



SAsiaFFG Training Program

05-07 June, 2018

Delhi, India

Status of Operational Flash Flood Forecasting & Early Warning Capabilities in Bangladesh

Mohammad Arifuzzaman Bhuyan

Tahiya Tarannum

Bangladesh Water Development Board

Ministry of Water Resources, Bangladesh

Email: arif81_bwdb@yahoo.com

Outlook of Presentation



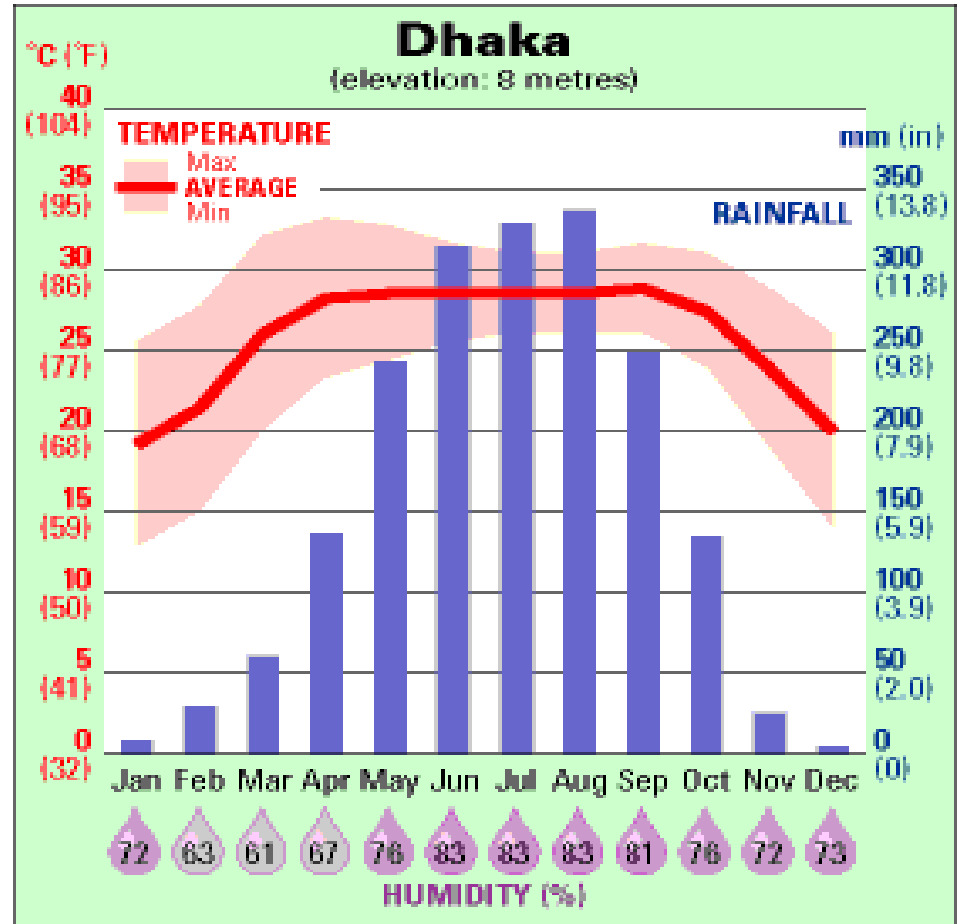
