

# Climate Change, Flood Early Warning System, and River Flood Disasters

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# **Outline of Presentation**

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Myanmar Climate, Role and Responsibility of DMH

Flood Monitoring and Forecasting in DMH

Early Warning For River Flood

**River Flood in Recent Years** 

**Flood Hazard Mapping Activities** 

**Ongoing Activities** 

Future plans

# **Climate Seasons**

- . Myanmar is in the tropical monsoon climate region. Based on the analysis of pressure, rainfall and temperature, the climate of this country can be described under the following four seasons:
- Northeast monsoon season (December to February)
- ► The Hot Weather Season (March to May)
- ► The Southwest monsoon season (May to September)
- The Retreating Southwest Monsoon Season (October and November)
- The country has experiences with meteorological, hydrological and seismic hazards and disaster. The historical severe cyclones are
  - 1. Great Sittwe Cyclone in 1968,
  - 2, Pathein Cyclone in 1975,
  - 3. Gwa Cyclone in 1982,

- 4.Maungdaw Cylone in 1994
- 5. Cyclone Mala in 2006
- 6. Cyclone Nargis in May 2008
- 7. Cyclone Koman in 2015
- ► the historical flood of year 2004, 2010 and 2015 were all extreme meteorological and hydrological events.

# Rainfall Comparison between Normal(1961-1990) & Normal(1981-2010)



Figure :Rainfall Comparison between Normal(1961-1990) & Normal(1981-2010)

(81-10) normal was decreasing at the month of May, June, July and August and it was nearly unchanged for the other months.

## Minimum Temperature Comparison between Normal(1961-1990) & Normal(1981-2010)



Figure :Minium Temp Comparison between Normal(1961-1990) & Normal(1981-2010)

- In normal minimum temperature was decreasing from month January to May and September to December.
- ► It was nearly unchanged at month June, July and August.

### Maximum Temperature Comparison between Normal(1961-1990) & Normal(1981-2010)



Figure :Maximum Temp Comparison between Normal(1961-1990) & Normal(1981-2010)

- Normal maximum temperature was increasing nearly all months except February and December.
- It was clear that rate of maximum temperature was higher at the month April, June, July and August compare to other months.

**Comparison between Old & New Normal Monsoon Onset Dates** 

### 1961-1990



### 1981-2010



Figure : Comparison between old and new normal onset date

### Comparison between Old & New Normal Monsoon Withdrawal Dates





1981-2010



Figure : Comparison between old and new normal Monsoon withdrawal date

# Monsoon Onset Date in Myanmar (1955 to 2019)



# Monsoon Withdrawal in Myanmar (1955 to 2019)



# Monsoon Duration in Myanmar (1955 to 2019)



YEAR

# **Future Climate Projections**

- Global average temperature and sea-level are projected to rise under all IPCC scenarios
- Increase of global mean surface temperatures for 2081–2100 relative to 1986–2005 is projected to likely be in the ranges derived from the concentration-driven CMIP5 model simulations, 1.1°C to 2.6°C (RCP4.5), 2.6°C to 4.8°C (RCP8.5).
- The Arctic region will warm more rapidly than the global mean, and mean warming over land will be larger than over the ocean
- Precipitation: general increase, but variable
- **Extreme events**: increases in variability and some extreme events
- □ El Nino: little change/small increase in amplitude
- □ Monsoons: increase in Asian Monsoon summer precipitation variability

### **Precipitation % Departure**



### **Climate Scenario Change from Baseline RCP 8.5**







Projection of Precipitation in 2100 with RCP8.5



### Maximum Temperature Anomaly (°C)

### **Climate Scenario Change from Baseline RCP 4.5**







Projection of Maximum Temperature in 2100 with RCP4.5 Legend Maximum Tempe (°C) <1 1.1-1.2 1.3 - 1.4 1.5 - 1.6 1.7 - 1.8 1.9 - 2 2.1 - 2.2 2.3 - 2.4 2.5 - 2.6 2.7 - 2.8 2.9 - 3 3.1 - 3.2 3.3 - 3.4 3.5 - 3.6 3.7 - 3.8 3.9 - 4 4.1 - 4.2 4.3 - 4.4 4.5 - 4.6 4.7 - 4.8 >4.8

