

Country Report: Floods and Flood Forecasting System in Myanmar

Ms. Tin Yi

Director

Department of Meteorology and Hydrology

MYANMAR

Floods in Myanmar

- Widespread Floods, Flash Floods

Widespread/Riverine Floods

-mostly occur in the large and medium rivers and caused by the heaving rainfall striking at the head water region for considerable period (1- 3 days), the flood wave forming at the head water started to move downward and causing flood along the river up to the deltaic area.

- Severe riverine floods occurred in 1974, 1997, 2004, 2015, 2016



Causes of River Floods in Myanmar

- occurs in SW Monsoon period (June-Oct)

Ayeyarwady and Chindwin Rivers

- Intense heavy rain due to pronounced monsoon trough persisting for at least **3 days over Northern Myanmar areas**
- **Strong to vigorous monsoon** in Andaman Sea, Bay of Bengal and along the Myanmar coast
- Heavy rainfall **due to cyclonic storm crossing Myanmar and Bangladesh coasts** during pre-monsoon and post-monsoon

Thanlwin, Sittaung, Bago, Shwegyin , Dokehtawady and Ngawun Rivers

- **Strong to vigorous monsoon** in Andaman Sea, Bay of Bengal and along the Myanmar coast
- Mostly due to rainfall associated with **low pressure waves** (the remnants of typhoons and tropical storms of South China Sea) moving from east to west across the country

Flash Floods

-usually occur in small rivers and tributaries of large rivers and in streams in mountainous regions

-Due to heavy rainfall during short time and flood wave move downward swiftly

-Flash Floods in Myanmar

- **Manchaung Flash Flood** (at Shwe Settaw Pagoda) in 1987
- **Shwegin Flash Flood** in 1997
- **Wundwin Flash Flood** in 2001
- **Kyangin Flash Flood** in 2006
- **Shwechaung Flash Flood** in 2011

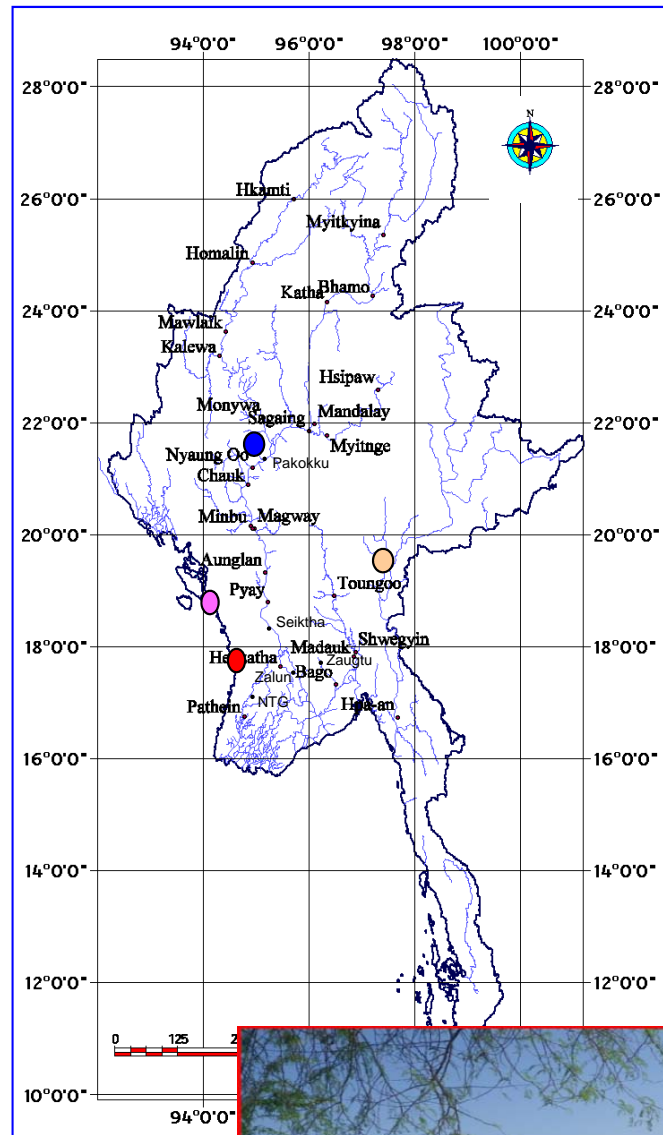


2011 Flash Flood

● **Thandwe (18-6- 2011)**
Rainfall 7.48 in (17-6-2011)
12.45 in (18-6-2011)
(Due to Depression at North Bay)

● **Gwa (19-20 July 2011)**
Rainfall 3.86 in (19-7-2011)
13.07 in (20-7-2011)
Affect houses - 356
Affected Population - 1691
Landslide - 20 ft
 (Thandwe-Gwa Highway)
20 ft
 (Gwa-NTG Highway)

● **Bawlakhe (Nanpon Stream)**
 - Rainfall 1.54 in (3 Oct 2011)
 - Some Streets were inundated
 - Some houses were inundated



Pakokku District (19-20 Oct 2011)

● **Rainfall (18-20 Oct 2011)**
Pakokku 6.65 in
Gangaw 5.95 in
Nyaung Oo 9.34 in
Affect Villages/wards 102
Death toll 161
Livestock losses 3384
Damaged Houses 2535
Damaged Gov. Buildings 15
Damaged religious Building 33
Damaged croplands (acres) 5378
Damaged Bridges 7
Affected Houses 9523
Affected Population 29751
The loss in terms of cash 1544.59
(million kyats)



Severe Flood Years (Since 1966)

<i>River</i>	Highest Water Level Recorded at	Year	Total Stations above Danger Level
<i>Chindwin</i>	Homalin	1968	14 stations
<i>Ayeyarwady</i>	Chauk, Minbu, Aunglan, Pyay	1974	20 stations
<i>Chindwin</i>	Mawlaik	1976	18 stations
<i>Ayeyarwady</i>	Myitkyina, Katha	1979	14 stations
<i>Chindwin</i>	Hkamti	1991	16 stations
<i>Sittoung Shwegyin</i>	Madauk Shwegyin	1997	19 stations
<i>Chindwin Thanlwin</i>	Kalewa, Monywa Hpa-an	2002	15 stations
<i>Ayeyarwady</i>	Bhamo, Sagaing, Mandalay, Nyaung Oo, Magway	2004	21 stations
<i>Chindwin</i>	Monywa	2015	23 stations
<i>Ayeyarwady/ Ngawun</i>	Nyang Oo , Zalun, Pathein	2016	29 stations

Occurrence of Flood Percentage in Months and Flood Frequency along Ayeyarwady River

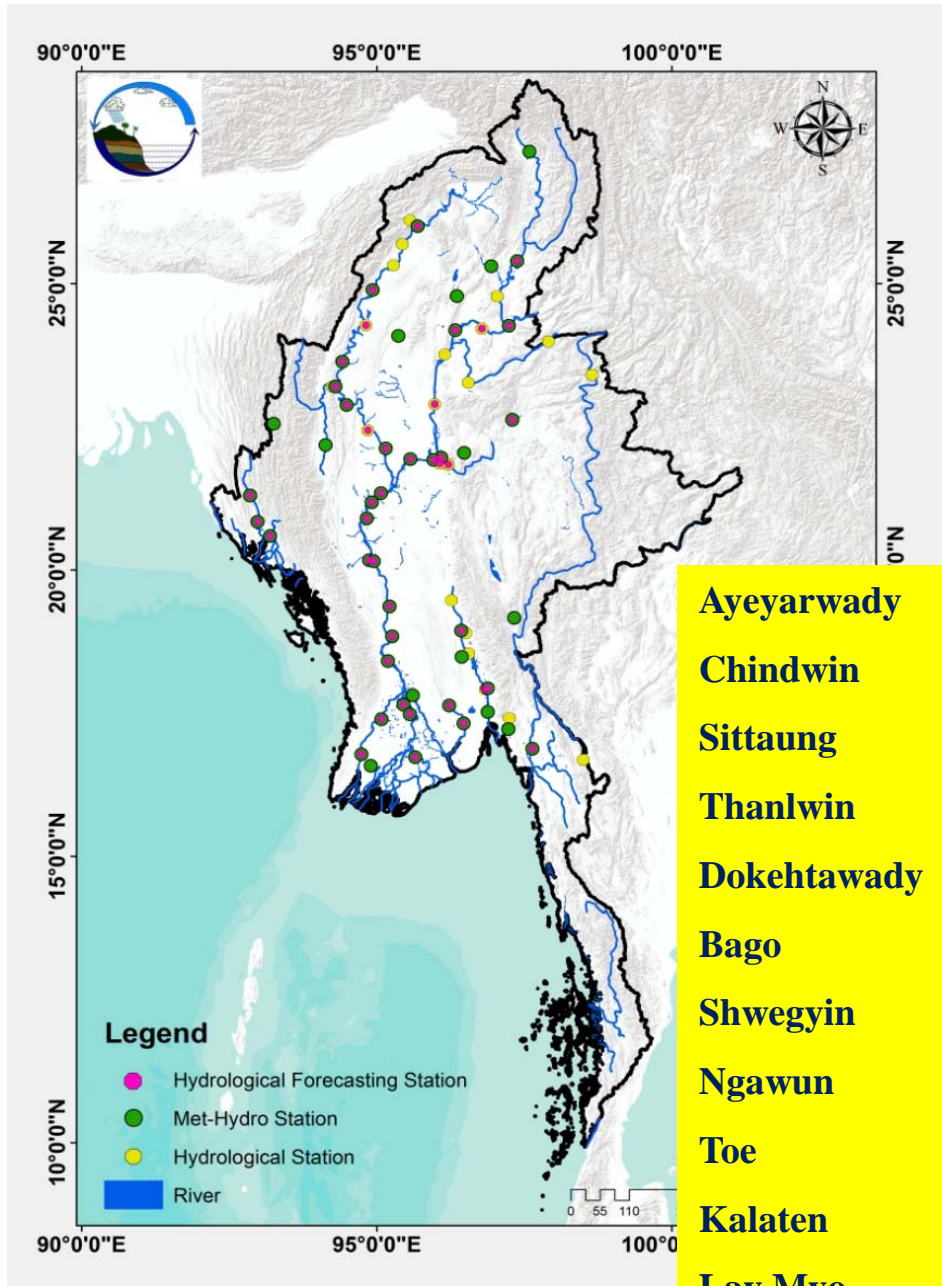
River/ Station	Monthly Flood Occurrence %						Floods		
	June	July	Aug	Sep	Oct	Nov	Flood Frequency	Flood Years	Duration(Total Year)
<i>Ayeyarwady River</i>									
Myitkyina	14	57	0	14	14	0	7	7	1967-2016(50 yrs)
Bhamo	10	60	10	15	5	0	20	15	1968-2016(49 yrs)
Katha	11	58	17	9	6	0	36	25	1966-2016(51yrs)
Mandalay	0	41	29	12	18	0	14	14	1968-2016(49yrs)
Sagaing	0	23	35	31	12	0	26	21	1966-2016(51yrs)
Pakokku	0	20	40	40	0	0	10	7	1998-2016(19yrs)
Nyaung Oo	0	29	35	25	10	0	51	32	1966-2016 (51 yrs)
Chauk	0	27	45	18	9	0	11	11	1973-2016(44yrs)
Minbu	0	23	41	27	9	0	44	29	1966-2016(51yrs)
Magway	0	33	33	24	10	0	21	12	1990-2016 (27 yrs)
Aunglan	0	19	44	38	0	0	16	13	1973-2016(44yrs)
Pyay	0	32	26	37	5	0	19	17	1966-2016 (51yrs)
Seiktha	0	13	56	25	6	0	16	9	1989-2016 (28yrs)
Henzada	0	24	47	24	5	0	58	32	1966-2016(51yrs)
Zalun	0	15	44	32	9	0	34	18	1985-2016 (32yrs)

Occurrence of Flood Percentage in Months and Flood Frequency along Chindwin and other Rivers

River/Station	Monthly Flood Occurrence %						Floods		
	June	July	Aug	Sep	Oct	Nov	Flood Frequency	Flood Years	Duration(Total Year)
<i>Chindwin</i>									
Hkamti	6	56	25	13	0	0	48	31	1967-2016 (50yrs)
Homalin	6	50	27	13	3	0	62	37	1968-2016(49yrs)
Mawlaik	2	41	33	16	8	0	63	35	1965-2016(52yrs)
Kalewa	2	44	31	18	5	0	61	36	1967-2016(50yrs)
Monywa	0	38	35	21	6	0	48	32	1966-2016 (51yrs)
<i>Dokehtawady</i>									
Hsipaw	0	0	100	0	0	0	1	1	1967-2016 (50yrs)
Myitnge	1	21	37	28	12	1	68	35	1972-2016 (45yrs)
<i>Sittoung</i>									
Toungoo	0	12	59	21	7	1	76	38	1966-2016(52yrs)
Madauk	2	29	56	11	2	0	98	45	1966-2016(51yrs)
<i>Shwegyin</i>									
Shwegyin	2	29	67	2	0	0	49	29	1966-2016 (51yrs)
<i>Bago</i>									
Zangtu	0	0	0	0	0	0	0	0	1987-2016 (30yrs)
Bago	6	29	65	0	0	0	17	14	1965-2016 (52yrs)
<i>Thanlwin</i>									
Hpa-an	2	32	50	14	2	0	103	43	1966-2016 (51yrs)
<i>Ngawun</i>									
NTG	0	31	37	22	10	0	51	29	1985-2016 (32yrs)
Pathein	0	0	80	20	0	0	5	3	2005-2016(12yrs)

