



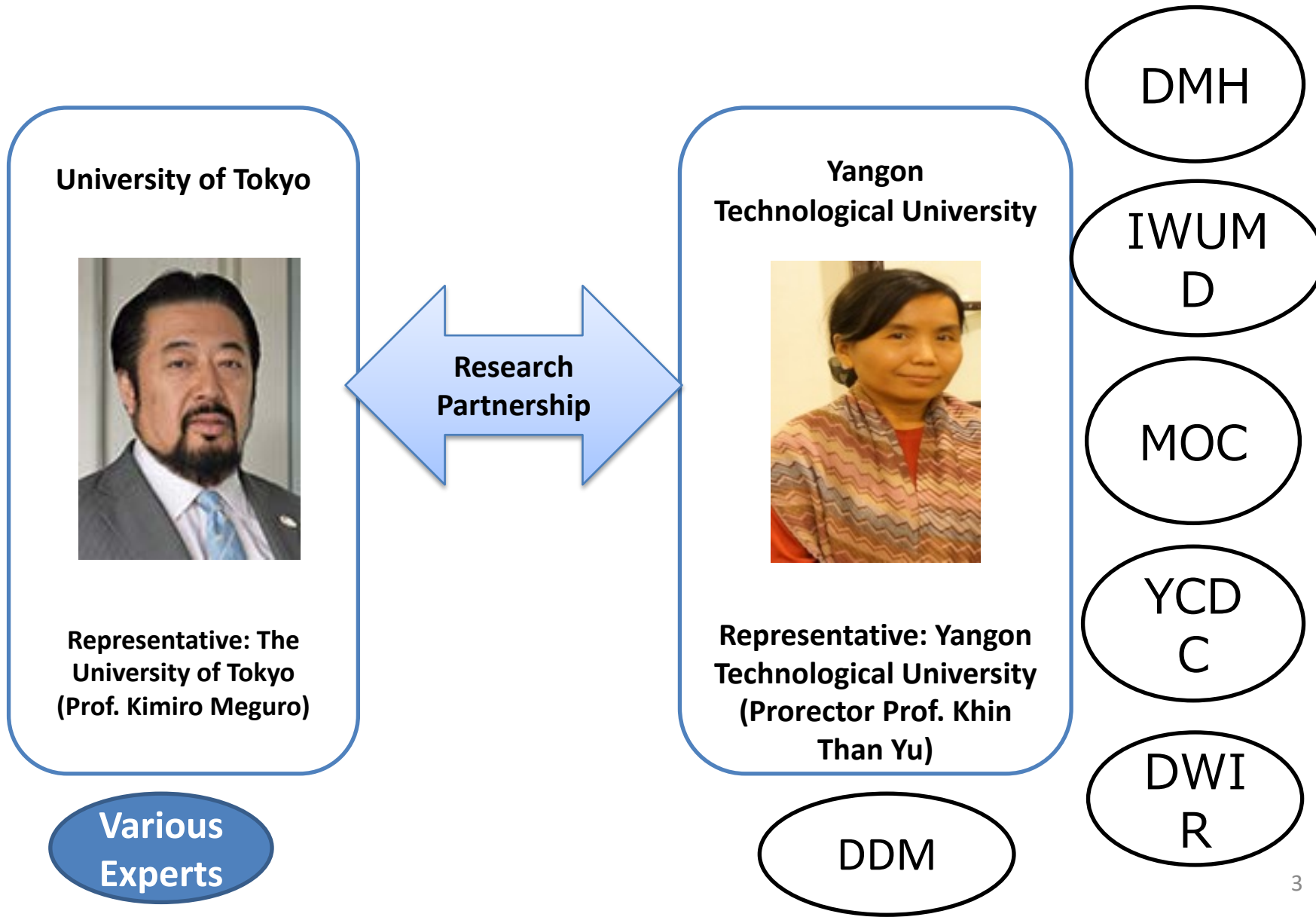
# Development of a Comprehensive Disaster Resilience System and Collaboration Platform in Myanmar







# Organization Relationship



# Water Related Disaster Group

## Group Leader from Japan side

- Dr. Akiyuki Kawasaki (Professor, Civil Engineering Department, the University of Tokyo)

## Group Leader from Myanmar side

- Dr. Win Win Zin (Professor, Civil Engineering Department, Yangon Technological University)

## Members

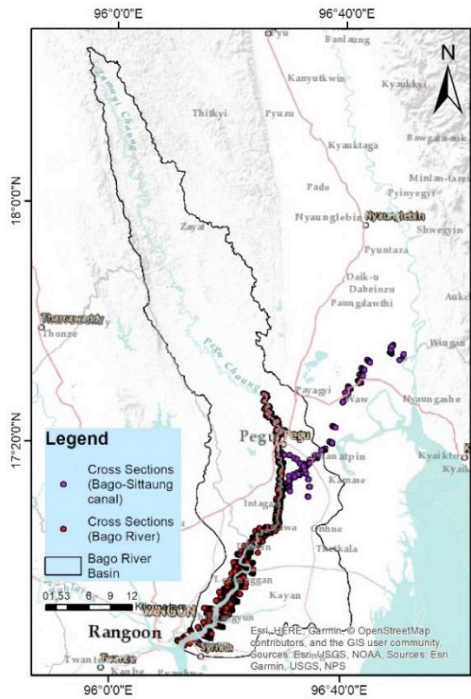
- Dr. Tajima (Professor, Civil Engineering Department, the University of Tokyo)
- Dr. Takenori Shimozono (Associate Professor, Civil Engineering Department, the University of Tokyo)
- Dr. Daisuke Komori (Professor, Civil Engineering Department, Tohoku University)
- Dr. Ralph Allen Acierto (Project Researcher, the University of Tokyo)
- Dr. Sementa Bagavati (Project Researcher, the University of Tokyo)
- Dr. Zin Marlar Tin San (Professor, Civil Engineering Department, Yangon Technological University)
- Mr. Chit Bo Bo Win (Project Assistant, JICA – SATREPS/YTU)
- Ms Shelly Win (PhD Delegate, YTU)
- Mr San Win Maung (Ph.D Delegate, YTU)
- Students from UTokyo, Tohoku University and YTU



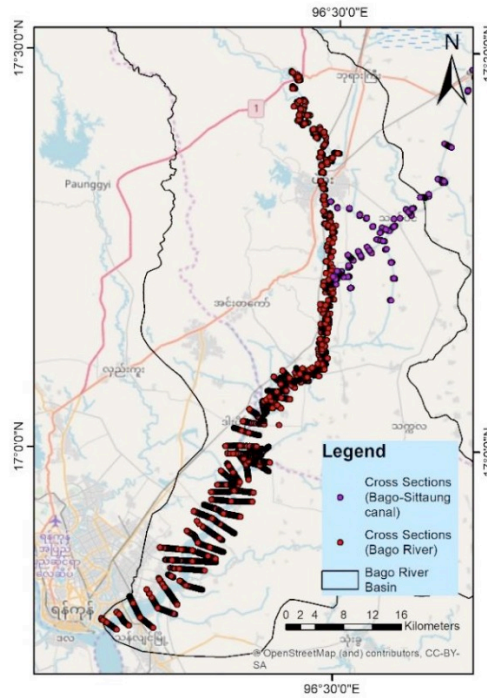
# Collaborated Governmental Departments

1. Department of Meteorology and Hydrology  
(Ministry of Transport and Communications)
2. Department of Disaster Management  
(Ministry of Social Welfare, Relief and Resettlement)
3. Directorate of Water Resources and Improvement of River Systems  
(Ministry of Transport and Communications)
4. Irrigation and Water Utilization Management Department  
(Ministry of Agriculture, Livestock and Irrigation)

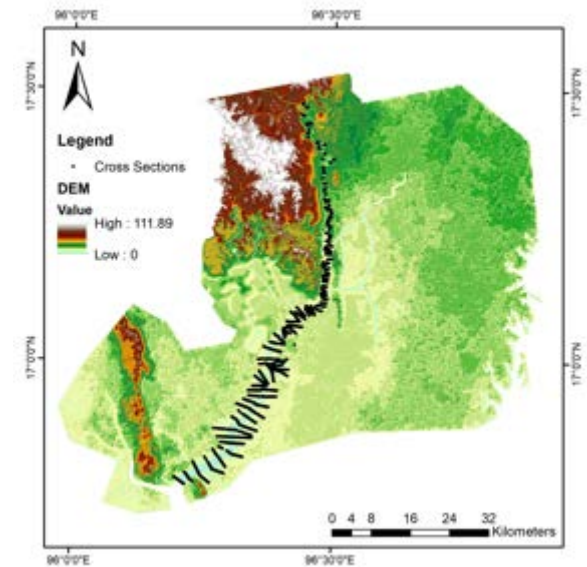
# Study Area



Bago River Basin



Location of Cross sections

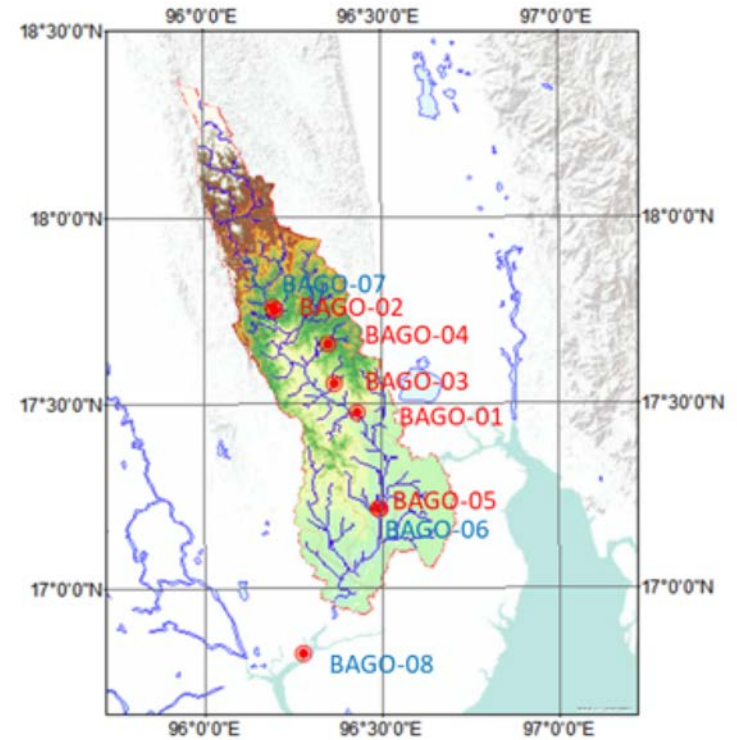


10 m Resolution DEM

(Source: Seemanta, 2018, U Tokyo)

## Information of Stations

Station Code	Station Name	Type	Maintenance
BAGO-01	Zaung Tu Weir	Weather (AWS)	IWUMD
BAGO-02	Zaung Tu Dam	Weather (AWS)	DHPI
BAGO-03	Salu Dam	Weather (AWS)	IWUMD
BAGO-04	Shwe Laung Dam	Weather (AWS)	IWUMD
BAGO-05	Tawa Sluice Gate	Weather (AWS)	IWUMD
BAGO-06	Tawa Sluice Gate	Water Level (AWLS)	IWUMD
BAGO-07	Zaung Tu Dam	Water Level (AWLS)	DHPI
BAGO-08	Kalawe Bridge	Water Level (AWLS)	DWIR





# Installment of Hydro-meteorological observation

- Post-installation meeting and frequent updates for coordination
- Regular updating of maintenance manual for equipment
- Equipment handling experience for local stakeholders for long-term maintenance works

**BAGO-01**

Zaung Tu Weir  
Weather Station



**BAGO-02**

Zaung Tu Dam  
Weather Station



**BAGO-03**

Salu Dam  
Weather Station



**BAGO-04**

ShweLaung Dam  
Weather Station



**BAGO-06**

Tawa Sluicgate  
Water Level Station



# 2018 Flood, Bago city, Myanmar



ဥသာ(၂)၊ Main လမ်း



ကျွန်းသာယာရပ်ကွက်



ဥသာ(၇)၊ ဓမ္မစေတီလမ်း



ဥသာ(၇)၊ ပြင်စီဈေးလမ်း

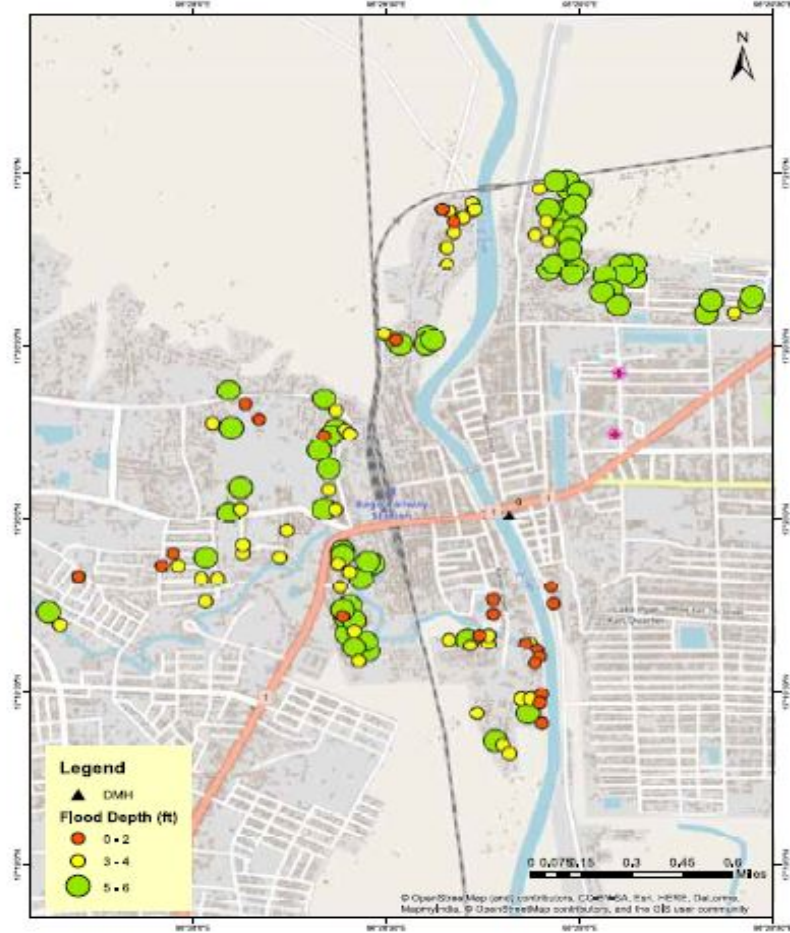


## Questionnaire Survey in Flooded area, Bago, Myanmar



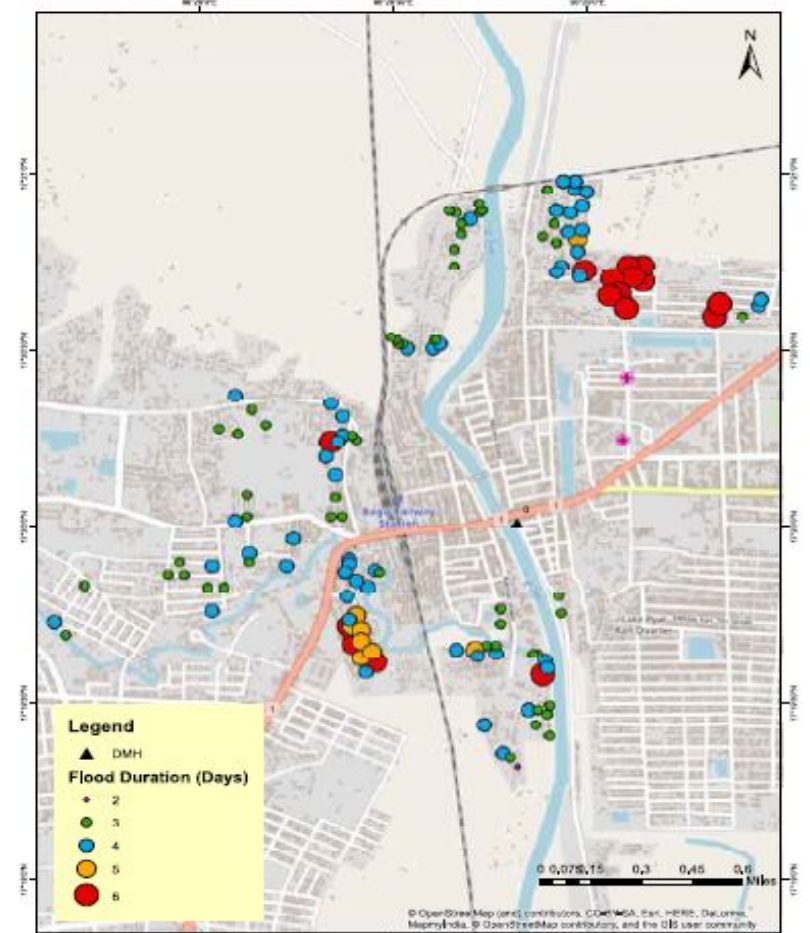


**Flood Depth in Bago ( July, 2018)**

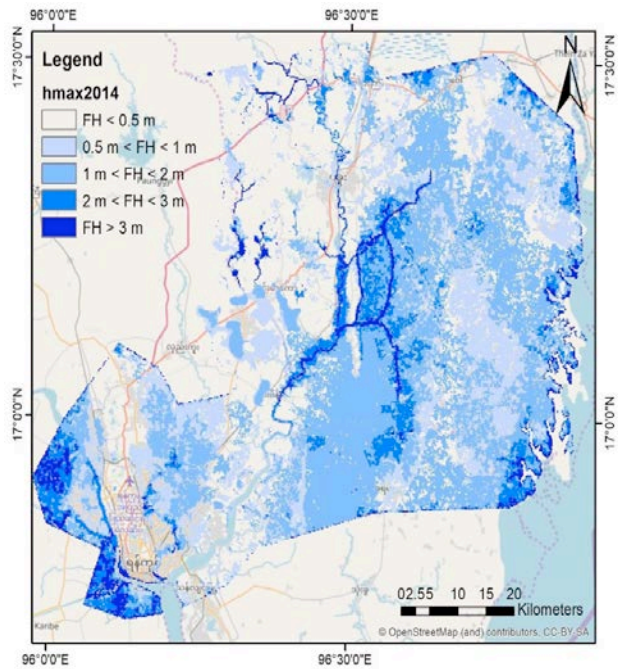


(Source:YTU)

