasp the topographical characteristics by using free GIS software (e.g., QGIS) and understanding of land covering situation by using free satellite images (e.g., LANDSAT from GLCF or images provided by SA during disaster) 2) Make a comparison between satellite precipitation (e.g., GSMaP) and BMKG's

Phase	Draft Utilization Plan	Efforts to Realize the Plan
	satellite information (precipitation and topography). [Basin Management Office: BBWS, PU] ・Interpolation of information by using satellite information (precipitation and topography) in the area where the density of ground observation network is low. ・Formulation of flood management plan by using analysis tool such as IFAS and iRIC in the area where qualitative evaluation with meteorological and hydrological analysis has not been conducted.	precipitation data to verify the precision of satellite precipitation. ・ Conduct flood hazard analysis for the case of using ground monitoring station data as well as for the case of using satellite precipitation data and verify the analysis results. ・ Upon acknowledging the above verification, conduct flood hazard analysis in the area where the density of ground monitoring network is scarce. ・ As BPBD, disaster management organization, does not have enough skills and knowledges for conducting hydrological and hydraulic analysis, it is necessary to establish long-term support system in which PU which has skills and knowledges gives capacity enhancement activities to BPBD in sustainable manners.

3.3.4 Lao PDR

Phase	Draft Utilization Plan	Efforts to Realize the Plan
Monitoring of Damage Status	[Remote Sensing Center: RSC] ・ Monitoring of disaster status utilizing satellite images [Department of Disaster Management and Climate Change, Ministry of Natural Resources and Environment: DDMCC], [National Geographic Department, Ministry of Home Affairs: NGD] ・ Provision of information to RSC and tie-up with RSC	・ It is recommended to make positive use of SA because no budget for purchase of satellite images is available. ・ It is necessary to formulate cross-organizational SOP for satellite image analysis and provision of analysis results, and to make it known to the related agencies. SOP should clearly specify the functions of NGD as the agency for development of geospatial information and the method of cooperation with RSC. ・ It is necessary to continuously build up the capacity of the RSC analysis engineers.
Flood forecasting	[Department of Meteorology and Hydrology: DMH] ・ Utilization of satellite information (precipitation and topography) in the area where the density of ground observation network is low. ・Construction of flood forecasting system by utilizing satellite information (precipitation and topography) and analysis tool such as IFAS. [Natural Resources and Environment Institute: NREI] ・Implementation of training for trainers in terms of construction of flood forecasting system by utilizing satellite information.	・ Flood with short arrival time such as flash flood occurs and causes damages and therefore, establishment of flood early warning system is necessary. ・ Although DMH is responsible for flood early warning, DMH still does not have sufficient skills and knowledges regarding conducting hydrological analysis while NREI has the skills and knowledge with track record of supporting DMH. ・ Thus, it is necessary to establish long-term support system in which NREI gives capacity enhancement activities to DMH in sustainable manners.

Phase	Draft Utilization Plan	Efforts to Realize the Plan
Flood management plan, hazard map	[Department of Water Resources: DWR] ・ Utilization of satellite information (precipitation and topography) in the area where the density of ground observation network is low. ・ Grasp of topographical situation and meteorological (precipitation) condition of the area disaster occurred by utilizing satellite information and satellite images. ・ Grasp of inundation-assumed area by utilizing satellite information (precipitation and topography) and analysis tool such as IFAS and iRIC. [NREI] ・ Implementation of training for trainers in terms of hazard analysis by utilizing satellite information (precipitation and topography).	・ Attempt to utilize the free satellite information such as satellite images, DSM as well as rainfall data that can be download from the internet sites (e.g GLCF site of University of Maryland provides Landsat images, DSM and etc.) using the textbooks as well as reference materials which were supplied during the activities of the Project. 1) Grasp the topographical characteristics by using free GIS software (e.g., QGIS) and understanding of land covering situation by using free satellite images (e.g., LANDSAT from GLCF or images provided by SA during disaster) 2) Make a comparison between satellite precipitation (e.g., GSMaP) and DMH's precipitation data to verify the precision of satellite precipitation. ・ Conduct flood hazard analysis for the case of using ground monitoring station data as well as for the case of using satellite precipitation data and verify the analysis results. ・ Upon acknowledging the above verification, conduct flood hazard analysis in the area where the density of ground monitoring network is scarce. ・ As DWR does not have enough skills and knowledges for conducting hydrological and hydraulic analysis, it is necessary to establish long-term support system in which NREI gives capacity enhancement activities to DWR in sustainable manners.

3.3.5 Malaysia

Phase	Draft Utilization Plan	Efforts to Realize the Plan
Monitoring of Damage Status	[Malaysian Space Agency, Ministry of Science Technology and Innovation: ANGKASA] ・ Acquisition of satellite images [Malaysian Remote Sensing Agency, Ministry of Science Technology and Inovation: ARSM] ・ Monitoring of disaster status utilizing satellite images [National Disaster Management Agency: NDMA] ・ Provision of information to ANGKASA and ARSM and cooperation with both agencies	・ Positive use of SA is recommended continuously. If the requirement is not satisfied by SA, commercial satellite images purchased by ARSM will be used as complementary images. ・ Efforts are desired to increase number of organizations that provide information to the Malaysia Geospatial Online Services (MyGOS) (system for joint use of geospatial information) and utilize geospatial information more positively. ・ ARSM has the technology for and experience in satellite image analysis, but the problem is that image analysis takes so much time. It is recommended to make continuous efforts to build up its technical capacity to enable analysis in a shorter time and to formulate SOP to define the analysis specifications and procedures for more efficient analysis work.
Flood forecasting	[Department of Irrigation and Drainage: DID] ・Evaluation and improvement of existing flood forecasting system by installing of flood forecasting model using IFAS or iRIC	・ Construction of flood forecasting system by using modified hydrological model (such as IFAS and iRIC) concerning the effect of climate change for capacity enhancement of DID.
Flood management plan, hazard map	[DID] ・Prediction of climate change's impact by utilizing predicted precipitation (e.g., GSM) and meteorological and hydrological analysis model such as IFAS and iRIC.	・ Make a proposal of impact prediction for climate change by utilizing hydrological and hydraulic analysis model as flood damages have been caused recently by rainfall which exceeds the expectation.

3.3.6 Myanmar

Phase	Draft Utilization Plan	Efforts to Realize the Plan
Monitoring of Damage Status	[Emergency Operation Center, Relief and Resettlement Department, Ministry of Social Welfare, Relief and Resettlement: EOC] ・ Monitoring of damage status by simple analysis of images	・ It is necessary for EOC to realize the procurement of satellite images from SA at an early stage. ・ It is necessary to establish a disaster management agency that possesses satellite image analysis technology or is responsible for such analysis.
Flood forecasting	[Department of Meteorology and Hydrology: DMH] ・ Utilization of satellite information (precipitation and topography) in the area where the density of ground observation network is low. ・Construction of flood forecasting system by utilizing satellite information (precipitation and topography) and analysis tool such as IFAS.	Flood with short arrival time such as flash flood occurs recently and causes damages and therefore, establishment of flood early warning system is necessary. ・ DMH is hesitating to use the satellite information due to its accuracy. Thus, it is necessary to establish long-term support system in which selected personnel of DMH gives capacity enhancement activities to other DMH members in sustainable manners.

Phase	Draft Utilization Plan	Efforts to Realize the Plan
Flood management plan, hazard map	[Directorate of Water Resources and Improvement of river System: DWRI] ・ Utilization of satellite information (precipitation and topography) in the area where the density of ground observation network is low. ・ Grasp of topographical situation and meteorological (precipitation) condition of the area disaster occurred by utilizing satellite information and satellite images. ・ Grasp of inundation-assumed area by utilizing satellite information (precipitation and topography) and analysis tool such as IFAS and iRIC. ・ Implementation of hazard analysis by utilizing satellite information.	・ Attempt to utilize the free satellite information such as satellite images, DSM as well as rainfall data that can be download from the internet sites (e.g GLCF site of University of Maryland provides Landsat images, DSM and etc.) using the textbooks as well as reference materials which were supplied during the activities of the Project. 1) Grasp the topographical characteristics by using free GIS software (e.g., QGIS) and understanding of land covering situation by using free satellite images (e.g., LANDSAT from GLCF or images provided by SA during disaster) 2) Make a comparison between satellite precipitation (e.g., GSMaP) and DMH's precipitation data to verify the precision of satellite precipitation. ・ Conduct flood hazard analysis for the case of using ground monitoring station data as well as for the case of using satellite precipitation data and verify the analysis results. ・ Upon acknowledging the above verification, conduct flood hazard analysis in the area where the density of ground monitoring network is scarce. ・ DMH is hesitating to use the satellite information due to its accuracy. ・ Thus, it is necessary to establish long-term support system in which selected personnel of DMH gives capacity enhancement activities to other DMH in sustainable manners.

3.3.7 Philippines

Phase	Draft Utilization Plan	Efforts to Realize the Plan
Monitoring of Damage Status	[Office of Civil Defense, Department of National Defense: OCD], [Department of Public Works and Highway: DPWH], [Local Government Unit: LGU] ・ Registration as the users of the results of satellite image analysis. (It is necessary to determine the agency which is responsible for satellite image analysis in the event of flood occurrence.)	・ SOP for the transmission of information in the event of disaster occurrence has been established, but the agency to conduct analysis for monitoring the damage status is unclear and SOP for analyzing methods and analysis specifications has not been established. ・ It is necessary to define the agency which is responsible for analysis to monitor the damage status using satellite information and to formulate cross-organizational SOP for the related agencies at an early stage.
Flood forecasting	[Philippine Atmospheric, Geophysical and Astronomical Services Administration: PAGASA], [LGU] ・ Construction of flood forecasting system by utilizing satellite information (precipitation and topography) and	・ Flood with short arrival time such as flash flood occurs and causes damages and therefore, establishment of flood early warning system is necessary. ・ As LGUs are local government and do not have

Phase	Draft Utilization Plan	Efforts to Realize the Plan
	analysis tool such as IFAS. [PAGASA] ・Implementation of training for trainers in terms of construction of flood forecasting system utilizing satellite information.	enough skills and knowledges for conducting hydrological and hydraulic analysis, it is necessary to establish long-term support system in which PAGASA which is responsible for risk evaluation gives capacity enhancement activities to LGUs in sustainable manners.
Flood management plan, hazard map	[PAGASA], [LGU] ・ Utilization of satellite information (precipitation and topography) in the area where the density of ground observation network is low. ・Grasp of topographical situation and meteorological (precipitation) condition of the area disaster occurred by utilizing satellite information and satellite images. ・Grasp of inundation-assumed area by utilizing satellite information (precipitation and topography) and analysis tool such as IFAS and iRIC. [PAGASA] ・Implementation of training for trainers in terms of hazard analysis by utilizing satellite information (precipitation and topography). [DPWH] ・ Utilization of satellite information (precipitation and topography) in the area where the density of ground observation network is low. ・Consideration of high water level or flood control effect of dams by using IFAS ・ Hydrological consideration of flood control facilities by using iRIC.	・ Attempt to utilize the free satellite information such as satellite images, DSM as well as rainfall data that can be download from the internet sites (e.g GLCF site of University of Maryland provides Landsat images, DSM and etc.) using the textbooks as well as reference materials which were supplied during the activities of the Project. 1) Grasp the topographical characteristics by using free GIS software (e.g., QGIS) and understanding of land covering situation by using free satellite images (e.g., LANDSAT from GLCF or images provided by SA during disaster) 2) Make a comparison between satellite precipitation (e.g., GSMaP) and PAGASA's precipitation data to verify the precision of satellite precipitation. ・ Conduct flood hazard analysis for the case of using ground monitoring station data as well as for the case of using satellite precipitation data and verify the analysis results. ・ Upon acknowledging the above verification, conduct flood hazard analysis in the area where the density of ground monitoring network is scarce. ・ As LGUs are local government and do not have enough skills and knowledges for conducting hydrological and hydraulic analysis, it is necessary to establish long-term support system in which PAGASA which is responsible for risk evaluation gives capacity enhancement activities to LGUs in sustainable manners. ・ Implementation of capacity development activities for DPWH regarding hydrological and hydraulic analysis utilizing satellite information.

3.3.8 Singapore

Phase	Draft Utilization Plan	Efforts to Realize the Plan
Monitoring of Damage Status	[Center for remote Imaging, Sensing and Processing, National University of Singapore: CRISP] ・ Support for the surrounding countries in monitoring flood damage status	・ Singapore has a favorable environment with no large-scale disasters, and no major problems are evident in utilization of satellite information in terms of information and technology. ・ CRISP provides support for the surrounding countries in monitoring the damage status in the event of a disaster such as flood. In future, it is expected that CRISP will continue to provide assistance in the event of a disaster occurrence and fulfil the function of supporting capacity buildup in the utilization of satellite information in ASEAN countries, as one of the leading entities in ASEAN together with the AHA Centre.
Flood forecasting	[Meteorological Service Singapore: MSS], [Public Utilities Board: PUB] ・Provision of support to neighboring countries for meteorological and hydrological analysis, utilization of precipitation information, and construction of early warning system. （Implementation of training for trainers in terms of construction of flood forecasting system utilizing satellite information.）	・ It is recommended that the PUB supports ASEAN countries regarding conducting capacity enhancement of hydrological and hydraulic analysis under the scheme of ACDM where AHA takes a major role.
Flood management plan, hazard map	[PUB] ・Provision of support to neighboring countries for meteorological and hydrological analysis. （Implementation of training for trainers in terms of risk evaluation utilizing satellite information.）	・ It is recommended that the PUB supports ASEAN countries regarding conducting capacity enhancement of hydrological and hydraulic analysis under the scheme of ACDM in which AHA takes a major role.

3.3.9 Thailand

Phase	Draft Utilization Plan	Efforts to Realize the Plan
Monitoring of Damage Status	[Geo-Informatics and Space Technology Development Agency, Ministry of Science and Technology: GISTDA] ・ Provision of satellite images and assistance for satellite image analysis and provision of training programs to ASEAN countries	・ Assistance to ASEAN countries is provided as the space technology related agency under MOST, but a tie-up with TICA is required. ・ It is hoped to establish Asian Research and Training Center for Space Technology & Application (ARTSA) at an early stage and acquire the budget for its operation.
Flood forecasting	Royal Irrigation Department: RID], [Department of Water Resources: DWR], [Department of Disaster Prevention and Mitigation: DDPM] ・Provision of support to neighboring countries for meteorological and hydrological analysis, utilization of precipitation information, and construction of early warning system. （Implementation of training for trainers in terms of construction of flood forecasting system utilizing satellite information.）	・ Flood with short arrival time such as flash flood occurs in mountainous area and causes damages and therefore, establishment of flood early warning system is necessary. ・ As DDPM, disaster management organization, does not have enough skills and knowledges for conducting hydrological and hydraulic analysis, it is necessary to establish long-term support system in which RID which has enough track record of conducting hydrological and hydraulic analysis and TMD which has track record of utilizing satellite information give capacity enhancement activities to DDPM in sustainable manners.

Phase	Draft Utilization Plan	Efforts to Realize the Plan
Flood management plan, hazard map	[DDPM] ・Utilization of satellite information (precipitation and topography) in the area where the density of ground observation network is low. ・Grasp of topographical situation and meteorological (precipitation) condition of the area disaster occurred by utilizing satellite information and satellite images. ・Grasp of inundation-assumed area by utilizing satellite information (precipitation and topography) and analysis tool such as IFAS and iRIC. [RID], [Thai Meteorological Department: TMD] ・Implementation of training for trainers in terms of hazard analysis by utilizing satellite information (precipitation and topography). [DWR] ・Formulation of flood management plan for the area where master plan has not been prepared, especially in northeast region, by using IFAS and iRIC. ※It is necessary to clarify the targeting organization and area through five small committee of Thai government.	・Attempt to utilize the free satellite information such as satellite images, DSM as well as rainfall data that can be download from the internet sites (e.g GLCF site of University of Maryland provides Landsat images, DSM and etc.) using the textbooks as well as reference materials which were supplied during the activities of the Project. 1) Grasp the topographical characteristics by using free GIS software (e.g., QGIS) and understanding of land covering situation by using free satellite images (e.g., LANDSAT from GLCF or images provided by SA during disaster) 2) Make a comparison between satellite precipitation (e.g., GSMaP) and TMD's precipitation data to verify the precision of satellite precipitation. ・Conduct flood hazard analysis for the case of using ground monitoring station data as well as for the case of using satellite precipitation data and verify the analysis results. ・Upon acknowledging the above verification, conduct flood hazard analysis in the area where the density of ground monitoring network is scarce. ・As DDPM, disaster management organization, does not have enough skills and knowledges for conducting hydrological and hydraulic analysis, it is necessary to establish long-term support system in which RID which has enough track record of conducting hydrological and hydraulic analysis and TMD which has track record of utilizing satellite information give capacity enhancement activities to DDPM in sustainable manners. ・Implementation of capacity development of DWR for hydrological and hydraulic analysis utilizing satellite information.

3.3.10 Vietnam

Phase	Draft Utilization Plan	Efforts to Realize the Plan
Monitoring of Damage Status	[National Remote Sensing Department, Ministry of Natural Resources and Environment: NRSD] ・ Formulation of SOP for effective use of SA, for image procurement and analysis, and for joint use of information [Department of Natural Disaster Prevention and Control, Minister of Agriculture and Rural Development: DNDPC] after separation from [Department of Dyke Management Flood and Storm Control, Ministry of Agriculture and Rural Development: DDMFSC] ・ Cooperation with NRSD	・ NRSD is registered as DAN, but awareness within the country is lacking. Its positive activity as DAN is also required. ・ It is necessary to formulate SOP urgently. At this time, thorough mutual discussions between NRSD and DNDPC are required.
Flood forecasting	[DNDPC] ・Capacity development and improvement of rainfall prediction technique by using IFAS. ・Construction of flood forecasting system utilizing satellite information (precipitation and topography) and analysis tool such as IFAS. [Vietnam Academy for Water Resources: VAWR] ・Implementation of training for trainers in terms of construction of flood forecasting system utilizing satellite information.	・ Flood with short arrival time such as flash flood occurs in mountainous area and causes damages and therefore, establishment of flood early warning system is necessary. ・ As DMC, disaster management organization, does not have enough skills and knowledges for conducting hydrological and hydraulic analysis yet, it is necessary to establish long-term support system in which VAWR which is research institute gives capacity enhancement activities to DMC in sustainable manners.
Flood management plan, hazard map	[DNDPC] ・ Utilization of satellite information (precipitation and topography) in the area where the density of ground observation network is low. ・Grasp of topographical situation and meteorological (precipitation) condition of the area disaster occurred by utilizing satellite information and satellite images. ・Grasp of inundation-assumed area by utilizing satellite information (precipitation and topography) and analysis tool such as IFAS and iRIC. [VAWR] ・Implementation of training for trainers in terms of hazard analysis by utilizing satellite information (precipitation and topography).	・ Attempt to utilize the free satellite information such as satellite images, DSM as well as rainfall data that can be download from the internet sites (e.g GLCF site of University of Maryland provides Landsat images, DSM and etc.) using the textbooks as well as reference materials which were supplied during the activities of the Project. 1) Grasp the topographical characteristics by using free GIS software (e.g., QGIS) and understanding of land covering situation by using free satellite images (e.g., LANDSAT from GLCF or images provided by SA during disaster) 2) Make a comparison between satellite precipitation (e.g., GSMaP) and NHMS's precipitation data to verify the precision of satellite precipitation. ・ Conduct flood hazard analysis for the case of using ground monitoring station data as well as for the case of using satellite precipitation data and verify the analysis results. ・ Upon acknowledging the above verification,

Phase	Draft Utilization Plan	Efforts to Realize the Plan
		conduct flood hazard analysis in the area where the density of ground monitoring network is scarce ・ As DNDPC, disaster management organization, does not have enough skills and knowledges for conducting hydrological and hydraulic analysis yet, it is necessary to establish long-term support system in which VAWR which is research institute gives capacity enhancement activities to DNDPC in sustainable manners.

Chapter 4 Project Outputs

4.1 ASEAN Initiatives

4.1.1 Assessment by AHA Centre of Development Needs of ASEAN Countries for Satellite Utilization

During the three years in which this Project was implemented, the AHA Centre understood that the ASEAN countries have development needs for utilization of satellites. As development needs, it was proposed that training related to utilization of satellite information should be continued to expand the utilization methods for satellite information and that the AHA Centre itself should collaborate with the ASEAN countries and conduct disaster monitoring analysis as emergency responses.

To meet the development needs, the AHA Centre is required to take the lead in enhancing not only the network with the ASEAN countries but also the relationship with the resources such as instructors and related agencies and thus ensure the utilization of satellite information during emergency responses. Furthermore, the AHA Centre expressed its intention to secure the budget to utilize high-resolution satellite images in emergency and examine acquiring the capacity to analyze images in response to a disaster and quickly monitor the damage status when a disaster occurs.

The AHA Centre also recognizes the necessity to develop guidelines for acquiring satellite image data for emergency responses in collaboration with the United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UNSPIDER) and the Economic and Social Commission for Asia and the Pacific (UNESCAP).

4.1.2 Identification by AHA Centre on Response Skills for Utilization of Satellites of ASEAN Countries

Many of the ASEAN countries have not yet taken sufficient flood disaster prevention measures such as development of an observation network, formulation of disaster management plans, and issue of forecasting or warning through monitoring. Under such circumstances, it is exceedingly important for the future disaster responses that this training helped the countries with underdeveloped observation networks recognize that they would be capable of issuing flood forecasts and making risk assessment without cost by utilizing the satellite information (rainfall and topographic features). The textbooks and reference materials developed in this Project will be extremely useful when the AHA Centre takes the lead in providing similar programs in the future.

4.1.3 Building a Relationship with the AHA Centre and Training Resources

Through the implementation of the Project over three years it was confirmed with the AHA Centre that a relationship was built with the instructors, observation tour destinations and other resources necessary for implementation of training in satellite image analysis and flood analysis using satellite information, and the trip to Japan for observation of flood control measures and satellite information utilization.

Furthermore, lecture materials, teaching aids and management know-how necessary for implementing trainings and observation visits were also accumulated.

Upon completion of the Project, a list of training resource contacts and a set of training materials were provided to the AHA Centre by the Project Team. As satellite-related technologies and analysis techniques are evolving on a daily basis, the content needs to be kept updated and improved, but it will be very useful when the AHA Centre initiates similar programs in future.

4.1.4 Strengthening the AHA Centre-led Network of Disaster Management Officers

The broad network of disaster management officers was strengthened by the training over the three years. It was mentioned by the AHA Centre that the network centered around the AHA Centre was strengthened. In the future, it is vital to continuously provide training in which the AHA Centre is involved at the planning stage and thus continue to strengthen the AHA Centre-led network of disaster management officers.

4.2 Capacity Building Initiatives in Satellite Information Utilization

4.2.1 Acquisition of Basic Skills in Satellite Image Utilization

Through the training in acquisition and analysis of satellite images for the monitoring of damage status, the 56 disaster management officers from ASEAN countries acquired basic skills in satellite image utilization, including basic knowledge of earth observation satellites and satellite images and how to obtain and interpret satellite images.

As for basic knowledge of earth observation satellites and satellite images, the participants studied the basics of satellite image utilization, learning about the main satellite features, orbits and image capture methods, the mechanism of image capture, image resolution, bands, color adjustment, etc. As for the methods of obtaining satellite images, they learned about Landsat and SA, important sources of satellite images for the majority of countries and organizations. As for satellite image interpretation, they learned in particular about SAR images which are expected to be used more and more in future, together with hands-on practice in displaying and interpreting images. Visits to facilities involved in development and operation of satellites on the observation trip to Japan furthered their understanding of the training content.

As described above, the disaster management officers from ASEAN countries were able to acquire basic skills in use of satellite images through the Project.

4.2.2 Acquisition of Runoff and Inundation Analysis Methods Using Satellite Images

The 55 participants engaged in disaster prevention, river management and meteorology from ASEAN countries who participated in the training in satellite information utilization for flood analysis learned how to obtain and use GSMaP satellite observations of rainfall and DEM data such as ASTER GDEM as well as acquiring skills related to hydrological and hydraulic analysis using IFAS and iRIC analysis tools.

As basic knowledge of hydrological and hydraulic analysis, the participants studied the mechanism of runoff and inundation, an overview of analysis methods, and the effectiveness of information and satellite

information required for analysis. Satellite information is particularly useful for ASEAN countries which lag behind in development of meteor-hydrological observation networks and topographical information. As well as learning how to use satellite observations of rainfall (GSMaP, etc.) and DEM (ASTER GDEM, GTOPO30, etc.) which can be obtained free of charge via the internet, the participants also learned about the issue of satellite information accuracy. Further, simple survey methods using laser surveying equipment were introduced as a way of obtaining river cross-section data required for flood prediction and hydraulic analysis of river channels. Based on this basic knowledge, the participants then practiced flood prediction using IFAS and inundation analysis using iRIC.

Through the lectures and hands-on training, the ASEAN disaster management officers were able to acquire the basic skills necessary for building flood risk assessment and flood prediction systems using satellite information.

4.2.3 Mastery of Satellite Image Utilization Methods in Event of Disaster and for Risk Assessment

Through the training in acquisition and analysis of satellite images for the monitoring of damage status and the observation tour to Japan, a total of 115 disaster management officers from ASEAN countries studied cases of satellite image utilization in the event of various disasters, learned how to obtain satellite images in the event of disaster and how to interpret the affected area using satellite images, and also learned about risk assessment.

As for cases of satellite image utilization, the participants studied the procedures from occurrence of the disaster to provision of outputs by timeline. As for the method of obtaining satellite images in times of disaster, the participants studied the procedures from imagery request to data download using the actual website for SA, a typical source. Further, the participants also performed emergency flood map creation and PDNA on their own using actual satellite images and software.