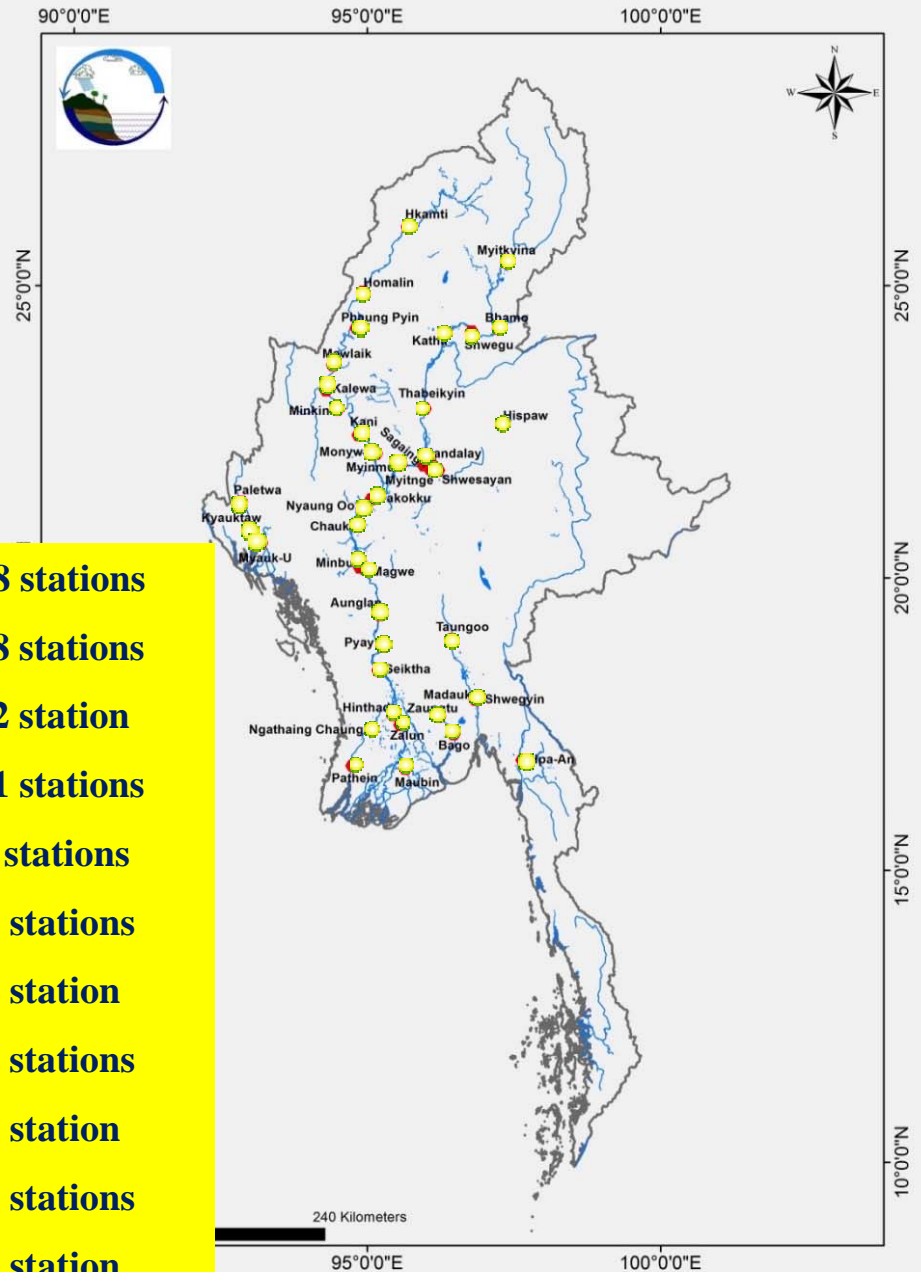
Responsibility of DMH for Flood Forecasting System in Myanmar

70 Hydrological Monitoring Stations



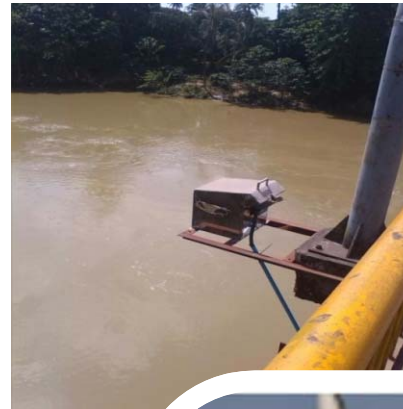
Ayeyarwady	- 18 stations
Chindwin	- 8 stations
Sittaung	- 2 station
Thanlwin	- 1 stations
Dokehtawady	- 3 stations
Bago	- 2 stations
Shwegyin	- 1 station
Ngawun	- 2 stations
Toe	- 1 station
Kalaten	- 2 stations
Lay Myo	- 1 station

Hydrological Forecasting Stations in Myanmar



DMH's Water Level Observation System

- ❖ Manual Observation system (Most stations/ still using)
- ❖ *Telemetry Water Level Monitoring System (starting to upgrade some stations by Gov. Budget/ Projects)*



Install the telemetry system with Funded by Norway Gov.



Flood Forecasting Methods

Daily water level forecast

- River Stage Correlation Method
- Multiple Linear Regression Method
- Integrated Flood Analysis System-IFAS (research)
- HBV model (testing for Chindwin)
- HEC HMS Model for Ayeyarwady, Chindwin and Sittoung river (testing)

Seasonal water level forecast

- Based on flood characteristic occurred in Analogue years
- Based on seasonal weather forecast
- Based on comparison of current flow with the individual hydrograph for the last (10) years
- Based on the average flow of the last (10) years
- Based on Flood frequency analysis
- Based on ENSO forecast

Flood Forecasting and Warning System and Dissemination

River Stage and Rainfall from Reporting Station



Flood Forecasting Center
(Hydrological Division-Nay Pyi Taw)

Discussion at 12:30 pm

Weather Forecasting Center
Meteorological Division-Nay Pyi Taw

Analyzing the Satellite Image

Weather Forecast



DMH Website
<http://www.dmh.gov.mm>

FACEBOOK



Flood Forecast and Warning

Radio/TV/media

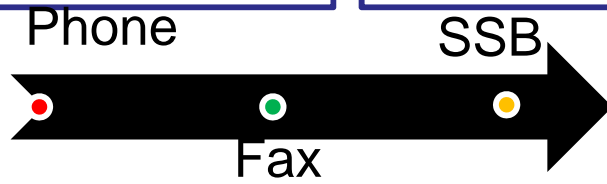
Concerned DMH Stations

Related Ministries and Dept.

Higher Authorities

Local Authorities

If the flood is severe case, the department has to request radio and television stations to broadcast the flood warning and bulletin frequently



Affected Area

Types of Forecast

Types of Forecast	Time of Issuance	Forecast Validity
General Long Range Water Level Forecast	April 28	Monsoon season(Early, Mid and Late)
Seasonal Water Level Forecast	April 28 June 28 August 28 October 28	Early Monsoon(May- June) Mid Monsoon (July-Aug) Late Monsoon(Sep-Oct) Winter Monsoon(Nov-Feb)
Monthly Water Level Forecast	28 th of every month	1 month
10 Days Water Level Forecast	8 th , 18 th , 28 th of every month	10 days
Daily Water Level Forecast	Daily	1 Day

Warning, Bulletin and Forecast

Warning

- **Flood Warning**
- **Minimum Alert Water Level**

Bulletin

- **Flood Bulletin**
- **Significant Water Level Bulletin**
- **Low Flow Bulletin**

Forecast

- **Daily W/L Forecast**
- **Dekad W/L Forecast**
- **Monthly W/L & Flood Forecast**
- **Seasonal W/L & Flood Forecast**
- **General Long Range W/L & Flood Forecast**

Daily Water Level Forecasts for (41) Stations at (11) Major Rivers

Department of Meteorology and Hydrology Daily Water Level Forecast

13-10-2016

Rivers	Stations	Danger Level (cm)	Water Level at (12:30) (cm)	Water level Changes during last (24) (cm)	Water Level Forecast at next 24 (cm)	Danger Levels Condition
Ayeyarwady	Myittha	1200	463	+41	488	
	Bhamo	1150	710	+46	740	
	Shwepyithar	930	533	+32	568	
	Katha	1040	582	+61	617	
	Jhabeikya	1480	687	+54	757	
	Mandalay	1260	690	+13	725	
	Sagalay	1150	598	+9	623	
	Myittha	1150	581	-3	596	
	Patheingyi	2150	1595	+5	1615	
	Myingon	2120	1571	-15	1586	
	Chauk	1450	798	-16	793	
	Myittha	1700	979	-20	969	
	Magway	1700	949	-17	939	
	Bogale	2550	1786	-23	1766	
	Paya	2900	2239	-20	2224	
	Seltha	1200	598	-34	578	
	Hinthada	1342	900	-21	880	
	Zalun	1160	713	-24	693	
Dobhlaung	Hala	600	211	+10	206	
	Shwepyithar	1050	341	+1	336	
	Myittha	870	383	0	398	
Chindwin	Hkamti	1360	840	+71	890	
	Homalin	2900	2584	+78	2629	
	Pheung Phe	1325	782	+39	832	
	Mawlaik	1230	692	+30	747	
	Kelawa	1550	865	+68	915	
	Minla	1350	790	+50	835	
	Kaol	1130	646	+44	686	
Monywa	1000	563	+53	628		

Rivers	Stations	Danger Level (cm)	Water Level at (12:30) (cm)	Water level Changes during last (24) (cm)	Water Level Forecast at next 24 (cm)	Danger Levels Condition
Sittaung	Toungtha	600	431	-14	436	
	Madauk	1070	881	-6	876	
Shwepyithar	Shwepyithar	700	478	-19	463	
Bago	Zaungtha	900	219	-8	209	
	Bago	880	420	-20	405	
Thanlwin	Hoson	750	408	-20	393	
Ngawun	Ngathaling - Chawng	1130	934	-16	919	
	Patheingyi	350	279	+15	304	
Toe	Mawlaik	720	507	-5	502	
Kalaten	Kalaten	1600	505	+51	515	
	Kalaten	550	353	+12	368	
Lay Mye	Myittha	980	558	+6	568	

- Ayeyarwady - 18 stations**
- Chindwin - 8 stations**
- Sittaung - 2 station**
- Thanlwin - 1 stations**
- Dokehtawady - 3 stations**
- Bago - 2 stations**
- Shwepyithar - 1 station**
- Ngawun - 2 stations**
- Toe - 1 station**
- Kalaten - 2 stations**
- Lay Mye - 1 station**

Significant Water Level Bulletin

(Issued at 11:00 hr M.S.T on 23-2-2016)

According to the (22:30) hrs M.S.T observations on 2016, February 22nd, the water levels of Ayeyarwady River at Myitkyina is (503) cm, and the rise of water level is about (12) feet within 16 hrs. It may rise about (7) to (8) feet above the present water level at Bhamo and Katha during the next (1) to (3) days and about (5) to (6) feet above the present water level at Mandalay, Sagaing, Myinmu, Pakokku and Nyaung Oo during the next (3) to (5) days and about (4) to (5) feet above the present water level at Chauk, Minbu, Magway, Aunglan, Pyay, Seiktha, Hinthada and Zalun during the next (6) to (11) days.

It is advised that the vessels running along the river and those who made plantations on sandbank during low flow period should make precaution measures for the sharp rise of water level.

Flood Warning

(Issued at 13:00 hr M.S.T on 17-7-2016)

According to the (12:30) hrs M.S.T observation today, the water level of Chindwin River at Hkamti is observed as about (1½) feet below its danger level. It may reach its danger level during the next (1) Day.

It is especially advised to the people who settle near the river bank and low lying areas in Hkamti Township, to take precaution measure.

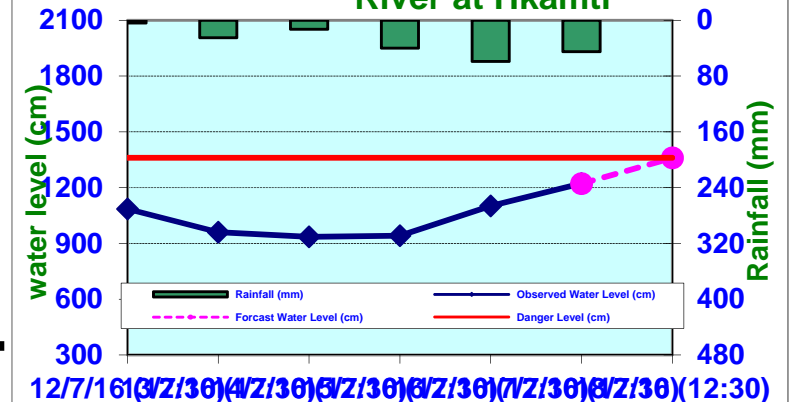
Flood Bulletin

(Issued at 13:00 hr M.S.T on 18-7-2016)

According to the (12:30) hr M.S.T observation today, the water level has exceeded by about (2) feet above its danger level, its may continue to rise about (1½) feet during the next (1) day and may remain above its danger level.