### **Climate Scenario Change from Baseline RCP 8.5**









### Minimum Temperature Anomaly (°C)

### **Climate Scenario Change from Baseline RCP 4.5**











### **Climate Scenario Change from Baseline RCP 8.5**









### **Rainfall Baseline Historical (1981-2010)**

											Naypy		Sagain	Sagain					
											itaw		g	g		Shan	Shan		
		Bago	Bago		Kachi			Magw	Mand		Counc	Rakhi	(Lowe	(Uppe	Shan	(Nort	(South	Tanint	Yango
	Ayeyar	East	West	Chin	n	Kayah	Kayin	ay	alay	Mon	il	ne	r)	r)	(East)	h)	)	haryi	n
His	2587	2567	1636	2289	2296	1236	2503	1005	996	4292	1116	3688	1037	2127	1436	1496	1483	3061	2687

### **Climate Scenario Change from Baseline RCP 4.5**

Rainfall (% Departure)

											Naypy		Sagain	Sagain					
											itaw		g	g		Shan	Shan		
		Bago	Bago		Kachi			Magw	Mand		Counc	Rakhi	(Lowe	(Uppe	Shan	(Nort	(Sout	Tanint	Yango
	Ayeyar	East	West	Chin	n	Kayah	Kayin	ay	alay	Mon	il	ne	r)	r)	(East)	h)	h)	haryi	n
2040	2.2	2.3	2.6	3.8	3.5	2.7	2.2	3.5	3.5	1.8	3.3	3.7	4.3	4.2	2.1	2.9	2.7	1.2	2.1
2060	3.0	3.2	3.6	5.2	4.7	3.7	3.0	4.7	4.8	2.5	4.5	5.1	5.9	5.7	2.8	3.9	3.6	1.6	2.9
2080	3.4	3.6	4.1	6.0	5.4	4.3	3.4	5.4	5.5	2.9	5.2	5.8	6.8	6.6	3.3	4.5	4.2	1.9	3.3
2100	3.5	3.7	4.2	6.0	5.5	4.3	3.4	5.5	5.6	2.9	5.2	5.9	6.8	6.7	3.3	4.5	4.2	1.9	3.3

(% Departure) = Actual / Normal\*100-100

- $+20\% \ge Normal \ge -20\%$
- Above Normal > +20 %
- Below Normal < -20 %

#### Maximum Temperature Baseline Historical (1981-2010)

	Ayeyar	Bago East	Bago West	Chin	Kachi n	Kayah	Kayin	Magw ay	Mand alay	Mon	Naypy itaw Counc il	Rakhi ne	Sagain g (Lowe r)	Sagain g (Uppe r)	Shan (East)	Shan (Nort h)	Shan (South )	Tanint haryi	Yango n
His	30.7	30.7	31.0	24.1	23.6	28.3	30.0	30.5	30.2	30.8	30.0	28.8	30.7	26.8	26.6	26.0	26.3	30.6	31.2

### **Climate Scenario Change from Baseline RCP 4.5**

Maximum Temperature Anomaly (°C)

	Ayeyar	Bago East	Bago West	Chin	Kachi n	Kayah	Kayin	Magw ay	Mand alay	Mon	Naypy itaw Counc il	Rakhi ne	Sagain g (Lowe r)	Sagain g (Uppe r)	Shan (East)	Shan (Nort h)	Shan (Sout h)	Tanint haryi	Yango n
2040	0.9	1.0	0.9	1.0	1.1	1.0	0.9	1.0	1.0	0.9	1.0	0.9	1.0	1.0	1.0	1.0	1.0	0.9	0.9
2060	1.2	1.3	1.3	1.3	1.5	1.3	1.3	1.3	1.4	1.2	1.3	1.2	1.4	1.4	1.4	1.4	1.4	1.2	1.2
2080	1.4	1.5	1.5	1.5	1.7	1.5	1.5	1.5	1.6	1.4	1.6	1.4	1.6	1.6	1.6	1.6	1.6	1.4	1.4
2100	1.4	1.5	1.5	1.5	1.7	1.6	1.5	1.5	1.6	1.4	1.6	1.4	1.6	1.6	1.6	1.7	1.6	1.4	1.4

+ 1.5 > Normal > -1.5Above Normal  $\ge +1.5$ Below Normal  $\le -1.5$ 

### Minimum Temperature Baseline Historical (1981-2010)

	Ayeyar	Bago East	Bago West	Chin	Kachi n	Kayah	Kayin	Magw ay	Mand alay	Mon	Naypy itaw Counc il	Rakhi ne	Sagain g (Lowe r)	Sagain g (Uppe r)	Shan (East)	Shan (Nort h)	Shan (South )	Tanint haryi	Yango n
His	23.0	21.7	22.0	16.3	14.1	19.1	20.6	21.3	21.0	22.3	21.1	21.1	21.3	17.9	16.8	16.5	16.9	22.0	22.9