Since a certain level of experience and training are required to acquire satellite image analysis and interpretation skills, it would be hard to say that the participants had completely mastered how to utilize satellite images in disaster response and risk assessment simply by participating in the training, but they were deemed to have mastered the basic techniques necessary for future satellite image utilization. As the participants basically used satellite images and software that can be obtained free in their own countries in the training implemented in the Project, it is hoped that they will continue their training with reference to the lecture materials and manuals and utilize their skills in their actual work.

In a move towards promotion of satellite information utilization, the challenges to formulation and realization of utilization plans based on the current situation in each country were summarized and distributed to the relevant organizations. It is hoped that in future each country will take steps to make the most of the techniques and experience gained through the Project.

4.3 Holding of Workshop

4.3.1 Purpose of Workshop

In this Study, the AHA Centre was given the explanation on the Draft Final Report (DF/R) as the output

of the Project for Capacity Development for Immediate Access and Effective Utilization of Satellite Information for Disaster Management in the ASEAN Region on June 1. Furthermore, this opportunity of visit was utilized to hold a workshop to gain extensive feedback on the output from the disaster management agency of Indonesia and other related agencies and exchange opinions with them on the future promotion of utilization of satellite information and images.

4.3.2 Workshop Schedule

The workshop was held at LOTUS 8 & 9 of INTERCONTINENTAL JAKARTA MIDPLAZA on June 2, 2016. The workshop schedule is shown below. In this schedule, the morning was allocated to the report of project outputs by the Study Team and AHA Centre while the afternoon was allocated to opinion exchange to promote utilization of satellite information and images in the future.

10:00 – 10:15	Opening Speech (1) JICA (Mr. Makoto KASHIWAYA, Principal Representative for ASEAN Coordination) (2) AHA Centre (Mr. Janggam Adhityawarma, Senior Disaster Preparedness and Response Officer)
10:15 – 10:45	Explanation of the Project Result
10:45 – 11:00	Q&A
11:00 – 11:30	Project Result from AHA Centre *Including Q&A
11:30 – 13:15	Lunch Break
13:15 – 14:45	Next Step & Discussion *Including Q&A, 20min Coffee Break
14:45 – 14:55	Wrap up
14:55 – 15:00	Closing by JICA (Mr. Atsushi SOMA, Deputy Director, Disaster Management Team 1, Water Resource and Disaster Management Group, Global Environment Department)

4.3.3 Participants

Participants were invited not only from the AHA Centre and the ASEAN Secretariat but also organizations that handle satellite images, organizations involved in flood prevention, and weather organizations in order to collect extensive opinions on utilization of satellite information in Indonesia in the future. Table 4-1 shows a list of participants.

Table 4-1 List of Participants in the Workshop

Agency	Deputy / Division / Center	Confirmed Workshop Attendees
Regional Disaster Management Agency DKI (BPBD DKI)	Regional Disaster Management Agency DKI (BPBD DKI)	Mr. Basuki Rakhmat Ms. Ratih Damayanti Ms. Priyanka P. Raramitha Mr. Aditya Bagus Wijaya
Indonesia Institute of Aeronautics and Space (LAPAN)	Technology and Data Center	Ms. Gusti Darma Yodha Mr. Andy Indredjeid Ms. Nonandivi Dawi S. Ms. Liasa Fibriawafi
	Application Center	Mr. Danaug S.
Meteorological Climatological and Geophysical Agency (BMKG)	Earthquake and Early Warning	Ms. Weniza
National Disaster Management Agency (BNPB)	Data Information Division	Mr. Agus Uifur
	Disaster Management Preparedness	Mr. Medi Herlianto
Ministry of Public Work and Housing (PU)	Directorate of River and Coastal	Mr. Andi Pamungkas
National Search and Rescue Agency (BASARNAS)	National Search and Rescue Agency	Mr. Ade Dian Permana, S.A.P., M. Si. Mr. Angga Kusuma, SE. Mr. Edi Purwito Aji, S. Kom, M. Kom. Mr. Arief Widiyantoro, S. Kom.
Geospatial Information Agency (BIG)	Management and Dissemination Geospatial	Ms. Murdoningnh Ms. Feonani Ayuningnh
ASEAN Coordinating Centre for Humanitarian Assistance on Disaster Management (AHA Centre)		Mr. Janggam Adhityawarma Mr. Bachtiar Andy Musaffa
The ASEAN Secretariat	Environment Division, Sustainable Development Directorate, ASEAN Socio-Cultural Community Department	Ms. Riena Prasiddha
Japan International Cooperation Agency	Deputy Director, Disaster Management Team 1, Water Resource and Disaster Management Group, Global Environment Department, Headquarters	Mr. Atsushi SOMA

Agency	Deputy / Division / Center	Confirmed Workshop Attendees
	JICA Indonesia Office	Mr. Makoto KASHIWAYA Mr. Shuichi HIRAYAMA Mr. Shigeki Ishigaki
	JICA Expert (BNPB)	Mr. Takafumi Shinya Mr. Haryono Hansen Sirait (Staff of Mr. Takafumi) Ms. Ciza Maulwa (Staff of Mr. Takafumi)

4.3.4 Outputs of Project

The Project outputs explained in the workshop were understood by the AHA Centre personnel and workshop participants, who also understood the effectiveness of utilization of satellite information. The strengthening of the network was confirmed to be important by the personnel of the AHA Centre and the Indonesian government agencies who participated in the workshop. They had an opinion that it should be further strengthened. Furthermore, they understood that this Project built a network between the ASEAN countries and the instructors, observation tour destinations and other resources necessary for implementation of training in satellite image analysis and flood analysis using satellite information, and the trip to Japan for observation of flood control measures and satellite information utilization.

The afternoon session for opinion exchange for promotion of utilization of satellite information and images in the future was allocated to (1) Explanation and discussion on the possibilities of utilization of satellite information in flood responses and (2) Explanation on the private-sector emergency responses to a disaster and discussion on the status quo in Indonesia.

Figure 4-1 Photos of Workshop

(1) Explanation and discussion regarding satellite information utilization possibility in flood management

The project team explained current situation of flood disasters in Indonesia, development status of ground observation network, current situation of flood countermeasures, and necessity of satellite information utilization. Then, the project team delivered question to participants about realistic cooperative framework among various agencies in Indonesia for taking countermeasures against flood. The comments of participants are as follows.

BNPB

- Even though BNPB is responsible for disaster management nationwide, activities which should be taken in disaster are not specified. On the other hand, as BPBD is disaster management agency in local government, BPBD is responsible for disaster management in each area. Thus, it can be said that BPBD has responsibility for risk evaluation and flood early warning.
- To realize the scheme, various ministries and agencies have to work together, however, in a real sense, it is not easy to construct such cooperative scheme among various agencies in Indonesia in general.
- Considering the current status of data availability in Indonesia, necessity of satellite information is understandable.

BMKG

- Activities and outputs of the project are reasonable. It seems good idea to utilize satellite information. As for the project output, BMKG considers that the project objectives have been achieved. BMKG would like to request sharing the project output.
- BMKG considers that technical support as well as provision of necessary information is needed for conduction of risk evaluation and for establishing flood warning system in Indonesia,
- BMKG has experiences of conducting hydrological analysis by using HEC-RAS which is free analytical tool while BMKG does not have such experience with using IFAS and iRIC.

BIG

- BIG has been conducting emergency rapid mapping right after disasters.

LAPAN

- It seems good idea to utilize satellite information for risk evaluation and early warning. LAPAN also has experience of preparing hazard map in limited area. This attempt was experimental and the targeting area was small.
- Topographic data is relatively well prepared while the coverage of ground monitoring network is not sufficient enough considering the whole area of Indonesia. Thus LAPAN agrees the utilization possibility of satellite information.

(2) Explanation on Private-sector Emergency Responses to Disaster and Discussion on Status Quo in Indonesia

The Study Team showed PASCO's emergency response manual in relation to emergency responses to a disaster. The Study Team picked up as an example the earthquake that occurred in Kumamoto, Japan on April 14, 2016 and explained how PASCO acted according to the emergency response manual.

Outline of explanation

- For emergency responses to a disaster, it is important to accumulate spatial information at normal times (such as satellite images, aerial photographs, and topographic maps). The information should be updated every year so that it is always up to date.
- After the Kumamoto Earthquake occurred, the response team was immediately called to duty. The respective departments made plans for satellite image acquisition and aerial photography and requested the implementation departments. On the following day, SPOT satellite images were already acquired. The Study Team explained this procedure, showing actual e-mail messages shared by the response team.
- The procedure in which landslides were identified was explained while comparing the normal-time and disaster-time satellite images. The necessity of accumulation of satellite images at normal times was thus explained.

The participating organizations gave the opinions shown below.

LAPAN and BIG

- The participants commented that, in Indonesia, the National Institute of Aeronautics and Space (LAPAN) accumulated normal-time satellite images and that the data was being updated. They also commented that the Geospatial Information Agency (BIG) supplied 1/50,000 topographic maps as normal-time spatial information.
- Although the private sector in Indonesia does not conduct responses described in the above, LAPAN itself is conducting similar responses. According to BIG, aerial photography for emergency responses is taken by BNPB.
  *This point was not confirmed because the participants from BNPB had left their seats.
- The participants gave their consent that satellite images are effective in monitoring the disaster status in emergency and that it is important to give quick responses to acquire satellite images when a disaster occurs.

4.4 Recommendations

Based on the outputs of this Project, the following recommendations are made.

4.4.1 Promotion of Utilization of Sentinel Asia Analysis Services

This Project provided the participants from the disaster management agencies with training on acquisition and analysis of satellite images to allow them to learn how to monitor the damage status using satellite images. However, it is necessary to continue to provide training on image analysis and increase the number of experienced personnel to allow them to actually conduct this procedure when a disaster occurs. To efficiently assess disaster damage using satellite images, the organization responsible for satellite image analysis must be clearly defined, but it was evident from the survey carried out in the Project that there are countries where such an organization does not exist. Furthermore, even when the organization in charge of satellite image analysis was clearly specified, in some cases it could not be said to have adequate skills or human resources. On the other hand, although use of SA to procure satellite images is progressing in each country, it was confirmed that the analysis services provided by SA are not actively utilized.

Since SA's analysis services are very useful particularly for countries with no clearly defined organization responsible for satellite image analysis in time of disaster and for organizations that lack technical skills and human resources, it is recommended that the name recognition of the analysis service of SA is improved and actively utilized in each of the countries. The possible methods for improving the name recognition are that the contact for SA or DAN in each country advertises the analysis service in the meetings for disaster management in each country and that the utilization of SA's analysis service is clearly stated in the SOP regarding the monitoring of the damage status using satellite information of each country.

4.4.2 Current Status of Satellite Information Utilization in Preparation and Mitigation

In this project, a total of 170 participants from ASEAN countries participated in 3 (Three) year trainings consist of training for utilization of satellite image for grasping disaster situation, training for hydrological and hydraulic analysis utilizing satellite information and training in Japan for obtaining the knowledge on disaster management and the measures in Japan.

In the trainings, capacity enhancement activities for conducting hydrological and hydraulic analysis for implementing flood control measures in “Prepared ness” and “Mitigation” phase utilizing free satellite information (image, precipitation, topography) as well as free analytical tools.

The major disasters occurred in ASEAN countries is flood while the skills and knowledges for flood control measures as well as the implementation of ground observation network are not sufficient enough in many countries in ASEAN in this current condition.

The skills for implementing flood control measures as well as the implementation of the ground monitoring network is not sufficient enough in many ASEAN countries.

Under given conditions, utilization of satellite information with obtained skills and knowledge through the trainings of the project can promote implementing flood counter measures.

Result of questionnaire survey to participants shows that almost all participants think it is useful to utilize free satellite information (precipitation and topography) and free analysis tool (IFAS and iRIC) for taking flood countermeasures, and they reported the consideration to their boss. However, no empirical utilization of satellite information is conducted so far.

Possible reasons for the disuse are described as follows.

- Limitation by English ability

  Generally, participants especially from countries in Indochina peninsula are not good at communicating in English while participants from Singapore, Philippines, and Malaysia are relatively good at English communication (including reading and writing). Therefore it is difficult to expect that person who did not participate in this training can improve his/her techniques with English textbook provided in this training by own effort.
- Apprehension of accuracy regarding analysis output

  On conducting hydrological and hydraulic analysis utilizing satellite information (precipitation and topography), the accuracy of the result is limited and is depend on the utilization status of ground observation data for its interpolation and calibration.

  On the other hand, in many countries in ASEAN, extremely high accuracy is required for forecasting for the release to public due to lack of understanding of limitation by recipients. In many cases, the data is released by top down approach, so if the natural phenomena is not as same as expected, the forecasting agency or person is to be blamed. Thus, under the situation in which expansion of observation network as well as the skills and knowledge are not sufficient, people tends to hesitate to implement such analysis. As a result, utilization of satellite information has not been promoted.
- Daily works, remaining power, role-sharing

  As staff is usually busy for daily works, it is necessary to attend training or seminar like this

training to obtain new technique or knowledge. In addition, the obtained technique or knowledge has not incorporated in daily works so far due to daily workload as well as the reluctance due to above mentioned reasons.

In addition, even though the necessity of disaster reduction or advance preparation is well recognized, the role and the responsibility among related agencies and organizations are not clearly defined in the countries where the implementation of such measures is delayed.

Therefore each member cannot take their responsibility clearly and properly for conducting disaster management.

As the utilization of satellite information is not conducted as expected, it is necessary to promote the utilization of satellite by recognizing its efficiency as well as usefulness through the simple utilization activities as described as follows.

1) Translation of textbooks and reference materials prepared in this project into local language

In this project, textbooks and reference materials were prepared in English. These materials should be translated in local language in order to promote utilization of satellite information.

2) Activities regarding accuracy recognition of satellite information

In this project, accuracy of analysis output in satellite information utilization was briefly mentioned and detailed information for evaluation was not provided. Therefore, provision of such information as well as evaluation of analytical results are required for further utilization of satellite information.

3) Grasping of topographical situation and meteorological (precipitation) situation in disaster area by utilizing satellite topographical information and satellite image

It is quite useful to put participants through the experience of recognizing the usefulness of satellite information by grasping topographic conditions, vegetation as well as location of residential area by utilizing free satellite image and topographic information from the internet site such as GLCF of Maryland University with free analytical tool such as QGIS. In addition, grasping the precipitation condition by utilizing free satellite precipitation information is also useful for the participants for further promoting the utilization of satellite information.

After the recognition of usefulness as well as the simplicity of utilization of satellite information, grasp the relationship among the topographic, vegetation, residential area and run-off amount.

In addition, it is necessary to confirm the accuracy of satellite information by comparing with the ground observation data.

4) Prioritize Risk Evaluation

For conducting meteorological and hydrological analysis, it is desirable to use ground observation data. However, ground observation network is not sufficiently implemented in many countries in ASEAN. Therefore utilization of satellite information is indispensable to implement flood control measures for reducing flood damages.

On the other hand, satellite information (precipitation and topography) have a limit on accuracy. Especially in formulating flood management plan, satellite information can be used for holistic approach or can be used as compliment data for regional analysis. Especially, it is not applicable for the area where the subtle differences of height of the buildings and topographic features affect the behavior
Regarding the structural measurement, it takes long time to implement considering financial situation in ASEAN countries. On the other hand, flood damage can be decreased with relatively small budget and brief time by conducting risk evaluation and provision of information to local population regarding risks as well as raising public awareness. Therefore it is necessary to prioritize risk evaluation.
On the other hand, for the area where the vulnerability to flood is high and the measures are urgently required, individual projects supported by donors are suitable.

5) Establishing long-term supporting scheme

An organization which is responsible for risk evaluation and flood early warning construction is usually disaster management organization or local government, not a river administrator, so many of these do not have skills and knowledge of meteorological and hydrological analysis. Therefore, it is not realistic to expect them to conduct verifying as well as calibrating analysis output and to transfer the learned skills and knowledge to other members in their own country. Therefore, it is necessary to establish the scheme in which training of trainers is given to members of agencies such as river management agency which is responsible for hydrological and hydraulic analysis for realizing long-term sustainable capacity enhancement activities toward above members.

6) Cooperation with AADMER WORK PROGRAMME 2016-2020

AADMER WORK PROGRAMME 2016-2020 was endorsed by ACDM in February 2016, and the program started in April. In AADMER WORK PROGRAMME 2016-2020, activities targeting Risk Aware will be carried out as Programme1. In order to evaluate disaster risks and improve risk recognition in ASEAN community, this program set three outputs: 1) Strengthening of risk and vulnerability evaluation in ASEAN, 2) Improvement of availability for data and information such as data relating to area risk and vulnerability, and 3) Improvement of data availability and information sharing system.
In ASEAN countries, it is expected that utilization of satellite information will be promoted by clarifying the importance of the risk evaluation through active involvement into this program.

Appendices

1. List of Participants

Key: A = Training in Obtaining and Analyzing Satellite Images for the Monitoring of Damage Status, B = Training in Utilization of Satellite Information for Flood Analysis, C = Observation Trip in Japan

Name	Organization	Department	Position	2013			2014			2015		
				A	B	C	A	B	C	A	B	C
Brunei												
Abdul Rahim Ismail	National Disaster Management Centre (NDMC)	---	Special Duties Officer Grade I		○	○						
Mohamad Adib Bin Matali	National Disaster Management Centre (NDMC)	---	Special Duties Officer Grade II		○	○						
Ainun Binti Haji Abdul Rahman	Survey Department (SD), Ministry of Development	Photogrammetry and Remote Sensing Unit	Chief Survey Technician				○	○	○			
Hajah Suryanny Haji Mohamad	Public Works Department (PWD), Ministry of Development	Department of Drainage and Sewerage	Drainage Engineer				○	○	○			
Merzuki Haji Latip	Public Works Department (PWD), Ministry of Development	Drainage Section/Division	Acting Executive Engineer/ Head of Hydrology Unit				○	○	○			
Azale Bin Haji Abdul Salim	Survey Department (SD), Ministry of Development	Survey Department	Senior Survey Technician								○	○
Cambodia												
Ly Chandara	National Committee for Disaster Management (NCDM)	Cabinet of Second Vice president	Executive Assistant to Senior Minister in Charge of Second Vice President of NCDM		○							
Mao Saohorn	National Committee for Disaster Management (NCDM)	Department of Emergency Response and Rehabilitation	Technical Officer in Emergency Response		○	○						

Name	Organization	Department	Position	2013			2014			2015		
				A	B	C	A	B	C	A	B	C
Thin Phirun	National Committee for Disaster Management (NCDM)	Secretariat General of NCDM	Executive Assistant to Senior Minister in Charge of Second Vice President of NCDM	○		○						
Meas Rasmey	National Committee for Disaster Management (NCDM)	Secretary General Office	Assistant to Secretary-General	○								
Phlang Ponleu Rath	National Committee for Disaster Management (NCDM)	National Committee for Disaster Management	Deputy Director of Information and International Relations				○					
Lonh Nrak	National Committee for Disaster Management (NCDM)	National Emergency Coordination Center	Information and Communication Technology Officer				○		○			
Sao Samphear	Ministry of Water Resources and Meteorology (MOWRAM)	Administration and Human Resource	Chief of Human Resource Development					○	○			
Chim Kosal	Ministry of Water Resources and Meteorology (MOWRAM)	Hydrology and River Work	Official					○				
Phlang Ponleu Rath	National Committee for Disaster Management (NCDM)	Information and International Relations Department	Deputy Director							○	○	○
Lonh Nrak	National Committee for Disaster Management (NCDM)	National Emergency Coordination Center (NECC)	Information and Communication Technology Officer							○	○	○
Indonesia												
Sridewanto Edi P	National Disaster Management Agency (BNPB)	---	---		○							
Endang Achadiat	Jakarta Regional Disaster Management Agency (BPBD Jakarta)	Emergency and Logistic Division	Emergency Section Chief		○	○						

Name	Organization	Department	Position	2013			2014			2015		
				A	B	C	A	B	C	A	B	C
Rangga Bima Setiawan	Jakarta Regional Disaster Management Agency (BPBD Jakarta)	Informatics and Controlling	Staff of Controlling	○	○	○						
Aulia Ismi Savitri	National Disaster Management Agency (BNPB)	---	---	○								
Omar Hasyadi	Jakarta Regional Disaster Management Agency (BPBD Jakarta)	Planning Sub Division	Financial Planner				○	○	○			
Muhammad Iskandarsyah	Jakarta Regional Disaster Management Agency (BPBD Jakarta)	Informatics section, Informatics and Controlling Division	---				○	○	○			
Asfirmanto Wasono Adi	National Disaster Management Agency (BNPB)	Disaster Risk Reduction Directorate	Disaster Risk Analyst							○	○	○
Tri Utami Handayaningsih	National Disaster Management Agency (BNPB)	Disaster Risk Reduction Directorate	Risk Management Analyst							○		
Meysita Noormasari	National Disaster Management Agency (BNPB)	Center for Data, Information and Public Relations	GIS and Spatial Analyst								○	
Ni Made Kesuma Astuti Indrianingsih Putri	National Disaster Management Agency (BNPB)	Center for Data, Information and Public Relations	Data Fields Staff									○
Lao PDR												
Sombath Douangsavanh	National Disaster Management Office (NDMO)	Social Welfare Department	Technical Officer	○	○	○						

Name	Organization	Department	Position	2013			2014			2015		
				A	B	C	A	B	C	A	B	C
Vimala Khounthalangsy	National Disaster Management Office (NDMO)	Social Welfare Department	Technical Staff	○		○						
Phonesavanh Saysompheng	National Disaster Management Office (NDMO)	Social Welfare Department	Technical Officer				○		○			
Phanida Narkkhavong	Ministry of Science and Technology (MOST)	Department of Technology and Innovation	Technical				○					
Phonethavy Thammavongso	National Disaster Management Office (NDMO)	Social Welfare Department	Technical Officer					○	○			
Sinthaly Chanthana	Department of Meteorology and Hydrology (DMH)	Weather Forecasting and Aeronautical Division	Deputy Head of Weather Forecasting and Aeronautical Division					○				
Ped Saiyasit	Ministry of Natural Resource and Environment (MoNRE)	Department of Disaster Management and Climate Change, Division of Preparedness and Response	Technician							○		
Xailee Xayaxang	Ministry of Natural Resource and Environment (MoNRE)	Department of Disaster Management and Climate Change, Division of Preparedness and Response	GIS and Disaster Database Technical Staff							○	○	○
Ekkaphanh Phommala	Ministry of Natural Resource and Environment (MoNRE)	Department of Water Resources Water Resources Data Information Center	Technical Officer								○	

Name	Organization	Department	Position	2013			2014			2015		
				A	B	C	A	B	C	A	B	C
Malaysia												
Mageshwari Valachamy	Malaysia Centre for Geospatial Data Infrastructure (MaCGDI), Ministry of Natural Resources and Environment (NRE)		Assistant Director		○							
Wan Mohd Sulaiman Bin W. Ismail	Department of Irrigation and Drainage (DID), Ministry of Natural Resources and Environment (NRE)	Flood Management Division	Deputy Director	○		○						
Mariyam Binti Mohamad	Malaysia Centre for Geospatial Data Infrastructure (MaCGDI), Ministry of Natural Resources and Environment (NRE)		Deputy Director	○		○						
Md Syafawie Bin Md Amin	National Security Council, Prime Minister's Department	Disaster Management Division	Assistant Secretary	○								
Mohd Anuar bin Ismail	National Security Council, Prime Minister's Department	Federal Territory of Kuala Lumpur	State Security Secretary				○		○			
Noor Mazlan Muhammad Noor	Public Works Department (JKR)	Slope Engineering Branch	Senior Assistant Director				○					
Wan Hazdyazad Bin Wan Abdul Majid	Department of Irrigation and Drainage (DID), Ministry of Natural Resources and Environment (NRE)	Flood Management Division	Assistant Director					○				
Mohd. Johari bin Md. Sharif	Department of Survey and Mapping Malaysia (JUPEM)	National Geospatial Database Division	Assistant of Director					○	○			

Name	Organization	Department	Position	2013			2014			2015		
				A	B	C	A	B	C	A	B	C
Rosmadinor Bin Mohamad	National Security Council, Prime Minister's Department	Disaster Management	Meteorologist							○		○
Mohammad Azizi Bin Fadzil	Malaysian Remote Sensing Agency (MRSA)	Processing & Distribution of Remote Sensing Data	Research Officer							○		
Goh Yee Cai	National Hydraulic Research Institute of Malaysia (NAHRIM), Ministry of Natural Resources and Environment (NRE)	Water Resources and Climate Change Research Centre	Research Officer								○	
Siti Hawa Adila Binti Mohd Yusof	Department of Irrigation and Drainage (DID), Ministry of Natural Resources and Environment (NRE)	Flood Management	Assistant Director								○	○
Myanmar												
Thiri Maung	Relief and Resettlement Department (RRD)	Coordination and Research Division	Staff Officer	○	○	○						
Khaing Mar Lar Kyaw	Relief and Resettlement Department (RRD)	Emergency Operation Center	Junior Staff Officer	○	○	○						
Hlaing Cho Oo	Relief and Resettlement Department (RRD)	Lower Division, Emergency Operation Centre	---				○					
Myint Myint Aye	Department of Meteorology and Hydrology (DMH), Ministry of Transportation	National Meteorological Centre	Deputy Superintendent				○					
Thu Ta Soe	Relief and Resettlement Department (RRD)	Sagaing Regional Office	Information Moderator					○				
Myo Myat Thu	Department of Meteorology and Hydrology (DMH), Ministry of Transportation	Hydrological Division	Senior Observer					○	○			
Houng Hlee	Relief and Resettlement Department (RRD)	Coordination and Research	Information Moderator						○			