Flood Forecasting System



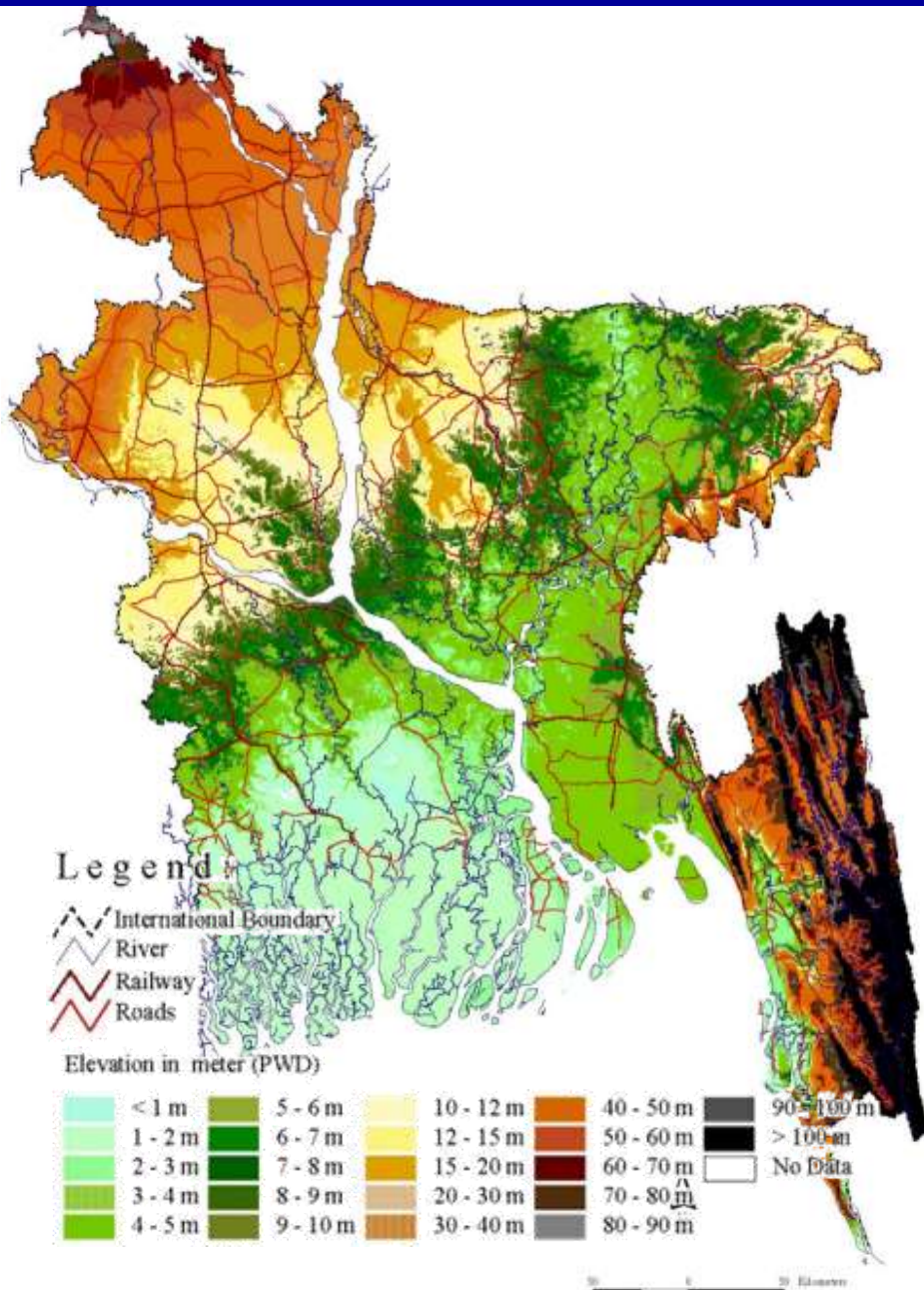
2017 Flash Flood

Climate

- Subtropical monsoon, characterized by wide seasonal variations in rainfall
- Moderately warm temperatures, and high humidity
- Three seasons are recognized: a hot, humid summer (March-June); rainy (flood) monsoon season (June-Oct.); and a cool, dry winter (Nov.-March).