### **Climate Scenario Change from Baseline RCP 4.5**

Minimum Temperature Anomaly (°C)

											Navdv		Sagain	Sagain					
		Page	Page		Vachi			Мали	Mand		itaw Counc	Dalchi	g (Lowo	g (Uppo	Chan	Shan Nort	Shan (Sout	Tanint	Vango
	Aveyar	East	Dago West	Chin	n	Kayah	Kayin	ay	alay	Mon	il	ne	(Lowe r)	(Oppe r)	(East)	(Nort h)	(Sout h)	haryi	n n
2040	0.9	1.0	1.0	1.1	1.1	1.1	1.0	1.1	1.1	1.0	1.1	1.0	1.1	1.1	1.1	1.1	1.1	0.9	1.0
2060	1.2	1.4	1.4	1.4	1.5	1.5	1.4	1.4	1.5	1.3	1.5	1.3	1.5	1.6	1.5	1.5	1.5	1.2	1.3
2080	1.4	1.6	1.6	1.7	1.8	1.7	1.6	1.7	1.7	1.5	1.7	1.5	1.8	1.8	1.7	1.8	1.7	1.4	1.5
2100	1.5	1.6	1.6	1.7	1.8	1.7	1.6	1.7	1.8	1.5	1.7	1.5	1.8	1.8	1.7	1.8	1.8	1.4	1.5

+ 1.5 > Normal > -1.5Above Normal  $\ge +1.5$ Below Normal  $\le -1.5$ 

### **Rainfall Baseline Historical (1981-2010)**



											aypy		Jagam	Jagam					
											itaw		g	g		Shan	Shan		
		Bago	Bago		Kachi			Magw	Mand		Counc	Rakhi	(Lowe	(Uppe	Shan	(Nort	(South	Tanint	Yango
	Ayeyar	East	West	Chin	n	Kayah	Kayin	ay	alay	Mon	il	ne	r)	r)	(East)	h)	)	haryi	n
His	2587	2567	1636	2289	2296	1236	2503	1005	996	4292	1116	3688	1037	2127	1436	1496	1483	3061	2687

### **Climate Scenario Change from Baseline RCP 8.5**

Rainfall (% Departure)

											Naypy		Sagain	Sagain					
											itaw		g	g		Shan	Shan		
		Bago	Bago		Kachi			Magw	Mand		Counc	Rakhi	(Lowe	(Uppe	Shan	(Nort	(Sout	Tanint	Yango
	Ayeyar	East	West	Chin	n	Kayah	Kayin	ay	alay	Mon	il	ne	r)	r)	(East)	h)	h)	haryi	n
2040	2.8	2.9	3.3	4.8	4.4	3.4	2.7	4.4	4.4	2.3	4.2	4.7	5.5	5.3	2.6	3.6	3.4	1.5	2.7
2060	4.5	4.8	5.4	7.8	7.1	5.6	4.5	7.1	7.2	3.8	6.8	7.6	8.9	8.6	4.3	5.8	5.5	2.4	4.3
2080	6.5	6.8	7.8	11.2	10.2	8.0	6.4	10.2	10.3	5.4	9.7	11.0	12.7	12.4	6.1	8.4	7.9	3.5	6.2
2100	8.6	9.1	10.4	15.0	13.6	10.7	8.5	13.6	13.8	7.2	13.0	14.6	17.0	16.5	8.2	11.2	10.5	4.7	8.3

(% Departure) = Actual / Normal\*100-100

### Maximum Temperature Baseline Historical (1981-2010)

	Ayeyar	Bago East	Bago West	Chin	Kachi n	Kayah	Kayin	Magw ay	Mand alay	Mon	Naypy itaw Counc il	Rakhi ne	Sagain g (Lowe r)	Sagain g (Uppe r)	Shan (East)	Shan (Nort h)	Shan (South )	Tanint haryi	Yango n
His	30.7	30.7	31.0	24.1	23.6	28.3	30.0	30.5	30.2	30.8	30.0	28.8	30.7	26.8	26.6	26.0	26.3	30.6	31.2

### **Climate Scenario Change from Baseline RCP 8.5**

Maximum Temperature Anomaly (°C)