Name	Organization	Department	Position	2013			2014			2015		
				A	B	C	A	B	C	A	B	C
Than Win Soe	Relief and Resettlement Department (RRD)	Hninthata Disaster Management Training Center	Staff Officer							○		
Kyaw Swar Htwe	Relief and Resettlement Department (RRD)	Myaung Mya District office	Assistant staff officer							○		
Thandar Aung	Relief and Resettlement Department (RRD)	Emergency Operation Centre	Junior Officer								○	
Thin Win Khaing	Department of Meteorology and Hydrology (DMH), Ministry of Transportation	Hydrological Division	Deputy Superintendent								○	○
Kyaw Ohn Lwin	Relief and Resettlement Department (RRD)	State Office Kayah	Chief Officer									○
Philippines												
Jose Ignacio Valera	Office of Civil Defense (OCD)	Operations	Chief		○	○						
Nivagine C. Nievares	Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA)	Hydro-Meteorology Division	Weather Specialist I		○	○						
Ronald Libron Villa	Office of Civil Defense (OCD)	Training Section	Chief	○								
Adelaida Castillo Duran	Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA)	Hydro-Meteorology Division	Weather Specialist I	○								
RHONALYN L. VERGARA	Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA)	Hydro-Meteorology Division	Weather Specialist I				○					
Aljerico A. Alcala	The National Mapping and Resource Information Authority (NAMRIA)	GISMB/ Geospatial Database Management Division	Information Technology Officer II				○					
Richard C. Orendain	Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA)	Hydro-Meteorology Division	Hydrologist					○	○			

Name	Organization	Department	Position	2013			2014			2015		
				A	B	C	A	B	C	A	B	C
Grecile Christopher R. Damo	Department of Public Works and Highways (DPWH)	Unified Managed Project Office - Flood Control Management Cluster	Engineer IV					○	○			
Romeo M. Dalodado	Mines and Geosciences Bureau (MGB)	CARAGA Regional Office No.XIII, Geosciences Division (GSD)	Chief, Geosciences Division							○		○
Margaret P. Bautista	Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA)	Department of Science and Technology	Assistant Weather Services Chief							○		
Maria Visna Mar Manio	Department of Public Works and Highways (DPWH)	Bureau of Maintenance(BOM)	Director III								○	○
Hilton T. Hernando	Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA)	Department of Science and Technology	Assistant Weather Services Chief								○	
Singapore												
Yeo Geok Kuan	Singapore Civil Defence Force (SCDF)	Operations Department	Assistant Director (Operations Readiness)	○		○						
Fu Jinhe	Singapore Civil Defence Force (SCDF)	Operations Department Operations Centre	Rota Commander							○		
Navin S/O Balakrishnan	Singapore Civil Defence Force (SCDF)	Operations Department Operations Centre	Rota Commander									○
Thailand												
Anchalee Phanpanya	Ministry of Interior, Department of Disaster Prevention and Mitigation (DDPM)	Disaster Mitigation Directing Center	General Administration Officer Professional level	○	○	○						

Name	Organization	Department	Position	2013			2014			2015		
				A	B	C	A	B	C	A	B	C
Amnat Phonmart	Ministry of Interior, Department of Disaster Prevention and Mitigation (DDPM)	Disaster Prevention Criteria Bureau	Civil Engineer, Senior Professional level		○							
Vichet Amnouyporn	Ministry of Interior, Department of Disaster Prevention and Mitigation (DDPM)	Disaster Prevention Criteria Bureau	Civil Engineer Practitioner Level	○		○						
Korakot Potisat	Ministry of Interior, Department of Disaster Prevention and Mitigation (DDPM)	Disaster Prevention and Mitigation Regional Center 18 Phuket	Policy and Plan Analyst, Professional Level				○	○	○			
Wichit Chuncuansungkom	Ministry of Interior, Department of Disaster Prevention and Mitigation (DDPM)	Disaster Prevention Criteria Bureau	Civil Engineer Senior Professional Level				○	○	○			
Kannika Pluemjai	Ministry of Interior, Department of Disaster Prevention and Mitigation (DDPM)	Disaster Prevention and Mitigation Provincial Office, Suratthani Province	Policy and Plan Analyst							○	○	○
Palida Puapun	Ministry of Interior, Department of Disaster Prevention and Mitigation (DDPM)	Research and Development Division, Research and International Cooperation Bureau	Policy and Plan Analyst							○	○	○
Vietnam												
Doan Thanh Chung	Department of Dyke Management and Flood, Storm Control (DDMFSC)	Southern Flood and Storm Prevention Center	Director		○	○						
Nguyen Xuan Tung	Department of Dyke Management and Flood, Storm Control (DDMFSC)	Flood and Storm Control Division	Official		○	○						
Nguyen Van Hoang	Department of Dyke Management and Flood, Storm Control (DDMFSC)	Flood and Storm Control Centre for Central and Highland Regions	Official	○								

Name	Organization	Department	Position	2013			2014			2015		
				A	B	C	A	B	C	A	B	C
Nguyen Van Anh	Department of Dyke Management and Flood, Storm Control (DDMFSC)	Flood and Storm Control Division	Official	○								
Nguyen Huu Duc	Department of Dyke Management and Flood, Storm Control (DDMFSC)	Dyke Manager Division	Official				○					
An Quang Hung	Disaster Management Center (DMC)	Information and Statistic Division	Deputy head of Information and Statistic Division				○					
Duong Duc My	Department of Dyke Management and Flood, Storm Control (DDMFSC)	Flood and Storm Management Division	Official					○	○			
Pham Doan Khanh	Disaster Management Center (DMC)	Community-based Disaster Risk Management Division	Deputy Head					○	○			
Nguyen Vinh Long	Ministry of Agriculture and Rural Development (MARD)	Department of Natural Disaster Prevention and Control (DNDPC), Sub-Department of Natural Disaster Prevention and Control in Central and Highland Regions	Officer of Sub-Department							○	○	○
Tran Thanh Van	Ministry of Agriculture and Rural Development (MARD)	Disaster Management Center (DMC) Geoinfomatic Division	Official							○		
Nguyen Thi Thu Trang	National Centre for Hydro-Meteorological Forecasting (NCHMF)	Hydrological Forecasting Division for the Central, Highland and Southern Regions of Viet Nam	Forecaster								○	

Name	Organization	Department	Position	2013			2014			2015		
				A	B	C	A	B	C	A	B	C
Nguyen Trong Uyen	Ministry of Agriculture and Rural Development (MARD)	Directorate of Water Resources	Officer									○
AHA Centre												
Janggam Adhityawarma	AHA Centre	---	Senior Disaster Monitoring and Analysis Officer		○	○						
Andy Musaffa	AHA Centre	---	Disaster Monitoring & Analysis Officer	○		○						
Yos Malole	AHA Centre	Operation	Preparedness and Response Officer (ERAT)				○		○			
Andy Musaffa	AHA Centre	---	Disaster Monitoring & Analysis Officer					○	○			

2. Training Contents

(1) Training in Obtaining and Analyzing Satellite Images for the Monitoring of Damage Status

The following lectures and practical training was carried out in this training. Note that the training content was repeatedly improved throughout the 3 years, and here the documents for the third year are used.

A: Methods of Obtaining Satellite Data and Images

A-1: Introduction to SA, Practical Training in the Method of Requesting Emergency Images (Instructor: JAXA)

Initially the instructor introduced the earth observation satellite ALOS-2, introduced SA, and introduced the training programs provided by SA. Also, the SA mechanisms, Joint Project Team (JPT) members, the satellites used, details of their main activities and examples, and the mechanism for providing data (WINDS), etc., were introduced.

Next, the instructor explained the relationship between the flow of emergency images to SA and the International Disaster Charter (IDC), and the method of requesting emergency images. Then the participants received practice in accessing the SA website, requesting emergency images, and the method of downloading the images.

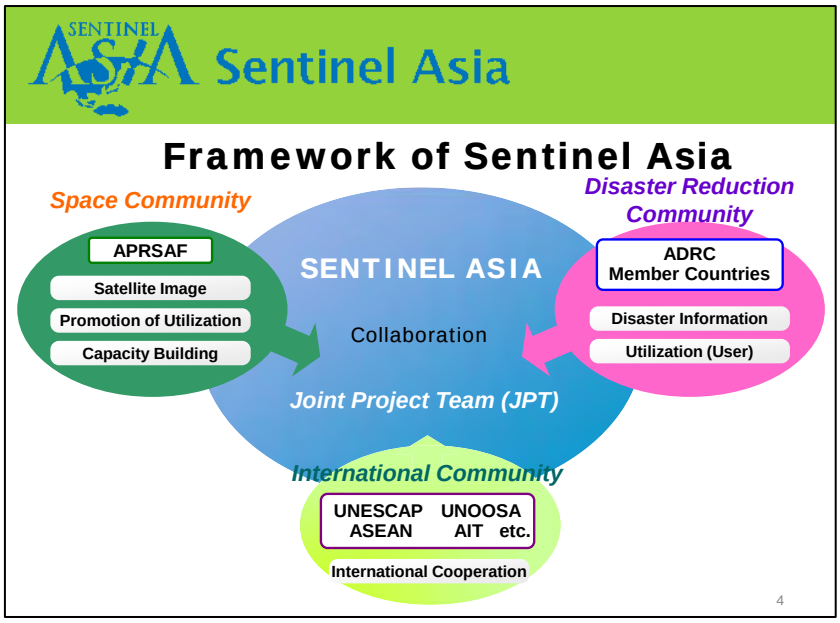


Fig. Sentinel Asia Mechanism

Fig. Image of Training in Requesting Emergency Images

A-2: Examples of Utilization of Satellite Data (Instructor: RESTEC)

The instructor introduced examples of the utilization of optical and SAR satellite images. Specifically climate change, vegetation monitoring, forestry management, ocean monitoring, earthquakes, landslides, floods, volcano activity, and other disaster monitoring were described as individual themes, actual images and analysis results were presented, and the information obtained was explained.

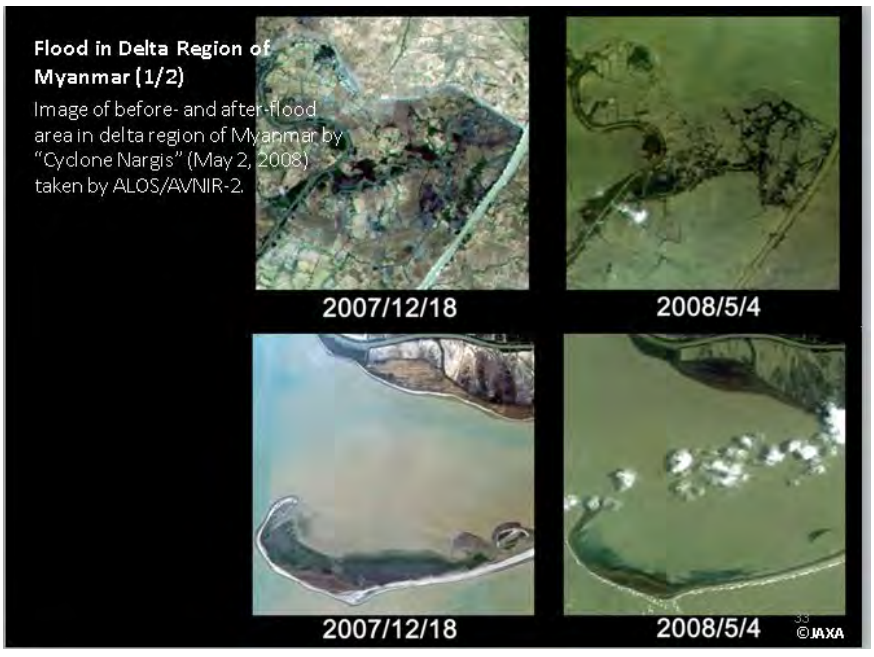


Fig. Example of Comparison of Satellite Images before and after Flooding

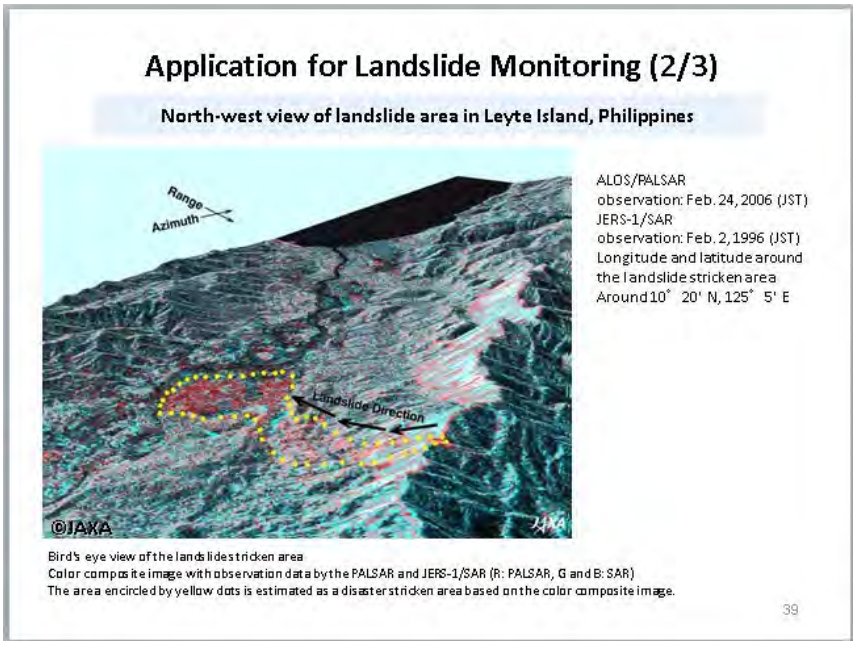


Fig. Example of Landslide Monitoring

A-3: Basic Principles of Optical and SAR (Instructor: RESTEC)

First, the instructor provided an overview of remote-sensing, the role of satellite remote-sensing when a disaster occurs, types of satellites, orbits and periods, the differences between optical and SAR, resolution, etc., using illustrations and examples so that it can be understood by beginners. For example, in the explanation about orbits and periods, it was explained that it is not possible to take a satellite image at any time and any where, etc., and the restrictions on the utilization of satellite images that should be known by persons engaged in disaster prevention and the reasons for these restrictions were described.

Next, as basic knowledge of SAR images, an overview and the characteristics of microwaves, the mechanisms of image taking, reflections, noise, shadows, geographical errors on images, etc., were explained. In addition, as basic knowledge of optical images, wavelengths, bands, color synthesis, the structure of digital images, the characteristics of typical optical satellites, etc., were explained.

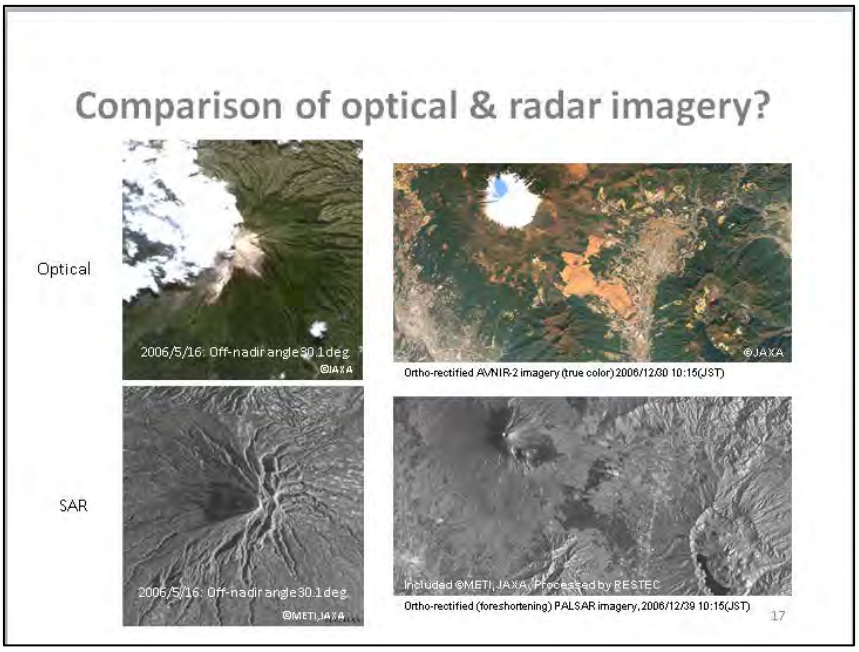


Fig. Differences in Viewing Optical Images and SAR Images

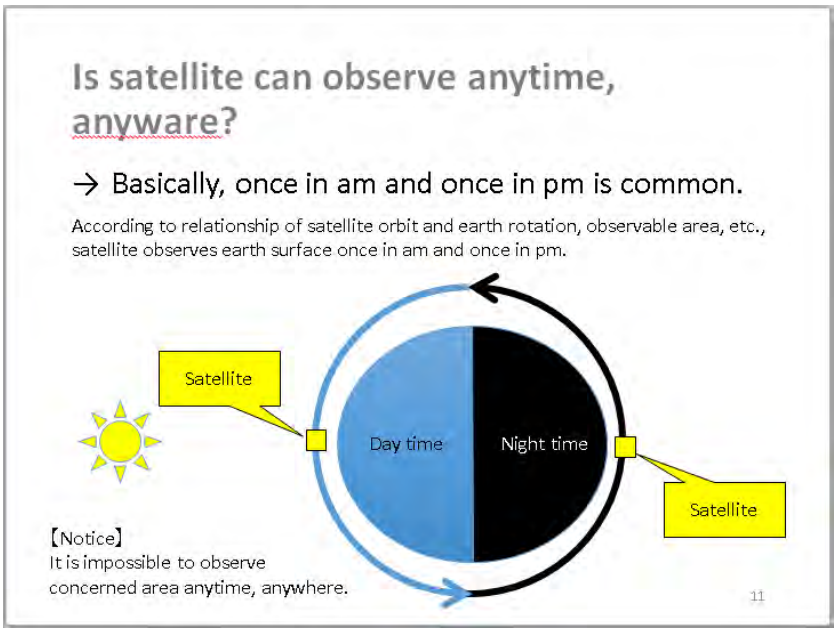


Fig. Timing at which Satellite Images can be Taken

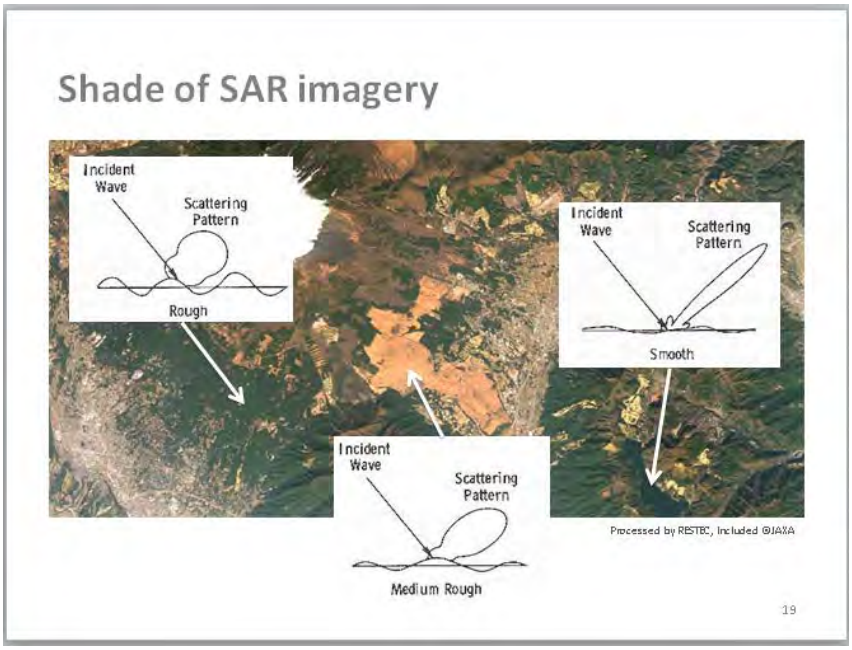


Fig. Shadows on SAR Image

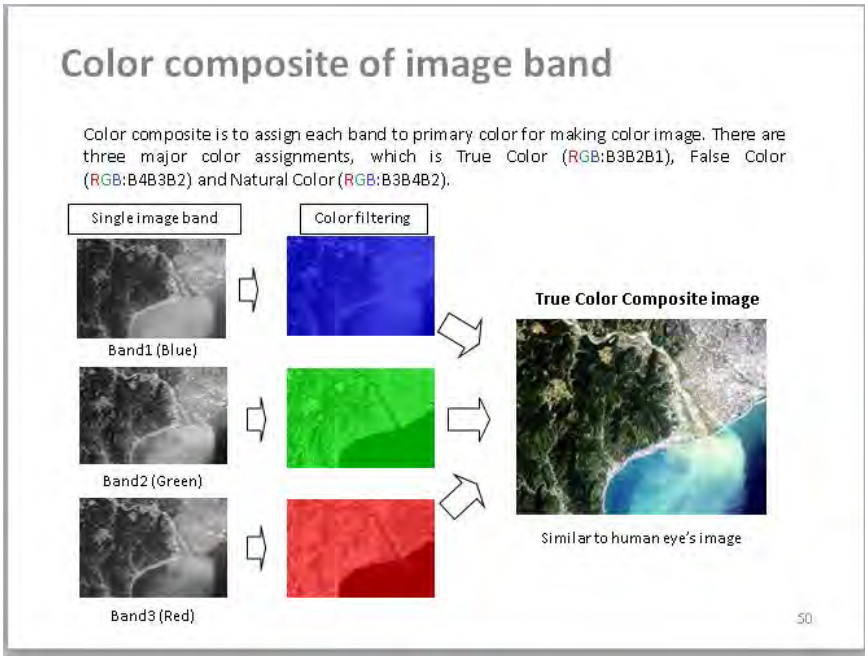


Fig. Display of Bands and Colors

A-4: Visualization of Optical Images and Analysis training (Instructor: RESTEC)

First, the instructor introduced optical images that can be obtained free of charge, and then as a typical example gave an overview of LANDSAT-8 and the specific method of obtaining images.

Next, under the guidance of the instructor, the participants practiced displaying LANDSAT-8 images, image interpretation, extracting changes, etc., using QGIS.

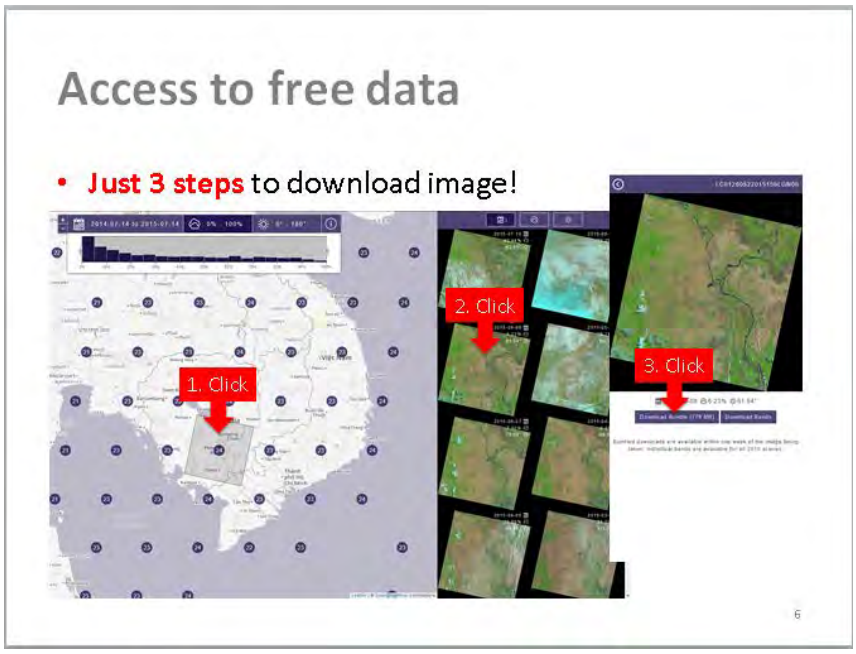


Fig. Method of Obtaining LANDSAT-8 Images

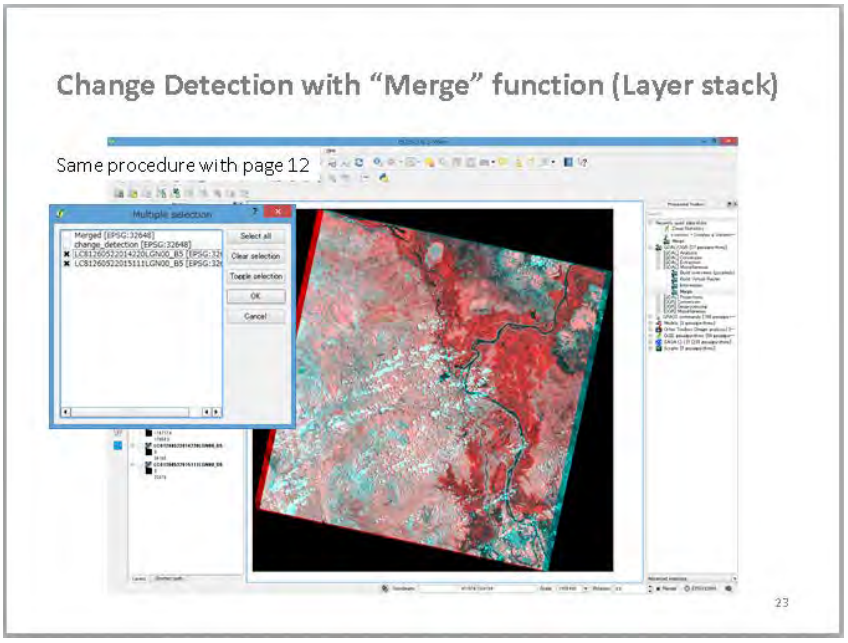


Fig. Image of Extracting Changes using an Optical Image

A-5: Visualization of SAR Images and Analysis Training (Instructor: RESTEC)

First, an example of identification of the extent of flooding using SAR images was introduced, and then the principles of identification of the extent of flooding and the procedures for classifying water and non-water areas on SAR images were explained.

Next, under the guidance of the instructor, the participants practiced visualization and analysis of SAR images using PALSAR ReMap and QGIS, which are analysis software for ALOS/PALSAR and ALOS-2/PALSAR-2. Visualization and analysis techniques for SAR images which can be taken even

in rainy weather will become more and more important for those responsible for disaster prevention, so more than half a day was spent on practical training.