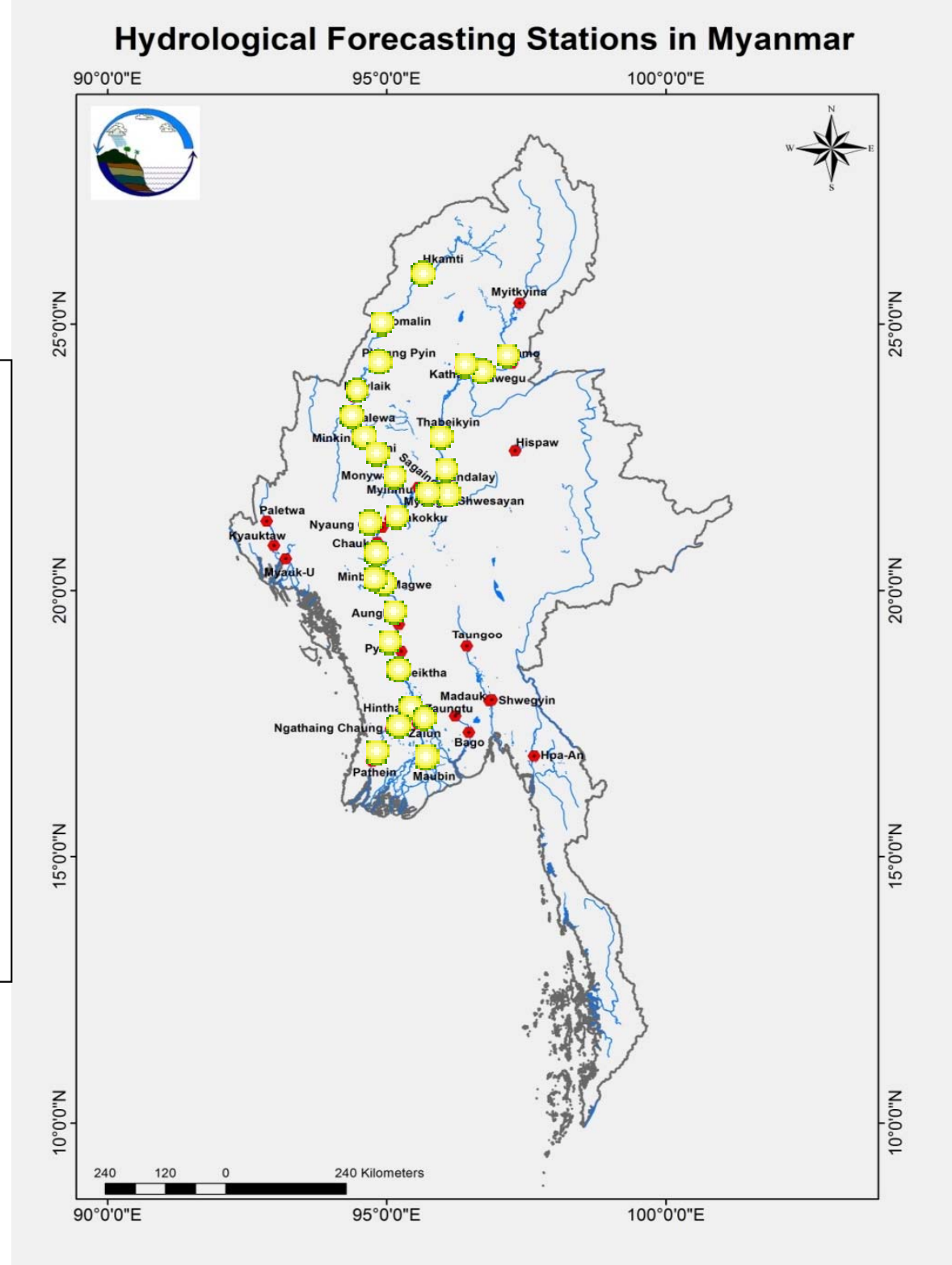
It is especially advised to the people who settle near the river bank and low lying areas along the Chindwin River, to take precaution measure.

Water Level Condition of Chindwin River at Hkamti

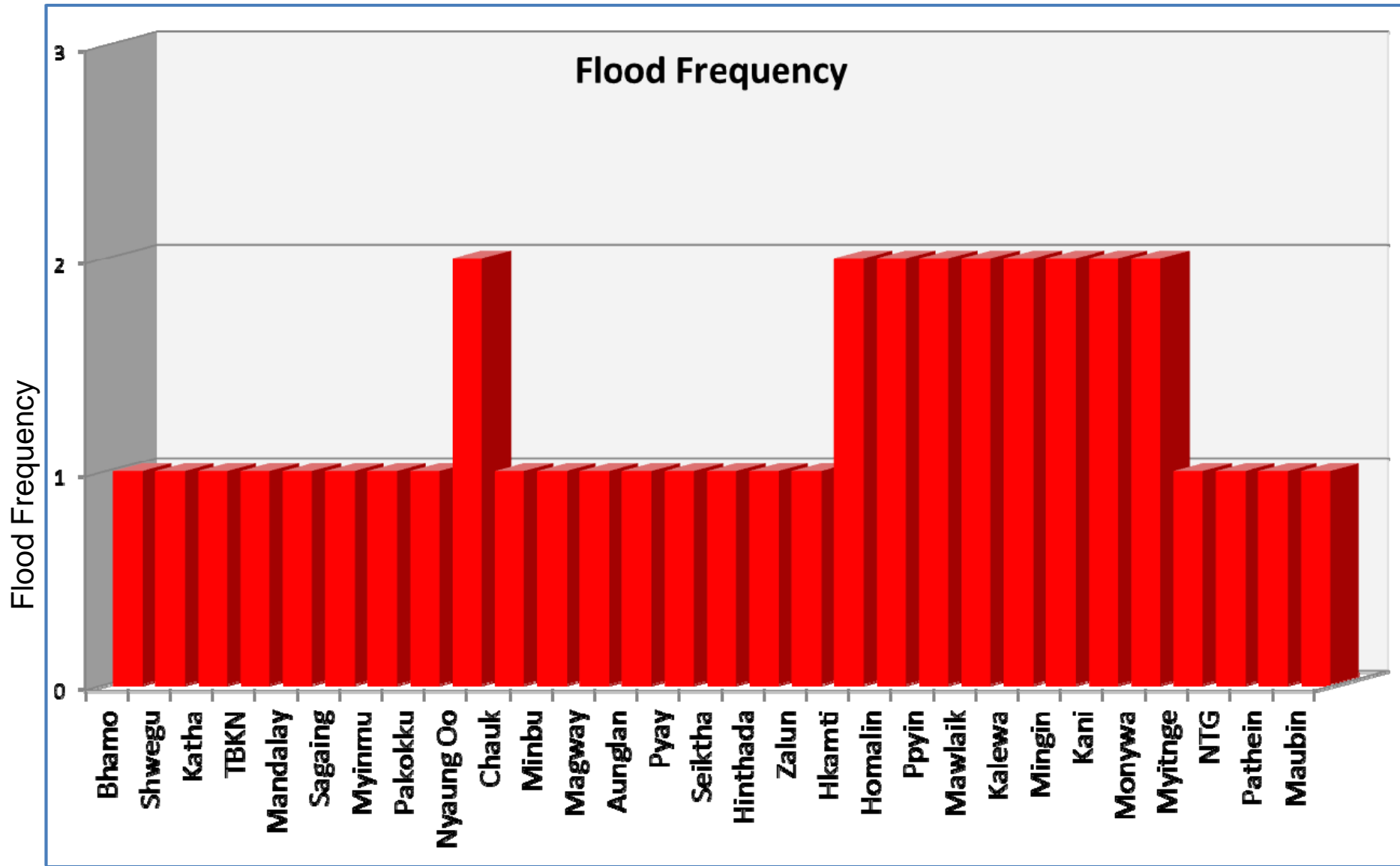


Flood Conditions during Monsoon Season 2016

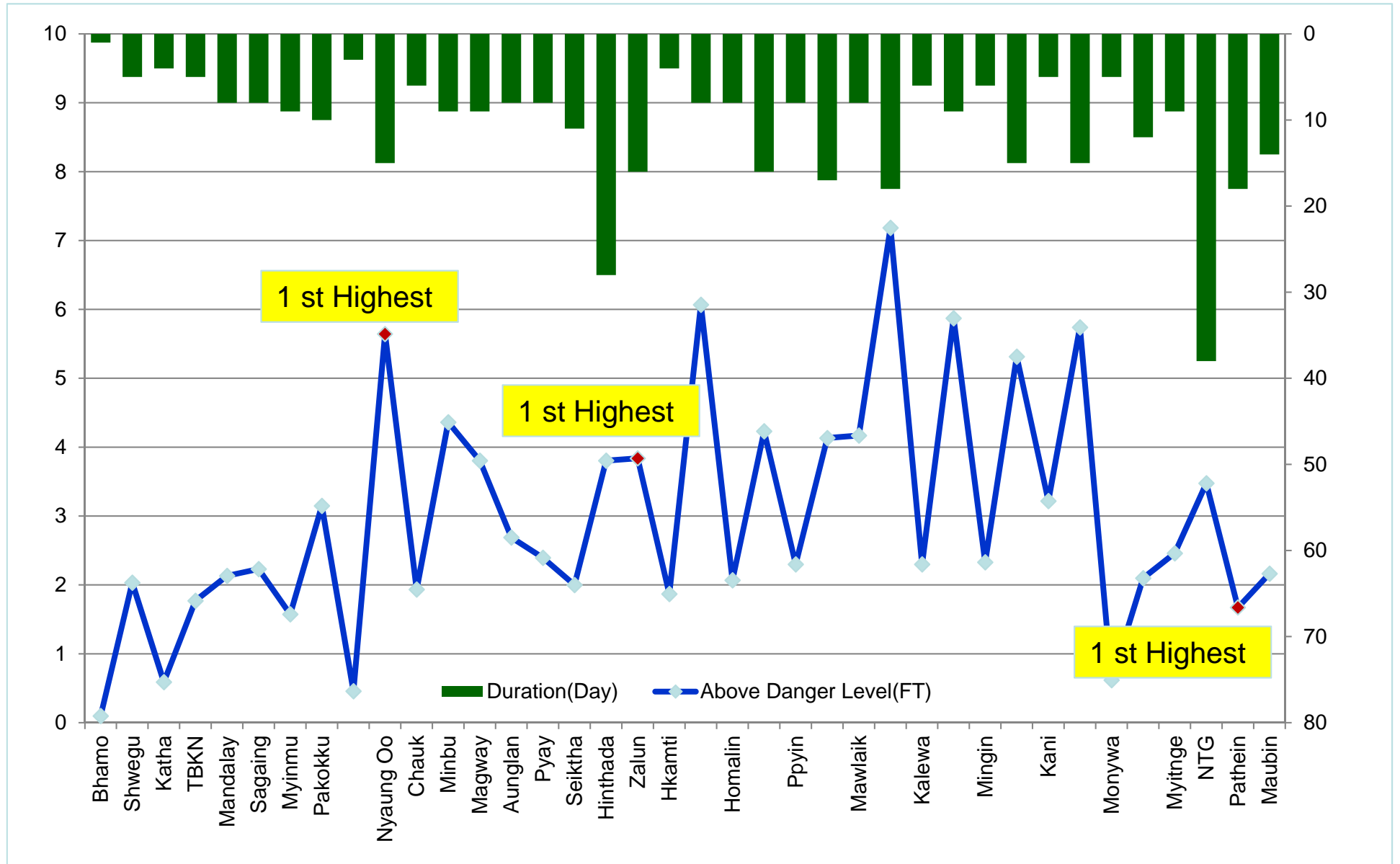
- Ayeyarwady River -17 Stations (Two times at Nyaung Oo)
- Chindwin River - 8 Stations (Two times at all stations)
- Dokehtawady River - 1 Station
- Ngawun River - 2 Stations
- Toe River - 1 Station



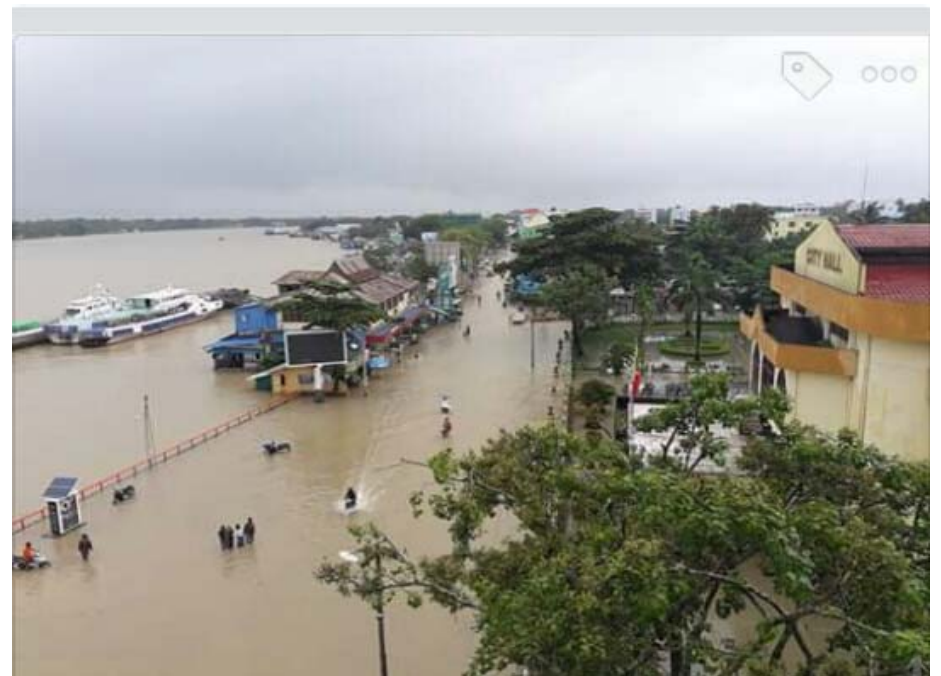
Floods Occurrences in 2016



Floods Occurrences during 2016



2016 Floods Photos



Issuing Flood Warnings and Bulletins during 2016

Rivers	Types of News		
	SWLB	FW	FB
1.Ayeyarwady	23	10	25
2.Chindwin	1	8	31
3.Sittoung		-	-
4.Shwegyin		-	-
5.Bago		2	-
6.Thanlwin		2	-
7.Ngawun		1	37
8.Dokehtawady		2	7
9.Kalaten(start date 1.8.16)		-	-
10.Toe(start date 1.6.16)		-	6
11.Lay Myo(start date 1.8.16)		-	-
Total	24	25	116