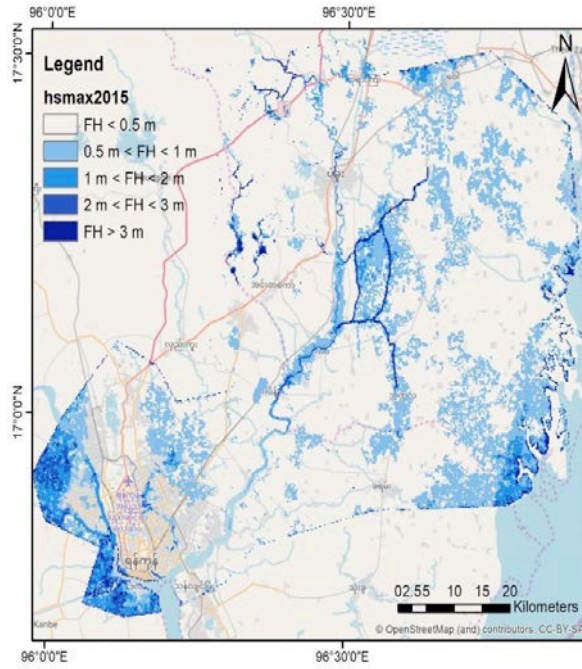
**Flood Duration in Bago ( July, 2018)**



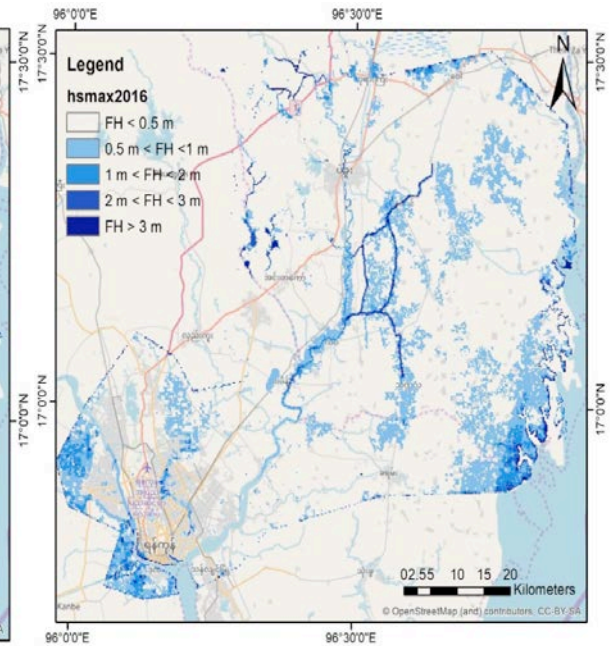
(Source:YTU)



(a)



(b)

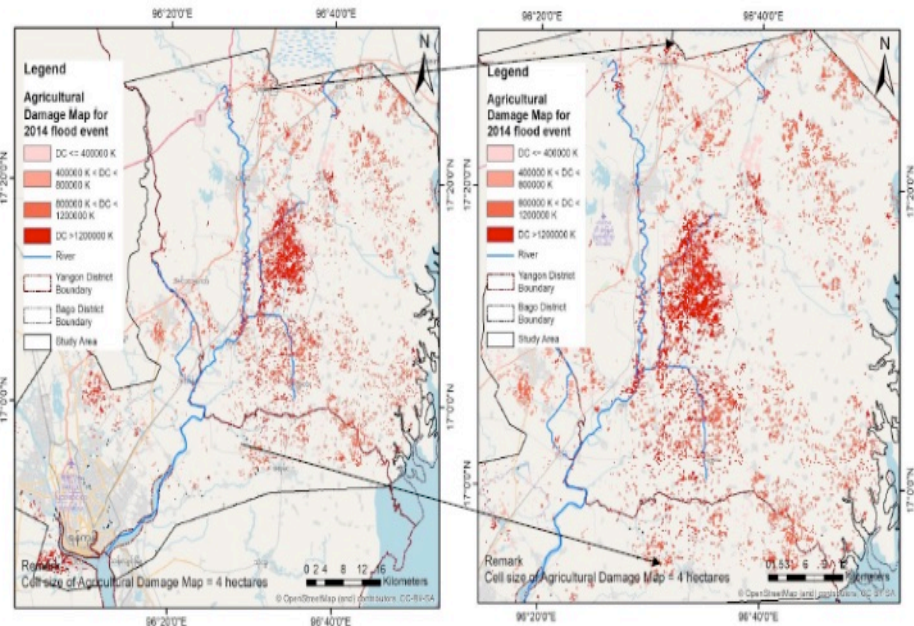


(c)

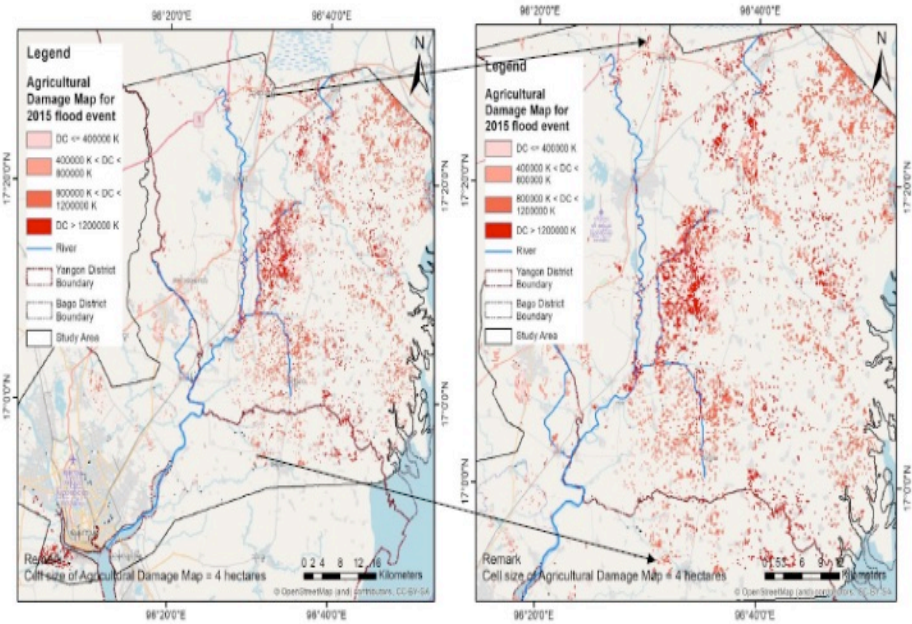
Flood Inundation Mapping for for (a) 2014 and (b) 2015, and (c) 2016

(Source: Shelly Win, 2018, YTU)





Agricultural Damage Spatial Distribution Map for 2014 Flood



Agricultural Damage Spatial Distribution Map for 2015 Flood

(Source: Shelly Win, 2018, YTU)





# Department of Meteorology and Hydrology



**11th GEOSS Asia-Pacific Symposium**

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# **Flood Early Warning System**

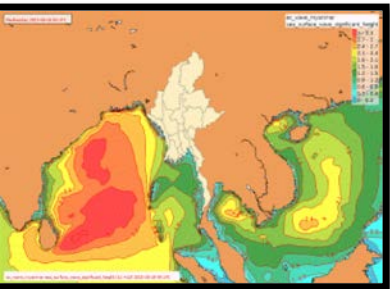
**Ms HTAY HTAY THAN  
DIRECTOR  
DEPARTMENT OF METEOROLOGY AND HYDROLOGY  
MINISTRY OF TRANSPORT AND COMMUNICATIONS**

**24 October 2018**

# Role and Responsibility of DMH for Disaster Risk Reduction

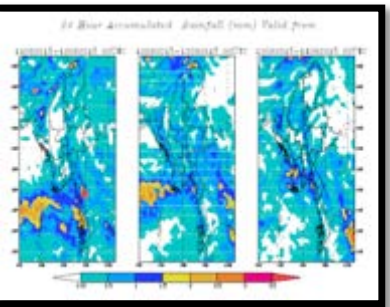


- **Early Warning System is the main responsibility of DMH in case of Disaster Risk Reduction**
- **DMH are observing Meteorological, Hydrological and Seismological phenomena to provide necessary information for disaster prevention/ mitigation and development of socio-economic activities.**



## Flood Forecasting Techniques

- ❖ Empirical model (based on single and multiple regression analysis)
- ❖ River Stage Correlation Method
- ❖ Integrated flood analysis system (IFAS) for small basin
- ❖ HBV Model
- ❖ HEC-HMS model



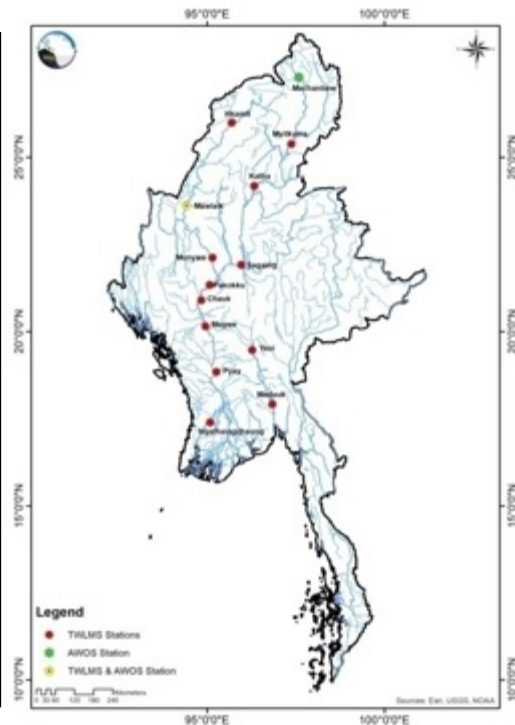
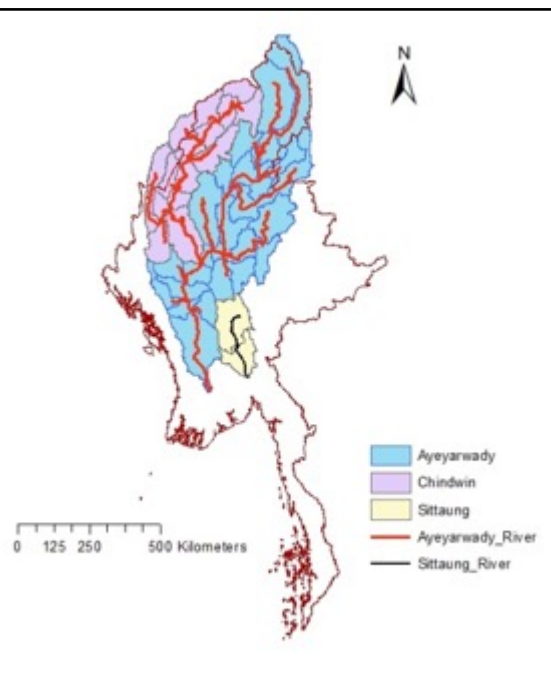


# Completed Project

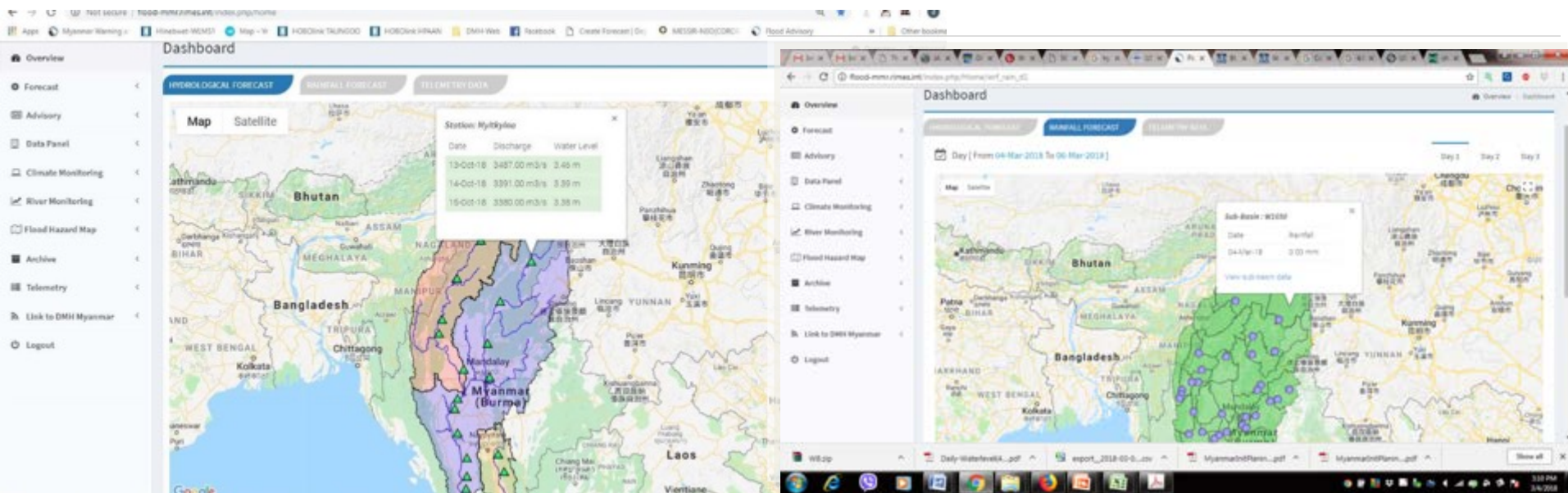
## Development and Implementation of User-Relevant End-to-End Flood Forecast Generation for Myanmar (April 2014 – September 2017)

The Objectives of project are:

- Enhancing meteorological and hydrological monitoring capacities
- Development of flood forecasting systems
- Development of Decision Support System (DSS) to communicate relevant, long-lead, location-specific flood risk information
- Training and Capacity Building



# ➤ Flood forecast model development for Ayeyarwady, Chindwin and Sittoung basins using HEC-HMS with GOI support



# ONGOING PROJECT- I

## Development and Implementation of the Myanmar Flash Flood Guidance System (FFGS)

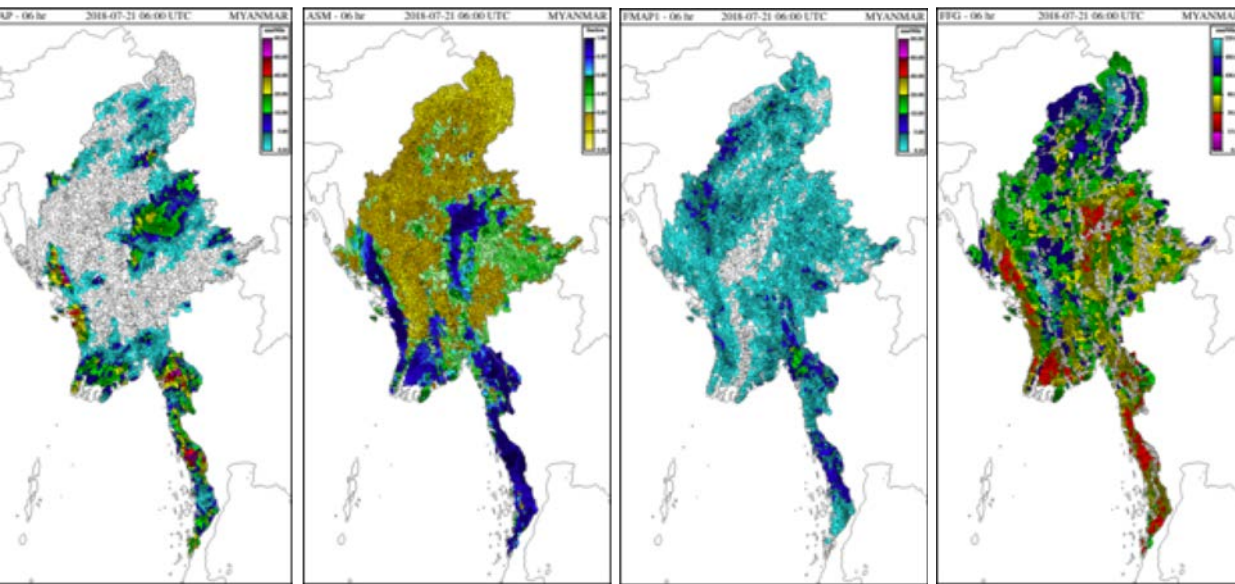
The main objectives of the Flash Flood Guidance System with global coverage are to:

- enhance NMHSs capacity to issue flash flood warnings and alerts;
- mitigate adverse impacts of hydrometeorological hazards;
- enhance collaborations between NMHSs and Emergency Management Agencies;
- generate flash flood early warning products by using state-of-the-art hydrometeorological forecasting models;
- provide extensive training including on-line training to the hydrometeorological forecasters;
- foster regional developments and collaborations; and
- Support WMO Flood Forecasting Initiative.