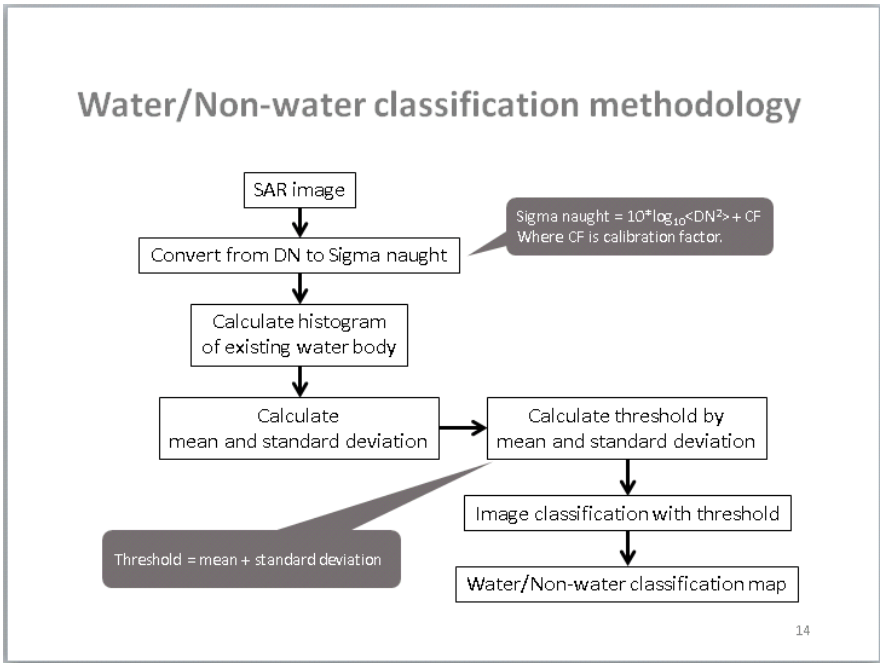


Fig. Procedure for Classification of Water and Non-water Areas

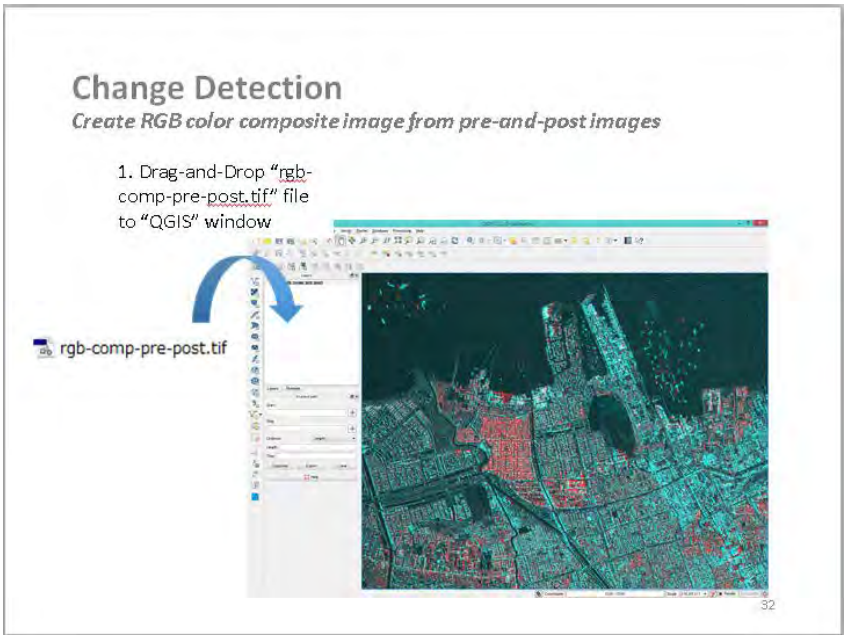


Fig. Image of Change in Land Coverage Using SAR Image

A-6: Examples of Utilization of SA and the International Disaster Charter (Instructor: AIT)

First the instructor presented an overview of SA and the International Disaster Charter (IDC), and then described the details of the emergency response activities actually undertaken by SA and IDC as a time series using as examples Typhoon Ruby in the Philippines (2014), landslides in Nepal and

Tajikistan (both in 2014), and the earthquake in Nepal (2015). In addition, the lessons learned and the issues arising from these activities were described using specific examples, such as the importance of satellite images before the occurrence of the disaster for determining the disaster status, the importance of preparation of standard procedures in accordance with the type of disaster, and the importance of exchanges between the relevant organizations in the affected country and the participants carrying out the analysis.

Next, the “Database Development for Emergency Response and Disaster Management”, which is one mini-project by JAXA, was described.

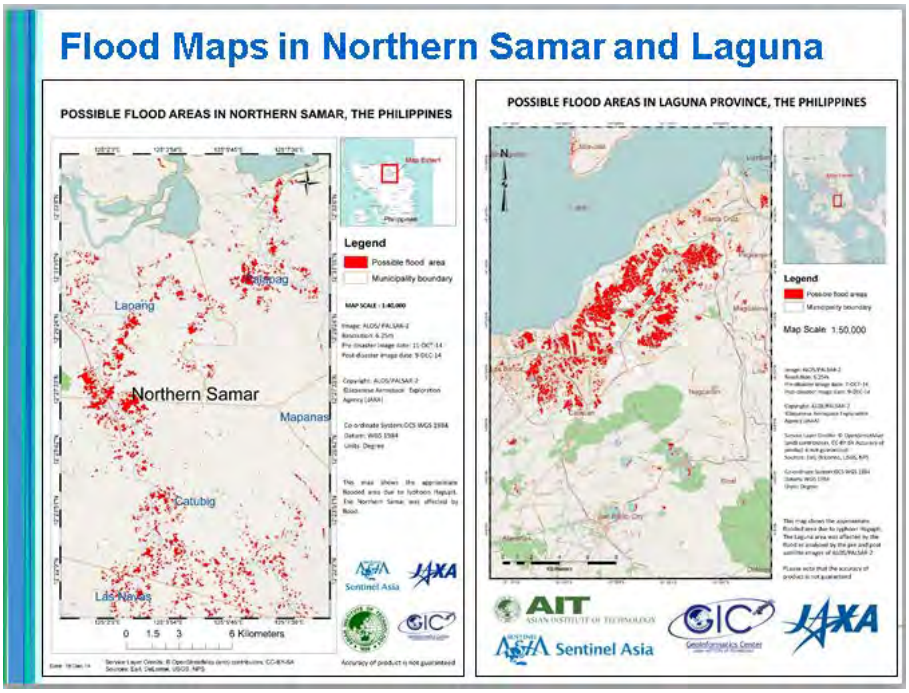


Fig. Example of Analysis Report for Floods that Occurred in the Philippines

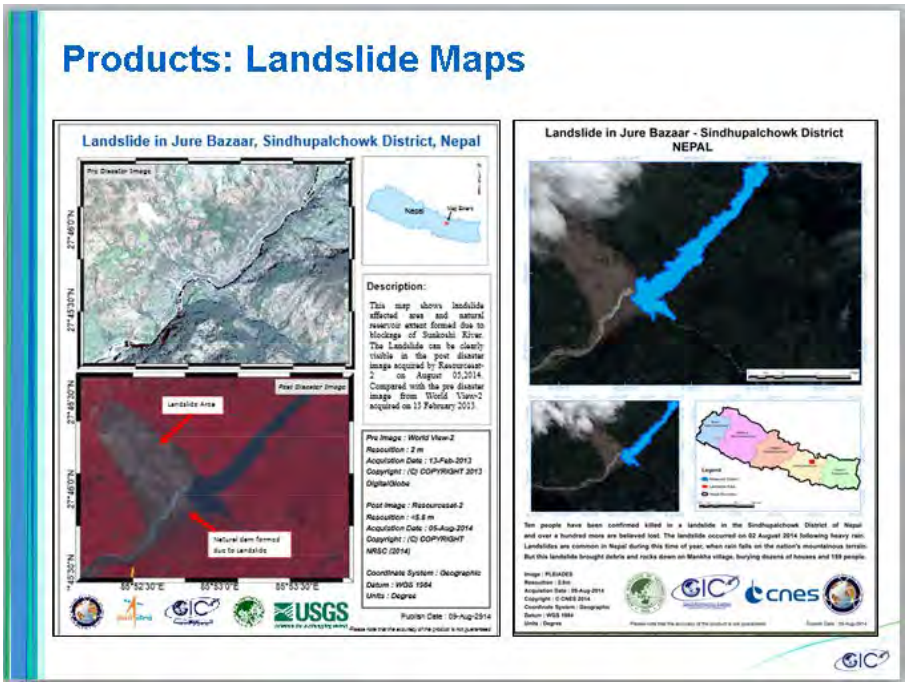


Fig. Example of Analysis Report for Landslide that Occurred in Nepal

B: Analysis of Disaster Extent and Disaster Status using SAR Images

B-1: Utilization and Obtaining Method of Commercial Satellite Images (Instructor: PASCO)

The instructor provided an overview of satellite images, requesting images during an emergency and the necessary prior operations, characteristics of the main commercial satellite images, costs, methods of obtaining, etc.

B-2: Method of Interpretation of SAR Images and Field Surveys for Interpretation (Instructor: PASCO)

The instructor and the participants went outdoors, and the instructor explained how to view features on SAR images, by comparing actual features such as buildings, roads, water areas, etc., with SAR images. Specifically, viewing features on the surface were confirmed including double reflections and shadows of buildings, reflections from specular surfaces such as roads and water areas, as well as the appearance of towers, fences, ground surface, etc., together with points to note during interpretation.

Fig. View of Field Survey

B-3: Overview and Practice on Preparation of Emergency Flooding Maps Using SAR Images before and after the Disaster (Instructor: PASCO)

Regarding preparation of emergency flooding maps using satellite images, first the instructor presented an overview of the work flow procedure and the main outputs. The example of response to the Great East Japan Earthquake was used in the explanation, and the outputs produced were introduced as a time series.

Next, the participants practiced preparation of emergency flooding maps using NEST and QGIS in accordance with the work flow.

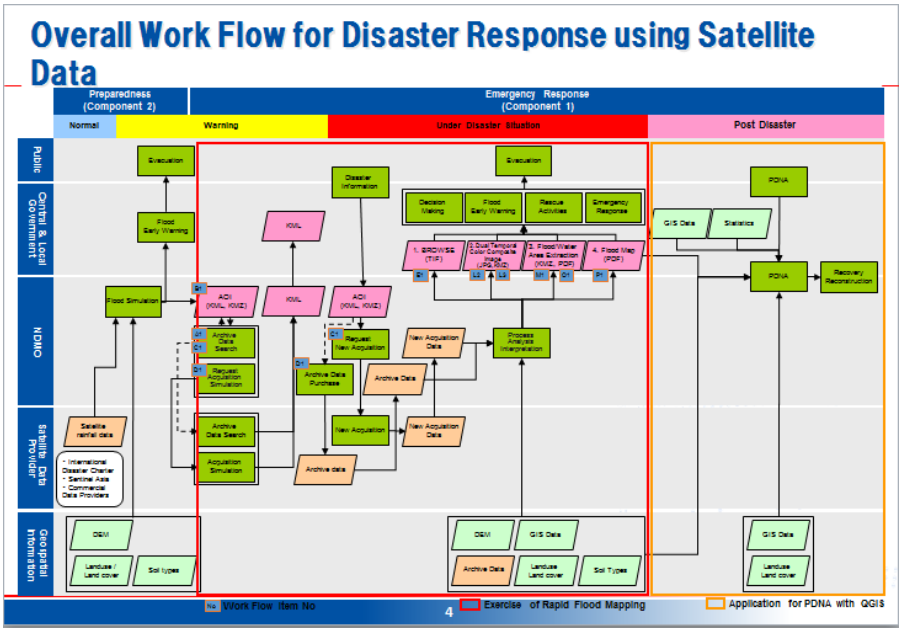


Fig. Image of Rapid Flood Mapping Work Flow

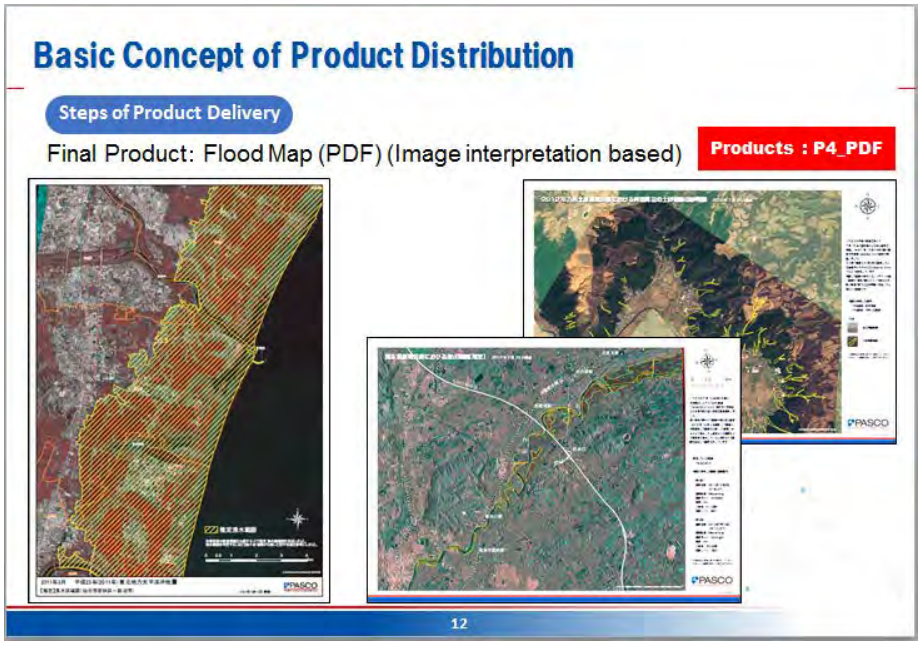


Fig. Image of Flooding Map

B-4: Overview and Practical Training in PDNA Using Satellite Images (Instructor: PASCO)

First, the instructor gave an overview of the procedure of PDNA using satellite images, then the participants practiced preparation of maps using SAR images and QGIS, counting affected houses, etc.

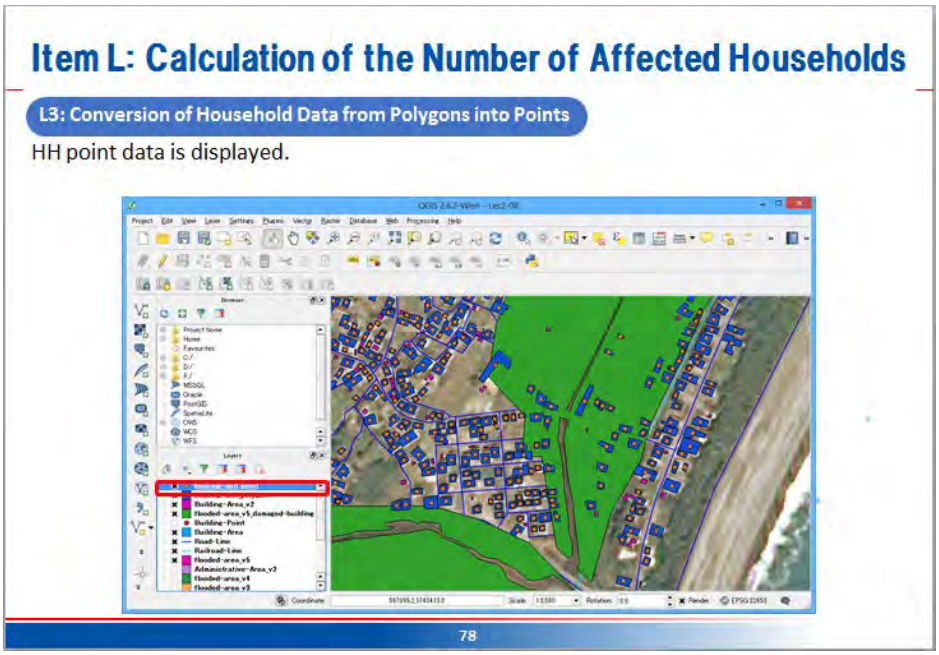


Fig. Image of Counting the Affected Households

C: Observation Trip

C-1: AHA Centre

The participants visited the AHA Centre and learned about the Centre itself and its activities.

Fig. Observation Trip to AHA Centre

C-2: Disaster Management Agency

The National Disaster Management Agency (BNPB), the agency responsible for disaster management within Indonesia, was visited, where the participants received explanations of their activities, etc.

Fig. Observation Trip to BNPB

(2) Training in Utilization of Satellite Information for Flood Analysis

The following lectures and practical training was carried out in this training. Note that the contents of the training and the training materials were repeatedly improved over the 3 years, so here the documents for the third year are used.

A: Basics of Hydrological and Hydraulic Analysis and Models and Applications of Models to each Country

A-1: Explanation on Basic Runoff Mechanism and Water-related Issues, Including Flooding etc.

Basic training was carried out to convey the basic knowledge of hydrology and hydraulics, taking beginners into consideration, and the mechanisms of runoff and flooding were explained.

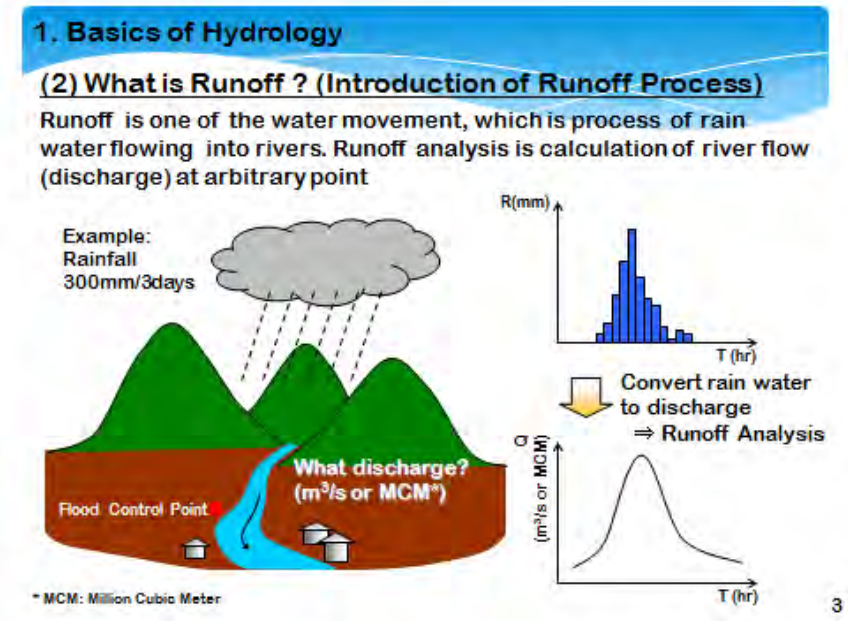


Fig. Overview of Runoff Phenomena

A-2: Utilization of Hydrological and Hydraulic Analysis as Flood Countermeasures, Including Establishment of Flood Control Plan, River Improvement Works and Flood Early Warning System etc.

Flood planning and countermeasures against flooding were introduced, and methods of analysis (hydrological analysis, hydraulic analysis) to formulate countermeasures and determine the flooding risk were explained.

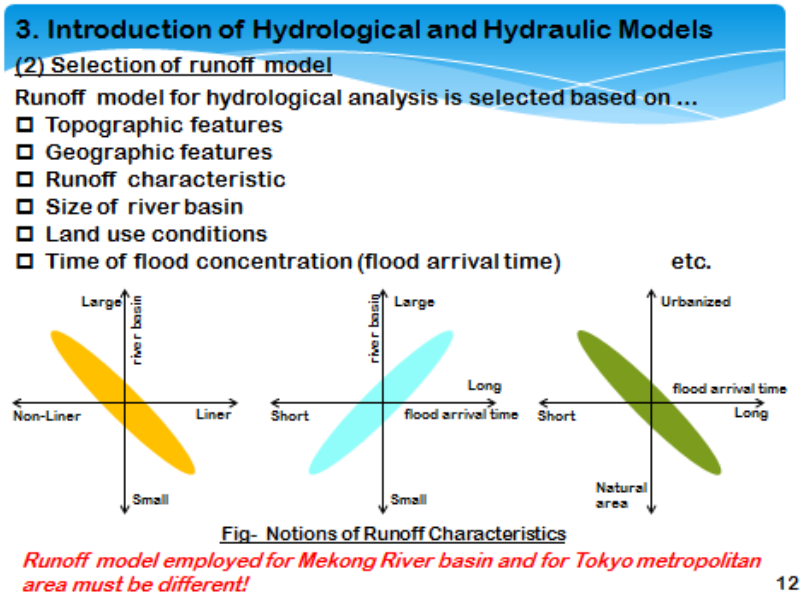


Fig. Relationship between Flood Countermeasures and Hydrological and Hydraulic Analysis

A-3: Brief Summary on IFAS (hydrological analysis) and iRIC (hydraulic analysis)

IFAS as a tool for carrying out hydrological analysis and iRIC as a tool for carrying out hydraulic analysis were introduced, and an overview of the principles on which each analysis is carried out was provided.

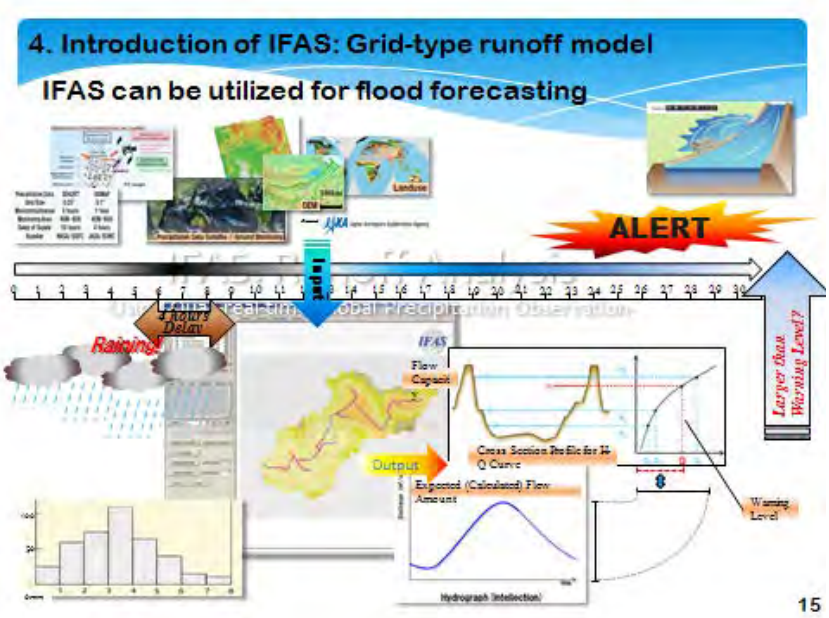


Fig. Introduction to IFAS

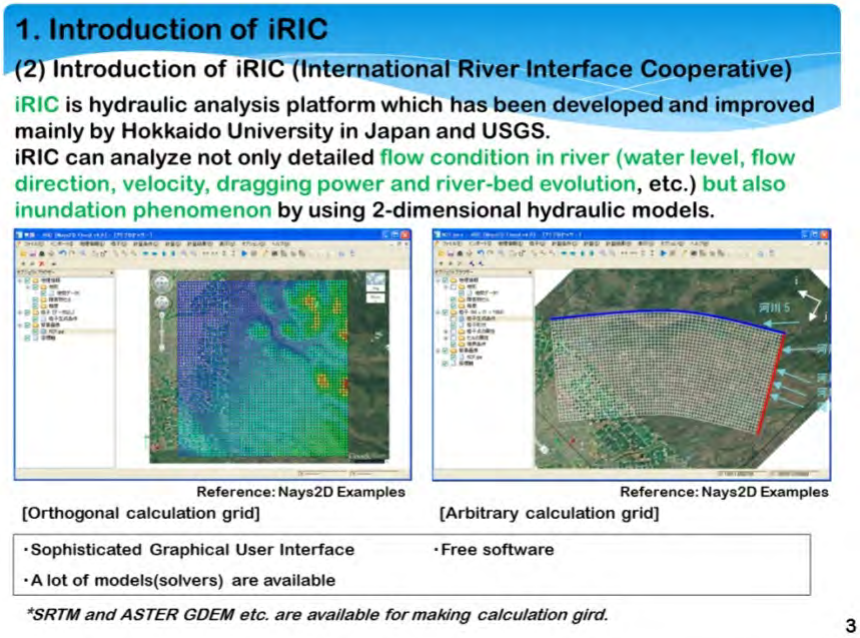


Fig. Introduction to iRIC

B: Utilization of Integrated Flood Analysis System, "IFAS" (Runoff analysis model)

B-1: Introduction, Advantages and Use Cases of IFAS

An overview of IFAS and its principles, as well as more detailed information were provided, and it was explained how natural phenomena could be analyzed using IFAS, and what results could be obtained. Also, examples that were used in actual work were described.

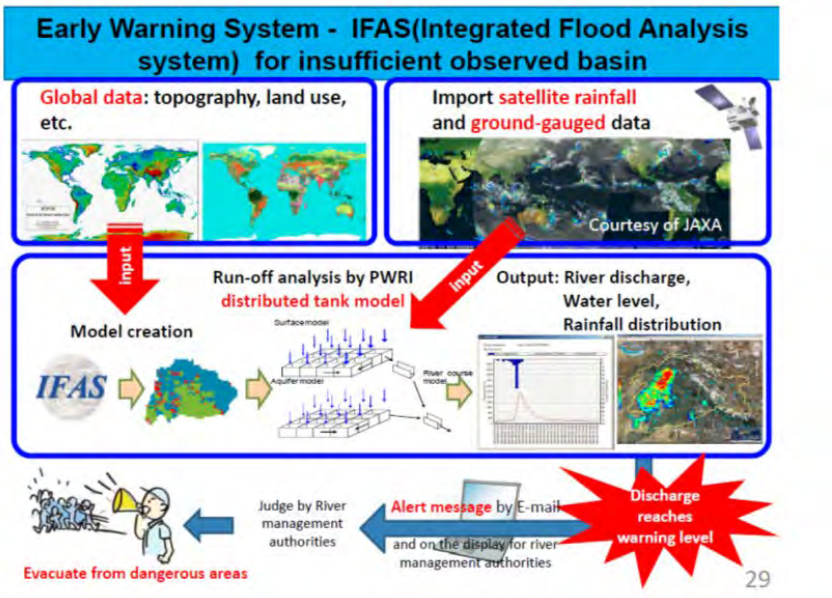


Fig. Overview of IFAS

B-2: Hands-on Training of IFAS Using Sample Data

B-3: Group-work and Discussion Using IFAS with Actual Local Data from Selected Countries and its Calibration

The participants were divided into 2 groups, and using actual data for the various ASEAN countries that was requested in advance from each country, the participants carried out practical analysis training using IFAS, so that they could experience analysis in an environment close to that of the actual situation.