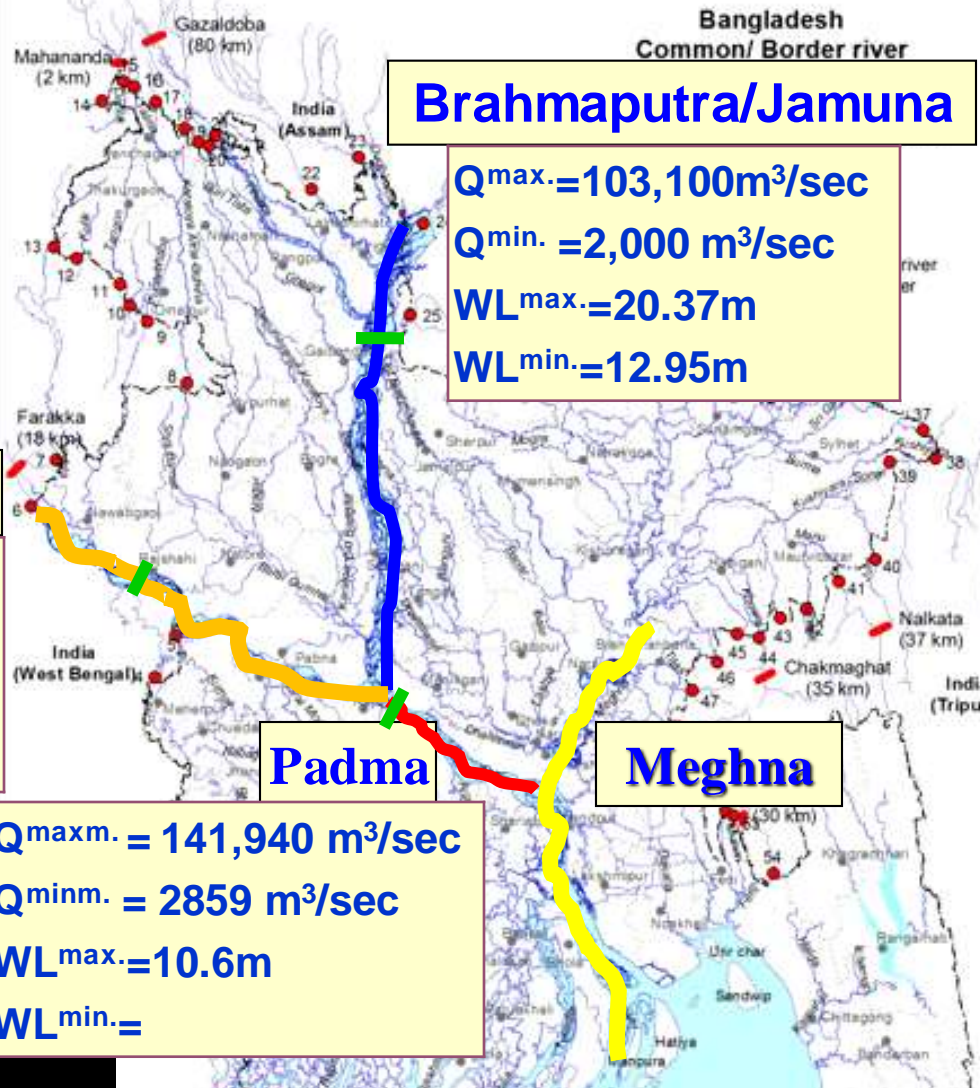


Bangladesh : Topography



- **Mostly flat**
 - flood plains - 80%.
 - hilly areas -12%
 - terrace areas -8%
- **About 16% of the area Lies below 1.50 m of MSL**
- **About 50% of the country is within 6-7 m of MSL**
- **About 68% of the country is vulnerable to flood**
- **25-30% of the area is inundated during normal monsoon**

RIVERS OF BANGLADESH



Brahmaputra/Jamuna

$Q_{max.} = 103,100 \text{ m}^3/\text{sec}$
 $Q_{min.} = 2,000 \text{ m}^3/\text{sec}$
 $WL_{max.} = 20.37 \text{ m}$
 $WL_{min.} = 12.95 \text{ m}$

Ganges

$Q_{max.} = 78,000 \text{ m}^3/\text{sec}$
 $Q_{min.} = 275 \text{ m}^3/\text{sec}$
 $WL_{max.} = 15.19 \text{ m}$
 $WL_{min.} = 7.44 \text{ m}$