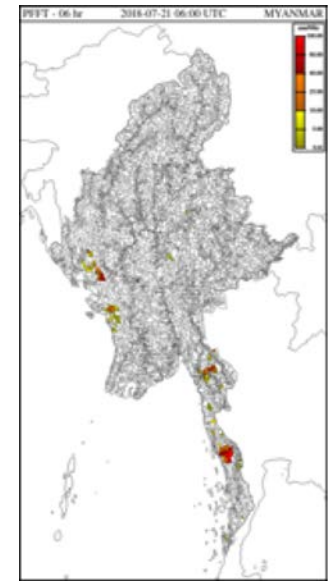
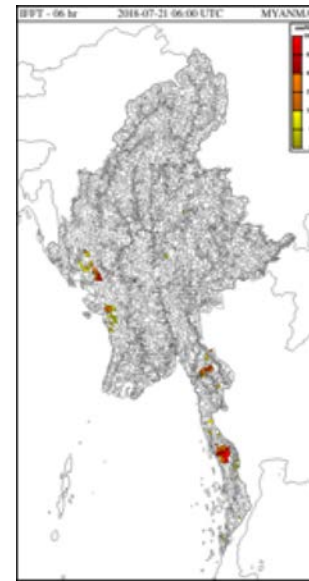
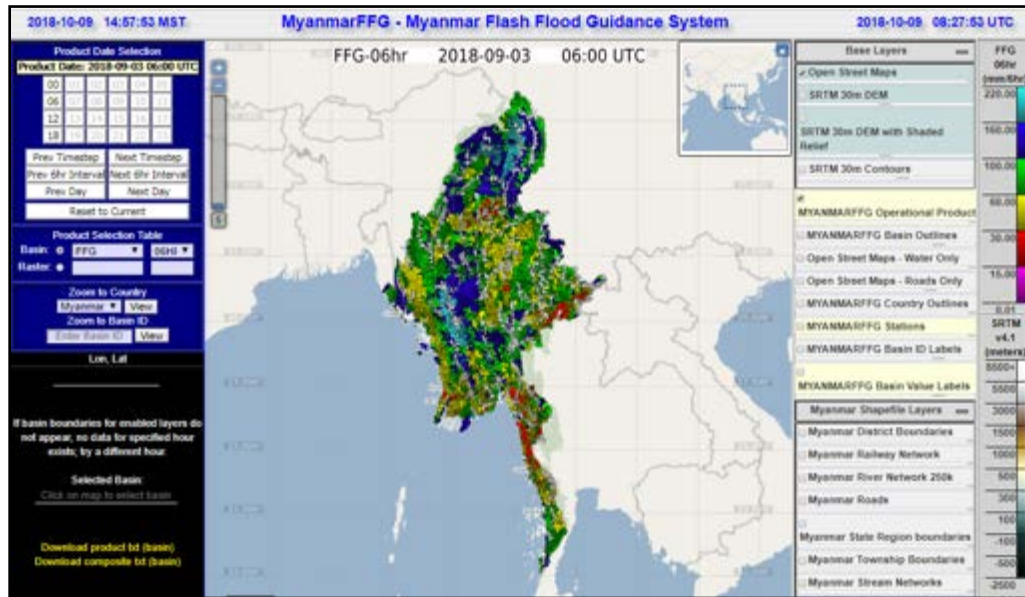




# Example application of Flash Flood Guidance System



**Flash Flood Guidance(FFG)**: The amount of actual rainfall of a given duration over a small basin required to generate flooding flows at the outlet of the basin.





# ONGOING PROJECT-II

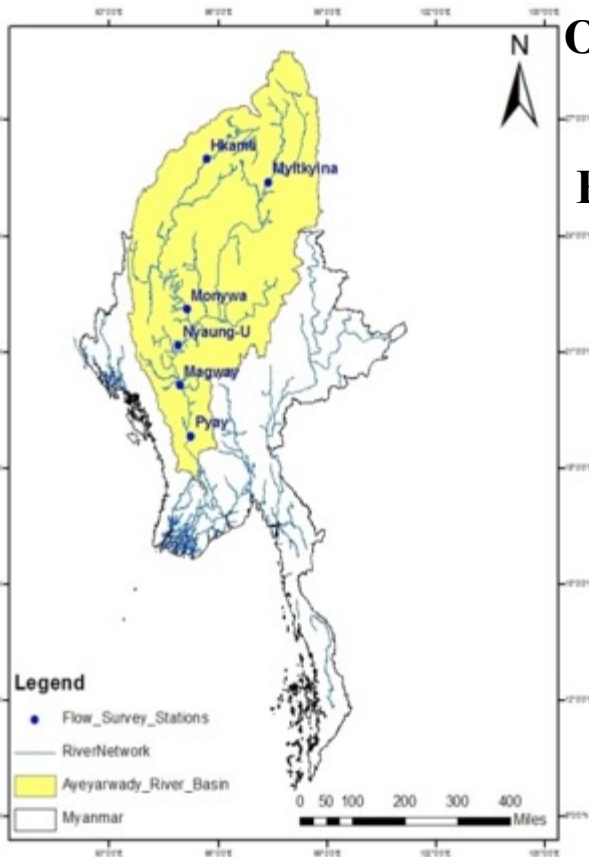
## AYEYARWADY INTEGRATED RIVER BASIN MANAGEMENT

### PROJECT-AIRBM

( 2015- 2020)



## Component 2 – Hydro met Observation and Information System Modernization



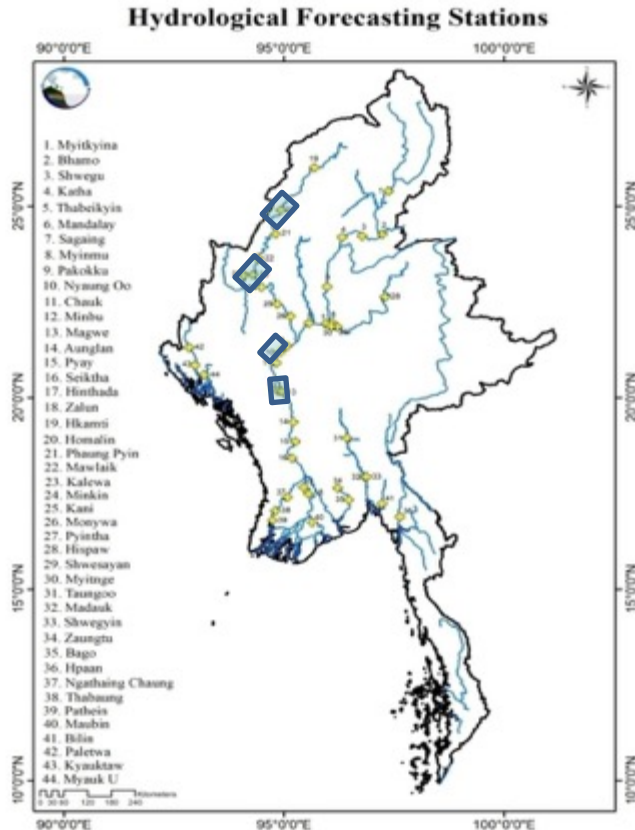
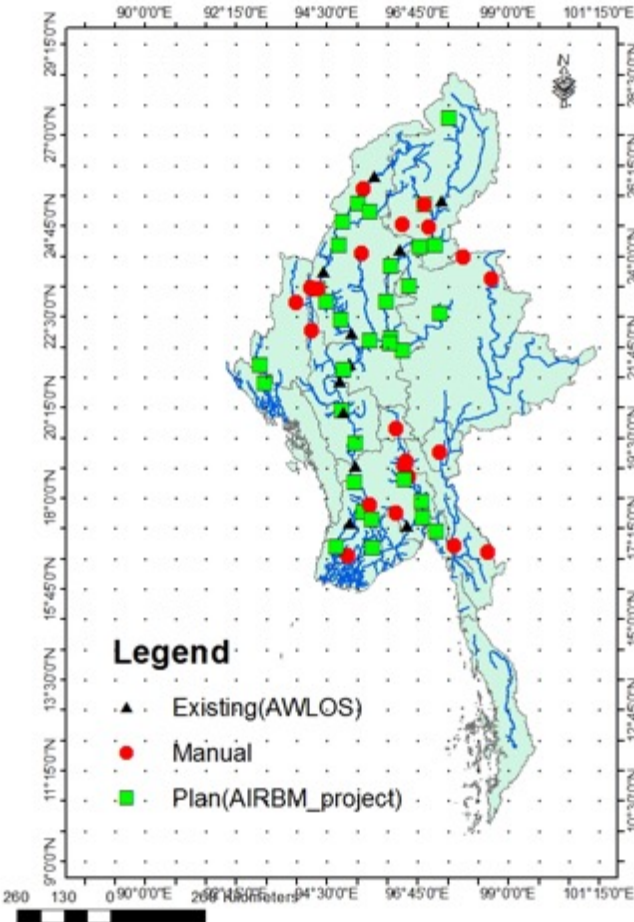
**Objective;** To improve the quality of weather, climate and hydrological information and services in Myanmar.

**Benefits;** The component 2 will

- increase the capacity of the DMH to provide information and services
- help to protect the lives and livelihoods of those living in areas affected by drought, floods and storms.
- help to reduce poverty by improving access to and accuracy of agricultural advisories that tend to increase farmers' productivity.

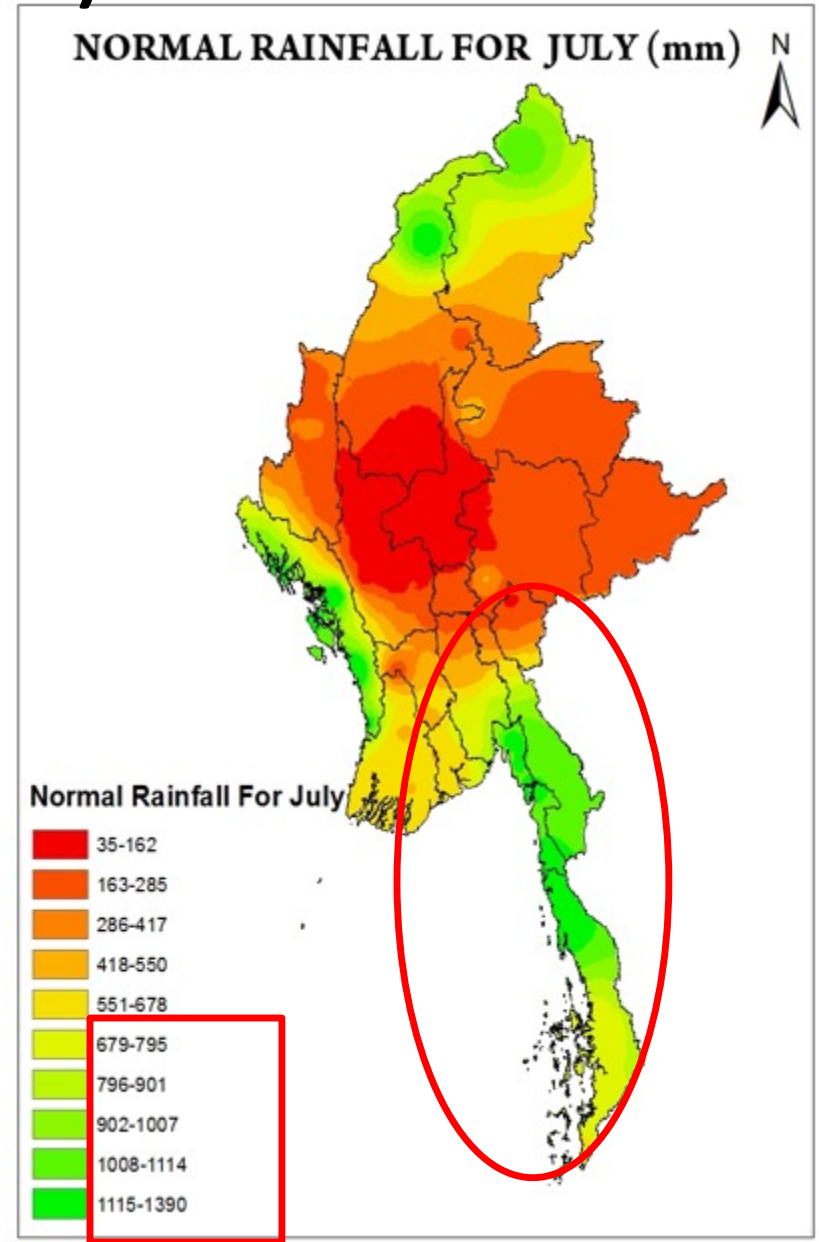
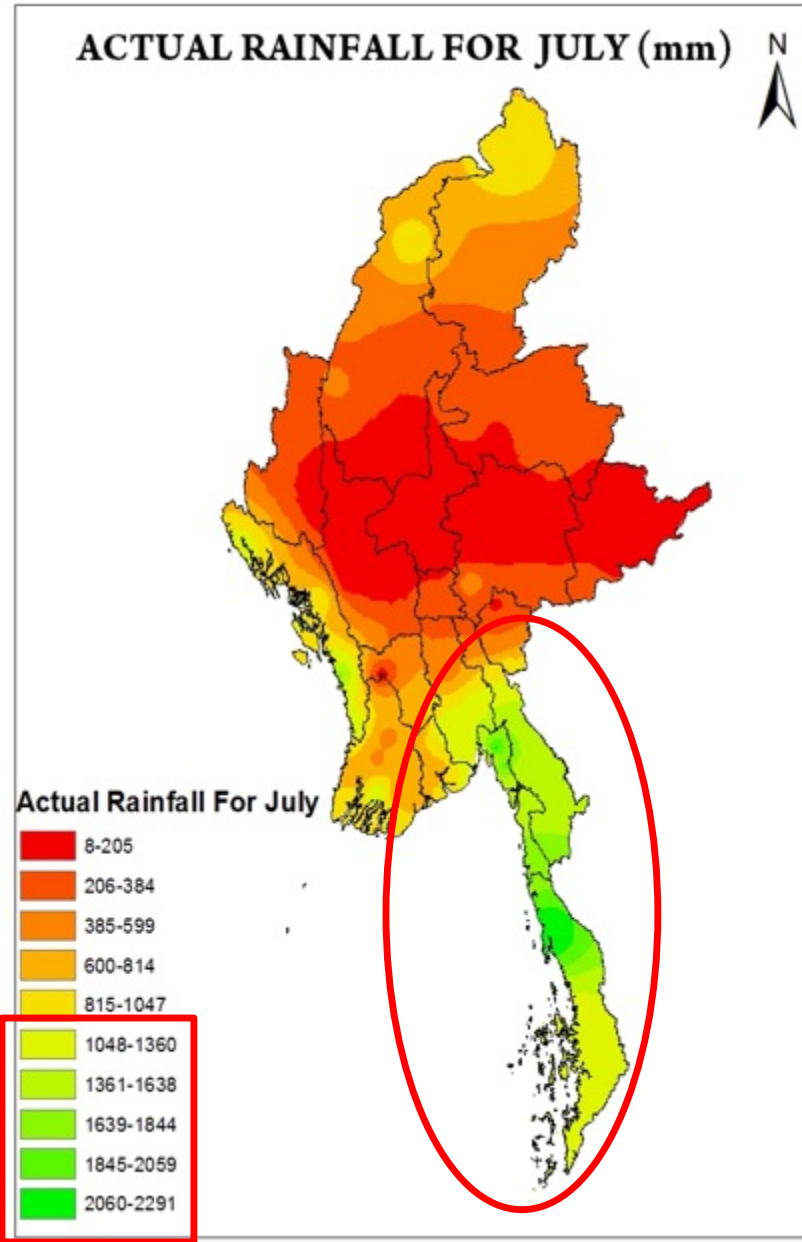
# Flood Forecasting System, including exclusive database for forecasting