Fig. View of Group Work

B-4: Analysis Results and Presentation

For the analysis results of each of the above 2 groups, each participant made a presentation with their analysis results. Getting the participants to make a presentation regarding their analyses encouraged each of them to think about what they had done, why they got the results they did, and to verify them.

Fig. Presentation of Analysis Results

C: Utilization of iRIC (Hydraulic modeling platform)

C-1: Introduction of iRIC, its Preprocessor, Postprocessor, and Analysis Examples

An overview of iRIC and how it was developed was explained, as well as what constitutive elements were developed in iRIC. Also, the analysis that can be handled by each solver (constitutive element) varies, so it was explained that various natural phenomena (movement of water) can be analyzed, by introducing actual examples.

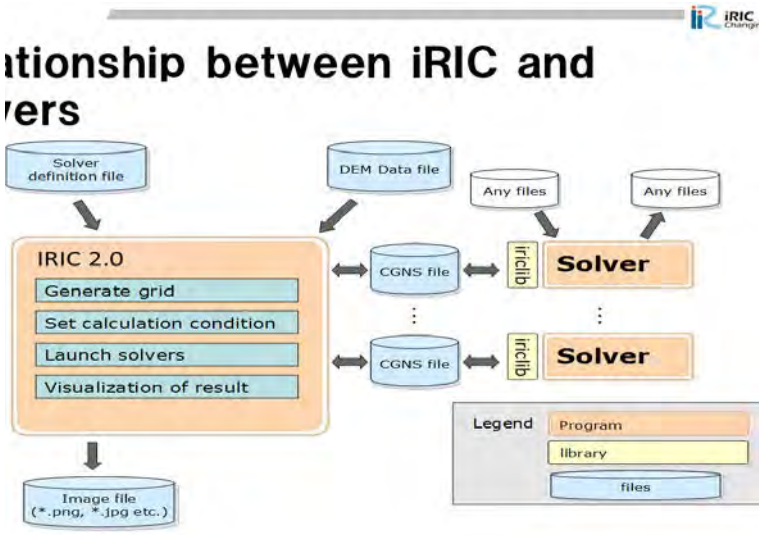


Fig. Configuration of iRIC

C-2: Hands-on Training of Inundation Analysis, River-bed Evolution and Rating Curve Creation by iRIC

The use of each solver in iRIC to carry out flooding analysis, and calculate variations in riverbeds and H-Q curves was explained, and practical training was carried out. Also the practical training was carried out using satellite information as much as possible.

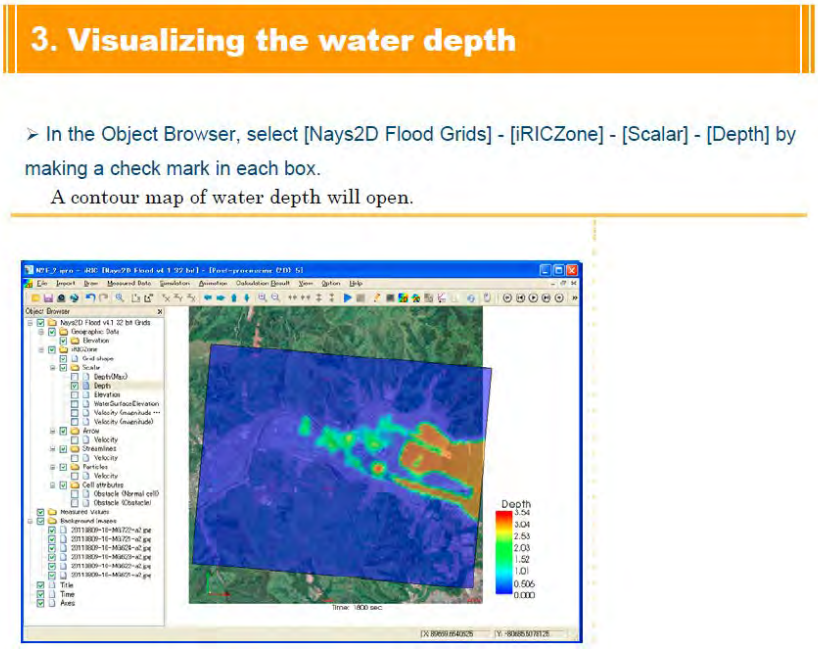


Fig. Flood Analysis Results Using iRIC

C-3: Introduction of Various Models (solver), Including One to Three Dimensional Flow Regime Analysis and Riverbed Evolution Analysis

Introduction was given to three-dimensional analysis of fluctuation in riverbeds using the iRIC solver. Also, it was explained that in the future it is possible that solvers will be developed that are adapted to the scale and extent of the analysis, and because this is open source anyone can participate in the development, so various organizations and people can participate.

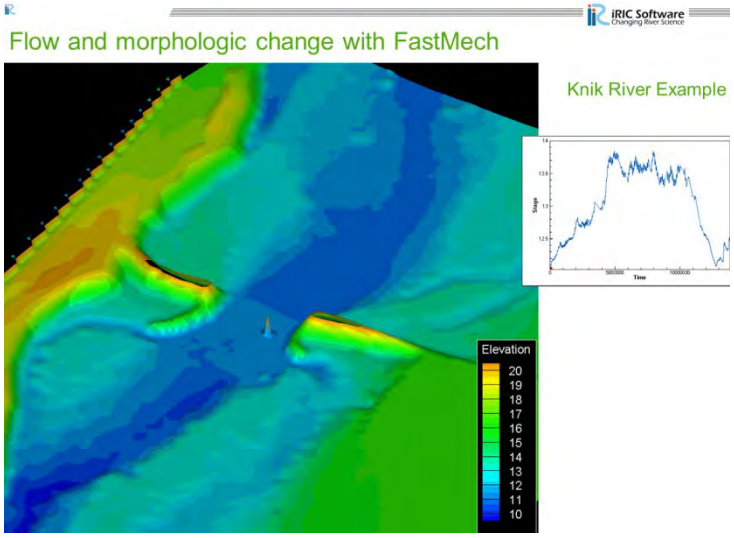


Fig. Example of Riverbed Variation Analysis Using iRIC

3. Presentation Materials of each Group (FY2015 Observation Trip)

Capacity Development for Immediate Access and Effective Utilization of Satellite Information for Disaster Management

PREVENTION MITIGATION

December 11, 2015

OUTLINE

- Current Situation on Prevention Mitigation
- Ideal Situation for ASEAN Countries
- Gaps (The difference between the Current Situation and the ideal)
- Resolve the issue and requirement for AHA Center

IDEAL STATE

- Lessen Casualty
- Budget Allocation for Prevention and Mitigation
- Risk Transfer
- Technology Sense Making Capabilities (Ownership of tracking Device-Satellite)
- Educated /Capacitated Community
- Communication of Action plan
- Empowering Province Governor Authorities
- Inter Agency Co- operation both within Govt and External Private Sector
- Mobile App Notification

IDEAL STATE

- Understanding Risk
  - Hazard Maps for all level of population
  - Leveraging on Current and future Technology (Sense-making)
  - Warning System in place
- Risk Financing
  - Enhancing existing and building future Infrastructure
  - Risk Insurance for different sectors (Economic, Social and Psychological)

IDEAL STATE

- Risk Governance
  - To Have political leader championing Disaster Management cause
  - Empowerment of prefecture and municipal leaders
- Build Back Better principle
  - To incorporate laws/ legislation governing infrastructure against disaster e.g. Building Code, Corporate Social Responsibility, Prohibition of building
  - Strategic level planning from the view point of National policy

Current Situation / Gaps

CURRENT SITUATION	GAPS
▪ Maintaining History of records *Data Informasi Bencana Indonesia (DIBI)* • Early Warning System • Awareness *Education to the residents of affected areas* *Water borne disease* • Dam Assessment • Dyking • Planning of drainage system	• Awareness to the rest of the local and provincial state is not properly disseminated • Funds are not properly distributed to for cause of Prevention and its primarily for response • Better internal communication between different departments when working on prevention and mitigation; there is also duplication of work leading to inefficient utilization of resources

Indonesia

Current Situation / Gaps

CURRENT SITUATION	GAPS
DYKE River Bank Dam Awareness Education to the villages Evacuation Resettlement	• Dykes No sufficient budget in the building and maintenance Not adequate Skill, Knowledge and Abilities for building of effective Dykes • Awareness Lack of continual Education for Awareness throughout the country especially in prefectures • Insufficient Education resources like manpower, expertise and materials • Interpret the map for planning and take action

Current Situation / Gaps

CURRENT SITUATION	GAPS
• Resettlement of Population • Awareness *Education to the residents of affected areas* *Water borne disease* • Evacuation	• Awareness of Resident in disaster areas is not thorough due to the mindset of the locals • Dykes - *Lack of expertise in proper Dyking methodolgy*

Myanmar

Current Situation / Gaps

CURRENT SITUATION	GAPS
• Harmonize Hazard Maps Maps of 1/10,000 available to the lowest municipalities • Road Slope construction Decrease road closure during disaster • Water Infrastructure like dikes and levees • Master Plan for Flood Control in Manila • Improving the drainage system to cover the 50 to 100 year return period • Education Information and communication system • Early Warning System	• Lack of appreciation of the maps in the local level. Inclusion of seismic and tsunami • Budget constraints in the construction of water infrastructure drainage improvement and the flood control master plan • Political will

Philippines

Current Situation / Gaps

CURRENT SITUATION	GAPS
• Channel • Dam • Awareness (Education to the villages) • Dyke • Early Warning System • Planning of drainage system	• Difficult to change the mindset of the people who are inhabiting disaster prone areas • There is lack of concerted effort by the local prefectures authorities to put in place prevention and mitigation plans and methodologies (lack of budget, manpower and knowledge) • Maintenance of the current prevention and mitigation measures are not done thus these early measures lose its effectiveness

Thailand

Current Situation / Gaps

CURRENT SITUATION	GAPS
• Flash floods • Planning of Drainage system • Evacuation and Road Closure • Early Warning System Mass SMS for potential • Auto- barricades activation	

Singapore

RECOMMENDATIONS

- ✓ To spearhead for the procurement of satellite shared among all the members state
- ✓ Centrally managing and distribution of Funds for Prevention and Mitigation
- ✓ To link up Countries with heavily subsidized projects to assist in developing mitigation and prevention measures

RECOMMENDATIONS

- ✓ Sharing of information for Sense Making among all members state Through the DMRS or WEB EOC platform
- ✓ Involvement of Senior Members in Government and get their "Buy In" so they can be Champions of the Cause
- ✓ Education to the Local Prefectures Similar to the appointment of Subject Matter experts to lead Expeditions

RECOMMENDATIONS

- ✓ Playing an Active role in Advocating of disaster Relief Reduction I.e. Advising members state to take more proactive approach
- ✓ Deployment of Technical Expertise in mitigation and Prevention as some countries may lack such expertise

THANK YOU

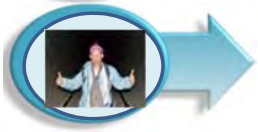
Training Programme on Capacity Development for Immediate Access and Effective Utilization of Satellite Information for Disaster Management

Presentation of Preparedness Group

November 30 th – December 11 th, 2015

JICA – AHA Center - PASCO

Squads of Preparedness Team

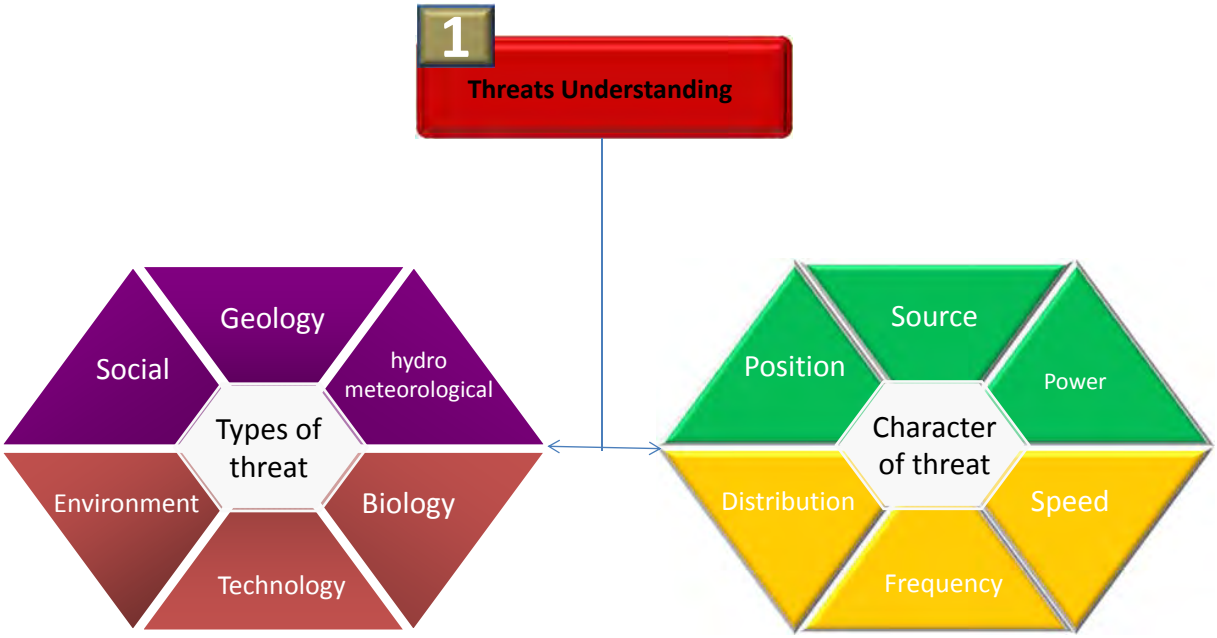
BRUNEI		AZALE BIN HAJI ABDUL SALIM Ministry of Development Survey Departement Senior Survey Technician
CAMBODIA		LONH NRAK National Comitte for Disaster Management (NCDM) National Emergency Coordination Center (NECC) Information and Communication Technology Officer
INDONESIA		NI MADE KESUMA ASTUTI I PUTRI National Agency for Disaster Management (BNPB) Center of Data, Information and Public Relation Data & Information Analyst
PHILIPPINES		ROMEO M. DALODADO Departement of Environtmen and Natural Resources Mines & Geoscience Bureau Chief Geoscience Division
THAILAND		PALIDA PUAPUN Ministry of Interior Departement of Prevention & Mitigation (DDPM) Research and Development Division Research and International Coorperation Bureau Policy and Plan Analyst
VIETNAM		NGUYEN TRONG UYEN Ministry of Agriculture and Rural Development (MARD) Directorate of Water Resouces Officer

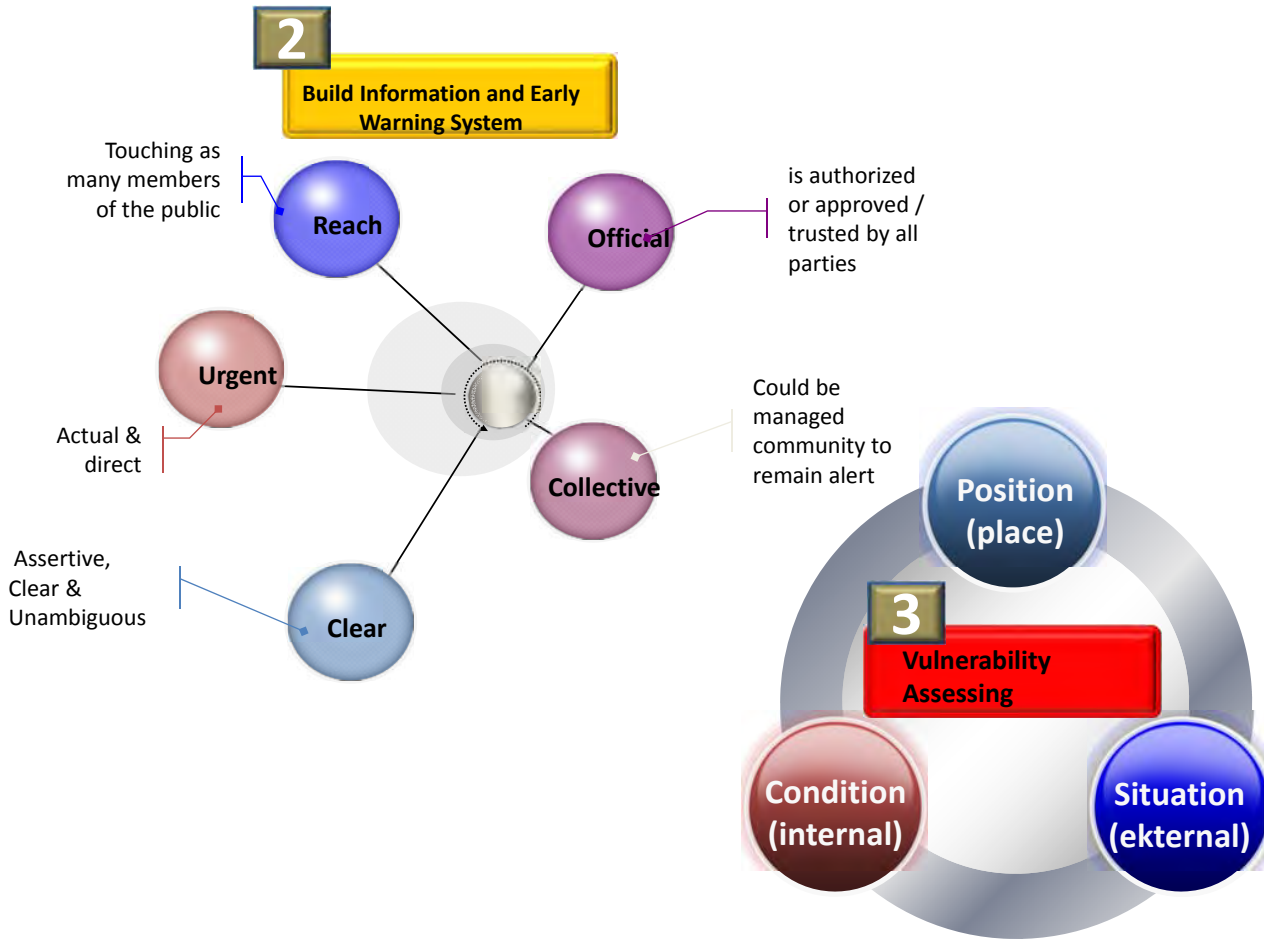
Preparedness Goal

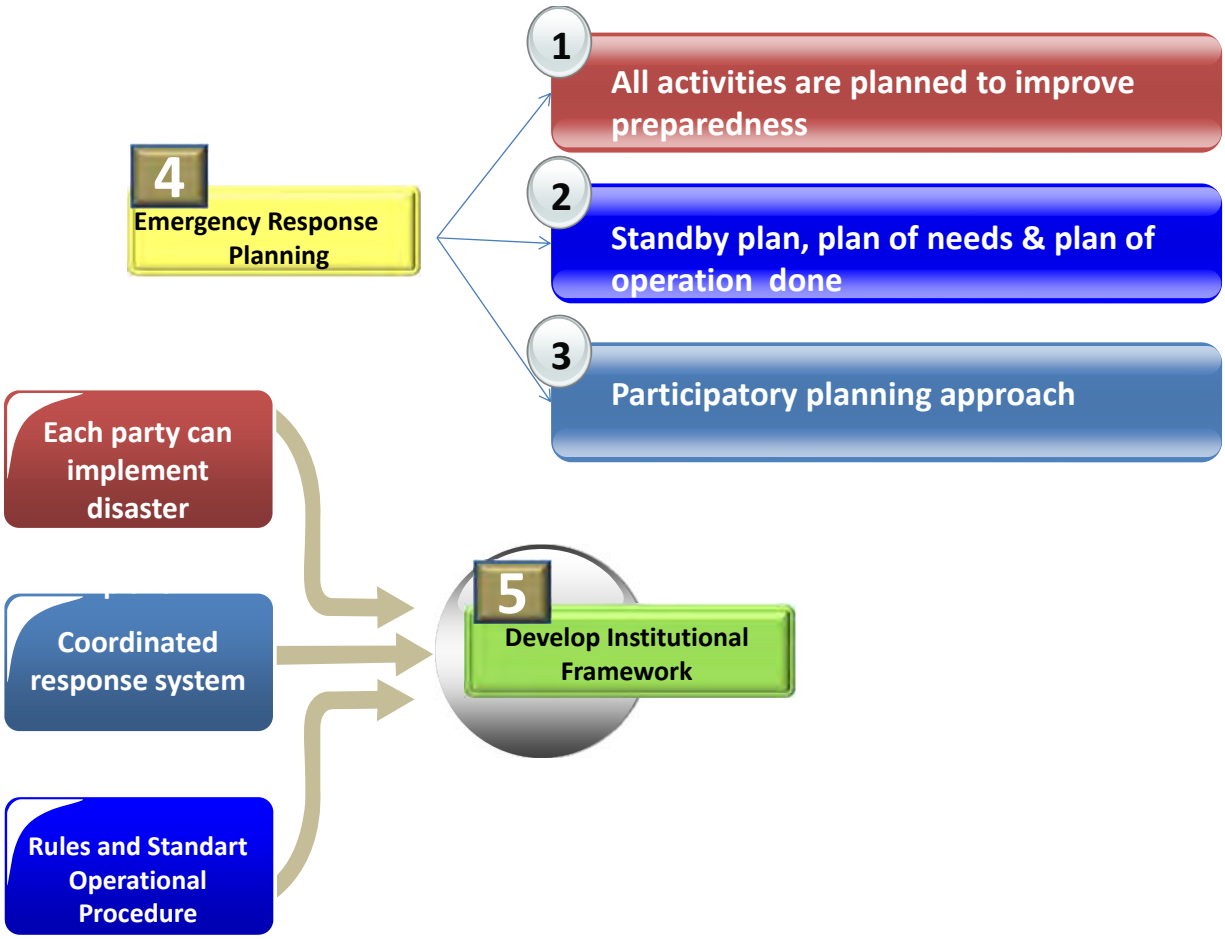
- Handling threats more quickly and accurately
- Handling vulnerabilities more quickly and accurately
- Improve the ability of more appropriate
- Establishing cooperation of the parties
- Reducing the impact of significant

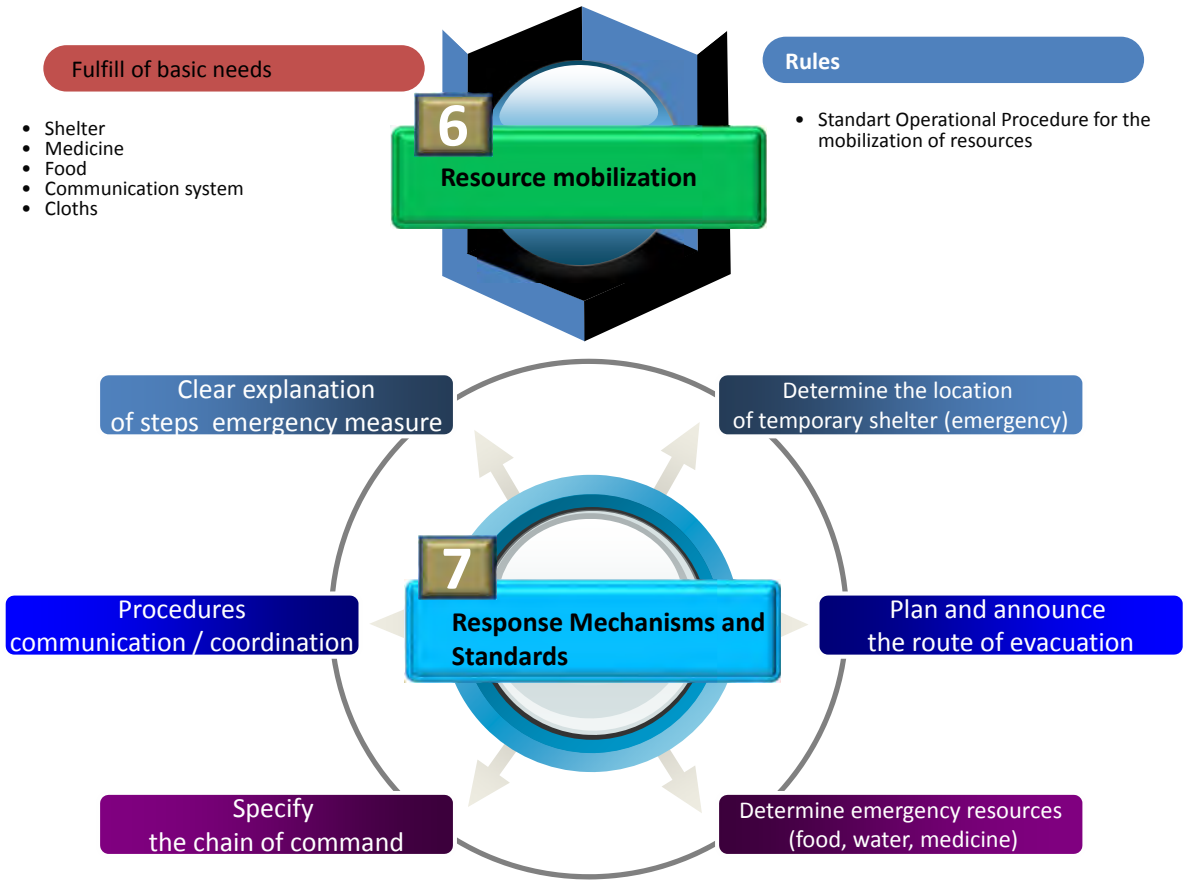
Preparedness System Framework

1. Threats Understanding
2. Vulnerability Aassessing
3. Build Information and Early Warning System
4. Emergency Response Planning
5. Develop Institutional Framework
6. Resource mobilization
7. Response Mechanisms and Standards
8. Coordination
9. Public Education and Training