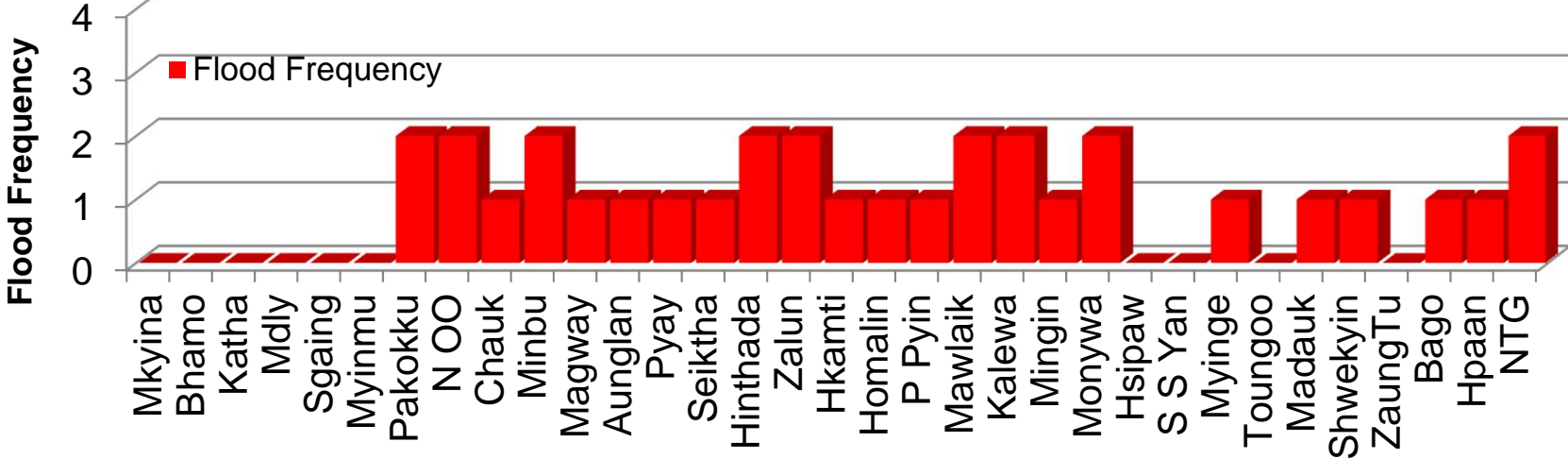
SWLB Significant Water Level Bulletin

FW Flood Warning

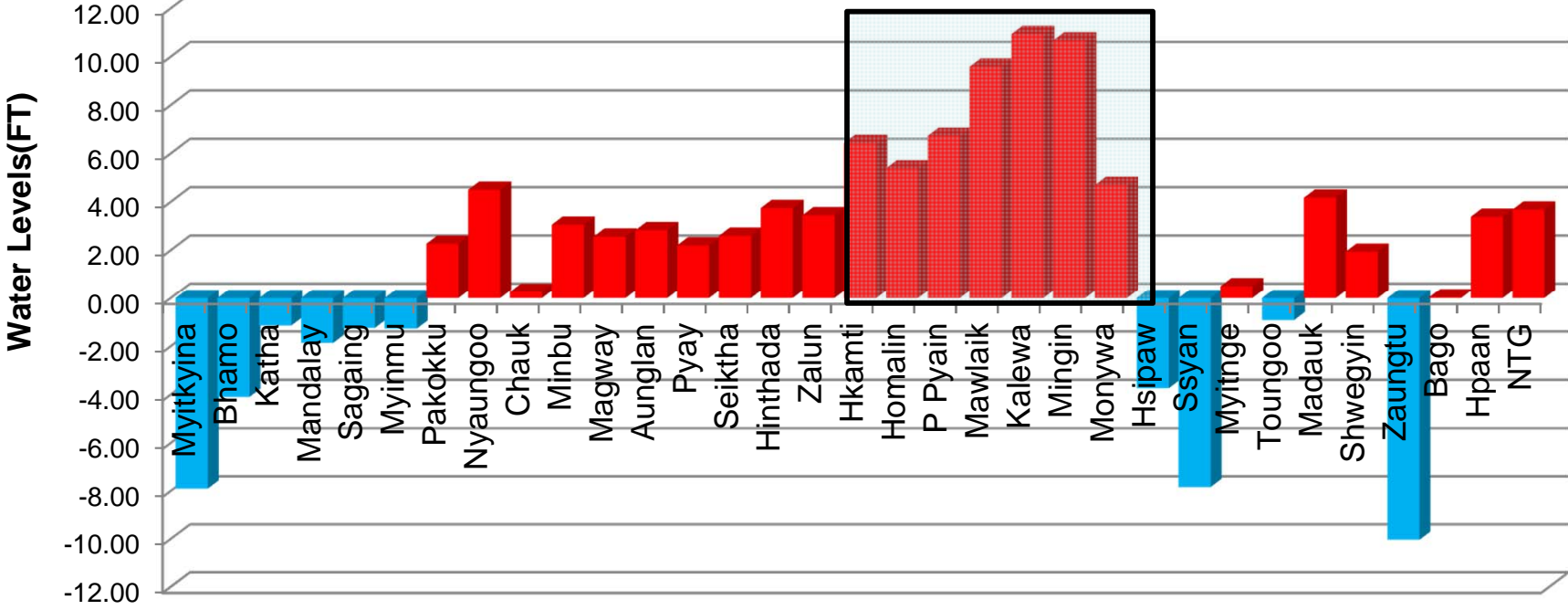
FB Flood Bulletin

Review on the occurrences of floods in 2015

Flood Frequency 2015(Monsson Season)



Annual peak water levels at 8 major rivers on 2015



Review on the occurrences of floods in 2015

Rivers	Types of News					
	SWLB		FW		FB	
	2014	2015	2014	2015	2014	2015
Ayeyarwady	2	1	3	12	4	25
Chindwin	-		7	8	5	23
Sittoung	-		1	2	9	7
Shwegyin	-		1	1	-	6
Bago	-		2	1	2	-
Thanlwin	-		4	1	8	6
Ngawun	-		2	3	8	40
Dokehtawady	-		1	1	-	-
Total	2	1	21	29	36	107

SWLB Significant Water Level Bulletin

FW Flood Warning

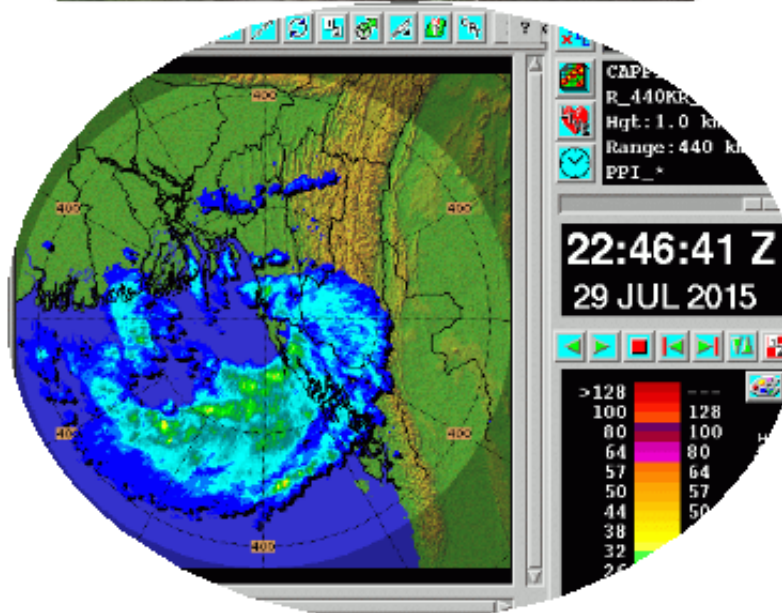
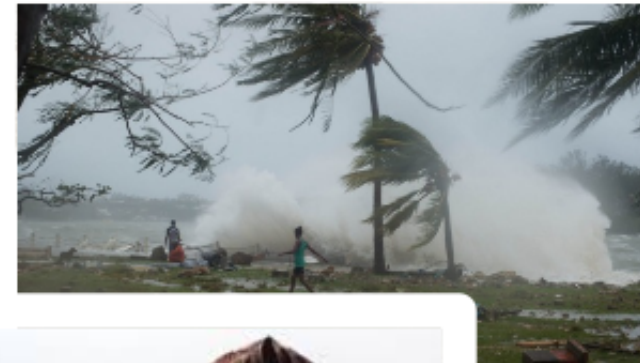
FB Flood Bulletin

Comparison of One Week Observed Rainfall and July Normal Rainfall (Due to Cyclone “Komen”)

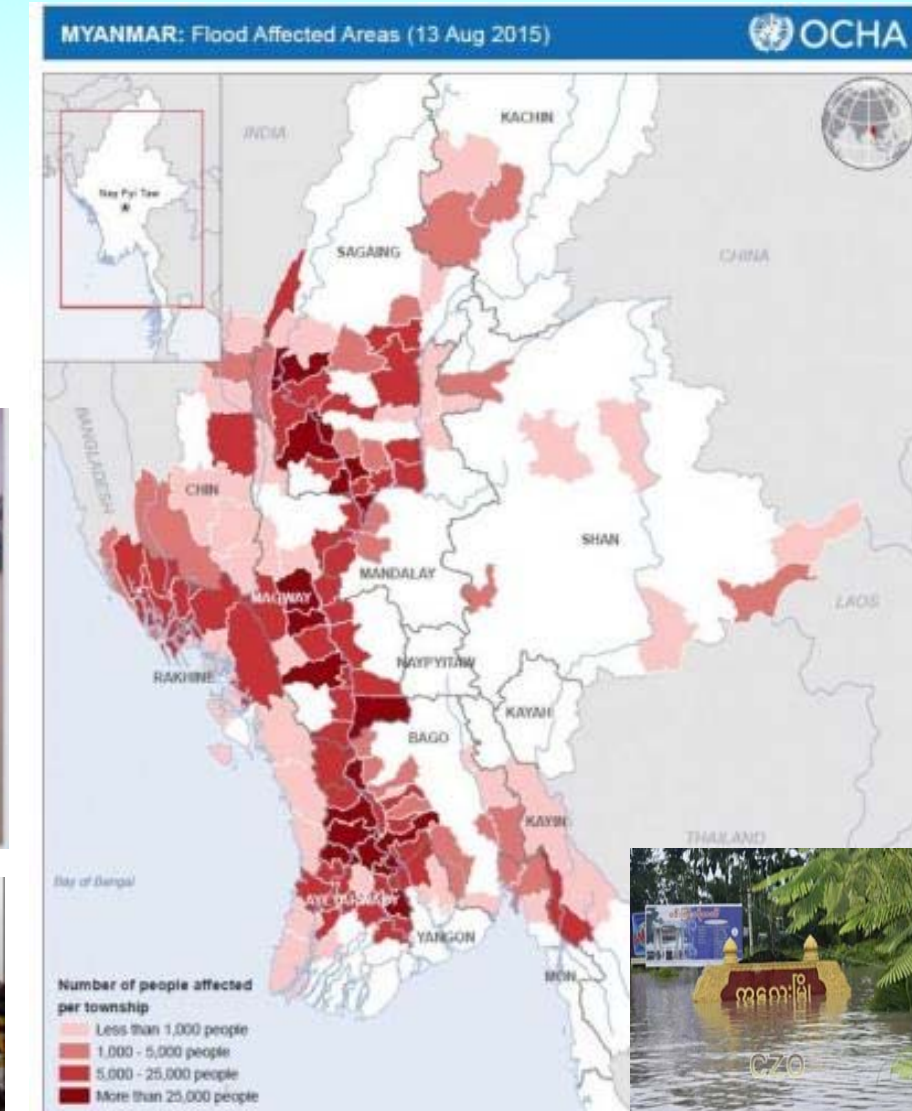
Regions and States	Stations	2015 July (25-31) Rainfall(inches)	July Normal Rainfall(inches)
Sagaing	Mawlaik	11.30	10.16
	Kalaywa	11.14	10.24
	Kalay	12.36	11.89
	Shwebo	7.05	5.83
	Monywa	4.69	2.87
Magway	Chauk	3.82	1.93
	Minbu	6.18	4.33
	Magway	6.93	3.58
	Aunglan	6.85	6.97
	Gangaw	8.46	6.10
	Sinphyugyun	7.56	2.28
Chin	Mindat	15.51	7.99
	Hakha	31.42	18.19
	Paletwa	42.52	33.19
	Falam	17.83	10.16
Rakhine	Kyauktaw	50.55	39.06
	Sittwe	36.06	45.67
	Kyaukpyu	35.20	47.01
	Thandwe	24.80	57.24
	Gwa	21.34	36.61
	Myauk U	29.84	38.98

Disasters due to Cyclone “Komen” in Myanmar (2015)

Images from Cyclone “KOMEN”



Flood affected areas and affected people (July, 2015)



2015 Severe flood in Myanmar

- **Cause** - severe flood and landslide by unusually heavy rainfall and also cyclone Komen
- **Period** - 20 July 2015 to August
- **Affected areas** - 12 States and Regions except from Kayah and Thanintharyi
- H.E President, in line with the section 11 of Natural Disaster Management Law, declared Chin State, Sagaing Region, Magway Region and Rakhine State as the worst disaster-affected areas on July 31.