## Plan to Install AWLOS and Flood Forecast System

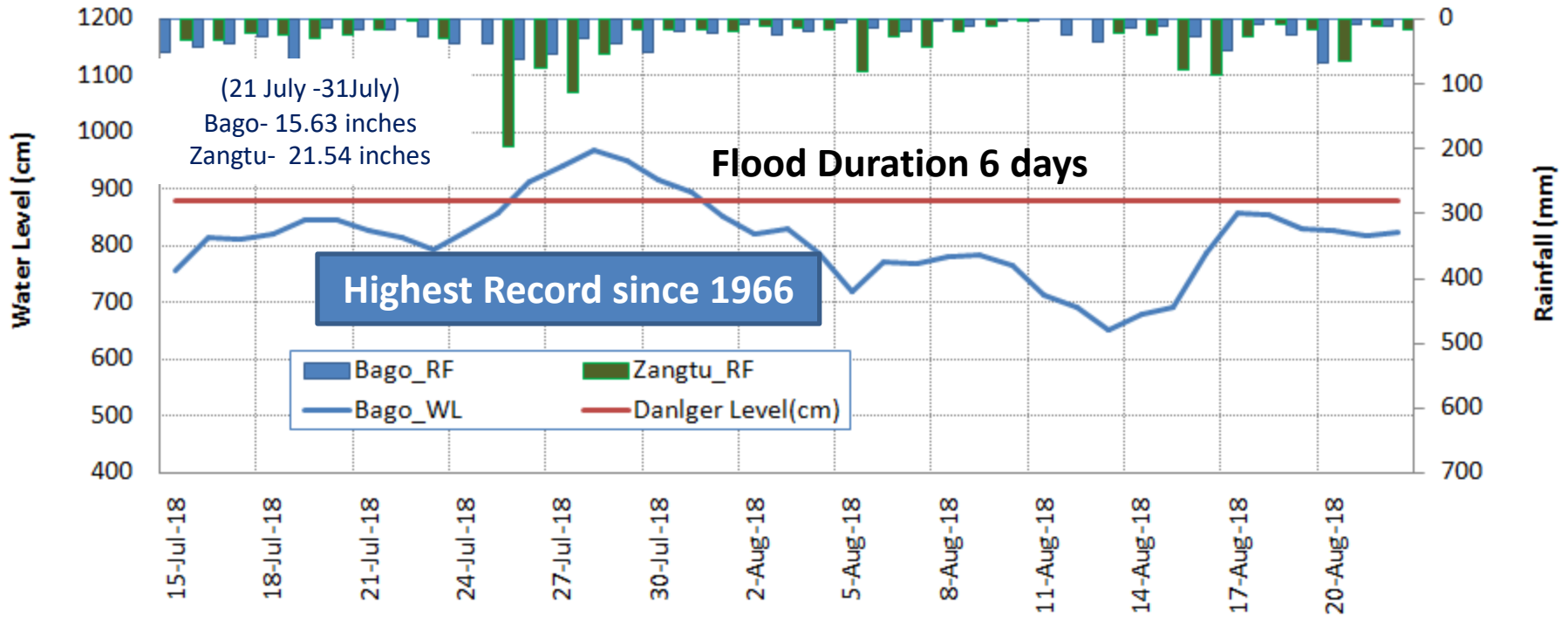


## Impact Based Forecast and Warning Pilot Area

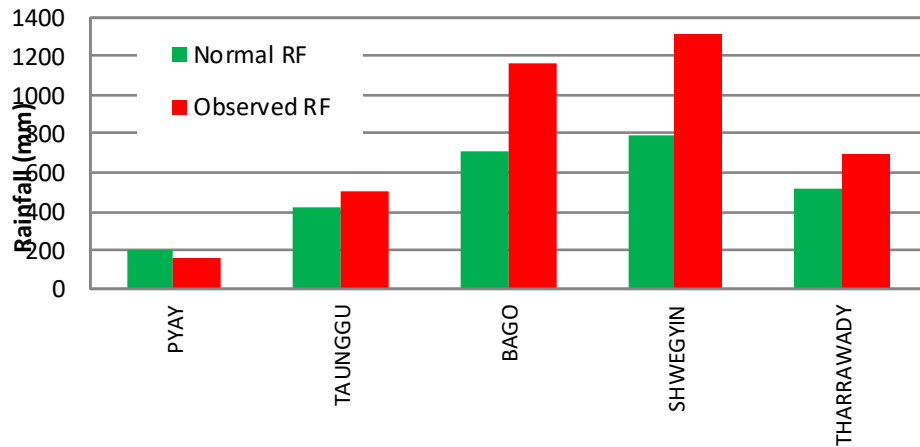
# Comparison of Actual and Observed Rainfall at July (2018)



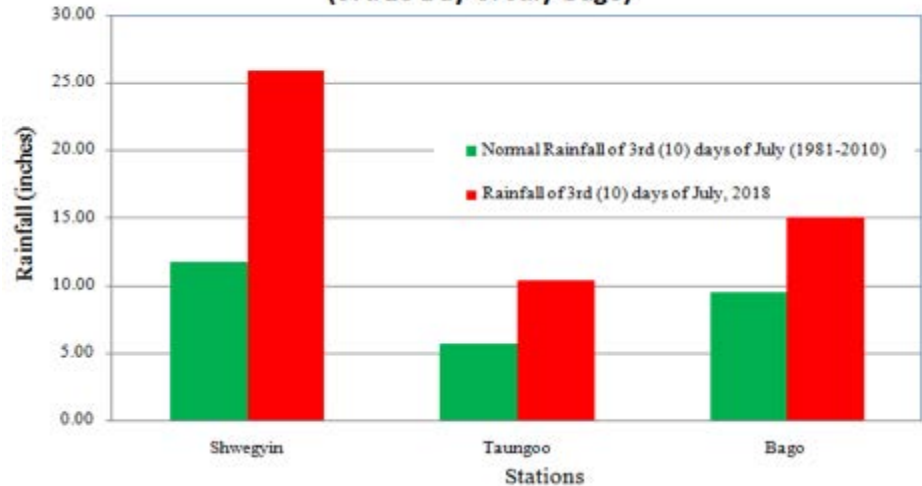
## Water Level and Rainfall Condition of Bago of Bago River (2018)



### Comparison of Monthly Normal Rainfall and Observed Rainfall of Bago Region (July 2018)

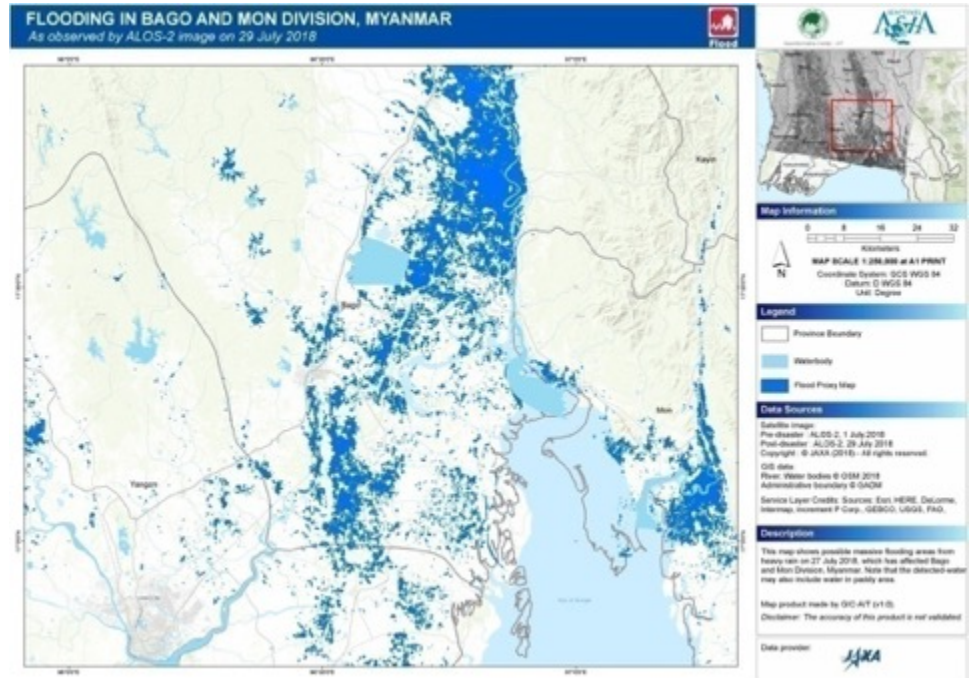
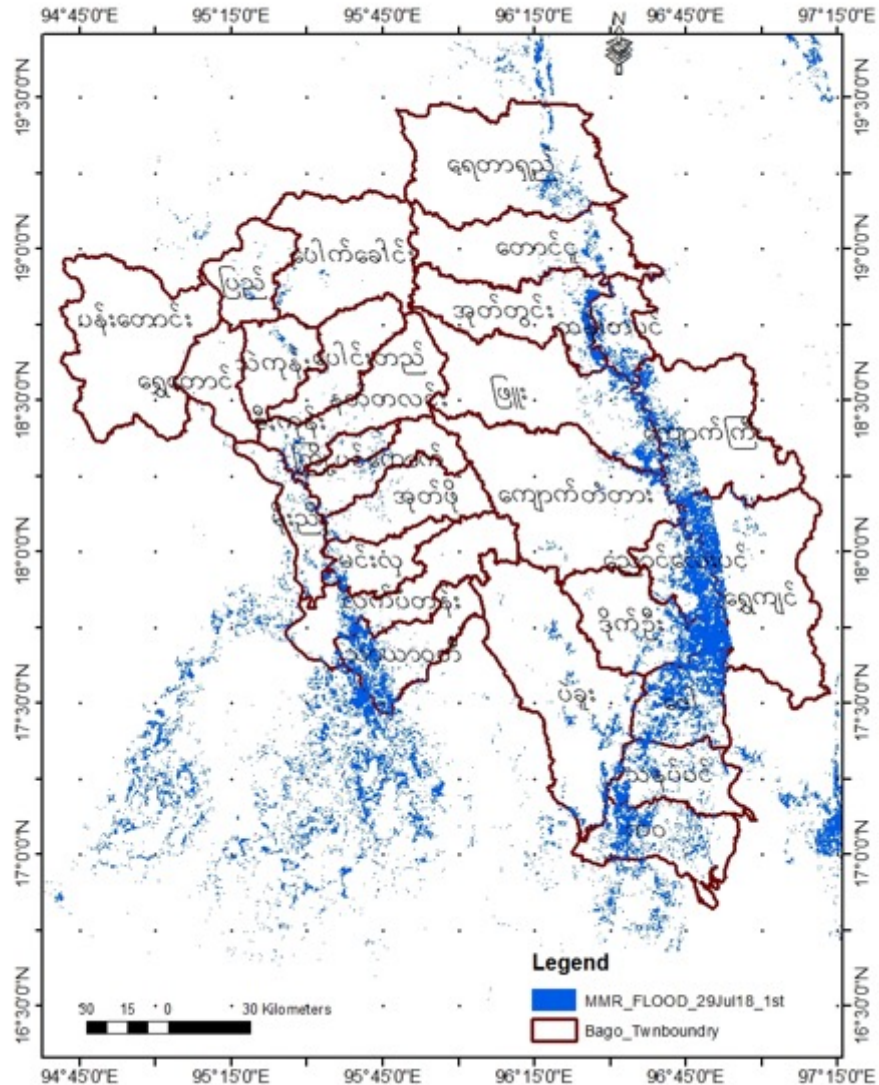