1
Threats Understanding
Geology
Social
hydro meteorological
Types of threat
Environment
Biology
Technology
Source
Position
Power
Character of threat
Distribution
Speed
Frequency


2
Build Information and Early Warning System
Touching as many members of the public
Reach
Official
is authorized or approved / trusted by all parties
Urgent
Actual & direct
Collective
Could be managed community to remain alert
Assertive, Clear & Unambiguous
Clear
Position (place)
3
Vulnerability Assessing
Condition (internal)
Situation (ekternal)

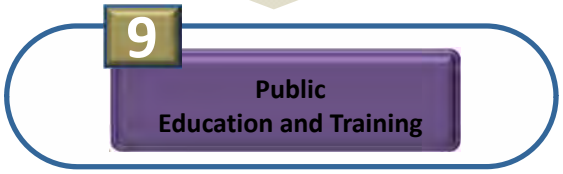

4
Emergency Response Planning
1
All activities are planned to improve preparedness
2
Standby plan, plan of needs & plan of operation done
3
Participatory planning approach
Each party can implement disaster
Coordinated response system
Rules and Standart Operational Procedure
5
Develop Institutional Framework


Fulfill of basic needs
Shelter
Medicine
Food
Communication system
Cloths
6
Resource mobilization
Rules
Standart Operational Procedure for the mobilization of resources
Clear explanation of steps emergency measure
Determine the location of temporary shelter (emergency)
7
Response Mechanisms and Standards
Procedures communication / coordination
Plan and announce the route of evacuation
Specify the chain of command
Determine emergency resources (food, water, medicine)

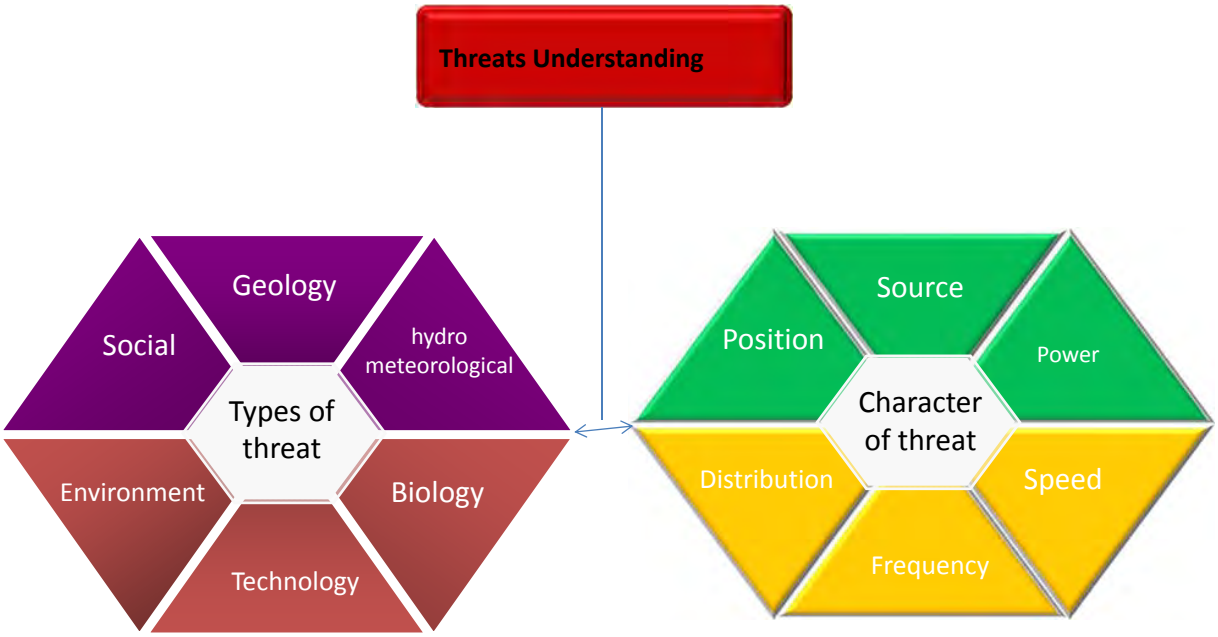
Training and education

To maintain the ability of the public and all parties

Involved theoretically and practically



			BNPB			
Threats Understanding	√	√	√	√	√	√
Vulnerability Assessing	√	√	√	√	√	√
Build Information and Early Warning System	√	√	√	√	√	On going
Emergency Response Planning	√	Draft	√	√	√	√
Develop Institutional Framework	√	√	√	√	√	√
Resource mobilization	√	None	√	√	√	√
Response Mechanisms & Standards	√	√	√	√	√	√
Coordination	√	√	√	√	√	√
Public Education and Training	√	None	√	√	√	On going

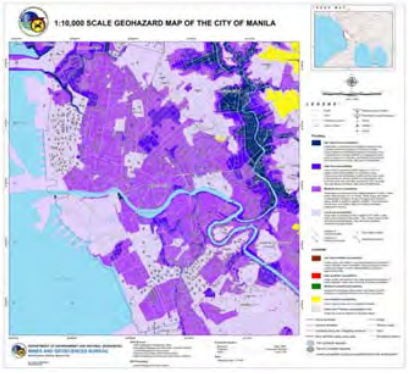


Philippine scenario almost similar to Japan in terms of exposure to natural hazards, both tectonics and hydrometeorological-related.

Provision of geohazard maps, reports, advisories to LGUs

Turn-over of geohazard maps to LGUs

Ilocos Sur Governor briefed on the geohazard map of the province by the MGB Geohazard IEC team (2009)



Letter of acknowledgement sent by the City of Manila in September 2014 upon receipt of digital files of geohazard maps from MGB.

Provision of geohazard maps, reports, advisories to LGUs

Geohazard threat advisory

Republic of the Philippines
Department of Environment and Natural Resources
MINES AND GEOSCIENCES BUREAU

FLOOD THREAT ADVISORY

October 12, 2012

To: Barangay Chairman
Barangay 152
City of Manila

Dear Sir/Madam:

Please be advised that the Geohazards Mapping and Assessment Team (GMAT) of the Mines and Geosciences Bureau (MGB) has conducted flood assessment in your barangay. The following are the results and recommendations following the assessment:

Location	Flood Susceptibility Rating	Remarks/ Recommendations
Barangay 152	High	Coordinate with city officials regarding the flood situation in your barangay

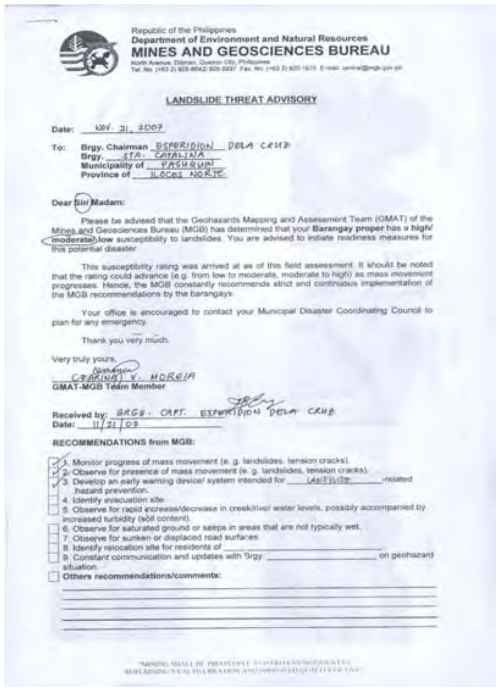
Kindly advise your affected constituents to initiate readiness and measures for this identified geohazard. This susceptibility rating was arrived at as of this field assessment. It should be noted that the rating could advance (e.g. from low to moderate, moderate to high, high to very high) as the physical conditions change. Hence, the MGB constantly recommends strict and continuous implementation of the MGB recommendations by the barangay.

Your office is encouraged to contact your City Disaster Risk Reduction and Management Council to plan for any emergency.

Thank you very much.

By the authority of the Director:

KARLO L. QUEAÑO, Ph.D
Supv. Science Research Specialist



Republic of the Philippines
Department of Environment and Natural Resources
MINES AND GEOSCIENCES BUREAU

LANDSLIDE THREAT ADVISORY

Date: NOV 21, 2007

To: Brgy. Chairman ESPERIDION DELA CRUZ
Brgy. STA. CATALINA
Municipality of PASUQUIN
Province of ILOCOS NORTE

Dear Sir/Madam:

Please be advised that the Geohazards Mapping and Assessment Team (GMAT) of the Mines and Geosciences Bureau (MGB) has determined that your **Barangay proper** has a high/ moderate/ low susceptibility to landslides. You are advised to initiate readiness measures for this potential disaster.

This susceptibility rating was arrived at as of this field assessment. It should be noted that the rating could advance (e.g. from low to moderate, moderate to high) as mass movement progresses. Hence, the MGB constantly recommends strict and continuous implementation of the MGB recommendations by the barangays.

Your office is encouraged to contact your Municipal Disaster Coordinating Council to plan for any emergency.

Thank you very much.

Very truly yours,

CRISTINA V. MOREIA
GMAT-MGB Team Member

Received by: BRGY. CAPT. ESPERIDION DELA CRUZ
Date: 11/21/07

RECOMMENDATIONS from MGB:

- [x] 1. Monitor progress of mass movement (e. g. landslides, tension cracks).
- [x] 2. Observe for presence of mass movement (e. g. landslides, tension cracks).
- [x] 3. Develop an early warning device/ system intended for LANDSLIDE -related hazard prevention.
- [ ] 4. Identify evacuation site.
- [ ] 5. Observe for rapid increase/decrease in creek/river/ water levels, possibly accompanied by increased turbidity (silt content).
- [ ] 6. Observe for saturated ground or seeps in areas that are not typically wet.
- [ ] 7. Observe for sunken or displaced road surfaces.
- [ ] 8. Identify relocation site for residents of _____.
- [ ] 9. Constant communication and updates with Brgy _____ on geohazard situation.
- [ ] Others recommendations/comments:

Direct information or written advisories on geohazard threats issued to cities/municipalities and barangays

Conduct of IEC campaigns and distribution of IEC materials

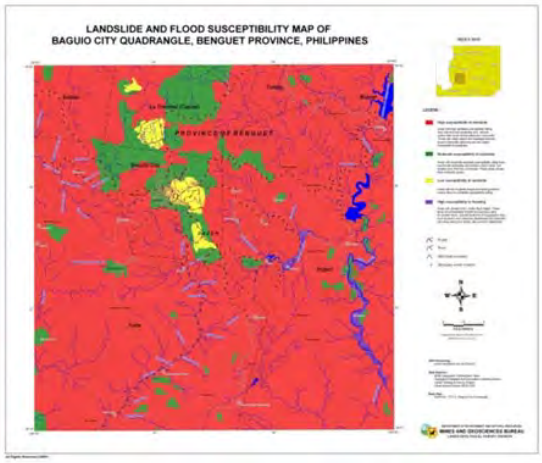
Province-wide IEC

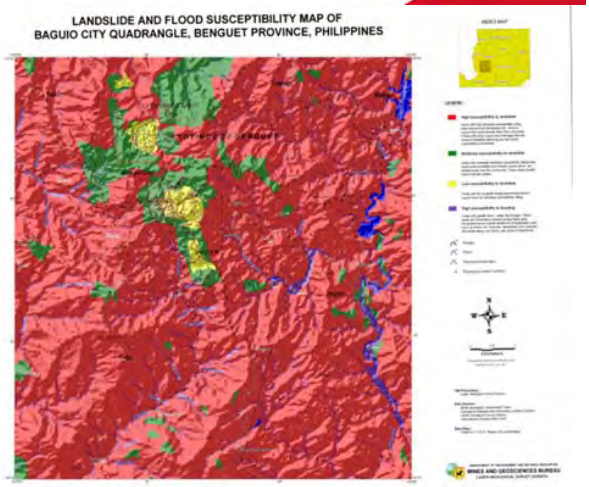
Posters and flyers

Installation of community-based geohazard warning signages

Geohazard assessment and mapping

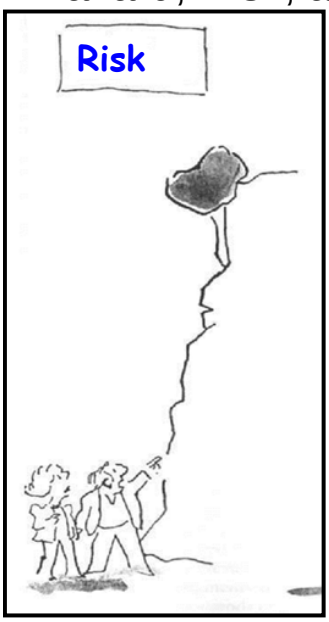
Enhanced geohazard maps with acquisition of IfSAR data from NAMRIA





Sedimentation Hazard from Landslide – Izu Oshima Island

Hazard, Risk, and Disaster Risk Reduction and Management



Risk assessment and mapping

Risk is understood.
Existing DANGER is recognized.
Risk information is disseminated.

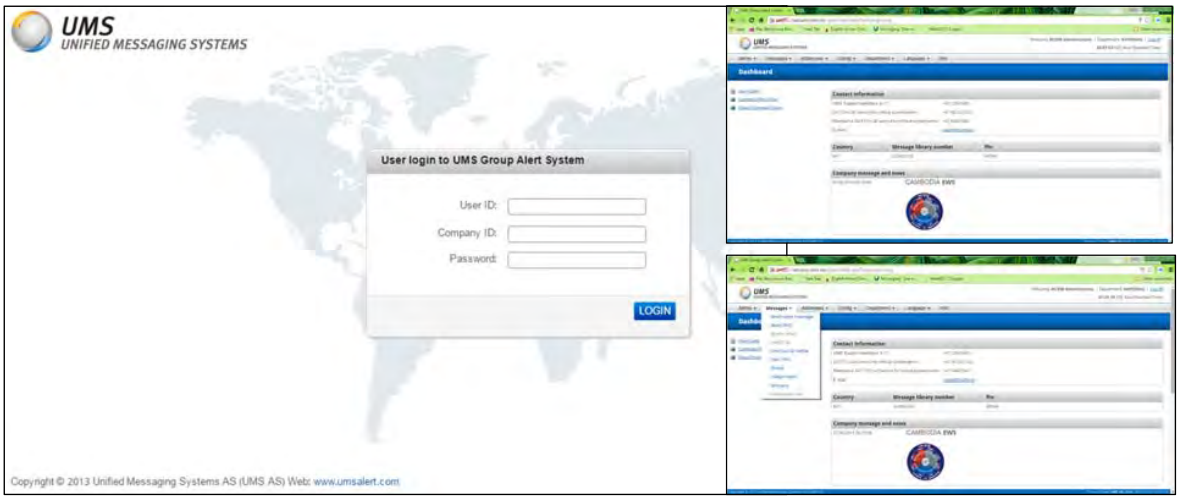
However, DENR-MGB has participated in risk assessment and mapping projects with other CSCAND agencies (RAP with PAGASA for flood risk assessment and mapping).

Moreover, risk assessment and mapping on a limited scale is included in the 2015 Work and Financial Plan of DENR-MGB.

Excellent case study – Flood in Kinugawa River and its Flood Control Activities – Flood Risk Maps include models for various failure point scenarios, existing guidelines manuals and hazard map portal for vital decision making, local municipalities capable of value adding and own creativity in generating own risk maps for the public.

Build Information and Early Warning System

Cambodia Early Warning System (EWS)



Emergency Response Planning

Central Emergency Operation Centre (CEOC)
(DDPM Director-General: Director of CEOC)

Provincial Emergency Operation Centre (PEOC)
(Governor: Director of PEOC)

BMA's Emergency Operation Centre (BMA EOC)
(BMA Governor: Director of BMA EOC)

District Emergency Operation Centre (DEOC)
(District Chief: Director of DEOC)

District Emergency Operation Centre (DEOC)
(District Chief: Director of DEOC)

Municipality

Sub-district Administration Office

Pattaya City

Develop Institutional Framework

Disaster Prevention and Mitigation Act 2007

Thai National Disaster Prevention and Mitigation plan 2015

1. Implementing and mainstreaming disaster risk reduction
2. Ensuring multi-sectoral cooperation in emergency management
3. Enhancing an inclusive measure for Build Back Better and Safer in recovery, rehabilitation and Reconstruction
4. Strengthening and standardizing international cooperation and coordination in disaster risk management

Sendai Framework

Priority 1 Understanding disaster risk

Priority 2 Strengthening disaster risk governance to manage disaster risk

Priority 3 Investing in disaster risk reduction for resilience

Priority 4 Enhancing disaster preparedness for effective response to “Build Back Better”

Develop Institutional Framework

พระราชบัญญัติ

ป้องกันและบรรเทาสาธารณภัย

พ.ศ. ๒๕๕๐

ภูมิพลอดุลยเดช ป.ร.

ให้ไว้ ณ วันที่ ๒๘ สิงหาคม พ.ศ. ๒๕๕๐

เป็นปีที่ ๖๒ ในรัชกาลปัจจุบัน

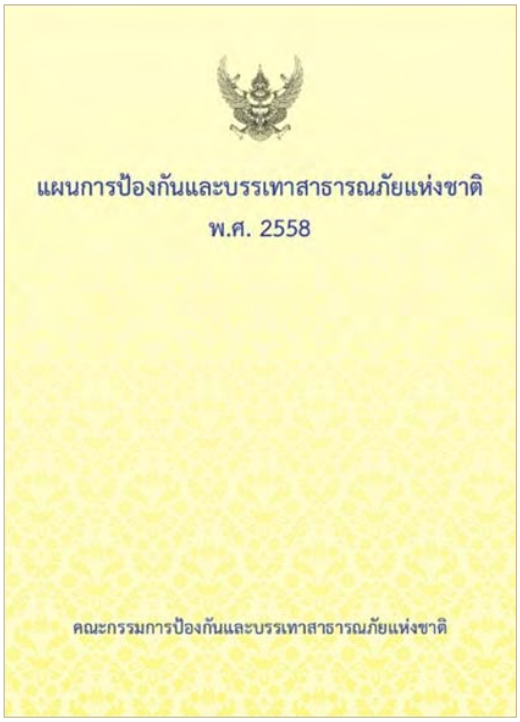
พระบาทสมเด็จพระปรมินทรมหาภูมิพลอดุลยเดช มีพระบรมราชโองการโปรดเกล้า ฯ ให้ประกาศว่า

โดยที่เป็นการสมควรมีกฎหมายว่าด้วยการป้องกันและบรรเทาสาธารณภัย

จึงทรงพระกรุณาโปรดเกล้า ฯ ให้ตราพระราชบัญญัติขึ้นไว้โดยคำแนะนำและยินยอมของสภานิติบัญญัติแห่งชาติ ดังต่อไปนี้

มาตรา ๑ พระราชบัญญัตินี้เรียกว่า "พระราชบัญญัติป้องกันและบรรเทาสาธารณภัย พ.ศ. ๒๕๕๐"

มาตรา ๒ พระราชบัญญัตินี้ให้ใช้บังคับเมื่อพ้นกำหนดหกสิบวันนับแต่วันประกาศใน



แผนการป้องกันและบรรเทาสาธารณภัยแห่งชาติ

พ.ศ. 2558

คณะกรรมการป้องกันและบรรเทาสาธารณภัยแห่งชาติ

Fulfill of basic needs

- Shelter
- Medicine
- Food
- Communication system
- Cloths

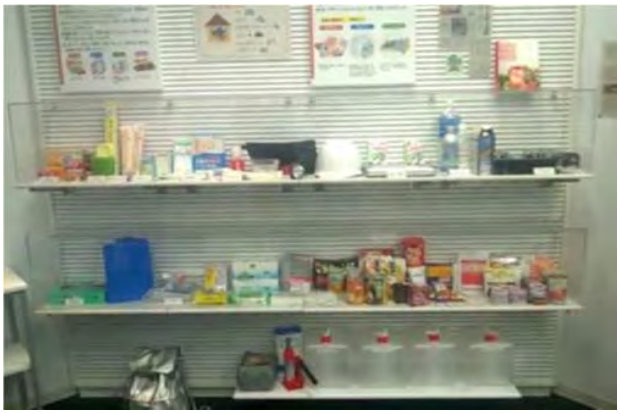
6 Resource mobilization

Rules

- Standart Operational Procedure for the mobilization of resources

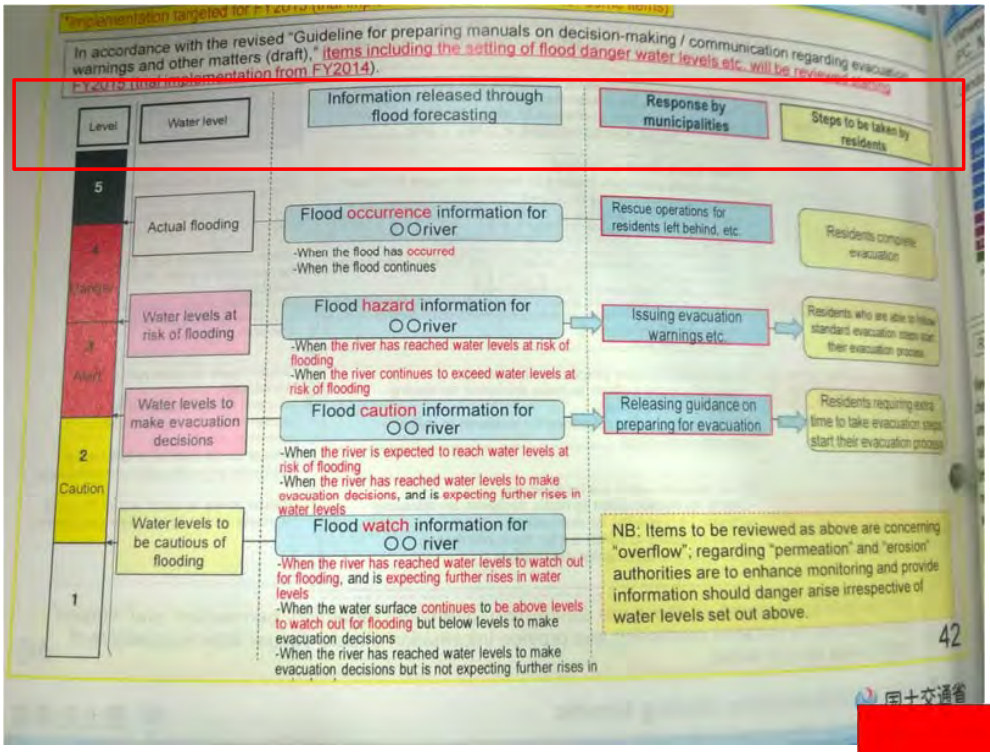
BNPB prepare the basic need for the evacuation mobilization

TSUNAMI/STROM SURGE DISASTER PREVENTION STATION, OSAKA

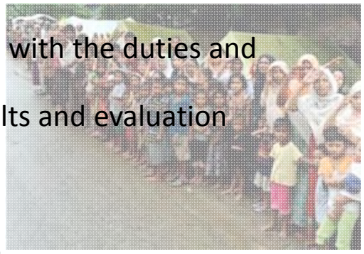


7 Response Mechanisms and Standards

- Clear explanation of steps emergency measure
- Determine the location of temporary shelter (emergency)
- Procedures communication / coordination
- Plan and announce the route of evacuation
- Specify the chain of command
- Determine emergency resources (food, water, medicine)



1. Team Leader



- Provide guidance to each unit to take appropriate action with the duties and functions of each
- Provide reports to the head of the region about the results and evaluation activities that have been done team

2. Logistics and Equipment

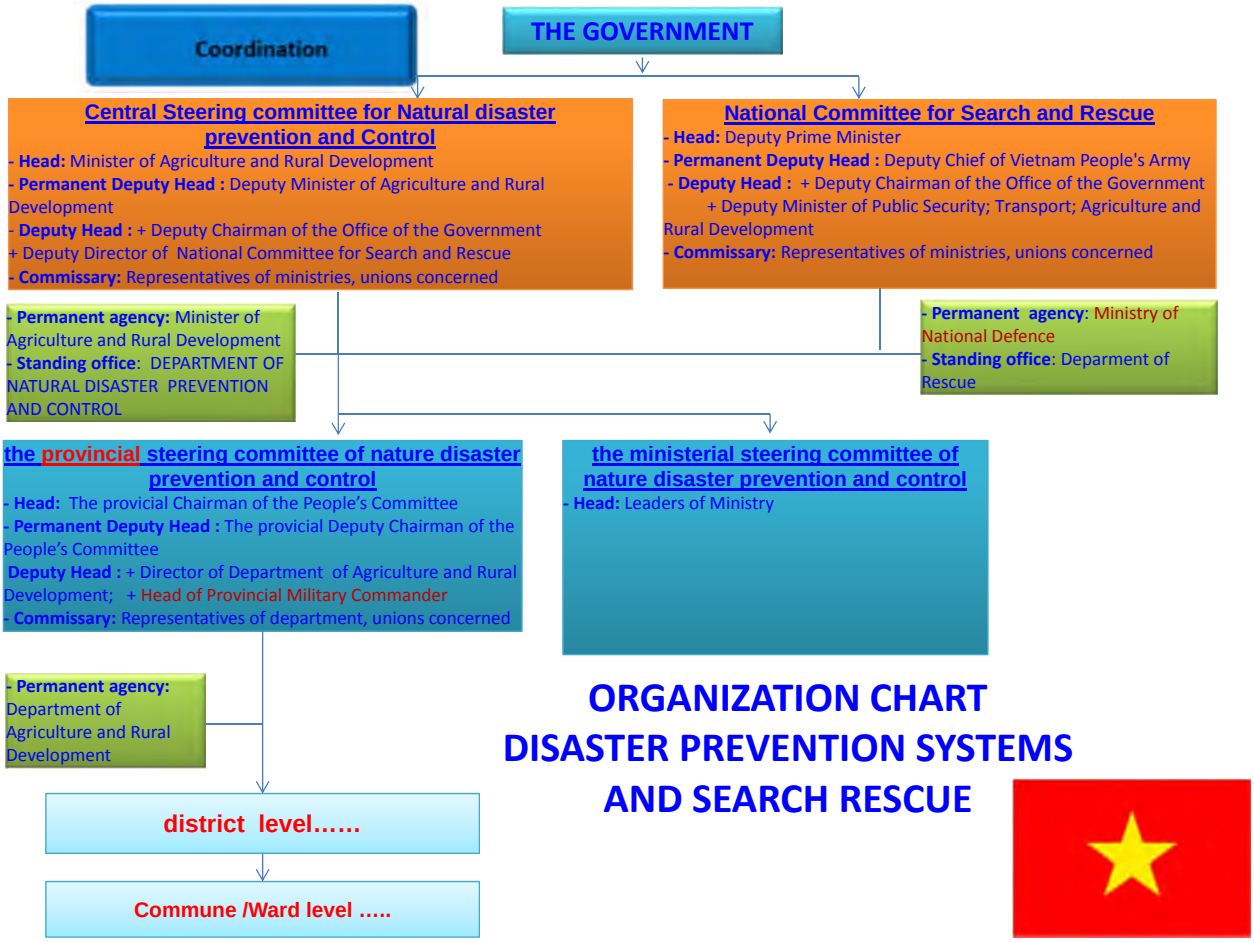
- Examine and provide the necessary equipment for disaster
- Setting up refugee camps, temporary shelter if necessary

3. Protection vulnerable groups

- Collecting vulnerable groups that are within the scope of duties
- Conducting analysis of the needs of vulnerable groups based data obtainable
- Provide protection, respect of rescue, security, health and psychosocial services for vulnerable people
- Helping to direct the public to reach the evacuation site and ensuring smooth evacuation route

4. SAR and Security

- Looking for disaster victims, provide first aid to victims
- Collecting the victims were found in both the living and the died
- Sending disaster victims who survived to the health center or ZIP nearest health
- Implement medical treatment
- Provide security in villages and refugee camps



ORGANIZATION CHART DISASTER PREVENTION SYSTEMS AND SEARCH RESCUE

SHARING SOME EXPERIENS IN VIETNAM

- Implement guideline 4 spot: Four on-the-spot which includes leadership on-the-spot, human resources on-the-spot, means and materials on-the-spot, and logistics on-the-spot in for consequences of floods and storms;.
- To step up public information to raise community awareness. To build up capabilities for self-defense against natural disasters, to promote the tradition of mutual assistance and support in disaster relief;
- To formulate plannings and plans, to zone off and assess risks of natural disasters in order to work out appropriate policies for key regions, localities and areas, which serve as bases for active prevention; to promulgate norms and technical instructions on construction of works in areas frequently affected by natural disasters; to adjust and supplement regulations and norms disaster forecasts.