	Ayeyar	Bago East	Bago West	Chin	Kachi n	Kayah	Kayin	Magw ay	Mand alay	Mon	Naypy itaw Counc il	Rakhi ne	Sagain g (Lowe r)	Sagain g (Uppe r)	Shan (East)	Shan (Nort h)	Shan (Sout h)	Tanint haryi	Yango n
2040	1.1	1.2	1.2	1.2	1.4	1.2	1.2	1.2	1.3	1.1	1.2	1.1	1.3	1.3	1.3	1.3	1.3	1.1	1.1
2060	1.8	2.0	1.9	2.0	2.2	2.0	1.9	2.0	2.1	1.9	2.0	1.9	2.1	2.1	2.0	2.1	2.1	1.8	1.9
2080	2.6	2.8	2.8	2.9	3.2	2.9	2.8	2.9	3.0	2.7	2.9	2.7	2.9	3.0	2.9	3.1	3.0	2.6	2.7
2100	3.5	3.8	3.7	3.8	4.3	3.9	3.7	3.8	3.9	3.6	3.9	3.6	3.9	4.0	3.9	4.1	3.9	3.5	3.6

### Minimum Temperature Baseline Historical (1981-2010)

	Ayeyar	Bago East	Bago West	Chin	Kachi n	Kayah	Kayin	Magw ay	Mand alay	Mon	Naypy itaw Counc il	Rakhi ne	Sagain g (Lowe r)	Sagain g (Uppe r)	Shan (East)	Shan (Nort h)	Shan (South )	Tanint haryi	Yango n
His	23.0	21.7	22.0	16.3	14.1	19.1	20.6	21.3	21.0	22.3	21.1	21.1	21.3	17.9	16.8	16.5	16.9	22.0	22.9

### **Climate Scenario Change from Baseline RCP 8.5**

### Minimum Temperature Anomaly (°C)

	A	Bago	Bago	Chin	Kachi	Varrah	Varia	Magw	Mand	Mon	Naypy itaw Counc	Rakhi	Sagain g (Lowe	Sagain g (Uppe	Shan (Faat)	Shan (Nort	Shan (Sout	Tanint	Yango
	Ayeyar 1 2	East	vvest	$\frac{1}{1}$	n 1 /	Kayan 1 A	Kayin 1 2	ay 1 2	alay 1 /	1 2		ne 1 2	r) 1 /	r) 1 /	(East)	n) 1 /	n) 1 /	$\frac{1}{1}$	n 1 2
2040	1.2	1.5	1.5	1.4	1.4	1.4	1.5	1.5	1.4	1.2	, 1.4	1.2	1.4	1.4	1.4	1.4	1.4	1.2	1.2
2060	1.9	2.1	2.1	2.2	2.3	2.2	2.1	2.2	2.3	2.0	2.2	2.0	2.3	2.3	2.3	2.3	2.3	1.9	2.0
2080	2.7	3.1	3.0	3.1	3.3	3.2	3.0	3.1	3.3	2.9	3.2	2.8	3.3	3.4	3.2	3.3	3.3	2.7	2.9
2100	3.6	4.1	4.0	4.2	4.5	4.2	4.0	4.1	4.4	3.8	4.2	3.7	4.4	4.5	4.3	4.4	4.4	3.6	3.8





### Scenario of Sea Level Rise due to the combination of Storm Surge and Extreme Water Level for RCP 2.6, RCP 4.5, and RCP 8.5 in the year 2060



# Scenario of Sea Level Rise due to the combination of Storm Surge and Extreme Water Level for RCP 2.6, RCP 4.5, and RCP 8.5 in the year 2080



### Scenario of Sea Level Rise due to the combination of Storm Surge and Extreme Water Level for RCP 2.6, RCP 4.5, and RCP 8.5 in the year 2100



# 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.











# **Meteorological Hazards Calendar**



Hazards	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cyclone				9	9				0	9	9	
High Temperature												
Low Temperature												
Drought												
Squalls& Thunderstorm												
Flood												
Heavy Rain									<b>L</b>			
Monsoon Depression					9	9	9	9	9			
Hail												







# **Types of floods**

- River Floods
- Flash Floods
- Coastal Floods
- Urban Flood



# **Causes of River Floods**

- Intense heavy rain due to pronounced monsoon trough persisting for at least 3 days over Northern Myanmar areas
- Heavy rainfall due to cyclonic storm crossing Myanmar and Bangladesh coasts
- Heavy 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