### Comparison of Normal Rainfall and Observed Rainfall (3rd 10 Day of July Bago)



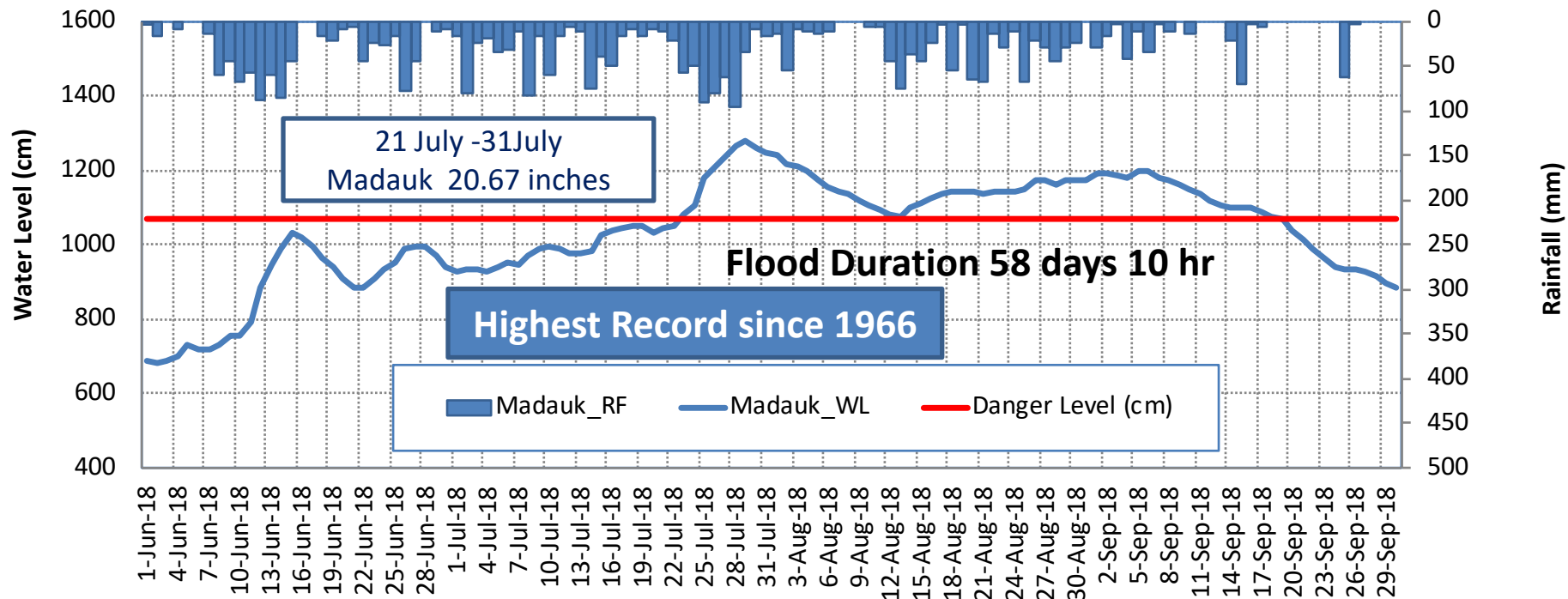


# Flood Inundation Map by Satellite Images at Bago Region (29-7-2018)

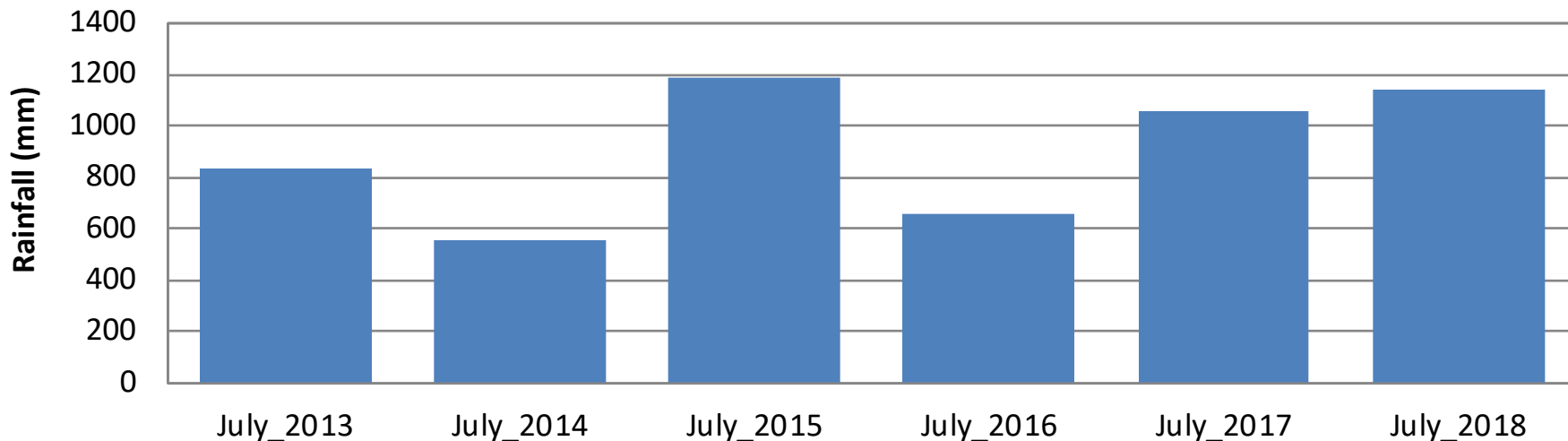




## Water Level and Rainfall Condition of Madauk of Sittoung River (2018)

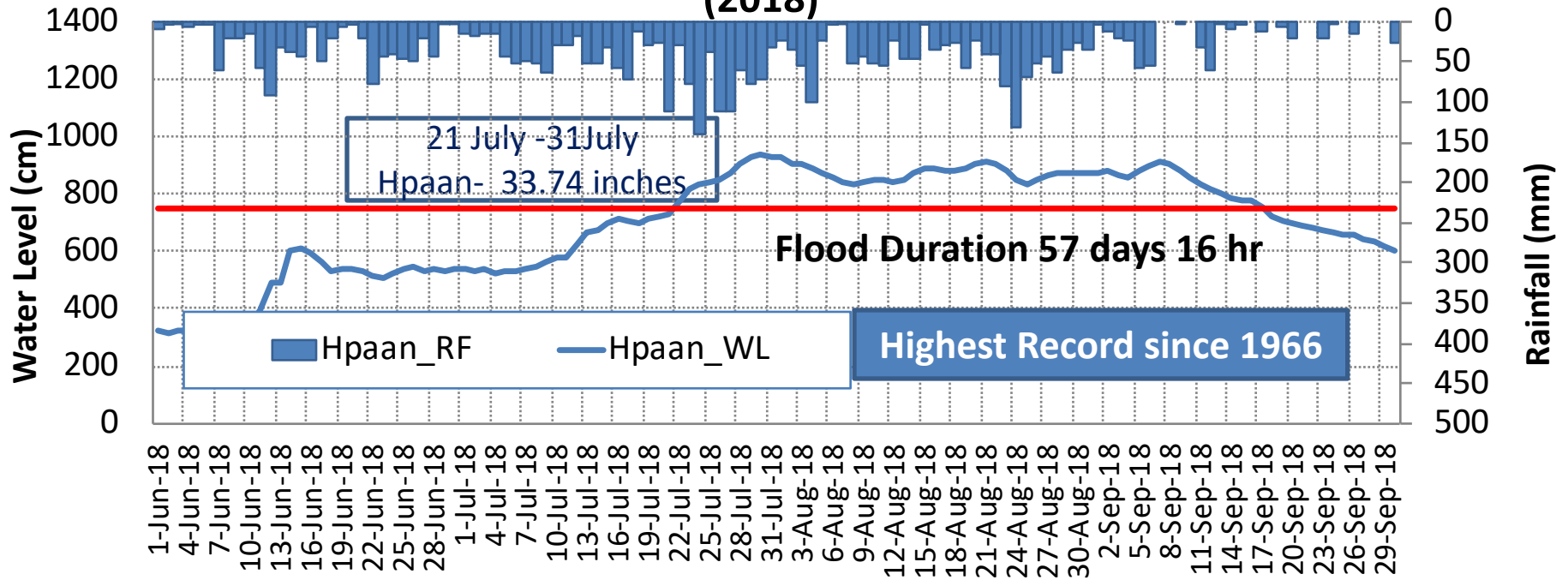


## Comparison of July Rainfall (2013-2018)



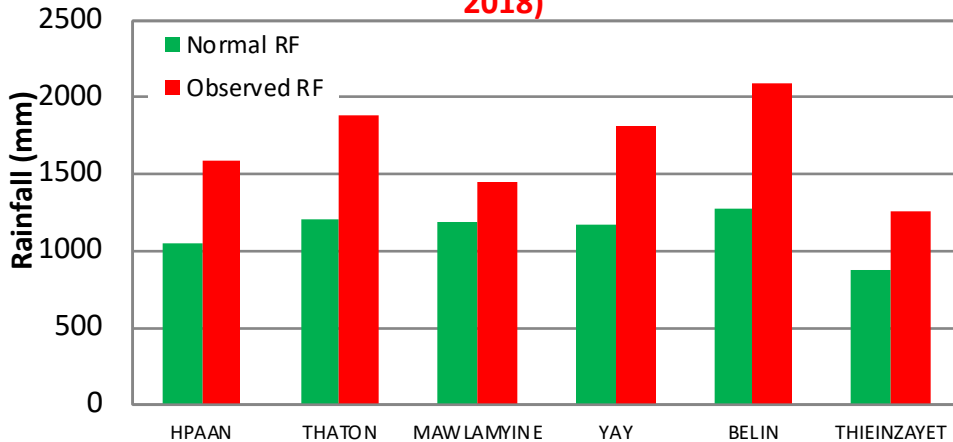
# Water Level and Rainfall Condition of Hpaan of Thanlwin River

(2018)

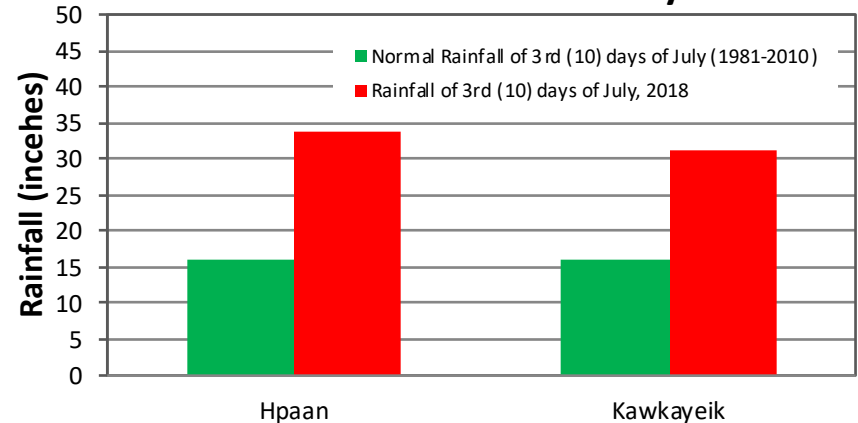


## Comparison of Monthly Normal Rainfall and Observed Rainfall of Kayin and Mon Region (July 2018)

2018



## Comparison of 3rd (10) days Normal Rainfall and Observed Rainfall of Kayin



# Future Plans

- ❖ Upgrade the manual observation system to automatic observation system
- ❖ Upgrading/modernization of the data transmission and telecommunication systems
- ❖ Integrate the observation data into central datastore for all Decision support Systems
- ❖ Improve the dissemination of flood warning
- ❖ Develop the impact based flood forecast and risk based warning system



# Department of Disaster Management

Ms. Phyu Lai Lai Tun  
Director, DDM



# Water-related Disasters in Myanmar

- Myanmar is multi-hazards prone country.
- the most significant water-related disaster are tropical cyclone, annual flood, flash flood, landslide, river-bank erosion and drought

# Flood in Recent Years (2015, 2016 , 2017 and 2018)

Affected-	Fiscal Year			
	2015-2016	2016-2017	2017-2018	2018-2019
Households	425600	135609	82114	45927
People	1701565	549152	335635	224090
Damaged Houses	39438	721	331	828
Casualties	181	19	10	34

# River-bank Erosions

Affected-	Fiscal Year		
	2016-2017	2017-2018	2018-2019 Up to 16-10-2018
Household	3095	6833	3372
People	13393	29560	13279



# Impacts caused by flood

- calculated damages in direct ways to roads, bridges buildings, equipment, paddy fields, fish and prawn lakes etc.
- non-calculated losses in indirect ways including the reduction of services, losses of job opportunities, and human resources
- Low quality of housing, lack access to basic services and local infrastructure increased disaster vulnerability.
- it is important to provide quick assistance after a disaster, it is also important to invest in disaster risk reduction activities.



# Disaster Management Goals and Policy

## Goals

- Save Lives
- Prevent Injuries
- Protect Property
- Protect the Environment

## Policy

- to build a community resilience by undertaking the effective Disaster Risk Management and to get a better life for all disaster affected people

# National Disaster Management Committee

**Chaired by Vice-President**

National Disaster Management Working Committee

International Relations Working Committee

Information Working Committee

Transportation and Communication Working committee

Health Care Management Working Committee

Recovery and Reconstruction Working Committee

Search and Rescue Working Committee

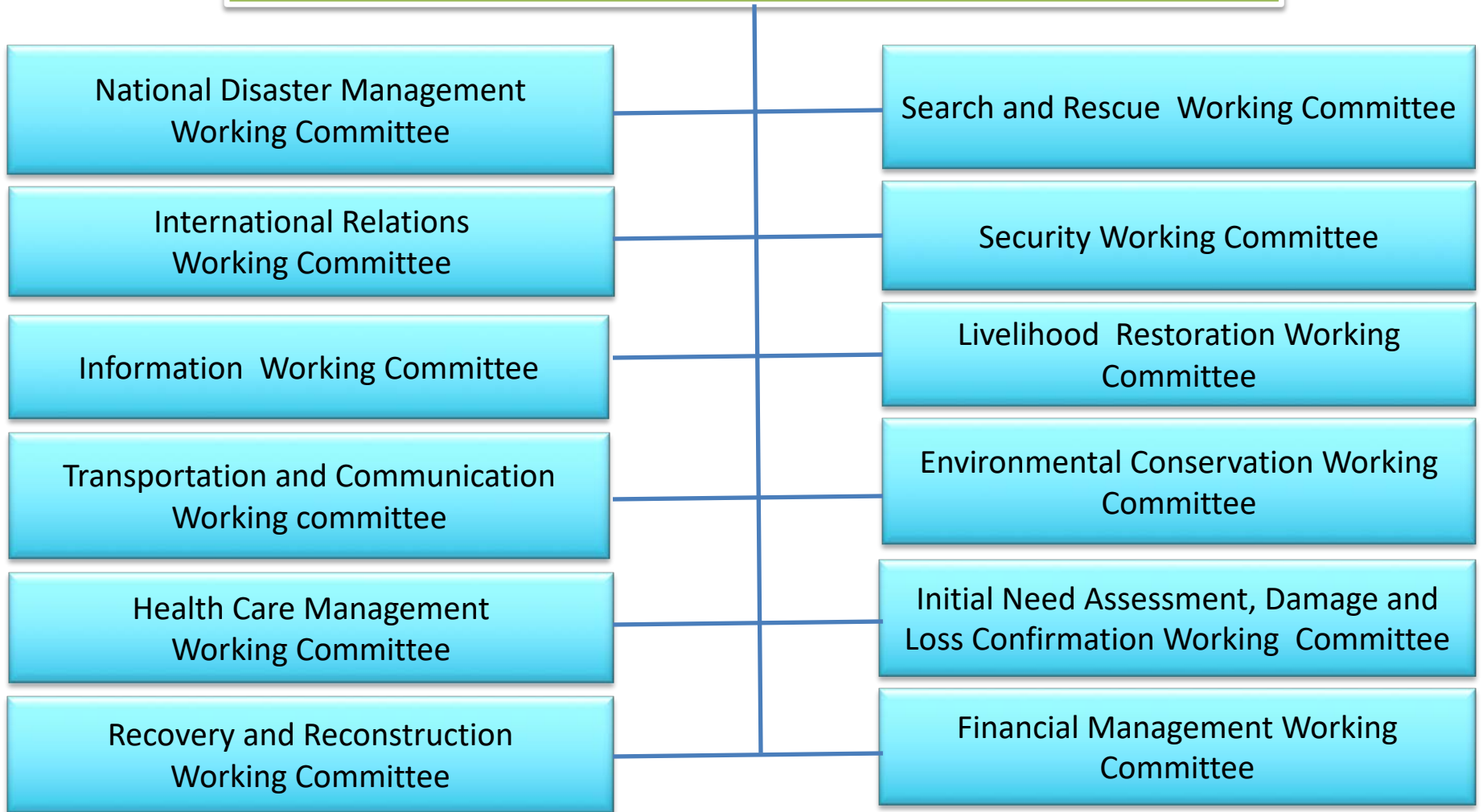
Security Working Committee

Livelihood Restoration Working Committee

Environmental Conservation Working Committee

Initial Need Assessment, Damage and Loss Confirmation Working Committee

Financial Management Working Committee



# Activities for reducing the impact on water-related disasters

- constructing cyclone shelters and multi-purpose shelters
- building retaining walls
- providing speed boats, fiber boats, life jackets
- Pre-opened the temporary camps
- Simulation exercises for flooding
- Digging and repairing the tubewells and lakes
- Awareness programme
- Pamphlets and poster







## **Directorate of Water Resources and Improvement of River Systems**

Mr. Aung Myo Khaing  
Director, DWIR

# Contents



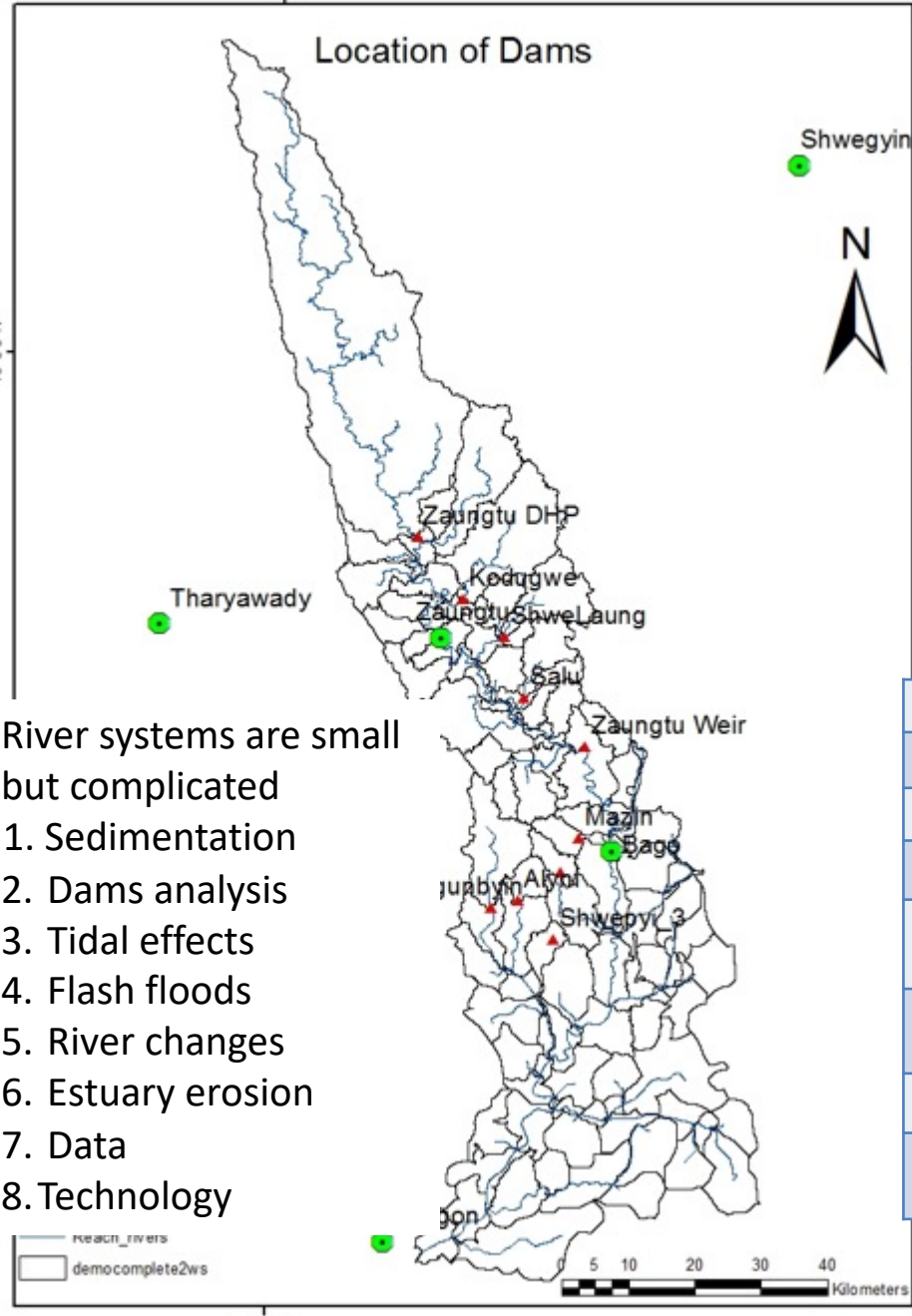
1. Introduction
2. Selected basins
3. DWIR's activities
4. Issues
5. Cooperation with IFI partners
6. Future expectations