- To regularly inspect and assess the current conditions of water reservoirs, to repair, upgrade and supplement incidental spillway facilities to ensure safety for dams; to perfect the operation process for multi-use purposes of works, particularly big reservoirs, in regulating and reducing floods for downstream areas and supplying water in the dry season

- To raise the rescue and salvage capacity for full-time and part-time forces and local forces; to regularly organize natural disaster prevention, fighting and reduction drills and exercises for branches and localities. To attach importance to ensuring non-interrupted communication and information; to raise the on-spot rescue capacity for organizations, individuals and communities, especially highland, deep-lying, remote, border, island regions and vessels operating on rivers and sea

- To intensify cooperation with countries in the region and the world on disaster warning and forecast, education, training, technological transfer, information, experience and practical lesson sharing
- In the process of management and exploitation, especially for permanent reservoir monitoring, inspection of the facility changes to proactively detect incidents;
- Preparation of operational procedures and processes reservoir or reservoir operators to ensure safe discharge of floods;

- To arrange rainfall stations in the basin reservoirs to collect rainfall data to make processes operate efficiently.

- To increase investment in the planting of dike protection trees; the tending and protection of protection trees constitute a regular dike protection task.

Training and education

To maintain the ability of the public and all parties

Involved theoretically and practically

Public Education and Training

COMMUNITY BASED DISASTER RISK MANAGEMENT PROGRAM (CBDRM)


- CBDRM programme was introduced on March 2010 by National Disaster Management Center (NDMC) with th support ASEAN Disaster Reduction Center (ADRC).
- To create **Disaster Resilient Community**.
- To develop community awareness in disaster risks and building up their capacity in managing emergencies and disaster situations.
- To increase the readiness and preparedness of the community for disaster by identifying hazards and reducing risks associated with them.



COMMUNITY BASED DISASTER RISK MANAGEMENT PROGRAM (CBDRM)

- This programme is a collaboration of relevant government agencies including the Consultative Council (Majlis) of Mukims and Kampongs.
- Each council normally comprises of the village head, secretary, treasurer and committees.
- With the success of the CBDRM, NDMC is extending the elements of CBDRN to the school community through a new called “School-Based Disaster Risk Management”. The program is co-organized with the Department of Schools, Ministry of Education. It is dedicated for the entire school community in the country to instill a safe and conducive learning environment. Students through SBDRM-trained teachers will be taught the “Do’s and Don’ts” should disaster strikes while school is in sessions.
- Other outreach programs such as:-
  - National Essay Competition,
  - Disaster Awareness Radio & TV Quiz & Message



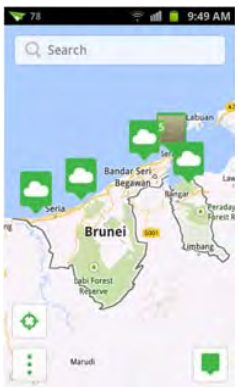
COMMUNITY BASED DISASTER RISK MANAGEMENT PROGRAM (CBDRM)

CBDRM program aimed at increasing community preparedness for disasters by:-

- ⇨ Identify the risks of disasters occurring in the area surrounding the village and their sub-district.
- ⇨ Generate hazard map.
- ⇨ Introduction to basic techniques first aid and CPR
- ⇨ The use of fire extinguisher
- ⇨ And how to prevent and avoid fire from happening.

TO MAINTAIN THE ABILITY OF THE PUBLIC AND ALL PARTIES

The Meteorological Department advises the public to **download (Mobile apps/App store)** the **Brunei WX** application to find out the latest weather information on their mobile phones. People can also visit the department's official website and Facebook page or call the weather hotline.



INVOLVED THEORETICALLY AND PRACTICALLY

The (University Brunei Darussalam)UBD/IBM Centre is currently working an early warning system for floods that will increase warning times from the one hour to 18 hours. By feeding LIDAR (Light Detecting and Ranging) data into their state-of-the-art IBM Blue Gene supercomputer, the Centre can come up with a model that predicts which areas will experience flash flooding

Ideal of ASEAN countries

- Donation the fund for ASEAN member
- Mobility of rescue man power/ equipment
- Borderless of disaster data on IT system as a user
- Sharing of Data/Experience/Technology transfer/
- Central system for early warning system
- Collaboration of each member

Issue and Requirement for AHA center

Variance of Disaster in our region almost similar situation; as Typhoon, earthquake, volcanic eruption, landslide, flood prone area, ground subsidence

- Fund the ASEAN Disaster foundation
- Database system for Need Assessment
- Development of IT system
- AHA shall build the disaster institute to share the data skill and knowledge to prepare to action in disaster event
- AHA shall build Central database of past disaster&EarlyWarningSystem
- AHA center to facilitate collaboration of each member

End of Presentation

Training Programme on Capasity Development for Immediate Access and Effective Utilization of Satellite Information for Disaster Management

ACTION PLAN BY EACH GROUP

-RESPONSE-

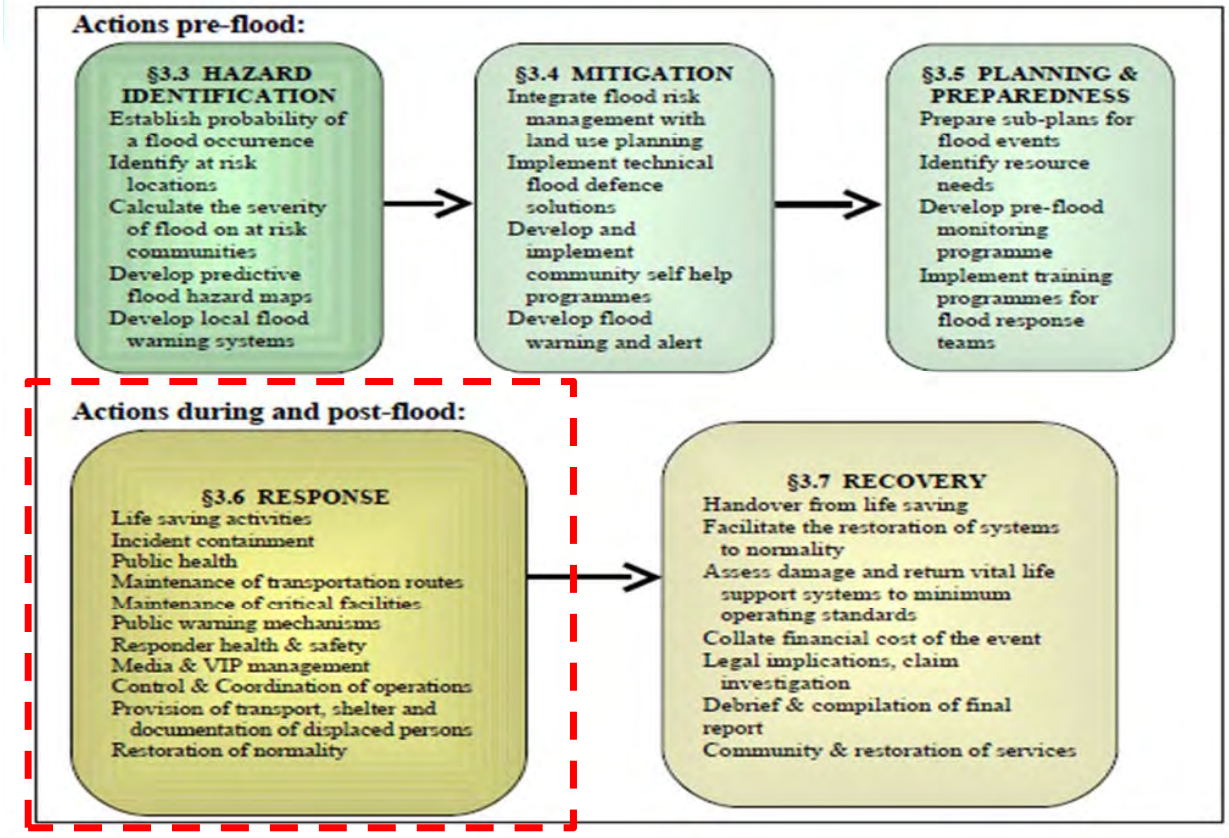
TEAM MEMBERS

1. Mr. Phang Ponleu Rath, Cambodia
2. Mr. Rosmadinor Bi Mohamad, Malaysia
3. Ms. Siti Hawa Adila Binti Mohd Yusof, Malaysia
4. Ms. Thin Win Khaing, Myanmar
5. Mr. Nguyen Vinh Long, Vietnam

DISASTER IN OUR COUNTRY

- Flood
- Typhoon
- Earthquake
- Landslides
- Tsunami

Example : Preparation of flood event



ELEMENTS OF RESPONSE (Pre-Response Phase):

- Planning
- Team leaders were selected;
- Implementing sectors were established such as Health, Water, Food, Education, Shelter sectors;
- Risk maps and Safety Area maps were set up;
- Logistic or supporters; and
- Facilitator and Communication

ELEMENTS OF RESPONSE (During Response Phase):

- Warning system,
- Deploy search and rescue,
- DALA,
- Evacuation,
- Mobile equipment and resources,
- Set up medical camps,
- Providing immediate assistance,
- Continuing assistance until more permanent and Sustainable solutions can be found,
- Immediate restoration of infrastructure.
- Daily needs example food, medicine, shelter etc

RESPONSE IN EACH COUNTRY

Element	Cambodia	Vietnam	Myanmar	Malaysia
Warning system	Yes	Yes	yes	Yes
search and rescue		Yes	Yes	Yes
providing immediate assistance including basic need(food, medicine, shelter)	yes	yes	yes	Yes
assessing damage	Yes	Yes	Yes	Yes
evacuation	Yes	Yes		Yes
continuing assistance until more permanent and sustainable solutions can be found,	yes	yes	yes	Yes
immediate restoration of infrastructure	yes	yes	yes	Yes

Ideal for ASEAN Countries

- Budget
- Capacity building
- Collect information and notification
- Inter agency cooperation
- technology

The Difference between the Current and the Ideal

- No fix budget allocation for disaster
- Lacks of inter agency cooperation
- Insufficient data (static data, response team)
- Not all agency have the detail preparation before and after disaster happen
- Lacks of disaster exposure from the grass root
- Government agency working in silo
- Less contribution from Private companies
- Not enough facilities (assets)
- Expertise is not enough

RESOLVE THE ISSUE

- Make budget proposal to government and international donor for disaster management
- Strengthening inter agency cooperation
- Data gathering and sharing information
- Each agency needs to have their OWN detail SOP for disaster management
- NGO's and government need to proactively educate the grass root generation regarding the disaster management
- Government have to make a new act
- Introduce incentive to private sector (BCP), win and win situation, less tax

Requirements for AHA Centre

- Share information for sense-making
- continue to provide training/share experience on disaster mitigation and management to ASEAN member countries

Lesson learnt

- Be prepared : preparedness and mitigation is bound to yield more effective returns than distributing relief after a disaster
- Create a culture of preparedness and prevention
- Evolve a code of conduct for all stake holders

Future directions

- Encourage and consolidate knowledge networks
- Mobilize and train disaster volunteers for more effective preparedness, mitigation and response
- Increased capacity building leads to faster vulnerability reduction
- Learn from best practices in disaster preparedness, mitigation and disaster response
- Mobilising stakeholder participation
- Anticipatory governance
- Indigenous knowledge system and coping practices
- Living with risk
- Public private partnership
- Technology driven

4. List of the Visited Agencies

No.	Country	Organization	Month/Year
1	Brunei	Meteorology Department (MD), Ministry of Communications	Jun. 2014
2	Brunei	National Disaster Management Centre (NDMC) and Multi Purpose Training Centre (MPTC)	Ditto
3	Brunei	Survey Department (SD), Ministry of Development	Ditto
4	Brunei	Public Work Department (PWD)	Ditto
5	Brunei	UBD/IBM Centre	Ditto
6	Cambodia	Forestry Administration (FA), Ministry of Agriculture, Forestry and Fisheries (MAFF)	Jan. 2014
7	Cambodia	Public Works Research Center (PWRC), Ministry of Public Works and Transportation (MPWT)	Ditto
8	Cambodia	Department of Hydrology and River Works (DHRW) & Department of Meteorology (DOM), Ministry of Water Resources and Meteorology (MOWRAM)	Jan. 2014 Jul. 2015
9	Cambodia	Geography Department (GD), General Department of Cadastre and Geography (GDCG), Ministry of Land Management, Urban Planning & Construction (MLMUPC)	Ditto
10	Cambodia	National Committee Disaster Management (NCDM)	Ditto
11	Cambodia	Flood Management and Mitigation Programme (FMMP), Mekong River Commission (MRC)	Ditto
12	Indonesia	National Disaster Management Agency (BNPB)	Nov. 2013
13	Indonesia	Agency for Meteorology, Climatology and Geophysics (BMKG)	Ditto
14	Indonesia	The Agency for Assessment and Application of Technology (BPPT)	Ditto
15	Indonesia	Data Processing & Mapping Centre (DMPC), Ministry of Public Works (PU)	Ditto
16	Indonesia	Jakarta Regional Disaster Management Agency (BPBD DKI)	Ditto
17	Indonesia	National Institute of Aeronautics and Space (LAPAN)	Ditto
18	Indonesia	Geospatial Information Agency (BIG)	Oct. 2014
19	Lao PDR	Department of Disaster Management and Climate Change (DDMCC), Ministry of Natural Resources and Environment (MONRE)	Jan. 2014 Jan. 2015
20	Lao PDR	Disaster Management Division (DMD), Social Welfare Department, Ministry of Labour and Social Welfare (MLSW) * Former National Disaster Management Office (NDMO)	Ditto
21	Lao PDR	Department of Meteorology and Hydrology (DMH), Ministry of Natural Resources and Environment (MONRE)	Ditto
22	Lao PDR	Department of Technology and Innovation (DTI), Ministry of Science and Technology (MOST)	Ditto

No.	Country	Organization	Month/Year
23	Lao PDR	Department of Water Resources (DWR), Ministry of Natural Resources and Environment (MONRE)	Ditto
24	Lao PDR	Ministry of Public Works and Transportation (MPWT)	Ditto
25	Lao PDR	National Geographic Department (NGD), Ministry of Home Affairs (MOHA)	Ditto
26	Lao PDR	Remote Sensing Center (RSC), Natural Resources and Environment Institute (NREI), MONRE	Ditto
27	Malaysia	Astronautic Technology Sdn. Bhd. (ATSB)	Jul. 2015
28	Malaysia	Department of Irrigation and Drainage (DID), Ministry of Natural Resources & Environment (NRE)	Ditto
29	Malaysia	Department of Survey and Mapping Malaysia (JUPEM), NRE	Ditto
30	Malaysia	Malaysia Centre for Geospatial Data Infrastructure (MaCGDI), NRE	Ditto
31	Malaysia	Malaysian Meteorological Department (MetMalaysia), Ministry of Science Technology and Innovation (MOSTI)	Ditto
32	Malaysia	Malaysian Remote Sensing Agency (ARSM), MOSTI	Ditto
33	Malaysia	Malaysian Space Agency (ANGKASA), MOSTI	Ditto
34	Malaysia	Malaysia Public Works Department (PWD/JKR), Ministry of Works	Ditto
35	Malaysia	National Security Council (NSC), Prime Minister's Department	Ditto
36	Myanmar	Directorate of Water Resources and Improvement of River Systems (DWRI), Ministry of Transport (MOT)	Feb. 2014
37	Myanmar	Forestry Department (FD), Ministry of Environmental Conservation and Forestry (MOECAF)	Ditto
38	Myanmar	Remote Sensing Department (RSD), Myanmar Technological University (MTU), Ministry of Science and Technology (MOST)	Ditto
39	Myanmar	Water Resource Utilization Department (WRUD), Ministry of Agriculture and Irrigation (MOAI)	Ditto
40	Myanmar	Department of Meteorology and Hydrology (DMH), Ministry of Transport (MOT)	Feb. 2014 Jan. 2016
41	Myanmar	Myanmar Aerospace Engineering University (MAEU), Ministry of Science and Technology (MOST)	Ditto
42	Myanmar	Relief and Resettlement Department (RRD), Ministry of Social Welfare, Relief and Resettlement (MoSWRR)	Ditto
43	Myanmar	Survey Department (SD), Ministry of Environmental Conservation and Forestry (MOECAF)	Ditto
44	Myanmar	Irrigation Department (ID), Ministry of Agriculture and Irrigation (MOAI)	Jan. 2016
45	Myanmar	Emergency Operation Center (EOC)	Ditto
46	Myanmar	Myanmar Information Management Unit (MIMU)	Ditto
47	Myanmar	Myanmar Geospatial and Resources Center (MGRC)	Ditto

No.	Country	Organization	Month/Year
48	Philippines	National Mapping and Resource Information Authority (NAMRIA), Department of Environment and Natural Resources (DENR)	Jan. 2014
49	Philippines	The Manila Observatory (MO)	Ditto
50	Philippines	Flood Control and Management Cluster (FCMC), Unified Project Management Office (UPMO), Department of Public Works and Highways (DPWH)	Jan. 2014 Nov. 2015
51	Philippines	Mines and Geosciences Bureau (MGB), Department of Environment and Natural Resources (DENR)	Ditto
52	Philippines	Office of Civil Defense (OCD), Department of National Defense (DND)	Ditto
53	Philippines	Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA), Department of Science and Technology (DOST)	Ditto
54	Philippines	Philippine Council for Industry, Energy and Emerging Technology Research and Development (PCIEERD), Department of Science and Technology (DOST)	Ditto
55	Philippines	University of Philippines (UP)	Ditto
56	Philippines	Environmental Management Bureau (EMB), Department of Environment and Natural Resources (DENR)	Nov. 2015
57	Philippines	Philippine Institute of Volcanology and Seismology (PHIVOLCS)	Ditto
58	Singapore	Centre of Remote Imaging, Sensing and Processing (CRISP), National University of Singapore	May 2014
59	Singapore	Meteorological Service Singapore (MSS), National Environment Agency	Ditto
60	Singapore	Public Utility Board (PUB), National Environment Agency	Ditto
61	Singapore	Singapore Civil Defense Force (SCDF)	Ditto
62	Singapore	Singapore Land Authority (SLA)	Ditto
63	Thailand	Department of Water Resources (DWR)	Nov. 2014
64	Thailand	Land Development Department (LDD)	Ditto
65	Thailand	Thai Meteorological Department (TMD)	Ditto
66	Thailand	Department of Disaster Prevention and Mitigation (DDPM)	Nov. 2014 Jan. 2016
67	Thailand	Geo-Informatics and Space Technology Development Agency (GISTDA)	Ditto
68	Thailand	Royal Irrigation Department (RID)	Ditto
69	Thailand	National Disaster Warning Center (NDWC)	Ditto
70	Thailand	Office of National Water and Flood Management Policy (ONWFMP)	Ditto
71	Thailand	Hydro and Agro Informatics Institute (HAII)	Jan. 2016
72	Thailand	Royal Thai Survey Department (RTSD)	Ditto
73	Vietnam	Vietnam National Satellite Center (VNSC), VAST	Dec. 2013

No.	Country	Organization	Month/Year
74	Vietnam	Department of Natural Disaster Prevention and Control (DNDPC), Directorate of Water Resources (DWR), MARD	Dec. 2013 Jan. 2015
75	Vietnam	Disaster Management Center (DMC), Directorate of Water Resources (DWR), MARD	Ditto
76	Vietnam	National Hydro-Meteorological Service of Viet Nam (NHMS), MONRE	Ditto
77	Vietnam	Vietnam National Remote Sensing Center (VNRSC), MONRE	Ditto
78	Vietnam	Department of Survey and Mapping Viet Nam (DOSMVN), MONRE	Jan. 2015
79	Vietnam	Institute of Meteorology Hydrology and Environment (IMHEN), MONRE	Ditto
80	Vietnam	Space Technology Institute (STI), VAST	Ditto
81	Vietnam	Vietnam Academy for Water Resources (VAWR), MARD	Ditto
82	Vietnam	Water Resources Management Department (WRMD), MONRE	Ditto

5. Summary of Current Status of Satellite Information Utilization of Each Country

(1) Brunei

Item		Details
(1) Situation of Disaster		・ The occurrence of the large scale damages caused by earthquake, volcanic eruption and typhoon is less frequent, while the disaster caused by factors such as smaller-scale floods and uncontrolled developments, etc. is more frequent. ・ Regarding floods, the flood damage occurs when the high tide time matches with the flood peak.
(2) Information	Satellite	・ SA is the main source of satellite information. Survey Department (SD) has a budget for procuring satellite images and can procure a commercial satellite depending on the situation.
	Hydrometeorology Topography	・ PWD conducts rainfall gauging observation. However, the total number of the observation stations is not sufficient. MD owns Automatic Weather Station (AWS), but the locations of the stations are concentrated only in urban areas. MD also conducts rainfall observation by utilizing DCA's Weather Doppler Radar. ・ PWD conducts water level observation, but the total number of the observation stations is not sufficient. ・ The responsible department for river cross-section survey is not certain. ・ Regarding topographic data, SD owns LiDAR data. SD also owns land use data.
(3) Technology	Image Analysis	・ 3 engineers specializing in optics and SAR image analysis are enrolled in SD. In the past they attempted visual interpretation of flood coverage using TerraSAR-X images after the disaster and optical images before the disaster. ・ Staff trained in SAR images are enrolled in PWD, but they need more experience to reach a level at which they can provide analysis service quickly in the event of actual disaster.
	Hydrologic and Hydraulic Analysis	・ PWD is outsourcing the conduction of hydrologic and hydraulic analysis to Universiti Brunei Darussalam / IBM Center (UBD/IBM). ・ SD does not have the skills to conduct hydrologic and hydraulic analysis. ・ UBD/IBM develops their own model for conducting runoff-inundation analysis and also develops the flood forecasting system; UBD/IBM also develops and utilizes their own model for the meteorological forecasting.
(4) Disaster Management Activities	Monitoring of Damage Status	・ National Disaster Management Centre (NDMC) is responsible for collection of information in the event of disaster occurrence, but there are problems monitoring damage status especially in areas where communications systems are not provided or to which access is difficult. ・ There is no agency responsible for monitoring damage status using satellite images.
	Flood Forecasting	・ MD issues the meteorological warnings and notifies to the ministries, agencies and residents via FAX, E-mail, telephone and SMS. ・ PWD has never issued flood warning until now, however they are considering the issuance.
	Flood Control Plan, Hazard Map	・ PWD is responsible for formulation of the Flood Control Plan, for implementation of the countermeasures and for management of river channel, canal and dams, as well as the flood damage mitigation. ・ PWD requested to verify the effectiveness of the design of drainage system and the river improvement to the project team. ・ PWD prepared flood risk maps at four districts based on the past flood records.