# Warnings and Bulletins from DMH



#### Meteorological Forecasts, Warnings, Bulletins

**Aviation Weather Forecast** 

Sea Route Forecast

- Squall Wind Weather Forecast

- Special Weather Forecast

- Cyclone/Surge Forecast

Untimely Rainfall Forecast

- Fog Warning

Port Warning

New Records

Agro-meteorological Bulletin

#### Hydrological Forecasts, Warnings, Bulletins

- Daily, (10) days, Monthly and Seasonal Water Level Forecast
  - Significant Water Level Bulletin
  - Flood Warning and Bulletin

Minimum Alert Water Level and Bulletin

Minimum Alert Water Level Bulletin (for Low Flow Season)

**Seismological Services** 

Tsunami Warning

Earthquake News

### **Existing Hydrological Forecasting stations and Water Levels Monitoring System**



### **Manual Observations**







Automatic

**Observations** 

### HOBOlink°





# **Flood Forecasting Methods**

# **Daily Water Level Forecast**

- **Giver Stage Correlation Method**
- **U** Multiple Linear Regression Method
- **Integrated Flood Analysis System-IFAS**
- **HBV model based on excel**
- □ HEC-HMS Model for Ayeyarwady, Chindwin and Sittoung river

# **Seasonal Water Level Forecast**

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

# Flood Forecasting, Warning System and Dissemination



# **Flood Early Warning Information**

### Flood Warning

### (Issued at 16:00 hr M.S.T on 9-8-2017)

According to the (15:30) hrs M.S.T observation today, the water level of

Chindwin River at Hkamti is observed as about (6)feet below its danger level. It

may reach its danger level during the next (2) days.

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: 14:00 hr M.S.T on 12-8-2017)

#### Flood condition of Chindwin River

According to the (13:30)hr M.S.T observation today, the water level of Chindwin River at Hkamti has exceeded about (1½) feet above its danger level, it may continue to rise about (1) foot during the next (1) day and may remain above its danger level.

#### Advisiory

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 Hazard Mapping by using HEC-RAS Modeling



## Flood Hazard Mapping by using RRI Modeling







- 1. Riverine flood
- 2. Flash Flood
- 3. Drought
- 4. Landslide
- 5. Strom surge
- 6. Salt water

intrusion

7. Tsunami



### Flood Condition at 2015 Monsoon Season

#### Comparism of 2015, Monsoon Period Actual & Normal



DMH MYANMAR WRF(30 km) RAINFALL (inches) FORECAST(24 hr)



Patna

Bhuba

Ranch

Raipur

- Under the influences of Cyclonic Storm (Komen) over the Northeast Bay of Bengal, heavy rainfall were very frequent over the whole country especially peak and Late Monsoon period of 2015, Southwest Monsoon Season.
- As the results, the total rainfall for 2015 Southwest monsoon was recorded above normal rainfall.
- 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 disasteraffected areas on July 31.
- Especially Minkin, Monywa and Kalay water level is observed highest maximum record during monsoon season 2015.



# Flood Condition at 2016 Monsoon Season



Map Sources: UNCS Surce Yorr Alief and Resettlement Department . The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations. Map created on 2 Aug 2016.



Satellite image (Roanu)



- Under the influences of Cyclonic Storm "Roanu", heavy rainfall were very frequent over the whole country during Southwest Monsoon Season 2016.
- As the results, the total rainfall for 2016 Southwest monsoon was recorded above normal rainfall.
- So, at the mid monsoon period, the water levels of Ayeyarwady and Chindwin rivers were series of flood from 2015 to 2016, Nyaung Oo and Zalun of Ayeyarwady river and Pathein of Ngawun river were highest maximum water levels each recorded years. Dokehtawady and Maubin rivers are aslo flood, especially NTG of Ngawun river's flood duration is about (38) days above its danger level.



## Flood Condition at 2017 Monsoon Season

During the Southwest Monsoon season in 2017, •Heavy rain received in northern and northwestern parts of Myanmar as the result of western disturbance, "MORA" storm which crossed south of Bangladesh coast and the effect of remnants of Typhoon(HATO & DOKSURI) from the South China Sea, so water levels continued to rise up in all rivers.

•During the monsoon season of 2017, 8 major rivers out of 12 major rivers occurred the flood and DMH issued timely 65 times for flood warning and 300 times for Bulletins.