## Introduction

- Especially for the Navigation route, erosion protection, river morphological changes
- Mainly on navigable rivers, but erosion protection, channel survey and other environmental management in the selected rivers
- River morphological changes (analysis)
- Basin level understanding is still challenges
- Floods (elevation are very important) (river flow, cross-sections, longitudinal slopes are important)
- Focal department of NWRC in Myanmar

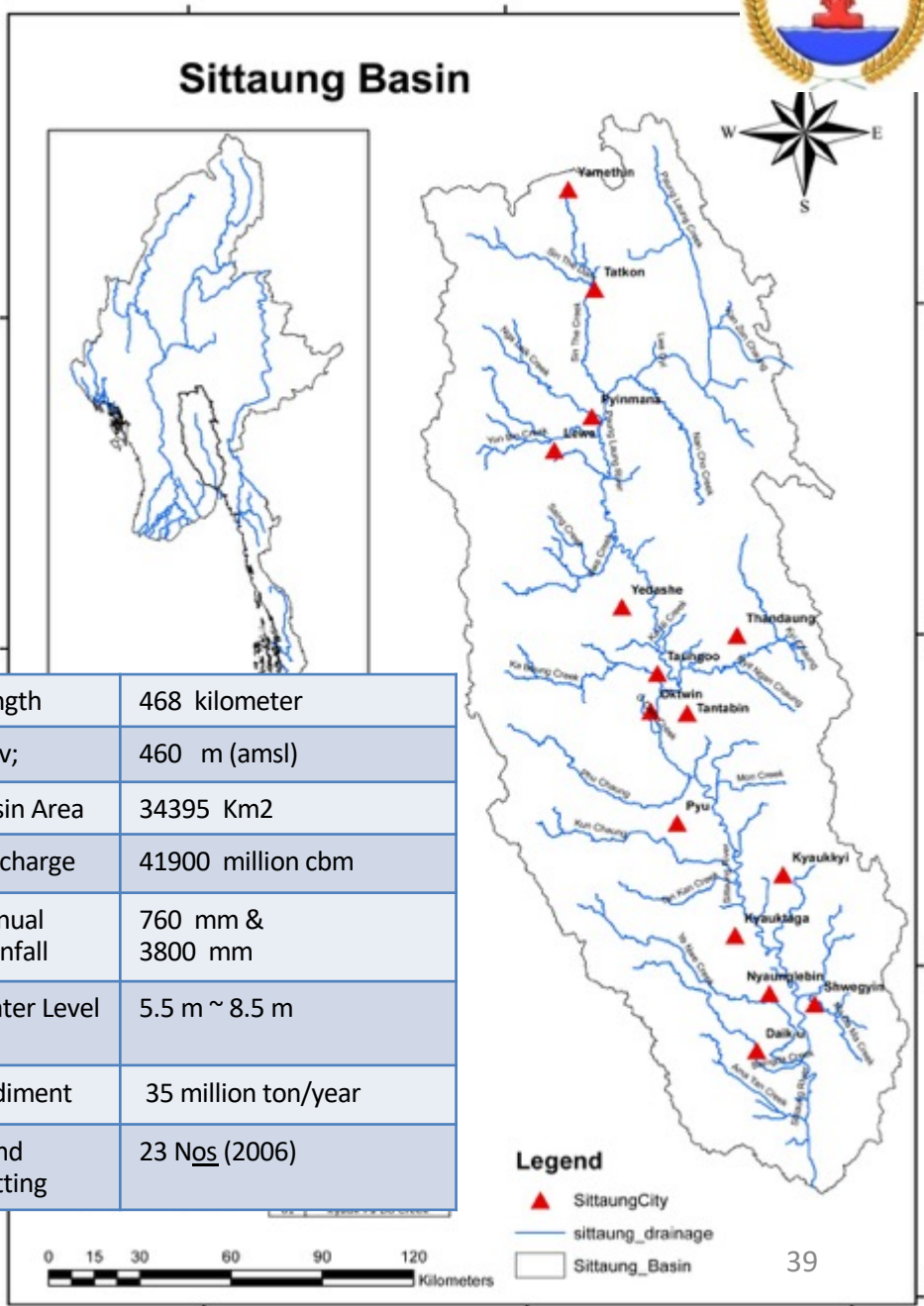


# JICA SATREPS Project and IFI supporting Myanmar in Bago & Sittaung Basins

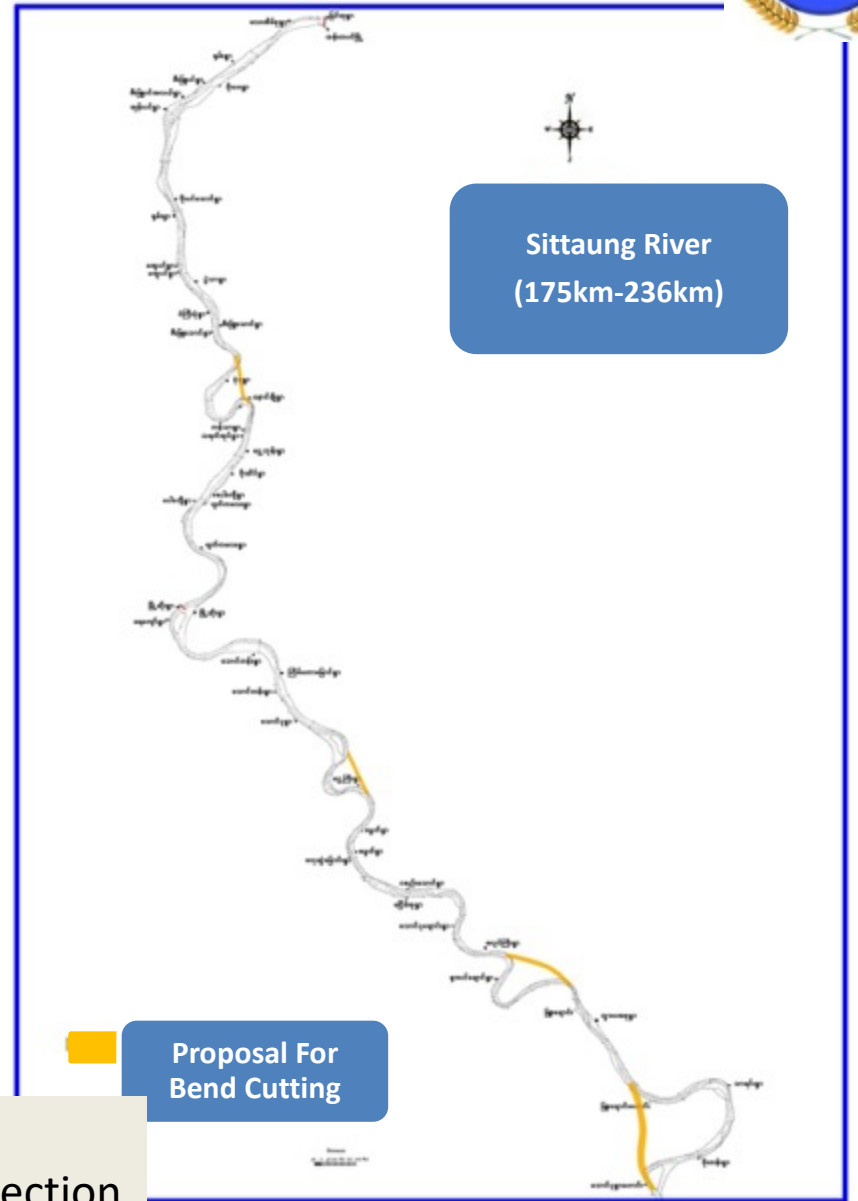
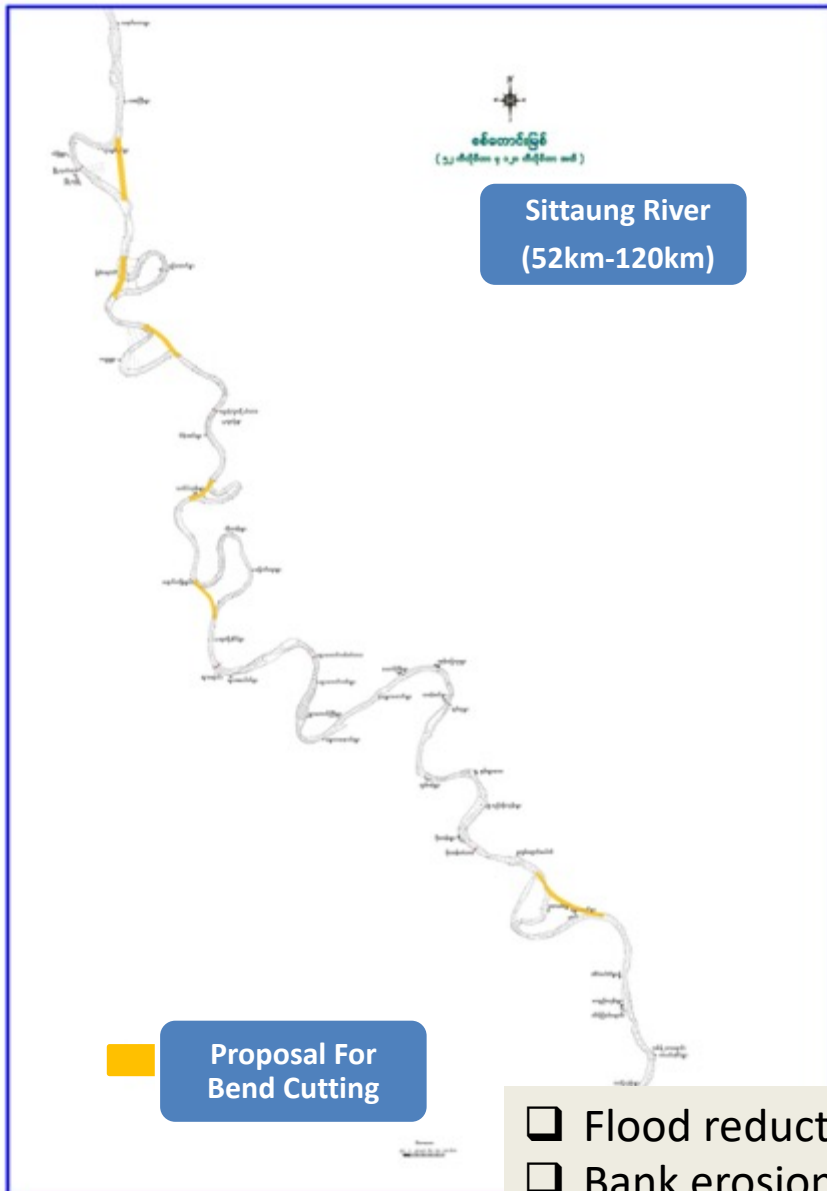


River systems are small but complicated

1. Sedimentation
2. Dams analysis
3. Tidal effects
4. Flash floods
5. River changes
6. Estuary erosion
7. Data
8. Technology



# DWIR Activities on Sittaung River

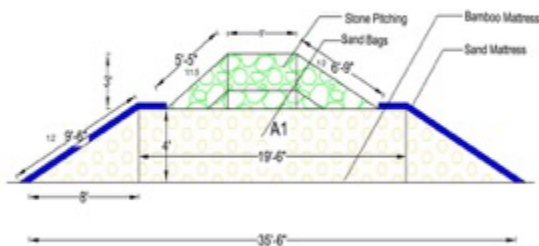




# Shwegyin Town ship river bank erosion protection



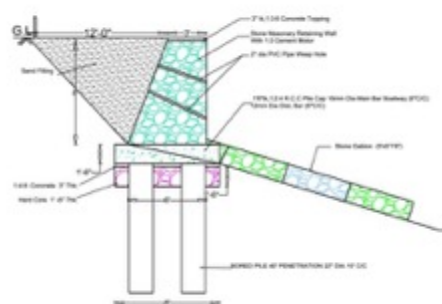
ရွှေကျင်မြို့နယ် ကျွန်းဆိပ်ကျေးရွာကမ်းခြေကာကွယ်ရေးလုပ်ငန်း  
 သံဇာတမြေစမ်းသပ်ရေးအခင်းကိရိယာများ (၂၇၀) ဖိစာ ထုတ်ဆောင်ခြင်းလုပ်ငန်း



$$A1 = \frac{19.5' + 35.5'}{2} \times 4' = 110 \text{sq-ft}$$

CROSS-SECTION

ရွှေကျင်မြို့နယ်ကျွန်းဆိပ်ကျေးရွာကမ်းခြေကာကွယ်ရေးလုပ်ငန်း  
 ထိုပိုင်းအခြေခံကျောက်စီမံခြင်းနှင့်ဆက်သွယ် (၁၂၀၀) ဖိစာ ထုတ်ဆောင်ခြင်းလုပ်ငန်း  
 နိဒါန်း