Padma

$Q_{max.} = 141,940 \text{ m}^3/\text{sec}$
 $Q_{min.} = 2859 \text{ m}^3/\text{sec}$
 $WL_{max.} = 10.6 \text{ m}$
 $WL_{min.} =$

Meghna

Total Rivers 405
 Transboundary 57

Life and livelihood of peoples of Bangladesh revolving around water of these rivers over the ages

Bay of Bengal

Flood Forecasting and Warning Center

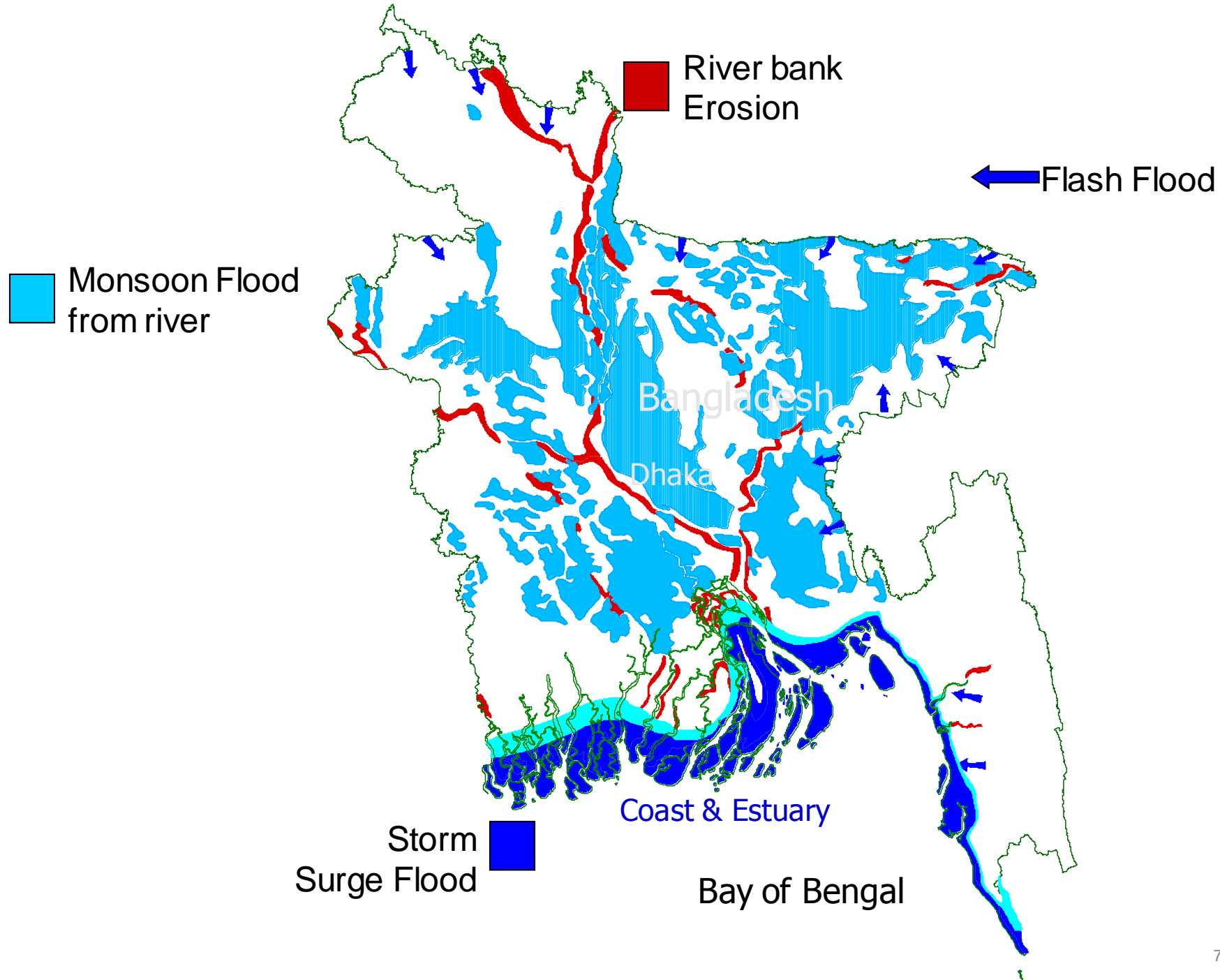
Aims in Flood Monitoring and Forecasting