#### Summary in the occurrences of floods (Above DL/Duration) in 2017





### Extreme Hydro-Meteorological Events of Myanmar Due to Climate Change (Cont..)



milles) northeast of Yangon, Myanmar, Sunday, July 29, 2018. (AP Photo/Myo Kyaw Soe)

-June 18, **2018**. **Flooding** in southern **Myanmar** has caused a **landslide** at a famed Buddhist pagoda, submerged homes and displaced hundreds of people **Mid Monsoon period during July**,

Southwest monsoon intensity was strong to vigorous and regionalized heavy rain in the whole country. Especially some stations at Sittaung river, Shwegyin river, Bago river and Thanlwin river were between 10 to 47 inches rainfall on 3<sup>rd</sup> Dekad of July. So the water levels rose up along these river.

•The water levels at Toungoo, Madauk, Shwegyin, Bago, Hpaan and Thaboung were exceeded their respective Danger Levels during July. Among of these stations, (28.7.2018) Madauk of Sittoung river was highest maximum water level recorded during (53) years, (30.7.2018) Hpann of Thanlwin river was highest maximum water level recorded during (53) years and (28.7.2018) Bago of Bago river was highest maximum water level recorded during (54) years.





	Monsoon	season in 2019
lo.	Rivers	Flooded Stations
1.	Ayeyarwady	Myitkyina, Bhamo, Shwegu, Katha, Thabeikyin, Mandalay, Sagaing, Myinmu.
2.	Chindwin	Hkamti
3.	Dokhtawady	Myitnge
4•	Sittoung	Toungoo, Madauk
5.	Shwegyin	Shwegyin (9 times)
6.	Bago	Bago (2 times)
7.	Thanlwin	Hpaan
8.	Thaungyin	Myawady (2 times)
9.	Ngawun	Thaboung (4 times)
0.	Kalaten	Paletwa, Kyauktaw
11.	Lay Myo	Myauk U
2.	Bilin	Bilin







During the monsoon season of 2019, our department (DMH) issued timely 54 times for Flood Warning and 119 times for Flood Bulletin.



30.01 - 35.7





#### Mid Monsoon period during July,

- Southwest monsoon intensity was strong to vigorous and regionalized heavy rain in the whole country. Especially some stations at Ayeyarwady, Chindwin, Dokehtawady, Ngwun, Kaletan and Laymyo river were between 10 to 47 inches rainfall on 1<sup>st</sup> Dekad of July. So the water levels rose up along these river.
- The water levels at Myitkyina, Bhamo, Shwegu,
  Katha, Thabeikyin, Mandalay, Sagaing,
  Myinmu, Hkamti, Myitnge, Thaboung, Paletwa,
  Kyauktaw and Myauk U were exceeded their respective Danger Levels during July.
- Among of these stations, (12.7.2019) Myauk U of Laymyo river was highest maximum water level recorded during (4) years.



Mid Monsoon period during August,

- The widespread rain occurred in the whole country due to strong to vigorous monsoon during the 1<sup>st</sup> and 2<sup>nd</sup> ten days of August, as the result of western disturbance and influence of depression "WIPHA" which crossed south china sea so water levels continued to rise up in some of the rivers.
- The water levels at Madauk, Shwekyin, Hpaan, Myawaddy, Thaboung and Bilin have exceeded their respective Danger Levels.

	Stations	August Monthly Rainfall (inches)
A Constantion	Puta O	31.65
	Taungoo	19.29
	Madauk	50.71
	Shwegyin	54.29
	Bago	39.45
	Hpann	67.40
DULL APLABLY	Myawaddy	22.20
	Bilin	63.54

20°0'0"N



Late Monsoon period during September in 2019,

- Southwest monsoon intensity was weak to moderate during the late monsoon period.
- Southwest monsoon has withdrawn at 17<sup>th</sup>, 22<sup>th</sup>, 25<sup>th</sup> and 26<sup>th</sup> of September on Northern, Central, Deltaic areas and the whole country of Myanmar.
- Due to the effect of the influence of monsoon withdrawn experienced the widespread rain in the whole country, especially the water levels of Sittaung, Shwegyin and Bago rivers rose up about 4 to 10 ft respectively.
- The water levels at **Toungoo**, **Shwegyin and Bago** have been exceeded their respective Danger Levels.