CROSS-SECTION

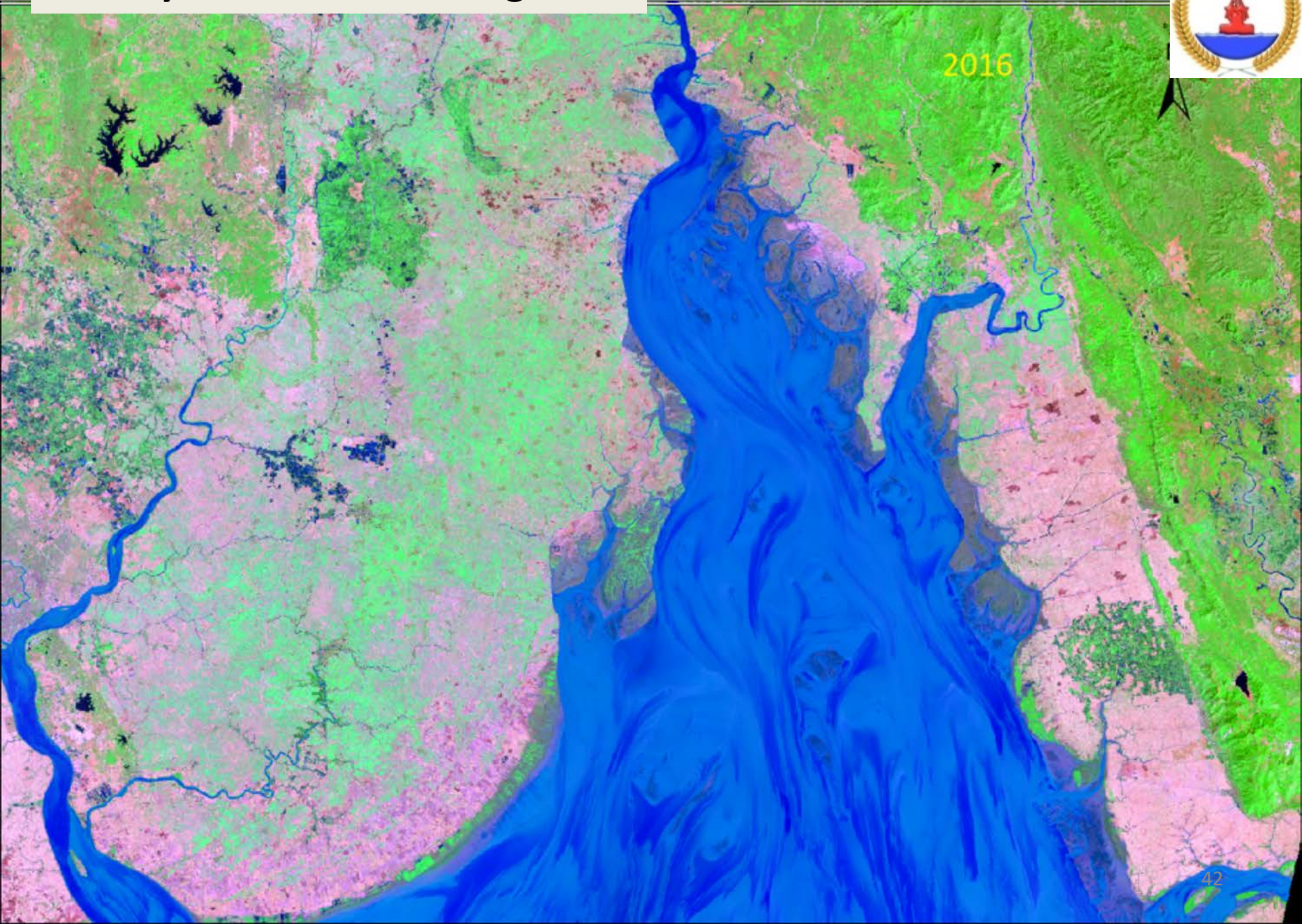
CROSS-SECTION

$$V1 = \frac{18.0' + 37.0'}{2} \times 4' = 110 \text{sq-ft}$$

CROSS-SECTION



# Estuary erosion in Sittaung River

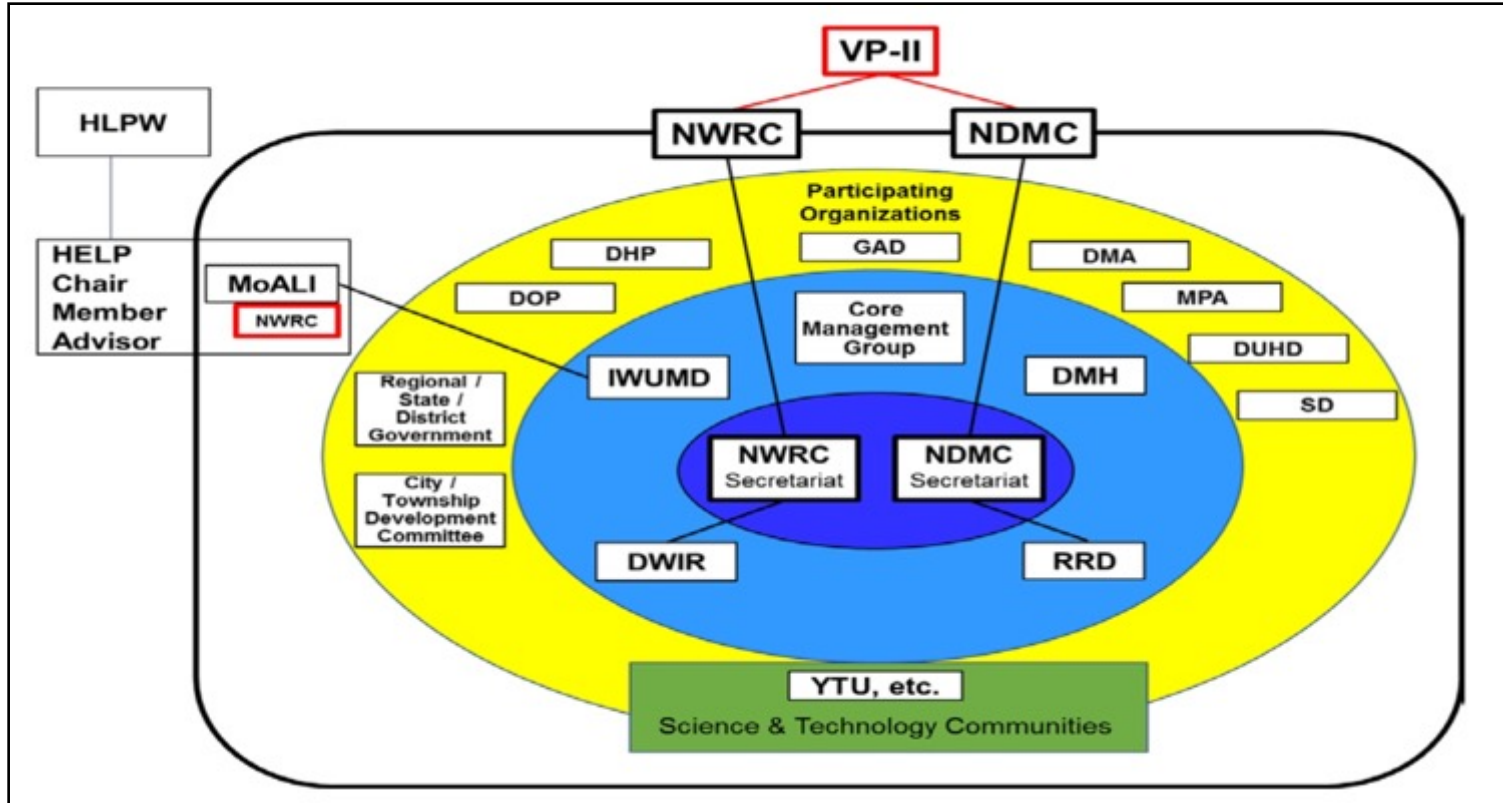




# Outcomes of IFI meetings in Myanmar



## 1. Institutional Structure

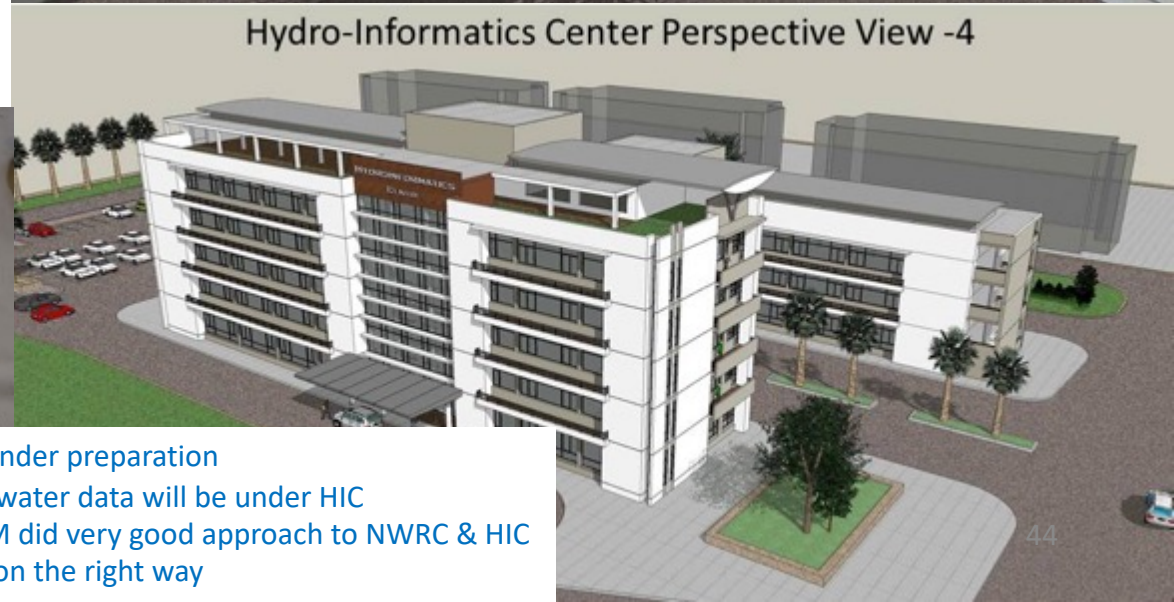
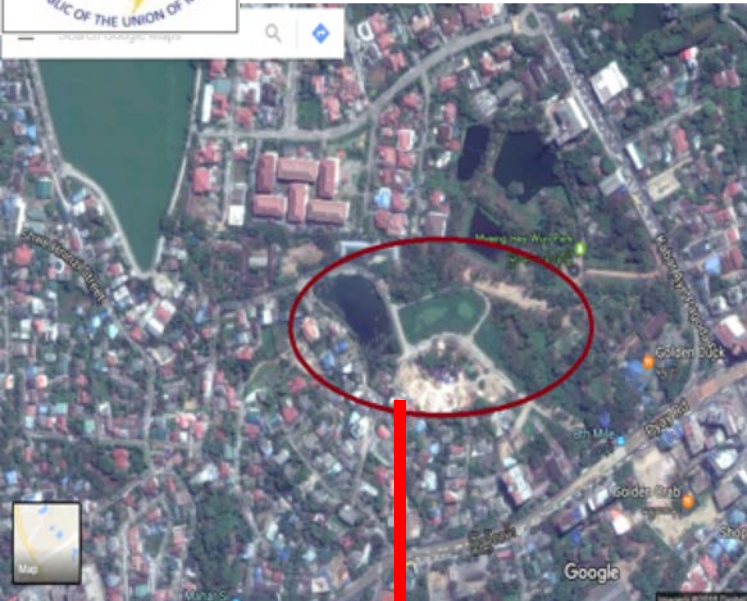


2. Basin Selection (Sittaung river Basin)

3. Data Policy

4. Data analysis (DIAS)

# Role of NWRC & HIC



- HIC is under preparation
- Future water data will be under HIC
- ICHARM did very good approach to NWRC & HIC
- All are on the right way





# Future Expectations

- Good cooperation and systematic data management for future flood analysis
- Establish the Integrated Data Management System
- Capacity Building (Data management, analysis, modeling, etc,) to the relevant staffs
- Upgrade the existing monitoring facilities and capacity
- Reservoir monitoring, environmental flow & Dam safety in the project area
- Technology for sediment monitoring & control in the project area
- Learn the river survey technology for the usefulness of flood analysis
- Supports for the resilience to tidal bore and estuary erosion in Sittaung river
- DWIR will actively cooperate with IFI partners for flood risk reduction



# IWUMD's Implementation in Bago River Basin

# IWUMD's Implementation in Bago River Basin

- ❑ **Implementing Structural Measures**  
**Construction and Maintenance of Irrigation and Drainage Facilities for Irrigation and Flood Reduction**
- ❑ **Water Quantity**  
**Hydro-meteorological Investigations and Analyses for Water Availability and Flood Estimation**
- ❑ **Water Quality**  
**Water Quality Tests and Analyses**

# **Implementing Structural Measures**

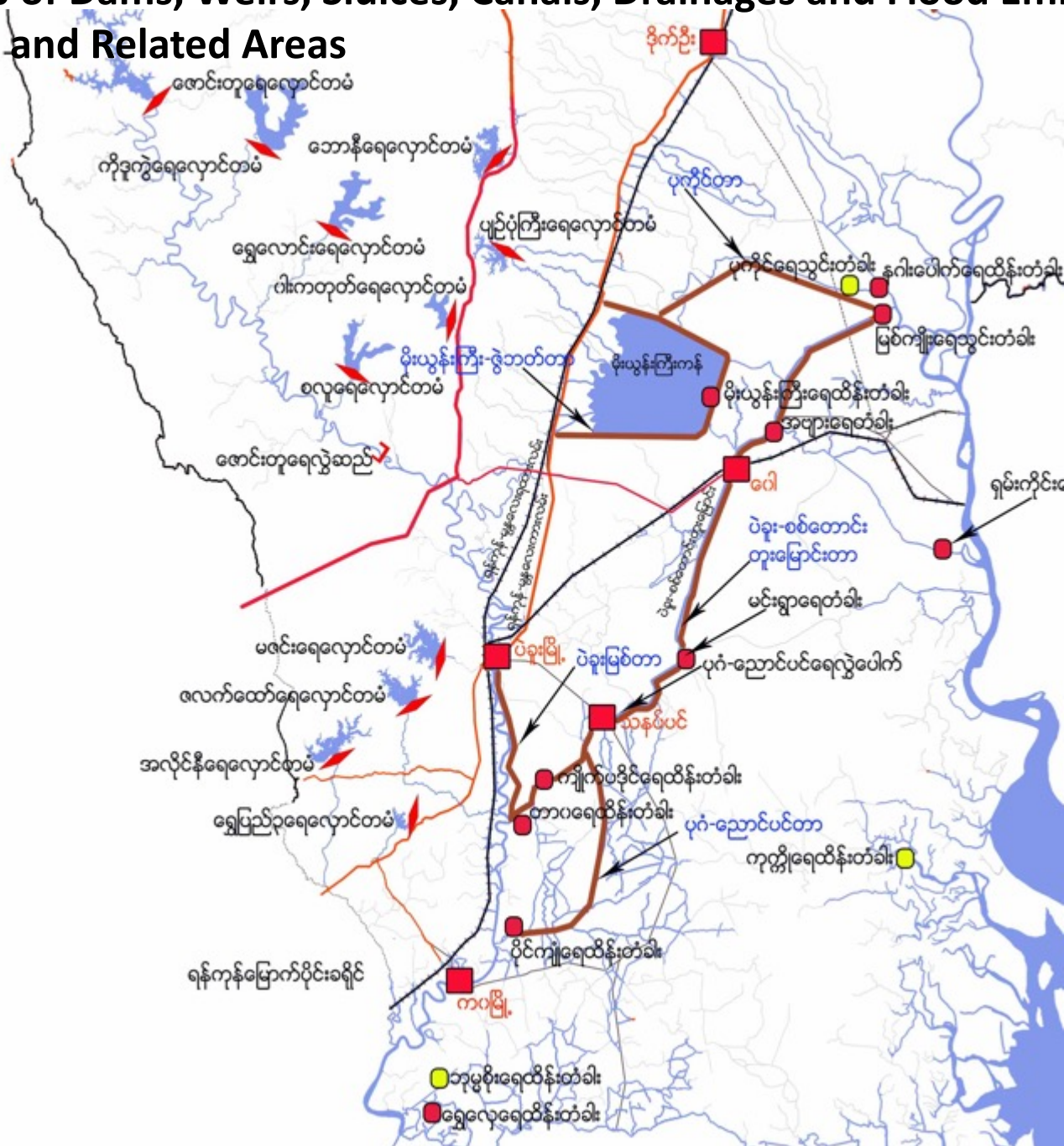
## **Maintenance Office, IWUMD**

**IWUMD in Bago Region has been implementing the following tasks in the Bago River Basin**

- (1) Construction and maintenance of Dams, Weirs and Sluice Gates for Flood Reduction and Irrigation to the agricultural fields**
- (2) Construction and maintenance of Flood Protection Embankments and Diversions for Flood Disaster Protection**
- (3) Excavation and Dredging of Streams, Creeks to reduce Flood Inundations in the Paddy Fields of the Region**



# Location Map of Dams, Weirs, Sluices, Canals, Drainages and Flood Embankments in Bago River and Related Areas



# Dams in the Tributories of Bago River





# Weirs and Sluices in the Bago River Basin



# Flood Diversion Sluice Gates constructed for Flood Reduction in Bago River Basin

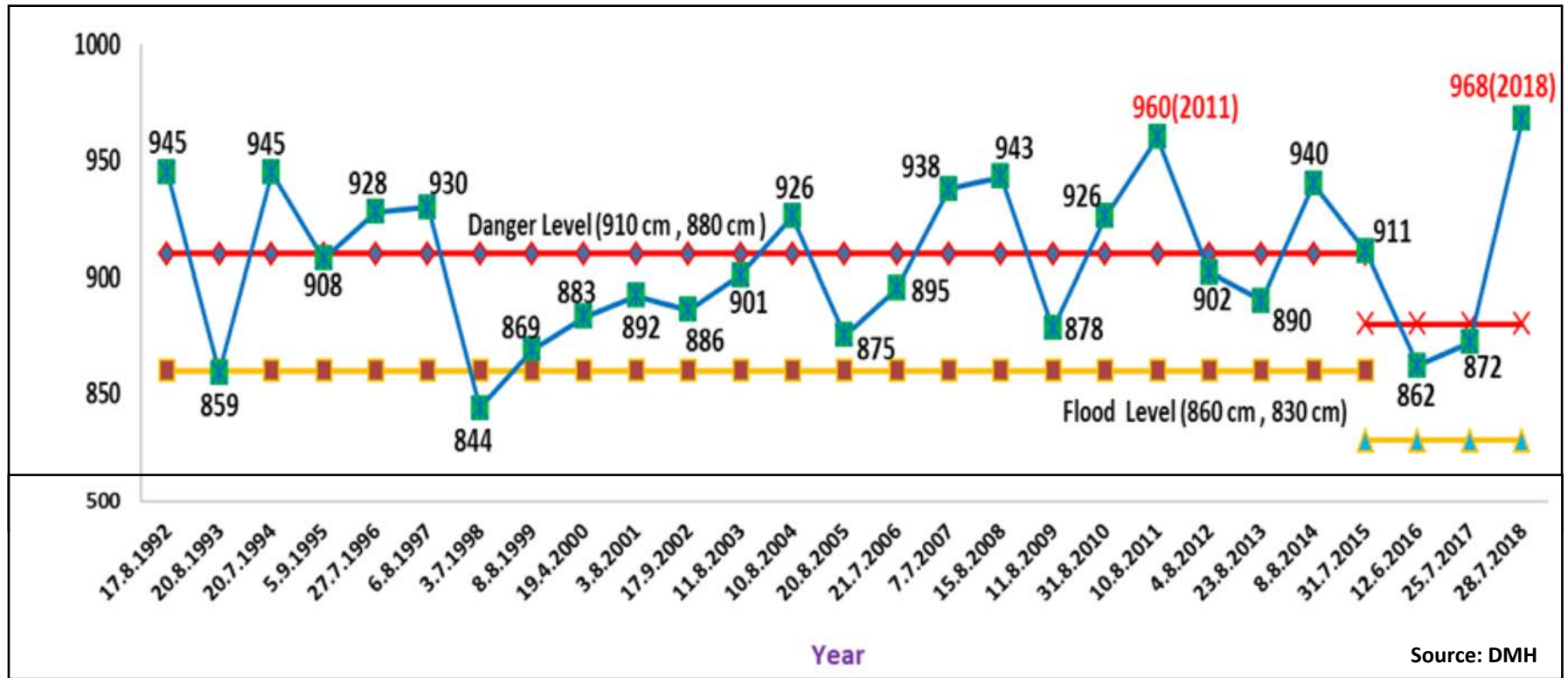




# Flood Protection Embankments Constructed for Flood Reduction Measures in Bago River Basin



# Implementation of Flood Protection and Flood Reduction



Outstanding Rainfalls caused Severe Floods over its Danger Flood Level in 2018.