(2) Cambodia

Item		Details
(1) Situation of Disaster		・ Cambodia is located in the lower reach of the Mekong River; therefore some floods occurred due to the precipitation in upper reaches regardless of the rainfall amount inside Cambodia. ・ The flood damages are concentrated in the areas around the Mekong River and Tonle Sap Lake.
(2)	Satellite	・ SA is the main source of satellite images, but the SA scheme is not functioning. Therefore, information is obtained through ASEAN member countries.

Item		Details
Information	Hydrometeorology Topography	・ DOM, Ministry of Water Resources and Meteorology (MOWRAM) owns the rainfall data. DOM also operates a meteorological radar. The original observation data collected by the meteorological radar is not disclosed to the public. ・ Regarding the data of river cross-section, water level and discharge, DHRW of MOWRAM is responsible and owns such data. ・ Geography Department (GD) of Ministry of Land Management Urban Planning and Construction (MLMUPC) has established the topographic map. ・ Forestry Administration (FA) of Ministry of Agriculture, Forestry and Fisheries (MAFF) prepares the forest cover and land use maps.
(3) Technology	Image Analysis	・ There is no agency capable of monitoring damage status using satellite images. ・ Staff trained in satellite image analysis including SAR images are enrolled in NCDM and GD, but they need more experience to reach a level at which they can provide analysis service quickly in the event of actual disaster.
	Hydrologic and Hydraulic Analysis	・ According to the history of the training experiences, it is concluded that DHRW has human resources with the basic knowledge of hydrologic and hydraulic analysis. ・ DHRW has previously developed H-Q curves.
(4) Disaster Management Activities	Monitoring of Damage Status	・ NCDM is responsible for taking the lead in all the activities as responses to natural disasters and disasters arising from human activities. ・ NCDM dispatches an assessment team to the affected area in collaboration with other agencies immediately after a disaster occurs to monitor the damage status.
	Flood Forecasting	・ DHRW is responsible for flood warnings. DHRW has requested to evaluate the countermeasures for the flash flood in mountainous region to the project team. ・ DOM is responsible for issuing the meteorological warnings of thunderstorms and heavy rain.
	Flood Control Plan, Hazard Map	・ MOWRAM including DHRW is responsible for the water resources management. ・ DHRW stipulates the flood control plan including the measures on flood control and embankment conservation. However, the plan has formulated without referring the hydrology and hydraulics. (It is based on the past disaster records.) ・ NCDM has developed the disaster damage information system (CamDi) with the assistance of United Nations Development Programme (UNDP). NCDM is planning to develop disaster risk maps. (NCDM is the policy making body. The implementation bodies are other agencies.) ・ MIME is responsible for dams and related works. In principle, MIME is obligated to inform the dam operation data to MOWRAM, however it has not been conducted in the past as floods occurred. There are cases that floods occurred due to the water discharge from dams.

(3) Indonesia

Item		Details
(1) Situation of Disaster		・ The most frequently occurred disaster is flood. The floods which occurred without the effect of high tide have a high percentage of occurrences. Among all flood events, the flash flood occurs relatively high frequency. ・ The floods occur mostly east coast of northern part of Sumatra Island, Eastern and norther parts of Kalimantan Island, southern part of Sulawasi Island and southern part of Papua region.
(2) Information	Satellite	・ LAPAN possesses Indonesia's very small earth observation satellite and receives signals from SPOT and Landsat. ・ 5 agencies including LAPAN are registered as JPT members in SA. In addition, LAPAN and The Agency for the Assessment and Application of Technology (BPPT) are registered members of DAN.

Item		Details
	Hydrometeorology Topography	・ BMKG observes and owns rainfall data. In addition, BMKG also owns ground weather stations (including AWS) and weather radars (it is scheduled to install 60 weather radars in all over Indonesia by 2019). ・ PU and the Local Governments conduct the water level observations. ・ Balai Besar Wilayah Sungai (Basin Management Office): BBWS owns the river cross section data. However, the data has not been fully updated. ・ BIG owns the topographic maps and land use maps.
(3) Technology	Image Analysis	・ Technical development for use of satellite images is promoted under the leadership of LAPAN. 60 to 70 engineers are enrolled in the Application Center of LAPAN. Engineers capable of SAR image analysis are also working with BIG. ・ BIG is not responsible for satellite image analysis.
	Hydrologic and Hydraulic Analysis	・ Each BBWS under PU has been formulating POLA and PANACIA for 65 basins. However those are not based on hydrological and hydraulic analysis. ・ PU provides the flood risk area information of a small-scale map to BMKG. ・ According to the interview results of PU, in the entire PU including BBWS, there are 14 staffs that are capable of conducting hydrological and hydraulic analysis. ・ It is concluded that Research Centre for Water Resources (PUSAIR) which is the water resources research institute of PU has staffs with enough knowledge on hydrology and hydraulic analysis as they have developed JFEWS and Tech4Water.
(4) Disaster Management Activities	Monitoring of Damage Status	・ LAPAN provides satellite images at the request of the BNPB national disaster management agency and BPBD local disaster management agencies under a system in which telephone calls are received even in the middle of the night. ・ BPBD monitors disasters in local areas, but disasters at national level are monitored by BNPB. ・ BNPB transmits information to high-ranking government officials, relevant organizations and the media by e-mail, SMS and facsimile.
	Flood Forecasting	・ BPBD is responsible for issuing weather warnings and flood warnings. The flood forecasting is conducted mainly based on the water level correlation of the upstream and downstream. ・ Jakarta Regional Disaster Management Agency (BPBD DKI) operates the flood forecasting and warning system, namely JFEWS, in the Jakarta region. ・ BBWS develops the flood guideline of the major rivers, and sets danger water levels and issues flood warnings.
	Flood Control Plan, Hazard Map	・ Each BBWS under PU has been formulating POLA and PANACIA for 65 basins. However those are not based on hydrological and hydraulic analysis. ・ Regarding the risk analysis, the flood risk (history) map (1/250,000) has been developed in each state (one map per state).

(4) Lao PDR

Item		Details
(1) Situation of Disaster		・ The most frequently occurred disaster is flood. ・ The number of deaths and flood damages to houses are concentrated in the Mekong River areas and the mountainous areas.
(2) Information	Satellite	・ Lao PDR does not possess its own satellites or receiving stations. It has to acquire satellite images from other countries and SA. ・ NGD has utilized satellite images to develop 1/100,000-scale topographic maps.
	Hydrometeorology Topography	・ NGD provides spatial information (DRM, Ortho images, GIS data of rivers and others). ・ DMH conducts rainfall and water level observations. The observed data is shared with Mekong River Commission (MRC).
(3) Technology	Image Analysis	・ RSC has image analysis engineers who can process not only optic satellite images but also SAR satellite images. ・ There are also image processing engineers in NGD.

Item		Details
	Hydrologic and Hydraulic Analysis	・ DWR of MONRE is now formulating Integrated Water Resource Management (IWRM) of the country, and utilizes the runoff analysis for analyzing the design scale of dams and the schedule of the dam release. ・ DWR has 4 staffs that are in charge of hydrologic and hydraulic analysis. They have utilized the water utilization model: IWWM (Integrated Quantity-Quality Model, Germany), the material circulation model: SWAT (Soil and Water Assessment Tool), and the image analysis software: ISIS (CH2M HILL, USA). ・ NERI has 3 staffs that have used HEC-RAS (Hydraulic Analysis software), SWAT and ISIS. NERI assists DWIR in formulating IWRM, especially on the hydrologic and hydraulic analysis. ・ DMH with the assistance of MRC has installed a flood warning and forecasting system in the Xe Bangfay River basin by using URBS (the runoff analysis model, Australia). They have a plan to install the flood warning and forecasting system in all basins. They have also conducted the runoff analysis in the Sekong River basin by utilizing IFAS.
(4) Disaster Management Activities	Monitoring of Damage Status	・ RSC has monitored the flood situation using satellite image analysis. ・ No Standard Operating Procedure (SOP) for satellite image procurement and analysis has been prepared.
	Flood Forecasting	・ RSC develops flood risk maps. ・ DMH is responsible for conducting flood monitoring and issuing the flood warnings. The flood forecasting is conducted by using the water level correlation of the upstream and downstream.
	Flood Control Plan, Hazard Map	・ DWR is preparing IWRM for the major four river basins. In addition, DWR intends to prepare the plan for other six river basins for the next 10 years (from 2015 to 2025). ・ The risk analysis is planned to be conducted in (1) the National Flood Risk Evaluation and Management Plan (MONRE) and (2) the Basin Flood Risk Management Plan (River Basin Committee: RBC).

(5) Malaysia

Item		Details
(1) Situation of Disaster		・ The major disasters occurred in Malaysia are floods and landslides caused by monsoon. In addition, the frequency of inland inundation has been increased due to the rapid development and urbanization, as well as environmental destruction. ・ The most frequently occurred disaster is flood. Of all, 20% of the floods are caused by flash floods. In terms of the number of fatalities per number of incidents, it is reported that the larger impacts are caused by cyclone, infectious diseases and landslides.
(2) Information	Satellite	・ ARSM has acquired a budget to purchase satellite images and uses commercial satellites such as Pleiades, SPOT, IKONOS and RADARSAT-2. Also, the agency possesses a receiving system to receive signals from SPOT-6/7.
	Hydrometeorology Topography	・ Malaysian Meteorological Department (MetMalaysia), DID and Ministry of Agriculture conduct rainfall observations. DID also conducts water level observations. The purpose of the observation network which is established by MetMalaysia is not for hydrological observation, therefore DID's observation data should be utilized for formulating the flood countermeasures. ・ There are 1297 rainfall gauging stations, and 332 water level stations in Malaysia. ・ The observed meteorological-hydrological data are open to public via InfoBanjir (publicinfobanjir.water.gov.my) which is available to share among ministries and agencies. ・ DID contacts river cross-section surveys for preparation of the structural measures and the development of the forecasting and warning system.
(3) Technology	Image Analysis	・ ARSM has 6 or 7 staff members with skill in satellite image analysis including SAR image analysis.
	Hydrologic and Hydraulic Analysis	・ 11 officers from DID have attended trainings on flood hazard maps organized by ICHARM. Therefore, it is concluded that they have the basic knowledge on hydrology and hydraulics.

Item		Details
(4) Disaster Management Activities	Monitoring of Damage Status	・ NSC receives reports from the agencies in charge such as the Malaysia Public Works Department (PWD/JKR) and DID and monitors the damage status of the entire disaster area. ・ If a disaster occurs, ANGKASA submits a request for photo images to SA. The acquired images (GeoTiff) are analyzed by ARSM and the results are distributed to the related agencies. ・ Flood coverage images in 2014 were made by ARSM and provided to DID.
	Flood Forecasting	・ DID has developed the flood forecasting and warning system for the six basins (Iskos, Bunmon, Sarawa, Kwantas, Kuria baha, and kurantan). However, the accuracy of the simulation results is not sufficient because of the model calibration issues. ・ DID has previously utilized IFAS, however it was reported that the simulation accuracy was approximately 50 %.
	Flood Control Plan, Hazard Map	・ DID has already formulated the flood control plan focusing on the high risk areas. In addition, DID is also responsible for risk evaluation including the preparation of flood hazard maps.

(6) Myanmar

Item		Details
(1) Situation of Disaster		・ The most frequently occurred disaster is flood. Floods occur in the delta area, whereas the flash floods and debris flow occur in the mountainous areas located upstream. The regional flood occurs in the urban area. ・ Cyclone Nargis (2008) caused the largest number of the victims. Followed by cyclones, the number of deaths per incidents caused by flash flood is high.
(2) Information	Satellite	・ Myanmar possesses no satellites or receiving stations of its own. Satellite images are acquired from foreign organizations including SA. ・ There are no agencies which actively utilize satellite images in their services.
	Hydrometeorology Topography	・ DMH conducts observations of rainfall and water level. They have also installed three weather radars with the support of JICA. ・ DWRI conducts river cross-section surveys, and owns the maps of the river channel networks and the basin boundaries data. ・ Survey Department (D) of Ministry of Environment and Conservation and Forestry (MOECAF) owns the topography information. Ministry of Defense manages SD's topography maps and DEM, and the permission of Ministry of Defense is required for the data use.
(3) Technology	Image Analysis	・ There is no agency related to disaster management which possesses satellite image analysis technology. ・ Myanmar Information Management Unit (MIMU), an external agency, has remote sensing engineers who support disaster management activities as volunteers.
	Hydrologic and Hydraulic Analysis	・ A large number of DMH officers have attended the IFAS training program organized by ICHARM. They have reported that IFAS will not be actively utilized because the results of IFAS were not matching with the observed values. ・ Irrigation Department (ID) conducts hydrological analysis for the dam planning. They have utilized the runoff analysis model by setting the design scale (design flood scale) to prepare and implement the dam design. ・ DWRI has no experience to utilize the hydrologic and hydraulic analysis in their work. However, they have expressed very strong interests in the hydrological and hydraulic analysis which can be utilized for the river bank erosion, river bed variation, and sediment management.
(4) Disaster Management	Monitoring of Damage Status	・ At the time of a flood disaster in 2015, the external organization MIMU supported EOC and procured satellite images from SA. ・ MIMU performed satellite analysis as a voluntary task and provided the results to EOC.

Item		Details
Activities	Flood Forecasting	・ DMH conducts the monitoring and flood forecasting. The flood forecasting is conducted by using the water level correlation of the upstream and downstream. They have tried to utilize hydraulic analysis models such as IFAS for the flood forecasting, however the results of the analysis was not accurate enough ant thus, water level correlation method is utilized so far.
	Flood Control Plan, Hazard Map	・ In Myanmar, No flood management master plan nor related plan has been formulated yet, and the responsible agencies/departments for basin management is not clear. ・ DWRI of Ministry of Transport (MT) is responsible for river management, and implements the plans and designs of bank protection. Currently, the bank protection is designed based on the empirical values such as flood mark (water level).

(7) Philippines

Item		Details
(1) Situation of Disaster		・ The river basin is generally small. There are many rivers with a steep slope. ・ 139 flood events have occurred past 30 years which is the highest occurrence in ASEAN 10 countries. In addition, the number of affected people was more than 27 million people which are the second largest in the ASEAN countries.
(2) Information	Satellite Information	・ The Philippines possesses no satellites or receiving stations of its own. It has to acquire satellite images from other countries including SA. ・ The satellite images are utilized by PAGASA, Philippine Institute of Volcanology and Seismology (PHIVOLCS) and Mines and Geosciences Bureau (MGB).
	Other Information	・ Several agencies are observing rainfall, water level and tide. ・ DPWH is responsible for conducting river cross section survey for 421 rivers. ・ National Mapping and Resource Information Authority (NAMRIA) prepares spatial information including topography map, DEM and land use map, and provides them to other government agencies. ・ Recently, the nationwide DEM with 5 m mesh has been established based on the data obtained from IFSAR since 2013.
(3) Technology	Image Analysis	・ NAMRIA and Manila Observatory (MO) possess image analysis technology. However, neither is responsible for monitoring the damage status in the event of a disaster. ・ PAGASA is actively acquiring SAR image analysis technology.
	Hydrometeorology Topography	・ PAGASA and OCD staffs have attended the hydrology and hydraulic trainings of the project.
(4) Disaster Management Activities	Monitoring of Damage Status	・ SOP has been formulated to transmit information including forecasts and warnings and damage status in the event of disaster occurrence, but SOP on the sharing of roles and analysis procedures in satellite image analysis has not been established. ・ The responsible agencies are determined according to the type of natural disaster. Floods due to typhoons or tornadoes are controlled by PAGASA.
	Formulation of Disaster Prevention Plan	・ The flood management is conducted by DPWH for the major 18 rivers and by LGU for the other rivers. ・ On the other hand, Department of Environmental and Natural Resources (DENR) is responsible for the preparation of IWRM. IWRM is a plan to conduct the holistic management for dealing all the problems related to water including water disaster, water use and water quality and contamination. However, DENR does not have sufficient capacity to prepare the flood management plan. Therefore, DPWH handles the flood management plan.
	Flood Forecasting	・ PAGASA and some of LGUs have developed flood forecasting and warning systems. Metropolitan Manila Development Authority (MMDA) has also installed a forecasting and warning system in the Marikina basin.

(8) Singapore

Item		Details
(1) Situation of Disaster		・ Large scale natural disasters such as earthquake, floods, and volcanic eruption are not occurred so far. Instead, anthropogenic disaster and accidents in the industry which deal with hazardous materials have occurred. ・ In the city area, inland inundation has occurred due to regional heavy rain.
(2) Information	Satellite Information	・ CRISP operates the satellites and receiving stations owned by Singapore. Forest fire information utilizing NOAA data has been provided to Indonesia at the time of forest fire.
	Hydrometeorology Topography	・ DEM with 5 m mesh and the vertical accuracy of 1 m is utilized in the flood risk map. ・ SLA has established the special information platform: GeoSpace: GIS data for the government authorities. Established with 520 layers. One Map: Spatial Information for the general public. It includes the information such as train and firefighting. Information of the contents is provided by each government agency. Data.gov.sg: provides the special information analysis tool and API for the general public.
(3) Technology	Image Analysis	・ All 50 staff members of CRISP have knowledge of satellite image analysis technology. ・ CRISP is registered in SA as a DAN member and has experience in disaster analysis in the event of earthquake disaster.
	Hydrologic and Hydraulic Analysis	・ PUB has developed the run-off analysis system based on the own-built hydrological model and conducted the runoff analysis. And, they have also conducted one- and two dimensional models for analyzing the discharge capacity of the drainage channels. Therefore, it is concluded that PUB has sufficient knowledge on hydrology and hydraulics.
(4) Disaster Management Activities	Monitoring of Damage Status	・ CRISP provides image analysis in the event of disaster occurrence, but has no tie ups with organizations related to disaster management. ・ Flash floods occur as a disaster, but it is not necessary to monitor the damage status because the water subsides in a few hours. It is difficult to monitor this type of disaster by means of satellite images.
	Flood Forecasting	・ The weather forecast and warning system has been established by MMS and the flood warning (water level warnings) has been established by PUB. This system could provide enough lead time prior to the disaster, however if runoff analysis is applied in the forecasting and warning system, it is expected to secure much longer lead time.
	Flood Control Plan, Hazard Map	・ The drainage maintenance plan with the 10 year design flood is developed in order to respond the inland inundation due to the regional heavy rain. The drainage area which is targeted in the drainage management plan is a few km^2 which is very small and limited area, and the flood arrival time tends to be extremely short, such as a few minutes to several tends of minutes. Therefore, it is concluded that the accuracy of the current satellite information is not sufficient to use.

(9) Thailand

Item		Details
(1) Situation of Disaster		・ The large scale flood occurs during the rainy season that about 80% of annual rainfall amount is recorded. ・ In the northern part of mountainous region, there are inland inundation, landslides and debris flow. In addition, in the northeast region, inland inundation occurs frequently during the rainy season. ・ Most part of central region is located in the low-lying areas of the Chao Phraya River basin and the urban area experiences floods every year. In the southern part, the rainfall amount is the largest in Thailand, and mud flow and inland inundation occur.
(2) Information	Satellite	・ GISTDA is responsible for space-related technologies and possesses a domestic satellite and receiving stations. ・ GISTDA provides satellite information to the surrounding countries. ・ There are plans to establish an ARTSA to support Asian countries.
	Hydrometeorology Topography	・ Royal Thai Survey Department (RTSD) owns National Geospatial Information Database (NGIS) which integrates aerial photo (nationwide) and GIS data (14 layers) including DEM (30 m mesh). This information was provided to GISTDA during the flood disaster. ・ GISTDA input in NGIS the attribute information which owned and provided by the disaster related ministries and agencies. ・ TMD and RID conduct the rainfall observations. ・ Mainly RID and DWR conduct the water level observation. RID is focusing on the irrigation areas and installs a telemetry water level observation network. ・ RID, DWR and EGAT own the river cross section data. ・ Land Development Department (LDD) owns the nationwide DEM (5m grid). Also RID and MOST own LiDAR data.
(3) Technology	Image Analysis	・ Image analysis engineers work with GISTDA and they can process both optical satellite images and SAR satellite images. They have experience in monitoring damage status by analysis of satellite images. ・ AIT is the prime DAN of SA and possesses advanced technology for both optical satellite images and SAR satellite images.
	Hydrologic and Hydraulic Analysis	・ RID has the experience on developing MIKE series, HEC-RAS/HMS, Flood Works, the flood forecasting and warning system by utilizing RRI Model, as well as the development of the flood forecasting system based on the water level correlation. ・ RID has more than 100 staffs who could utilize hydrologic and hydraulic analysis model. The capacity building of new staffs has been recognized as a challenge by RID. ・ DWR has the experience on developing models with MIKE series and Flood Works/Info Works (HR Wallingford Co., Ltd.). 5 staffs have been conducting hydrologic and hydraulic analysis. ・ TMD has 7 technical officers who are capable of developing hydrological models and it is their intention to increase the technical staffs (approximately 10 technical officers) through the education program for new staffs. ・ LDD has 2 technical officers who are conducting the disaster analysis focusing on flood, drought, soil erosion and landslides.
(4) Disaster Management Activities	Monitoring of Damage Status	・ GISTDA is responsible for satellite image analysis in the event of a disaster occurrence under a 24-hour service system. SOP has been established. ・ GISTDA has developed the Thailand Monitoring System (TMS) to disclose not only the flood situation but also forest fires and drought disasters on the website: http://tms.gistda.or.th
	Flood Forecasting	・ By JICA's assistance, a flood forecasting system has been installed which is capable of forecasting the parameters such as discharge, water level and the inundation areas up to 7 days in advance in the Chao Phraya River basin. ・ DWR owns the flood forecasting and warning system in 10 river basins in the mountainous areas where the flood risk is high. The system is not based on the runoff analysis. It is a very simple system which issues warnings when the rainfall amount exceeds a certain value. ・ Regarding the warning system operated by DDPM, it is also a simple system which utilizes manual rainfall gauges and water level gauges installed in villages and issues warnings when the observed values exceed a certain value.

Item		Details
	Flood Control Plan, Hazard Map	・ The flood master plan for the Chao Phraya River basin has been prepared by JICA's assistance in 2013. ・ The responsible ministries and agencies for the risk analysis are not stipulated in any laws. RID, LDD and DDPM have prepared flood risk maps individually. However, the covered area of the maps is very limited. DWR has prepared nationwide risk hazard maps, however the information is lost.

(10) Vietnam

Item		Details
(1) Situation of Disaster		・ The most frequently occurred disaster is cyclone and flood. The largest number of disaster victims is recorded by cyclone. ・ 10% of floods are caused by tidal effects whereas 20% of floods are caused by flash floods.
(2) Information	Satellite	・ Vietnam possesses its own satellite (VNREDSat-1) and receiving stations. The image data is provided for a fee even to governmental agencies. ・ Satellite image data acquisition in event of a typhoon disaster or disaster emergency is possible under a 24-hour system. ・ SPOT data can be received and an annual budget of 1.5 million dollars is maintained. ・ DDMFSC and NRSD are the contacts for SA. ・ Rain clouds are observed by MTSAT.
	Hydrometeorology Topography	・ The nationwide DEM (1/50,000 level) is published on the internet. There is also the nationwide DEM (1/10,000 level with 25 m mesh). ・ MoNRE develops a GIS database (7 layers: contour, lakes, rivers, vegetation, urban areas, road, administrative boundaries, and land use). ・ A new disaster prevention law was put in force in June 2014. ・ NHMS installed meteorological-hydrological observation stations at 700 locations. They also conduct river cross-section survey. ・ DOSMVN of MONRE owns topography maps.
(3) Technology	Image Analysis	・ Image analysis engineers work the NRSD and VNRSA under MONRE. ・ Space Technology Institute (STI) under Vietnamese Academy Science and. Technology (VAST) has image analysis engineers, of whom 5 are SAR image analyzers. STI can provide remote sensing training courses including SAR image analysis. ・ STI is coordinating the registration of DAN and DPN (as of January 2015).
	Hydrologic and Hydraulic Analysis	・ It is concluded that DNDPC, DMC and IMHEN have the basic knowledge and skills on hydrology. ・ ICHARM held several training programs on hazard mapping between 2004 and 2008, and the participants include 8 officers from MARD (including 4 officers from DNDPC), 28 officers from IMHEN, and 36 officers from several other agencies. ・ DMC has an officer who received a master's degree from ICHARM. Also DMH has the experience on the operating the Vietnam disaster warning, analysis and decision-making system (VINAWARE). In addition, DMC with VINAWRE participated the raining on MIKE11/21, the flood analysis model, held by DHI Co., Ltd.
(4) Disaster Management	Monitoring of Damage Status	・ SOP for satellite image procurement and analysis has been recommended, but not established yet. ・ A Flood Monitoring System similar to the system operated in Thailand is under development with the cooperation of Thai GISTDA.

Item		Details
Activities	Flood Forecasting	・ Several ministries and authorities are conducting meteorological-hydrological observation and issuing the flood warnings. ・ In Vietnam, (1) MONRE is responsible for the early warning including monitoring, (2) MARD is responsible for the response during the disaster, and (3) National Committee for Search and Rescue (VINASARCOM) is responsible for the search and rescue. ・ NHMS of MONRE conducts meteorological observation and forecasting of the major 15 river basins. They issue the warnings in accordance with the degree of risk and urgency via the media including TV and radio, as well as deliver to DNDPC of MARD. Based on the warning and information, DNDPC determines how to act (evaluation, etc.) in cooperation with VINASARCOM, delivers the decisions to residents if necessary. ・ The information such as the evacuation instruction is delivered from DNDPC to NSCNDPC, and then NSCNDPC to the local organizations via telephone and FAX, and finally to residents.
	Flood Control Plan, Hazard Map	・ MONRE is responsible for the flood master plan and river basin management whereas MARD is responsible for the examination of countermeasures on natural disasters including flood, drought, irrigation and landslides. ・ Because responsibilities of MONRE and MARD are duplicated, the river management has been made by both MARD and MONRE by each river basin. Therefore, the nationwide unified management is not conducted. ・ Department of Water Resource Management (DWRM) of MONRE is in charge of water resources management including foods management. ・ DNDPC is conducting risk analysis, including the flood management and landslide hazard maps.