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Stations	Sept Monthly Rainfall(inches)		
РТО	14.06		
Machanbaw	12.28		
Myitkyina	17.05		
Hkamti	13.54		
Toungoo	16.14		
Madauk	20.71		
Shwegyin	25.75		
Zaungtu	19.57		
Bago	16.00		







### ပေါင်မြို့နယ် သဲဖြူကုန်းကျေးရွာ မလတ်တောင်မြေပြိုကျမှု သေဆုံးသူ ၅၃ ဦးထိရှိလာ

#### ပါင် ဩဂတ် ၁၁

မွန်ပြည်နယ် ပေါင်မြို့နယ် သဲဖြူကုန်းကျေးရွာအုပ်စု မိုင်တိုင်အမှတ် ၁၈၄/၅ မှ ၁၈၄/၆ အကြားရှိ မလတ် တောင်မြေသားပြိုကျမှုဖြစ်ပွားခဲ့သည့် ဖြစ်စဉ်တွင် ဩဂုတ် ၁၁ ရက် ည ၈ နာရီအထိ သေဆုံးသူ ၅၃ ဦးနှင့် အသက်ရှင် လျက်ကယ်ဆယ်နိုင်သူ ၄၇ ဦးအထိ ရှာစွေတွေ့ရှိခဲ့ကြောင်း ပေါင်မြို့နယ် မီးသတ်ဦးစီးမှု၊ ဦးတင်သောင်းဦးက အတည် ဖြောကြားခဲ့သည်။

\_\_\_\_\_\_ ဒီနေ့ ည ၇ နာရီအထိဆိုရင် သေဆုံးသူအလောင်း ၃ လောင်းကို ရှာဖွေတွေ့ရှိခဲ့ပါတယ်။ အသက်ရင်လျက် ဆိုလို့ မနေ့သက ဆိတ်တစ်ကောင်နဲ့ နွှားတစ်ကောင်တွေ တာပါ။ နောက်တစ်ခုက ဒေသခံတွေ လာပူးပေါင်းစေချင် တယ်။ ဘာဖြစ်လို့လဲဆိုတော့ ဒီနေရာမှာ ဘယ်သူရှိလဲ၊ ဘယ်သနေထိင်လဲ၊ ဘယ်လောက်ရှိလဲ အဲဒါတေသိရင် ရှာဖွေရတာ ပိုအဆင်ပြေတာပေ့ါ။ သေဆုံးသူအလောင်း တွေ့လို့ရှိရင် စက်စက်ခဲခဲနဲ့ သေရာထုတ်ယူနေရတဲ့ အနေ အထား ရှိနေပါတယ်။ စဖြစ်တဲ့နေ့ကဆိုရင် အသက်ရှင် ချက် ကယ်ထုတ်နိုင်ခဲ့တဲ့ ၂၈ ဦးမြောက် အမျိုးသားတစ်ဦ ဆိုရင် ပရိဘောက်ကားထဲမာသပ်နေတယ်။ သတိမိသ

က ကားစီးလာတယ်။ အမေတစ်ယောက်၊ သမီး တစ်ယောက်ကို ကယ်ထတ်နိုင်တယ်။ အဲဒီအစ်ကိကြီးကို မနက် ၈ နာရီ ကနေ ကယ်ထုတ်လိုက်တာ သနေ ၆ နာရီ လောက်မှာမှ အသက်ရှင်လျက်နဲ့ စက်စက်ခဲခဲကယ်ထုတ်



နိုင်တဲ့အနေအထားရှိခဲ့ပါတယ်။ အခုဆိုရင်

စက်ကိရိယာပစ္စည်းအစုံအလင်ပါရှိသည့် ကားနှင့် မီးသတ် ကယ်ဆယ်ရေးအပိုင်းကို အဖွဲ့လိုက်နေရာချထားတဲ့ အခါကျ 💿 တပ်ဖွဲ့ဝင်များ၊ အထူးတပ်ဖွဲ့ဝင် ၁၂ ဦး၊ တပ်မတော်သားများ၊ တော့ ပိုအဆင်ပြေသွားကြတာပေါ့" ဟု ၎င်းက ပြောသည်။ လူမှုကူညီကယ်ရေးအသင်းများက သေဆုံးသူအလောင်း ရေးရုံးမှ သိရသည်။ မြန်မာနိုင်ငံမီးသတ်တပ်ဖွဲ့(ဗဟို)ဌာနချုပ်မှ ခေတ်မီ များ ရှိ မရှိ ခေတ်မီစက်ကိရိယာများဖြင့် ရှာဖွေနေကြောင်း