Damages by flood (2015)

NO	States/ Regions	Damaged houses	Affected households	Affected people	Death toll
1	Sagaing	1963	96401	473329	46
2	Kachin	69	1485	7454	1
3	Shan	128	1032	5329	9
4	Mandalay	256	4693	18977	12
5	Chin	2951	3448	17924	12
6	Mon	45	1515	6632	-
7	Magway	414	63693	303694	2
8	Yangon	-	15674	63576	1
9	Rakhine	14130	18203	109707	62
10	Kayin	1	1471	7714	
11	Bago	281	87957	177315	5
12	Ayeyarwaddy	19118	126970	498759	1
13	Thanintharyi	3	137	587	-
14	Kayah	60	529	1840	22
Total		39,419	423,208	1,692,837	173

Replanting in the Flooded Area (2015)

No.	Regions/ States	Flooded Acre	Affected Acre	Damaged Acre	Replanting Acre
1	Nay Pyi Taw	23	-	-	-
2	Kachin	33552	15944	12959	8804
3	Kayar	146	104	68	6
4	Kayin	1162	648	106	74
5	Chin	5801	5801	3267	372
6	Sagaing	223855	184691	143937	72641
7	Pago	376446	229989	152847	106330
8	Magway	96846	96846	65912	15339
9	Mandalay	3583	262	28	5
10	Mon	13010	2294	-	-
11	Rakaing	291219	273154	217246	215792
12	Yangon	116894	76941	56486	23646
13	Shan	13491	3932	2704	469
14	Ayeyawaddy	318843	255408	214780	41449
	Total	1494871	1146014	870340	484927

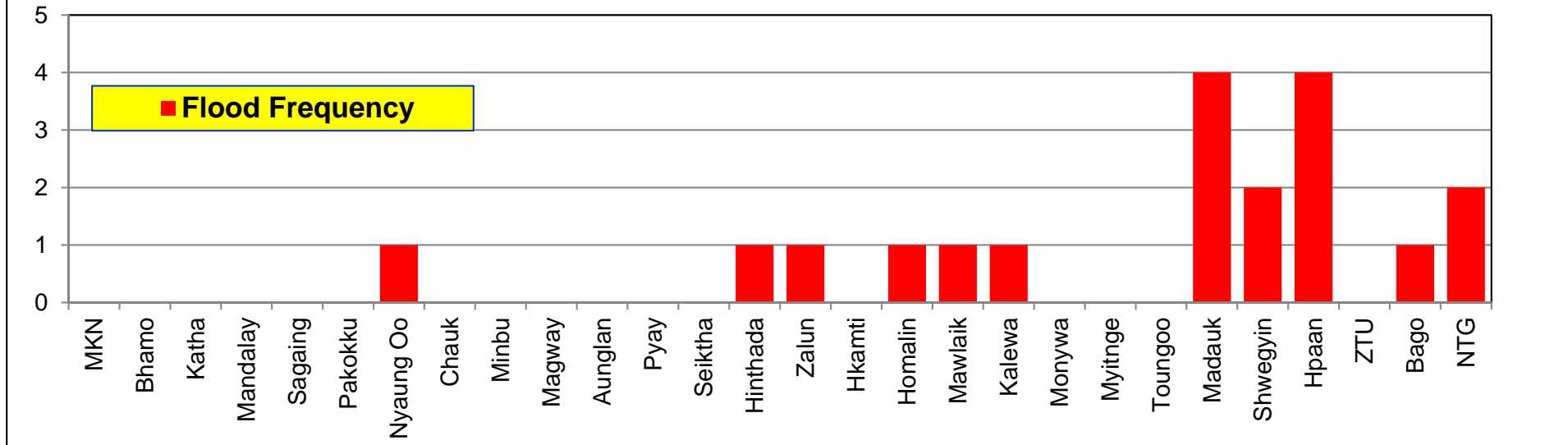
Contribution of humanitarian assistances(2015)



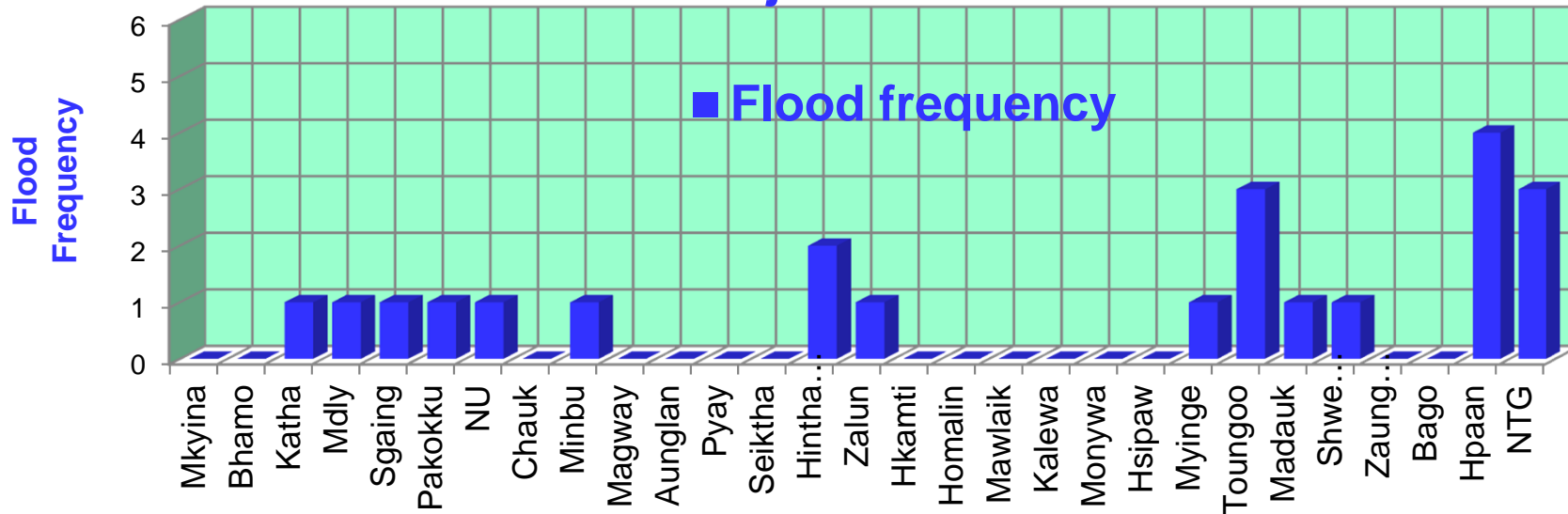
Receiving Donation for flood (2015)



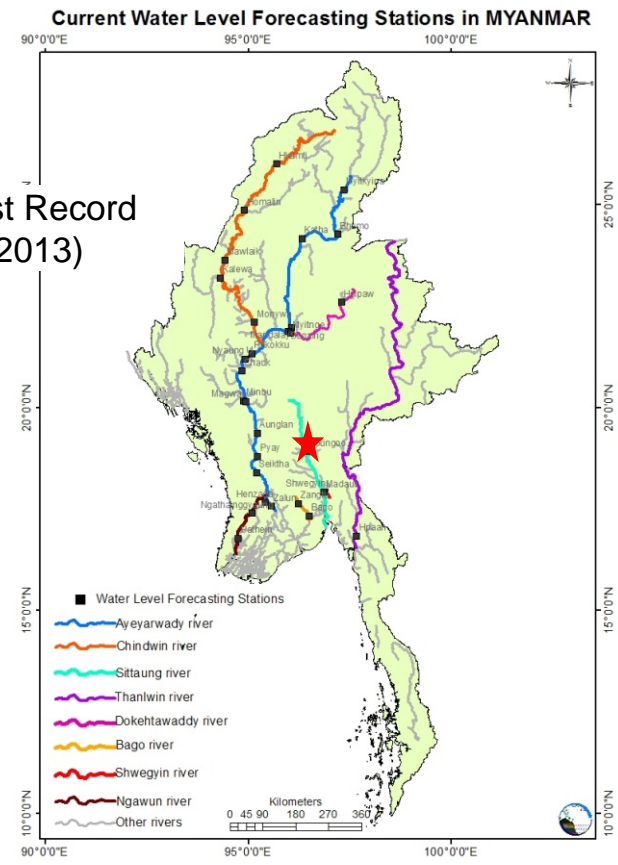
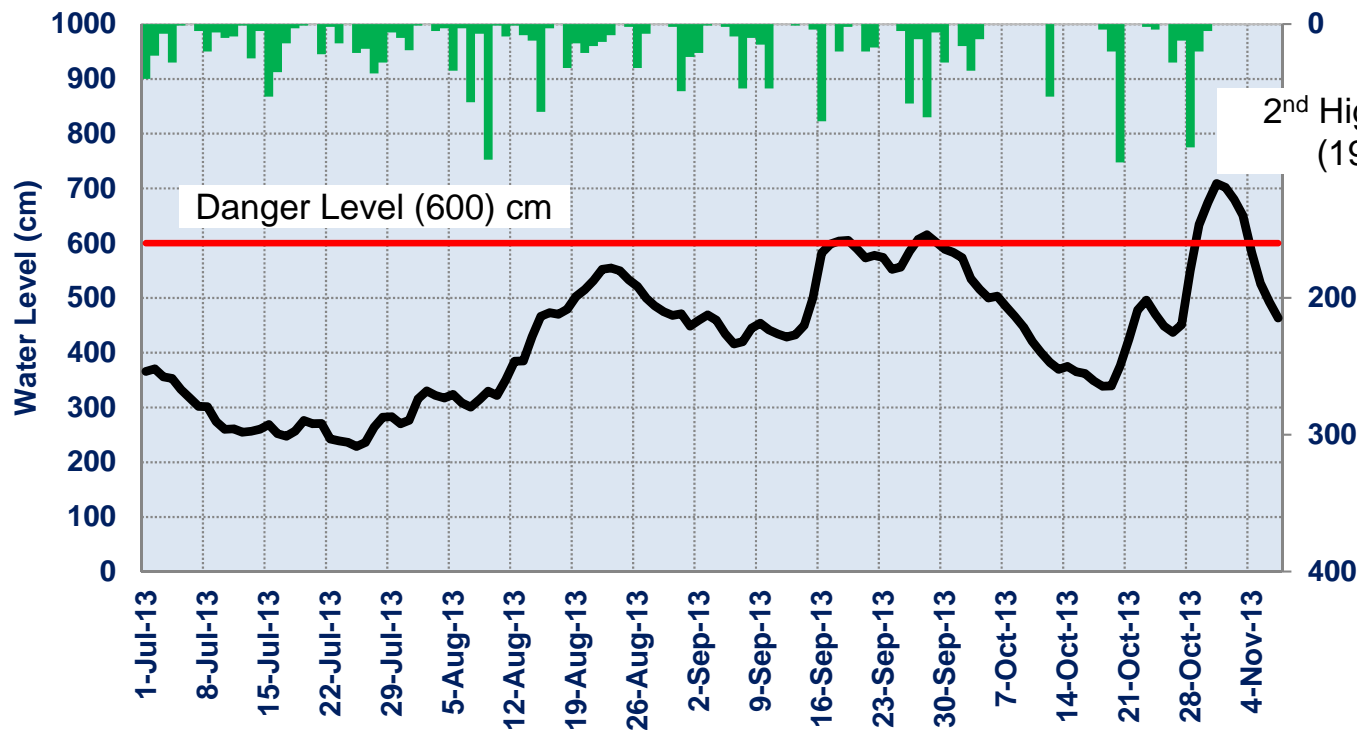
Flood Frequency during 2014 Monsoon Season



Flood frequency during 2013 monsoon season at 8 major rivers



Flood Hydrograph at Toungoo of Sittoung River (2013)



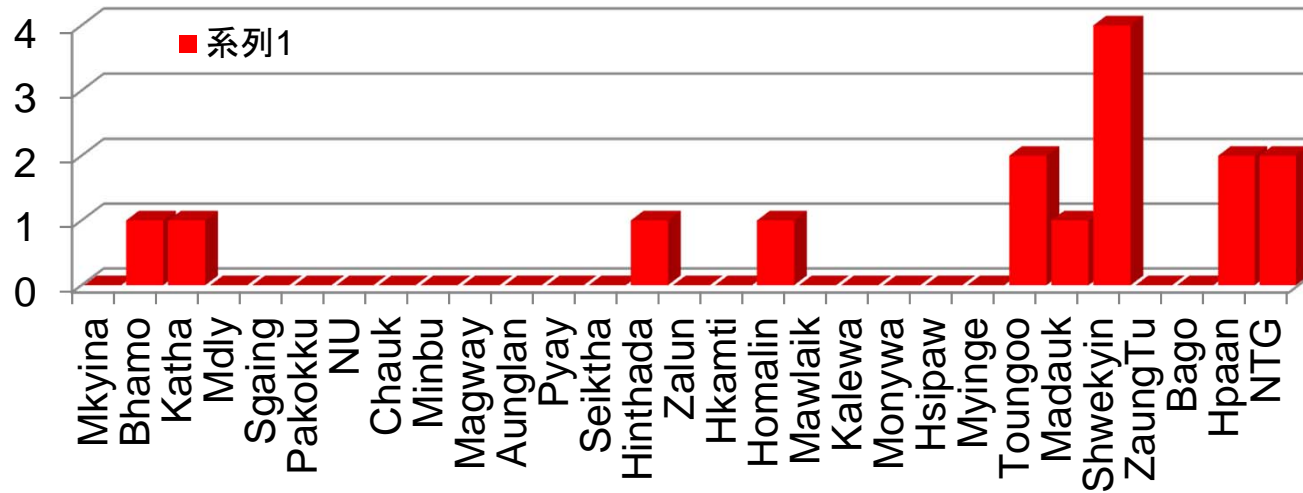
Relief camp - 72

Affected Population - 49848

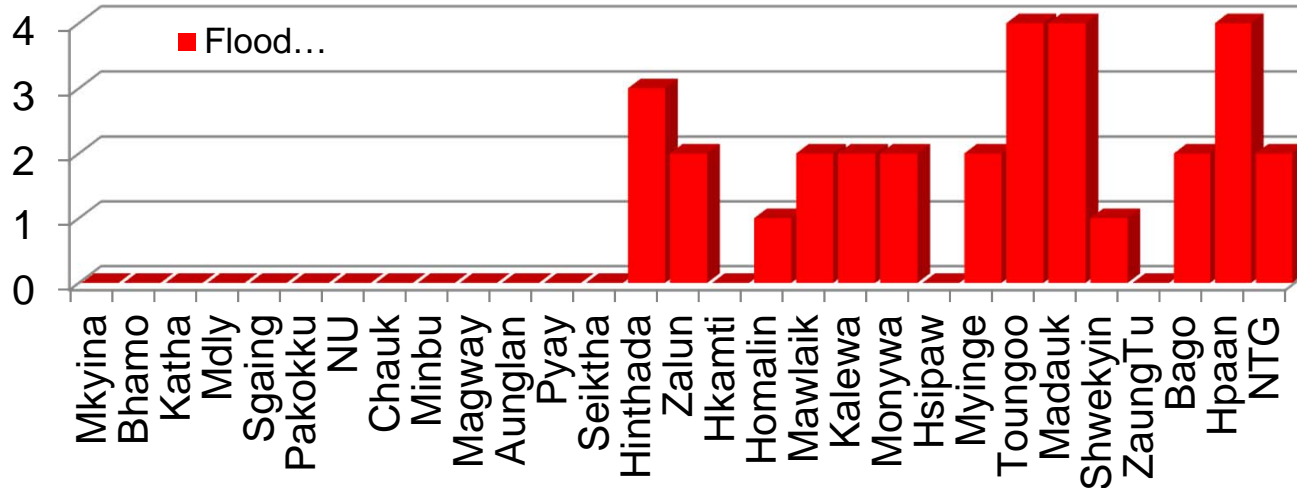
Affected Paddy and Crop - 57395 acres

Damaged Paddy and Crop - > 30000 acres

Flood Frequency in 2012(Monsoon Season)