Bago River Water Level at Bago City reached

880 cm at 16:30 on 25 July 2018

968 cm at 08:30 on 28 July 2018

Water Level Decreased under Danger Level on 1 August 2018 and remained its Danger Level for 7 Days

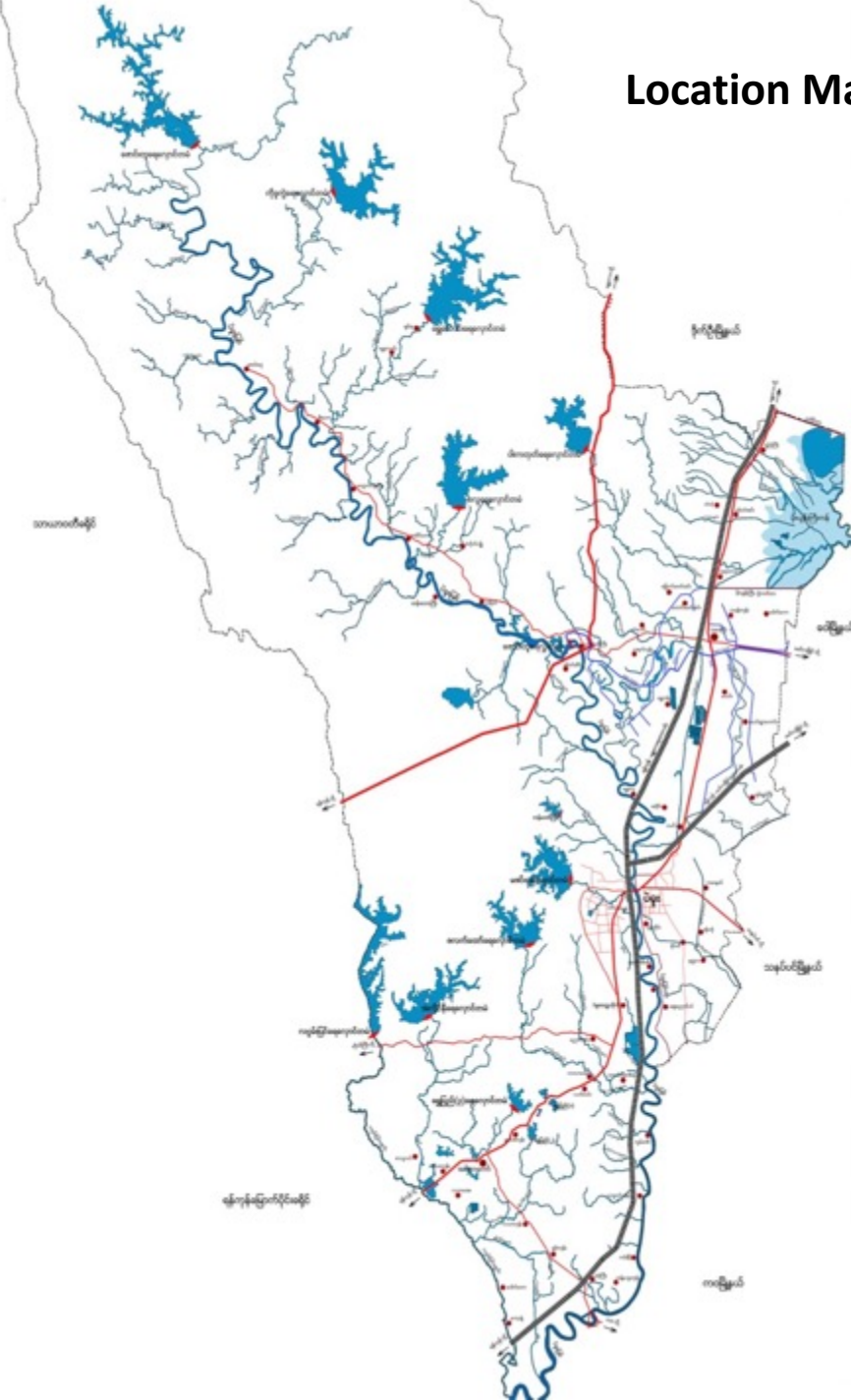
Emergency Preparedness are implemented for Protection of Bago River Embankment (It could protect flood inundation in the agricultural lands and villages)



# Emergency Preparedness for Flood Protection Embankments



## Location Map of Streams and Creeks in Bago River Basin



IWUMD is implementing excavation and dredging of drainages, streams and creeks for reduction of flood inundations in the Bago River Basin with the instructions of Regional Government, Suggestions of Senators, and Requests and needs from Local Community and Department's Comments and Suggestions.

IWUMD has been implementing re-excavation of shallow and blocked drainages, natural creeks based on the Drainage Framework of Bago Regional Government.



# Excavation and Dredging works in the Bago River Basin



Thaung Lay Yoe  
(Before Implementing)



Thaung Lay Yoe  
(After Implementing)



Excavation of Ngabat Yoe Creek



Excavation of Kali Creek



# **Water Quantity**

**Hydrology Branch, IWUMD**

**Hydro-meteorological Data Observation,  
Investigations and Analyses**

**(1) Water Availability and Water Management  
of Reservoirs and**

**(2) Flood Estimation for Flood Protection and  
Flood Reduction**

# Conditions of Hydro-met Observation (IWUMD)

- Most hydro-met stations are observed **Manually**
- Observation Frequency are

**Water level gauge stations Three Times per day:**

(1) **Stream Flow** Observations,

6:00 am, 12:00 Noon, 6:00 pm

(2) **Tidal Flow** Observations

6:00 am, **Maximum and Minimum Water Level** of every day

**Raingauge stations,**

Only 1 time per day

Daily rainfall is observed at 6:00 am when water level is observed.

# **Hydro-meteorological Data Observation in Bago River Basin Management Needs**

- **Hourly Rainfalls are necessary to know Rainfall Intensities**
- **Catchment Rainfalls are required to calculate Rainfall-Runoff Relationships, Inflows and Floods**
  - **Upgrading Manual Raingauge to Auto Raingauge**
  - **Install in Catchment Area**
- **Water Levels of Reservoirs, Weirs and Sluices are recorded with Manual Staff Gauges**
- **Need to install Auto Water Level Gauge Systems**

# **Implementation of Hydrology Branch of IWUMD**

## **Installed Auto Raingauge Stations in the Bago River Basin**

- (1) Wakadoke Dam**
- (2) Kodukwe Dam**
- (3) Thanatpin Maintenance Office**
- (4) Abyar Sluice**
- (5) Shangai Sluice**
- (6) Painkyone Sluice**

## **Installed Water Level Gauge Stations**

- (1) Dawei Chaung**
- (2) Tamarbin**
- (3) Bago (U/S of Bago Bridge)**
- (4) Tarwa**

# Locations of Auto Raingauge Stations

Legend



Google Earth

US Dept of State Geographer

Image Landsat / Copernicus

©2018 Google

Data SIO, NOAA, U.S. Navy, NGA, GEBCO





**Auto Rain gauge Station at Wakadoke Dam**

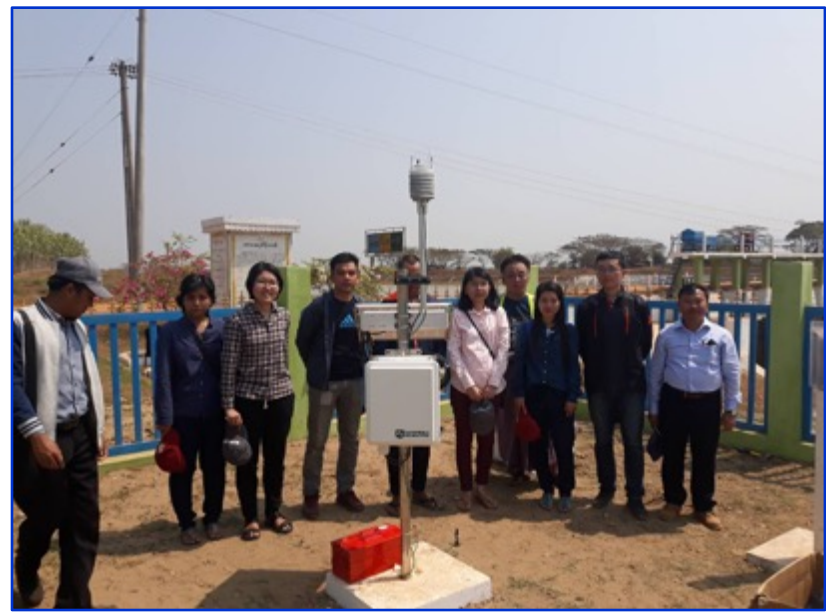
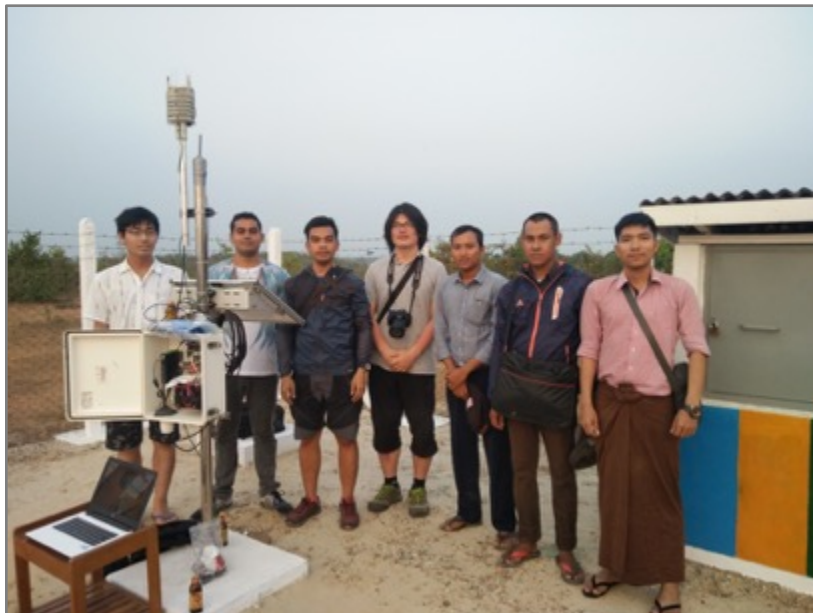
# **Joint Activities with SATREPS**

**Auto Weather Station at Salu Dam, Shwe Laung Dam,  
(Collaboration with Univ. of Tokyo, YTU, JICA SATREPS PROJECT)**

- (1) Salu Dam**
- (2) Shwe Laung Dam**
- (3) Zaungtu Weir and**
- (4) Tarwa Sluice**

# Auto Weather Station at Salu Dam, Shwe Laung Dam, Zaungtu Weir and Tarwa Sluice, Bago Basin

(Collaboration with Univ. of Tokyo, YTU, JICA SATREPS PROJECT)

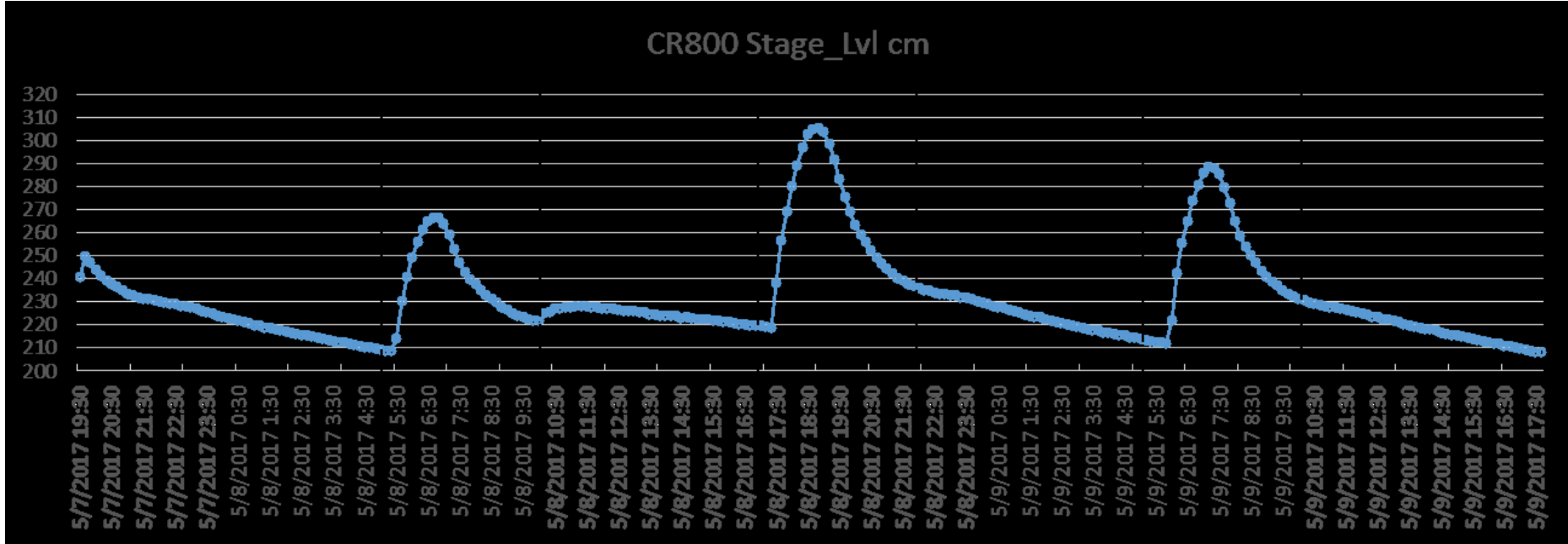




# **Auto Water Level Gauge Station at Tarwa Station, Bago River (Collaboration with Univ. of Tokyo, YTU, JICA SATREPS PROJECT)**



# Water Level Records Observed with Auto Water Level Recorder



Source: SATREPS Project



# **Water Quality**

## **Investigation Branch, IWUMD**

**(1) Water Sampling**

**(2) Water Quality Tests and Analyses**

**(3) Results for River Basin Water Quality Management**

# Sampling for Chemical Analysis

- Bago River and its main tributaries
- References sites from Sittaung River Basin
- Number of Sampling Sites 30
- Monthly cycles
- First weeks of every month
- To cover the whole Bago river and its tributaries
- 2 teams Implementation (IWUMD and FD)





## On going Activities

- ❑ Hydrological and flood inundation model in the target river basin will be developed using WEB-DHM model and RRI model
- ❑ DIAS (Data Integration and Analysis System)
- ❑ Department of GIS & RS in YTU will be launched on 29<sup>th</sup> October 2018
- ❑ For more information about our group activities, please visit to <http://www.kawasakilab.blogspot.com>