A National focal point in Flood Disaster Management by generating Flood Forecast

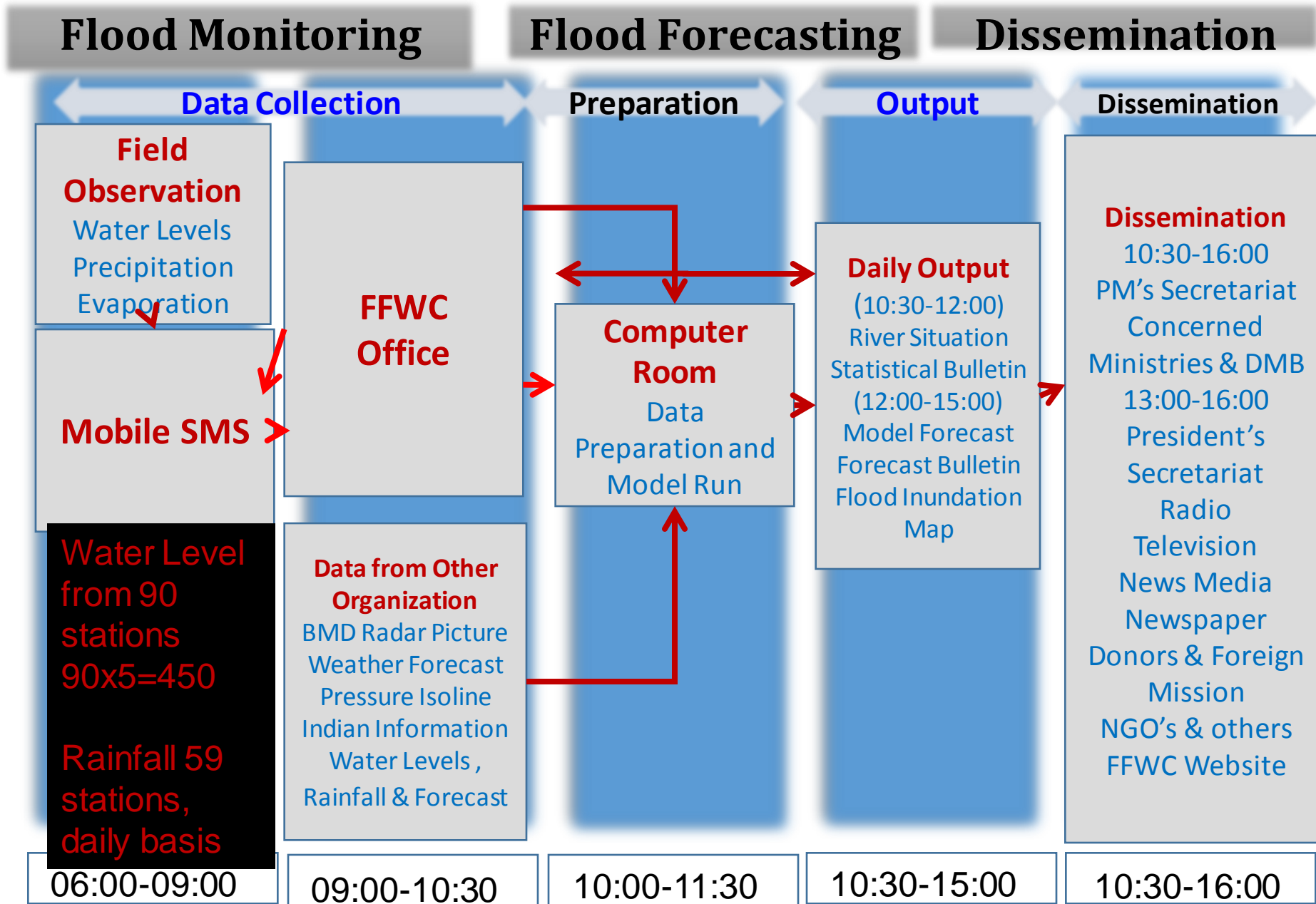


WAPDA Building (8th Floor), Motijheel, Dhaka.