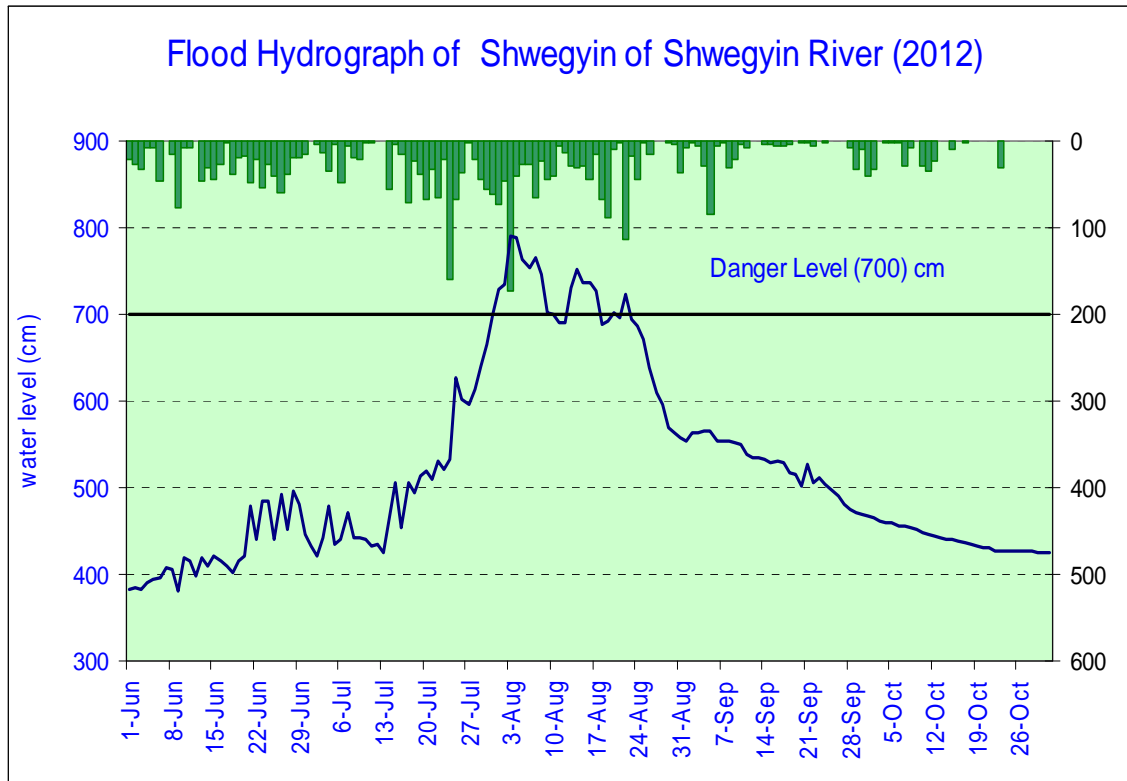


Flood Frequency in 2011(Monsoon Season)

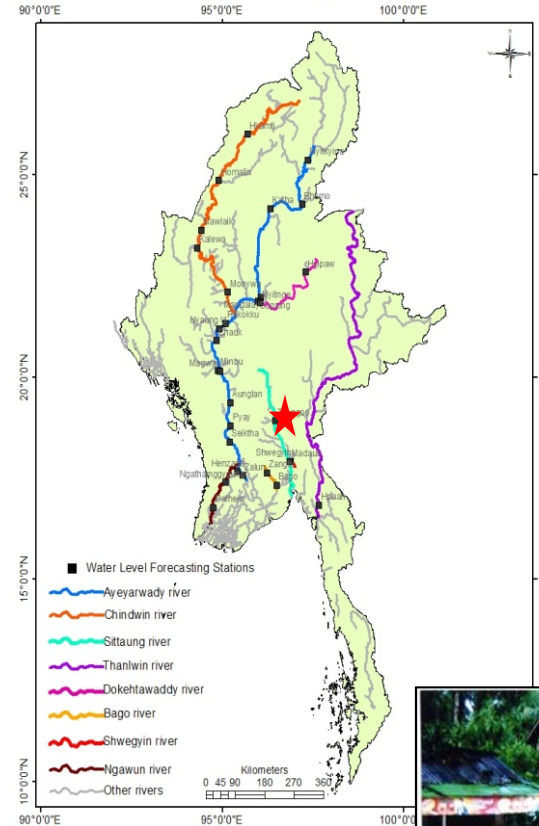


2012 Flood

3rd Highest (1966-2012) of Shwegyin of Shwegyin River



Current Water Level Forecasting Stations in MYANMAR



Flood duration is 10 days

- Inundated $\frac{3}{4}$ of the total area
- (3 to 4.5) ft flood depth
- 20 wards were inundated
- Flood affected population was about **11255**

Floods in 2011

Fig (4) Comparison of 2010 Water Level and 2011 Water Level during Monsoon Period at Hkamti of Chindwin River

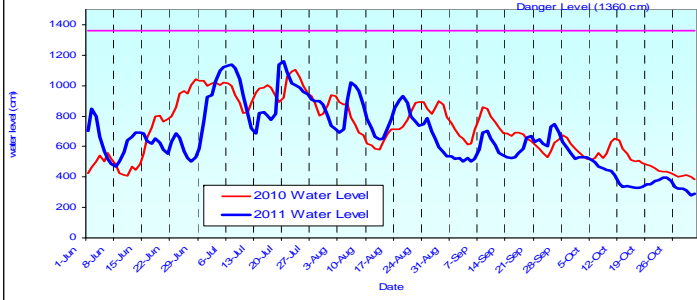
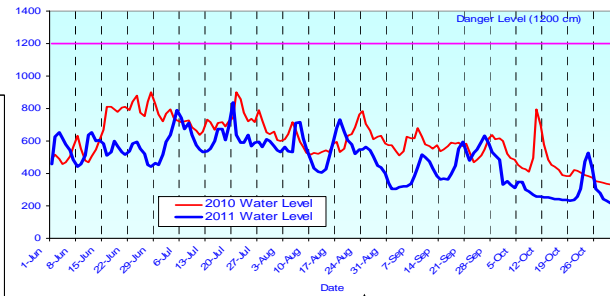


Fig (1) Comparison of 2010 Water Level and 2011 Water Level during Monsoon Period at Myitkyina of Ayeayawdy River



2011 Annual Peak/ Lowest Water level

4th Lowest (1967~2011)

1st Lowest (1967~2011)

2nd Lowest (1968~2011)

2nd Lowest (1966~2011)

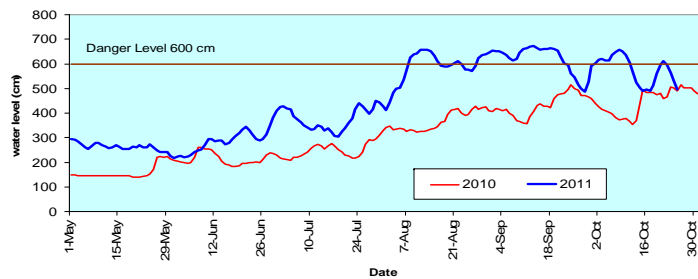
3rd Lowest (1968~2011)

4th Lowest (1968~2011)

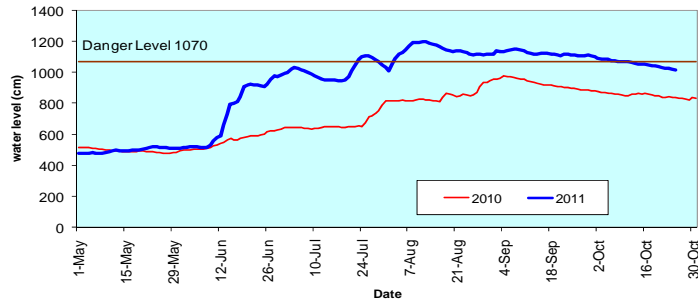
1st Highest (1965-2011)

2nd Highest (1966-2011)

Comparison of 2010 and 2011 Water Levels of Toungoo of Sittoung River



Comparison of 2010 and 2011 Water Levels of Madauk of Sittoung River



Comparison of 2010 and 2011 Water Levels of Hpaan of Thanlwin River

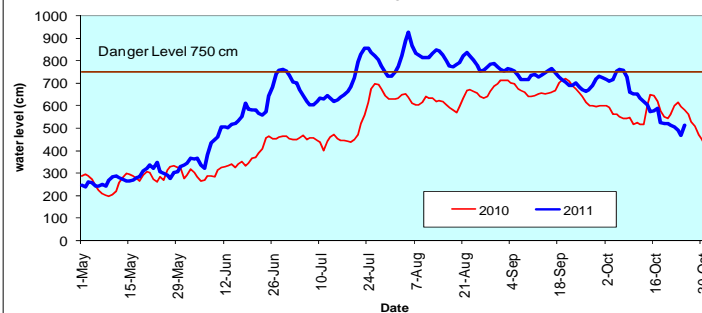
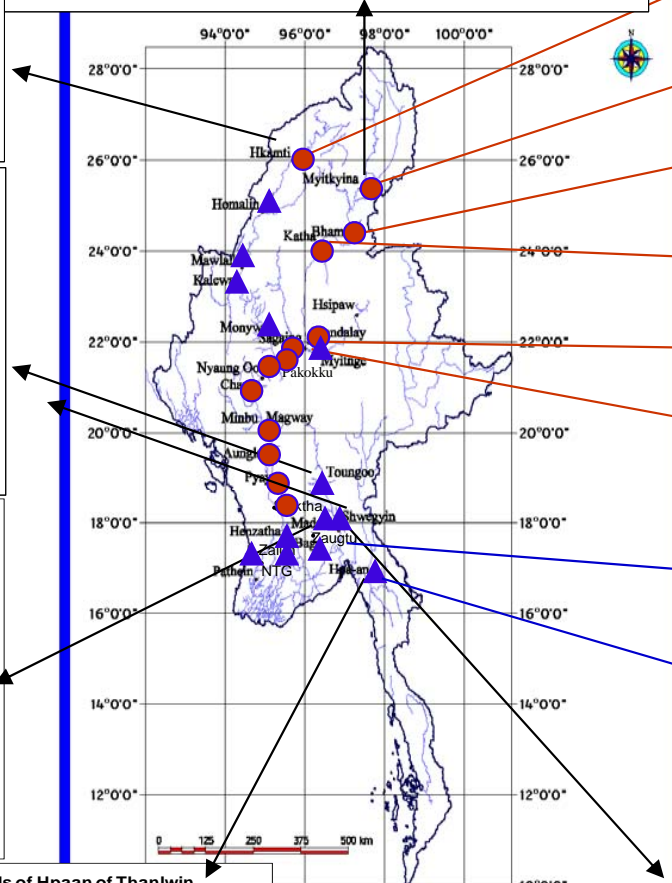
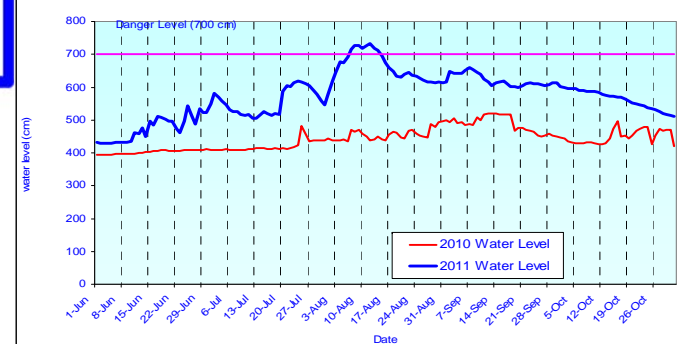