ပေါင်မြို့နယ်တွင် မြေပြိုမှုဖြစ်ပေါ်နေသည်နေရာနှင့် သက်ပြီး ပြည်နယ်လက်ကော်ကိုယ်စားလယ် ဦးဇော် ဇော်ထူးက "မိုးရေချိန်အလွန်များတော့ ဖြစ်တဲ့နေရာက များလာတယ်ပေါ့။ ဒီနေမနက်ဆိုရင် ပေါင်ကွဲခြံမှာ နည်းနည်းထပ်ပြိုကျတယ်။ အဲဒီပတ်ဝန်းကျင်က လူတွေ ကို မနေ့ကတည်းက ပြောင်းရှေ့ထားခိုင်းပါတယ်။ ဒီနေ့ မနက်မှာ ဖြူဘမှာ နည်းနည်းပြိုကျတယ်။ လူတွေတော့ ထိခိုက်မှုမရှိဘူး၊ ဒါပေမယ့် ထပ်ပြိုကျနိုင်တဲ့ အနေအထား ရှိနိုင်တဲ့အတွက် အဲဒီနေရာက လူတွေကို ဘေးလွှတ်ရာကို ရွှေပြောင်းပေးထားပါတယ်" ဟု ၎င်းက ပြောသည်။ ဩဂုတ် ၉ ရက်မှ ယနေ့အထိ ပေါင်မြို့နယ်တွင် တောင်မြေသားပြိုကျမှု ခြောက်နေရာရှိနေပြီး ထပ်မံပြိုကျ နိုင်သည်အနေအထားရှိနိုင်သည်ဟု တာဝန်ရှိသူများက ထုတ်ပြန်ထားသည့်အတွက် ဒေသခံများက စိုးရိမ်နေကြ သည်။ ပေါင်မြို့နယ် မလတ်တောင်မြေပြိုကျမှထဲသို့ ပါဝင် ခဲ့သော မိသားစုဝင်များအား ပြည်ထောင်စုအစိုးရနှင့် ပြည်နယ်အစိုးရအဖွဲ့တို့၏ လူ၊ဒါန်းမှုအပြင် စေတနာရှင် ပြည်သူများ လူုဒါန်းထားသော စားသောက်ဖွယ်ရာများ၊ အသံံးအဆောင်ပစ္စည်းများနှင့် လှူဒါန်းငွေများ လာရောက် လူဒါန်းထားကြောင်း ပေါင်မြို့နယ် သဘာဝဘေးကွပ်ကဲ ကိုတိန်း(ပေါင်)

In August 2019, due to the strong to Vigorous monsoon over the Andaman Sea and **Bay of Bengal, continuously** heavy rainfall get over the whole country.

- These peak-monsoon rains caused flash flooding and landslides.
- So, Landslide occur Southern Myanmar (Mon State and Tanintharyi Region).







# **Completed Project-I**

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



### **Output from Completed Project-I**

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



# **Completed Project-II**

Transformation of Urban Management(ADB TA-8456) Part II-Flood Management(*funding by ADB, technical assistance by CTI & ICHARM-Japan*) Implementation period: July 2014 to June 2016

### **Objectives**

- Hydro-meteorological analysis related to flood and storm surge;
- Flood and storm surge risk assessment;
- Capacity development of the DMH;
  - Training for the DMH officers on the RRI and storm surge analysis
  - Training activities on hydro-meteorological model
  - Business plan to strengthen institutional capacity
- Capacity development of organizations relevant to flood and storm surge risk assessment.



# **Output from Completed Project-II** Flood Hazard Mapping by using RRI Modeling



Flood Hazard Map (Mandalay), Flood scale: 100-year flood (4th Version

# **Completed PROJECT- III**

# DEVELOPING A METHODOLOGY FOR FLOOD FORECASTING FOR A SELECT RIVER BASIN IN MYANMAR

(Hydrological modeling system HEC-RAS) 2015-2017



- Training workshops on Hydrological modeling
- Training curriculum development (hydrological modeling)
- Drills and simulations for riverine floods for selected pilot site (Kale)
- Develop flood hazard maps for a selected river basin in Myanmar(Kale and Kalewa)

## **ONGOING PROJECT-I**

# AYEYARWADY INTEGRATED RIVER BASIN MANAGEMENT PROJECT (AIRBM) (31 March 2015- 31 March 2022)

# **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.

# Future Plans

- Upgrading the flood early warning system
- Upgrading the manual observation system to automatic observation system
- Developing the impact based flood forecast
- Developing the flood hazard maps and flood risk assessment
- Enhancing the Decision Support System
- Extending the Hydrological Services such as Water Quality

Monitoring, Groundwater Level Monitoring, Sedimentation Analysis



# THANK YOU FOR YOUR KIND ATTENTION