Activities of FFWC, BWDB



FFWC Output

Flood

Monitoring

- Daily Rainfall Situation
- Daily River Situation
- Flood Inundation Map (For Bangladesh and Dhaka City)
- Daily Situation Summary
- Annual and Monthly Reports, Study and Evaluation

Flood

Forecasting

- River Water Level Forecast (Short and Medium Range)
- Aerial and depth Inundation Forecast (Short range; 1 – 5 days)

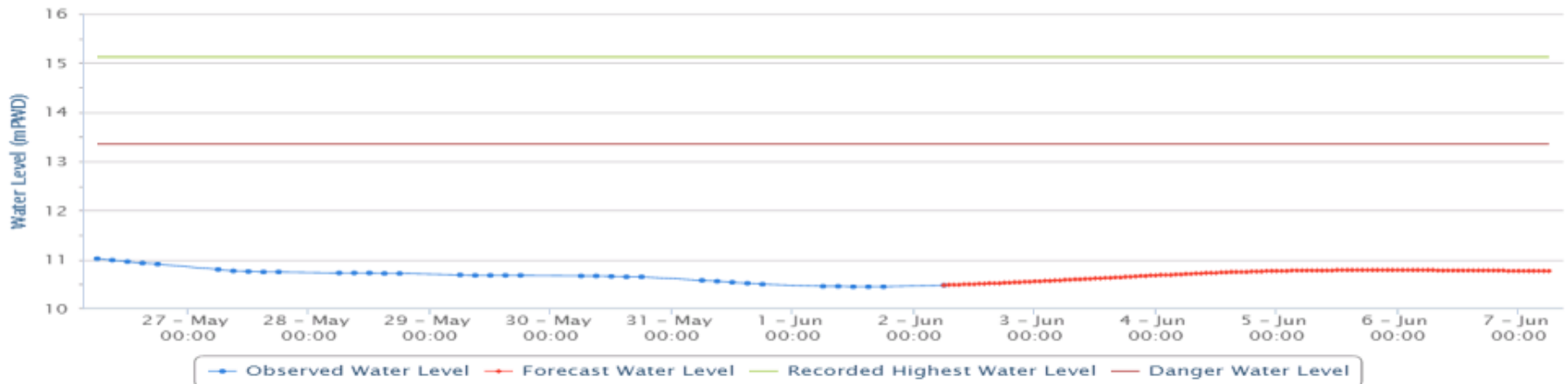
Flood Monitoring Report

FLOOD FORECASTING AND WARNING CENTER, BWDB

RIVER SITUATION AS ON 02-06-2016 AT 09:00 HOURS

| SL | RIVER | STATION NAME | RHWL (m) | D.L. WATER LEVEL | | + Rise - Fall in cm | Above D.L. in cm |
|--------------------------|-------------|---------------|-------------|------------------|------------|---------------------------|------------------------|
| | | | | 01-06-2016 | 02-06-2016 | | |
| BRAHMAPUTRA BASIN | | | | | | | |
| 1 | DHARLA | KURIGRAM | 27.66 | 26.50 | 23.46 | 23.60 | + 14 -290 |
| 2 | TEESTA | DALIA | 52.97 | 52.40 | 51.44 | 51.80 | + 36 -60 |
| 3 | TEESTA | KAUNIA | 30.52 | 30.00 | 27.75 | 27.72 | -3 -228 |
| 4 | JAMUNESWARI | BADARGANJ | 32.92 | 32.16 | 28.04 | 28.00 | -4 -416 |
| 5 | GHAGOT | GAIBANDHA | 22.81 | 21.70 | 18.35 | 18.38 | + 3 -332 |