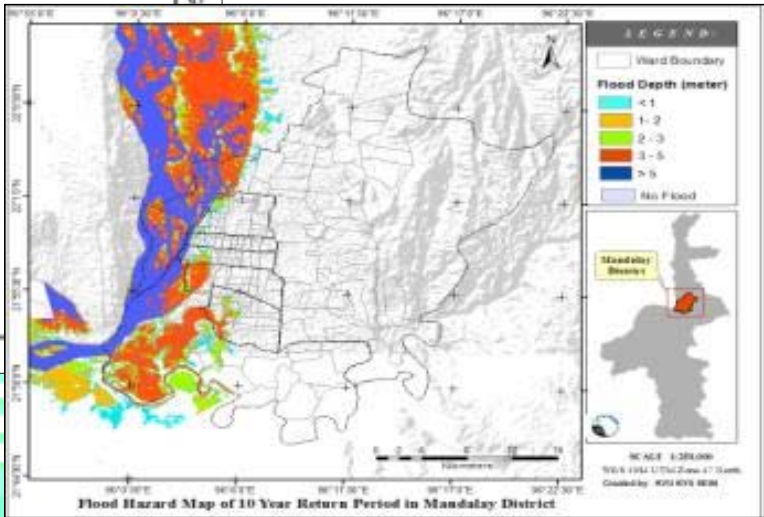
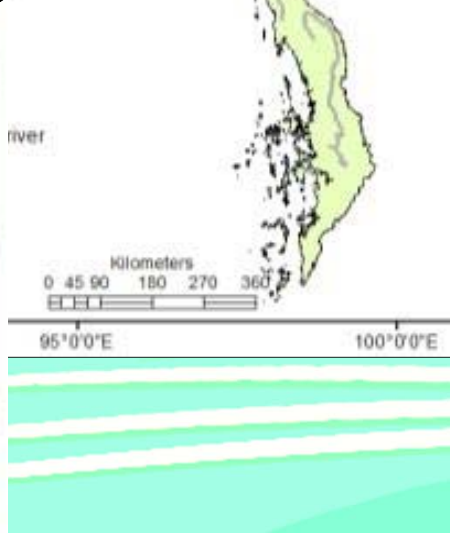
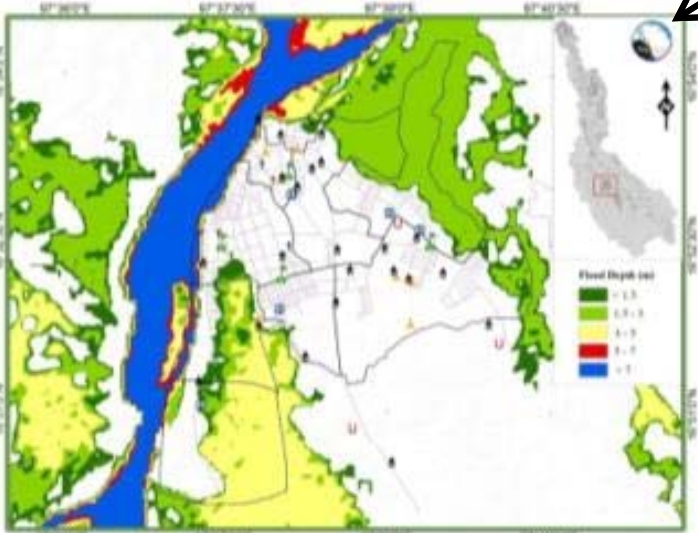
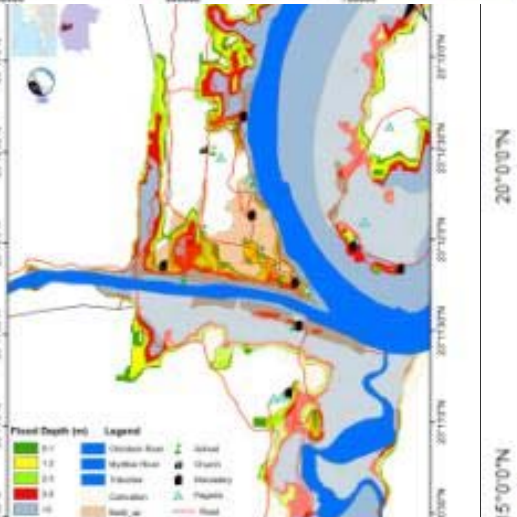
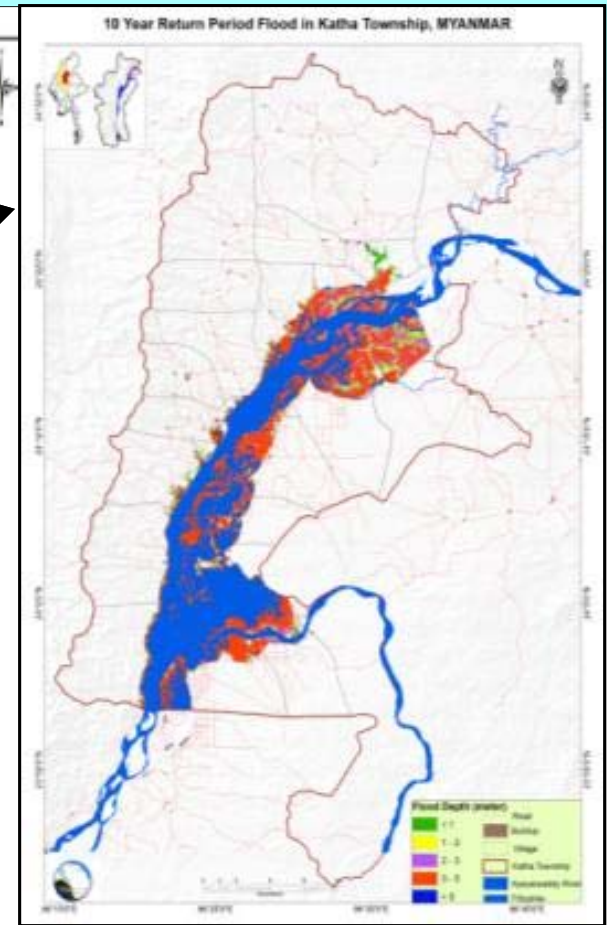
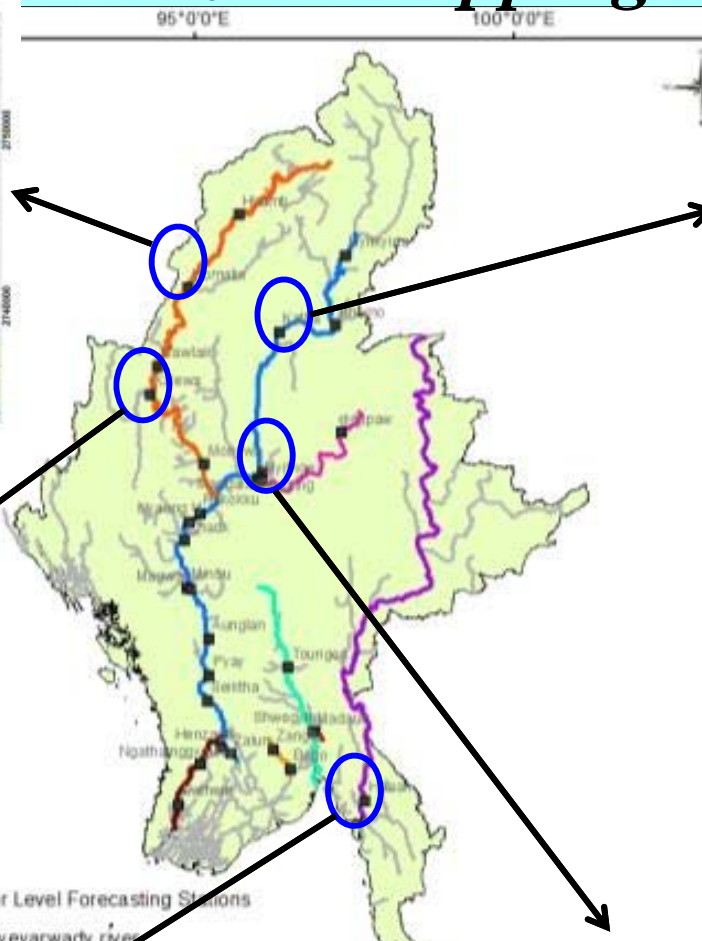
Fig (9) Comparison of 2010 Water Level and 2011 Water Level during Monsoon Period at Shwegyin of Shwegyin River



Recorded Floods during 2011 to 2016

<i>Year</i>	<i>River</i>	Station/ Recorded Flood Levels	Total Stations (above DL)
2011	<i>Bago/Thanlwin</i>	Bago (1 st), Paan(2 nd)	13 stations
2012	<i>Shwegyin</i>	Shwegyin (3 rd)	9 stations
2013	<i>Sittoung</i>	Toungoo (2 nd)	14 stations
2014	<i>Bago</i>	Bago (4 th)	11 stations
2015	<i>Chindwin/ Ayeyarwady/ Ngawun</i>	Monywa (1st), Kalewa(2nd),Seiktha (2nd), Zalun(2nd) Pakokku(3rd), Nyang Oo(3rd), Aunglan(3rd), Pyay(3rd), Hinthada(3rd), Ntg(4th)	23 stations
2016	<i>Ayeyarwady/Ngawun</i>	Nyang Oo (1st), Zalun(1st) , Pathein(1st)	29 stations

Flood hazard mapping



TA 8456: TRANSFORMATION OF URBAN MANAGEMENT

(PART II: FLOOD MANAGEMENT)

- Flood Mapping
- Funding by ADB/ Technical Support by ICHARM & CTI, JAPAN

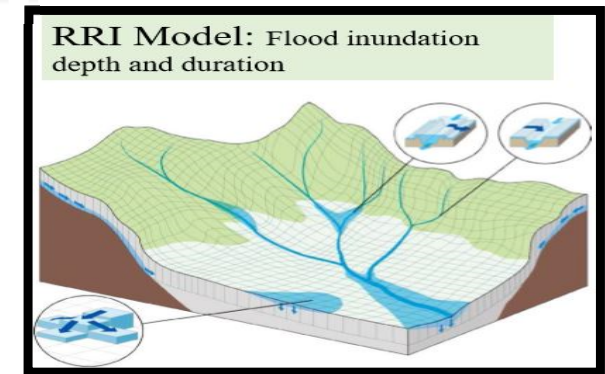


Fig. Flood Inundation Map in Yangon Region
(Flood Scale: 100 yr Return Period)

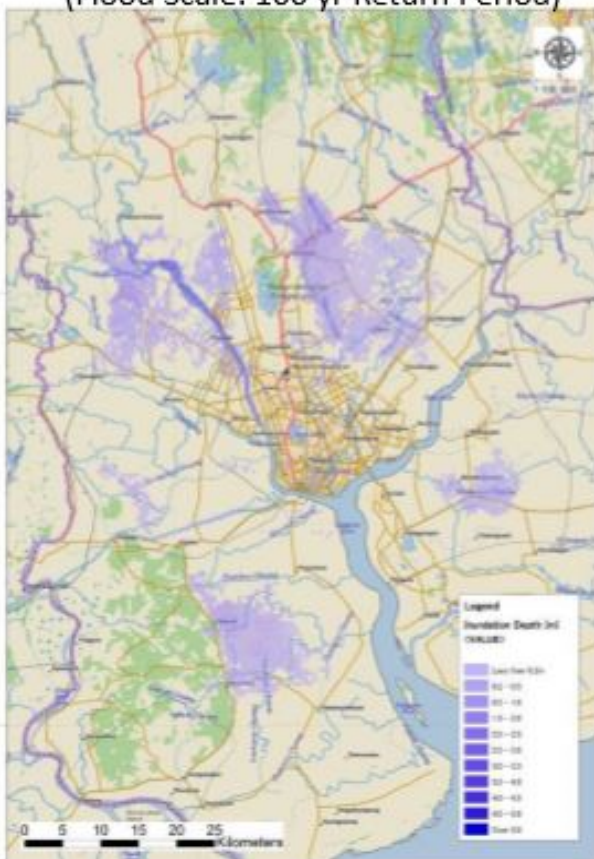


Fig. Flood Inundation Map in Mandalay
(Flood Scale: 100 yr Return Period)

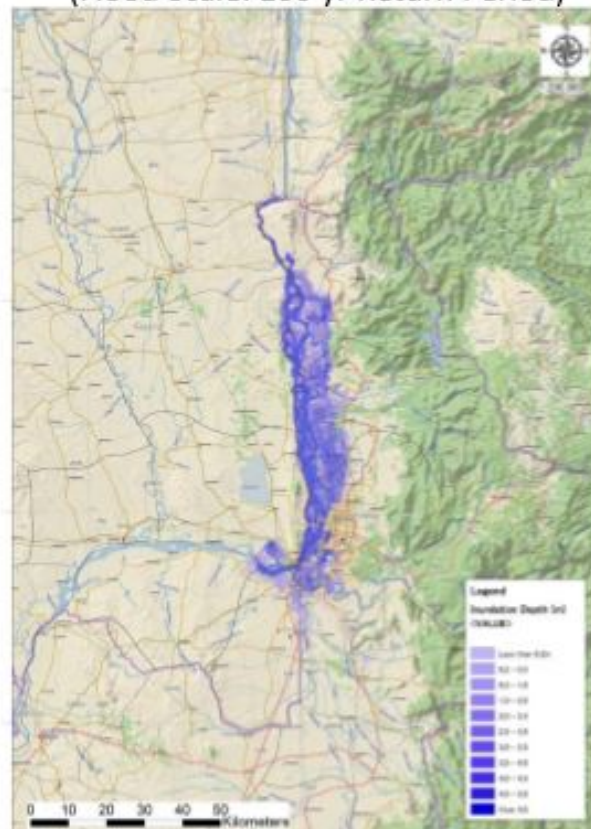
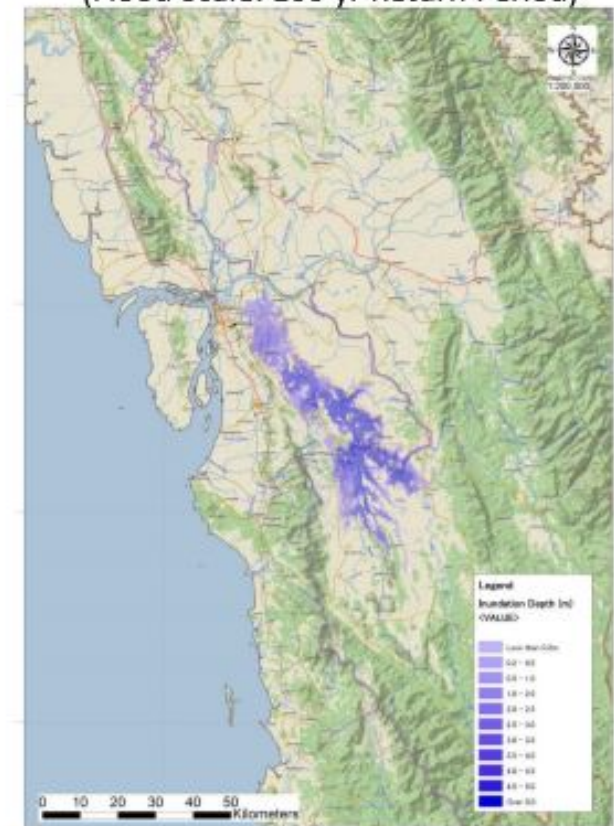


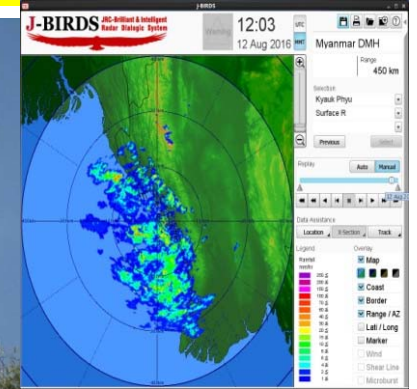
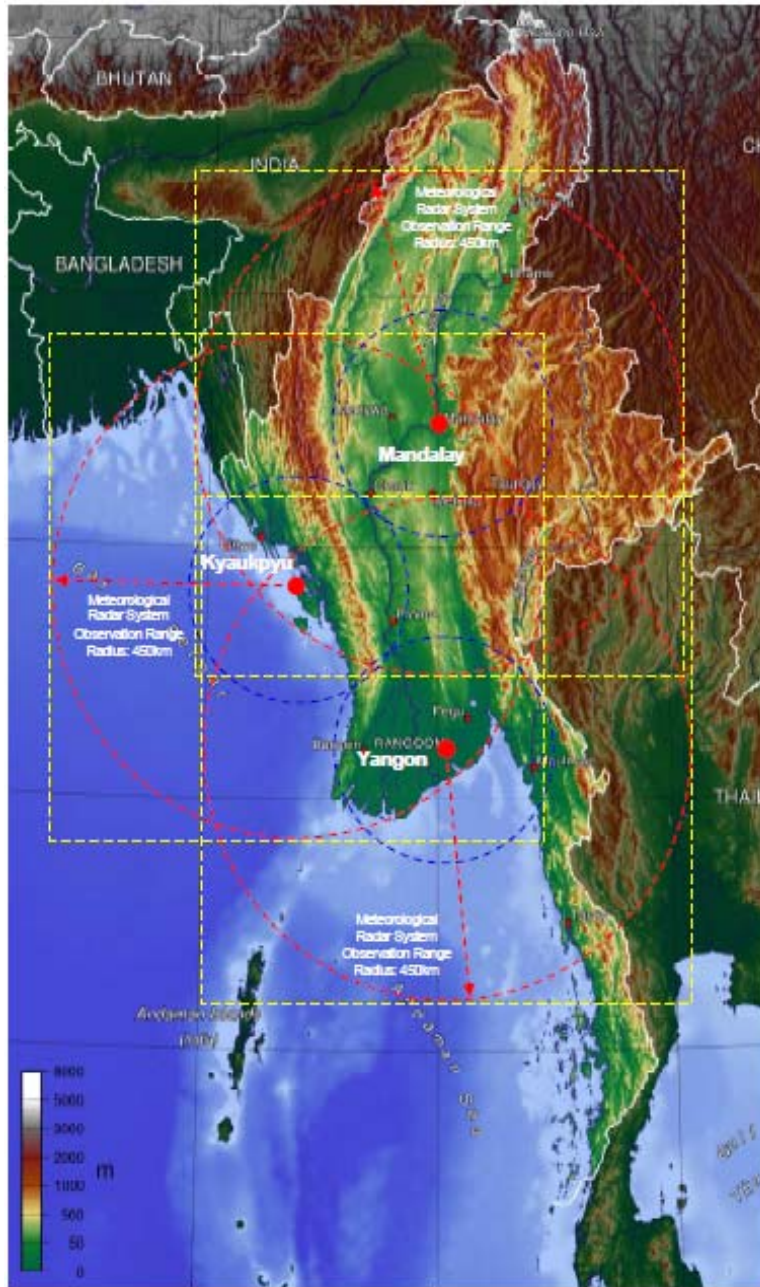
Fig. Flood Inundation Map in Mawlamyine
(Flood Scale: 100 yr Return Period)



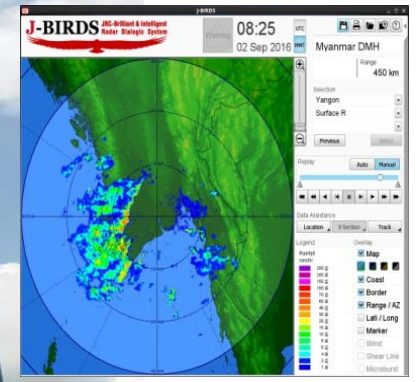
ONGOING ACTIVITIES

- **The project for establishment of disastrous weather monitoring system (3 Radars and 30 AWOS) (JICA Funding) (2014-2017)**
- **Development and Implementation of User-Relevant End-to-End Flood Forecast Generation for Myanmar(Technical support by RIMES and Indian Gov. Funding) (April 2014 – March 2017)(Installation of 13 TWLMS and 2 AWOS and Flood forecast model development)**
- **AIRBM Project (Component 2: Hydro met Observation and Information System Modernization (WB Project) (2014 -2020)**
- **Developing a methodology for flood forecasting for a selected river basin in Myanmar (Hydrological Modelling System) (2015-2017) (Technical support by NVE & ADPC and Norway Gov. Funding) (Hydrological modeling, Develop Flood Hazard Map, Drills and simulations for floods for pilot sites (Kale, Kalewa)**
- **To install 90 AWOS and 10 (TWLMS) by Gov. Budget (2016-2017 Budget yr)**
- **Modernization of Forecasting and Warning System for Natural Disaster in Myanmar (2017-2019) (Korea Gov. Funding, KMA and KMIPA) (AWS installation)**
- **To Develop Flood Early Warning for Thanlwin river basin (DMCD Project, Funding by MLIT, Japan (IDI, CTI, YEC)**

Project for establishment of disastrous weather monitoring system (3 Radars and 30 AWOS)



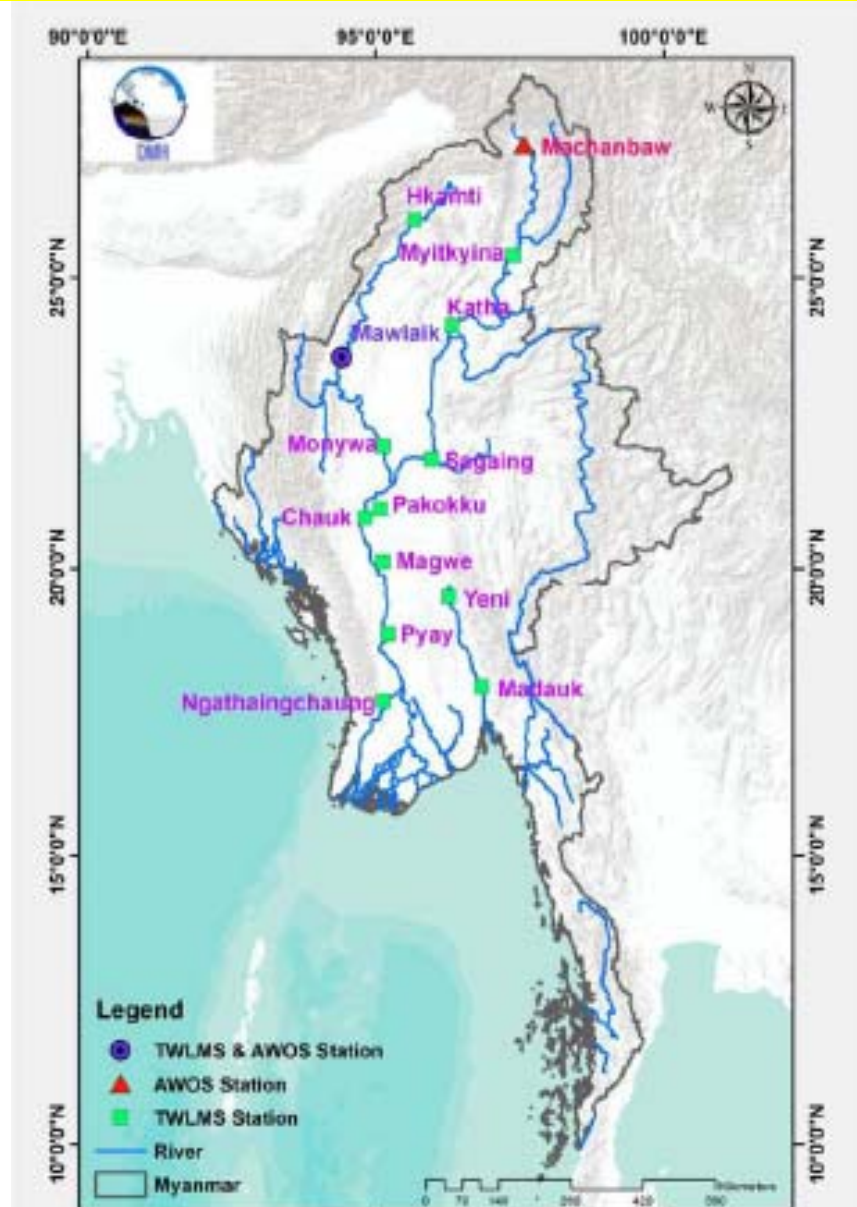
Kyaukpkyu



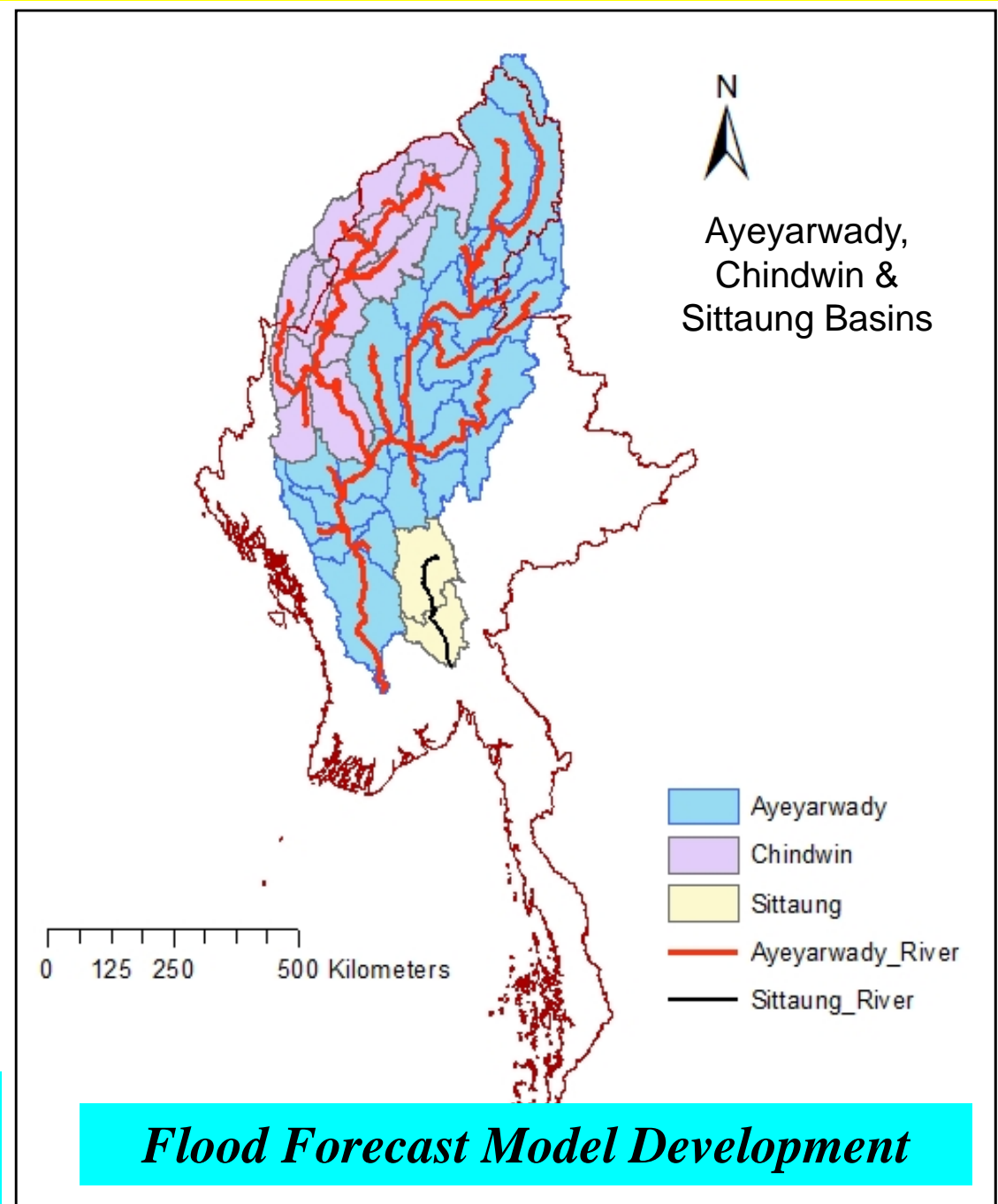
Yangon

Observed Data Processing Area

Development and Implementation of User-Relevant End-to-End Flood Forecast Generation for Myanmar



Installation of 13 TWLMS and 2 AWOS



Flood Forecast Model Development

Future Plans / Requirements to improve existing flood forecasting system

- **To upgrade the observation system (instruments and network)**
- **To upgrade the Data management system**
- **To upgrade the Early Warning Dissemination System**
- **To upgrade the discharge/sediment measurement instruments and also discharge/sediment observations**
- **To develop the advance and effective flood forecasting techniques**
- **Capacity Building (Education, Training)**
- **To establish the flood detection system (such as CCTV monitoring system)**
- **To establish the flash flood guidance system**
- **To upgrade the RS and GIS section especially for Flood Hazard Mapping (software, high resolution DEM and satellite images, techniques, CB)**
- **To improve the Flood Hazard mapping**
- **To upgrade the long range flood forecast techniques (seasonal and monthly)**
- **To develop the studying and analysis of climate change impact on floods**

CONCLUSION

DMH will cooperate and collaborate with the local and international organizations to upgrade the Flood Forecasting System to reduce the flood risks in Myanmar .

Thank you for your kind attention!

Website -<http://www.moezala.gov.mm>

<https://www.facebook.com/dmhmoezalanaypyitaw/>