| 6 | KARATOA | CHAK RAHIMPUR | 21.41 | 20.15 | 15.72 | 15.65 | -7 -450 |
| 7 | KARATOA | BOGRA | 17.45 | 16.32 | 11.82 | 11.76 | -6 -456 |
| 8 | BRAHMAPUTRA | NOONKHAWA | 28.10 | 27.25 | 23.33 | 23.47 | + 14 -378 |
| 9 | BRAHMAPUTRA | CHILMARI | 25.07 | 24.00 | 21.08 | 21.19 | + 11 -281 |
| 10 | JAMUNA | BAHADURABAD | 20.62 | 19.50 | 16.55 | 16.70 | + 15 -280 |
| 11 | JAMUNA | SARIAKANDI | 19.07 | 16.70 | 14.08 | 14.16 | + 8 -254 |
| 12 | JAMUNA | SERAJGANJ | 15.12 | 13.35 | 10.46 | 10.49 | + 3 -286 |
| 13 | JAMUNA | ARICHA | 10.76 | 9.40 | 6.04 | 5.88 | -6 -342 |

Jamuna at Serajganj (year 2016)
As on 02-Jun



| River Name | Location | RHWL (mPWD) | Danger Level (mPWD) | 01-06 06:00 AM | 02-06 06:00 AM | 03-06 06:00 AM | 04-06 06:00 AM | 05-06 06:00 AM | 06-06 06:00 AM | 07-06 06:00 AM |
|------------|-----------|----------------|------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| Jamuna | Serajganj | 15.12 | 13.35 | 10.46 | 10.48 | 10.59 | 10.71 | 10.78 | 10.79 | 10.77 |

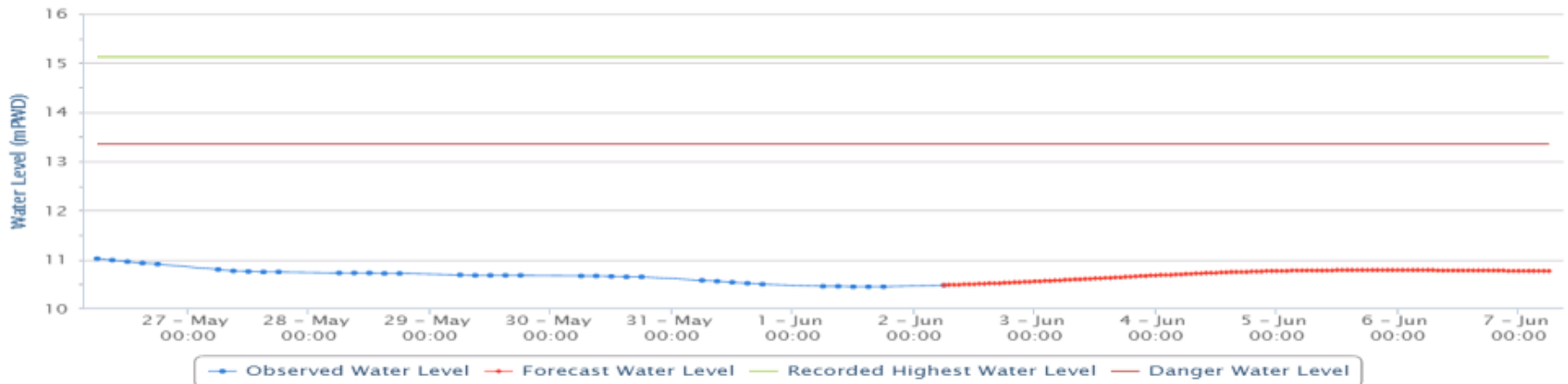
Flood Monitoring Report

FLOOD FORECASTING AND WARNING CENTER, BWDB

RIVER SITUATION AS ON 02-06-2016 AT 09:00 HOURS

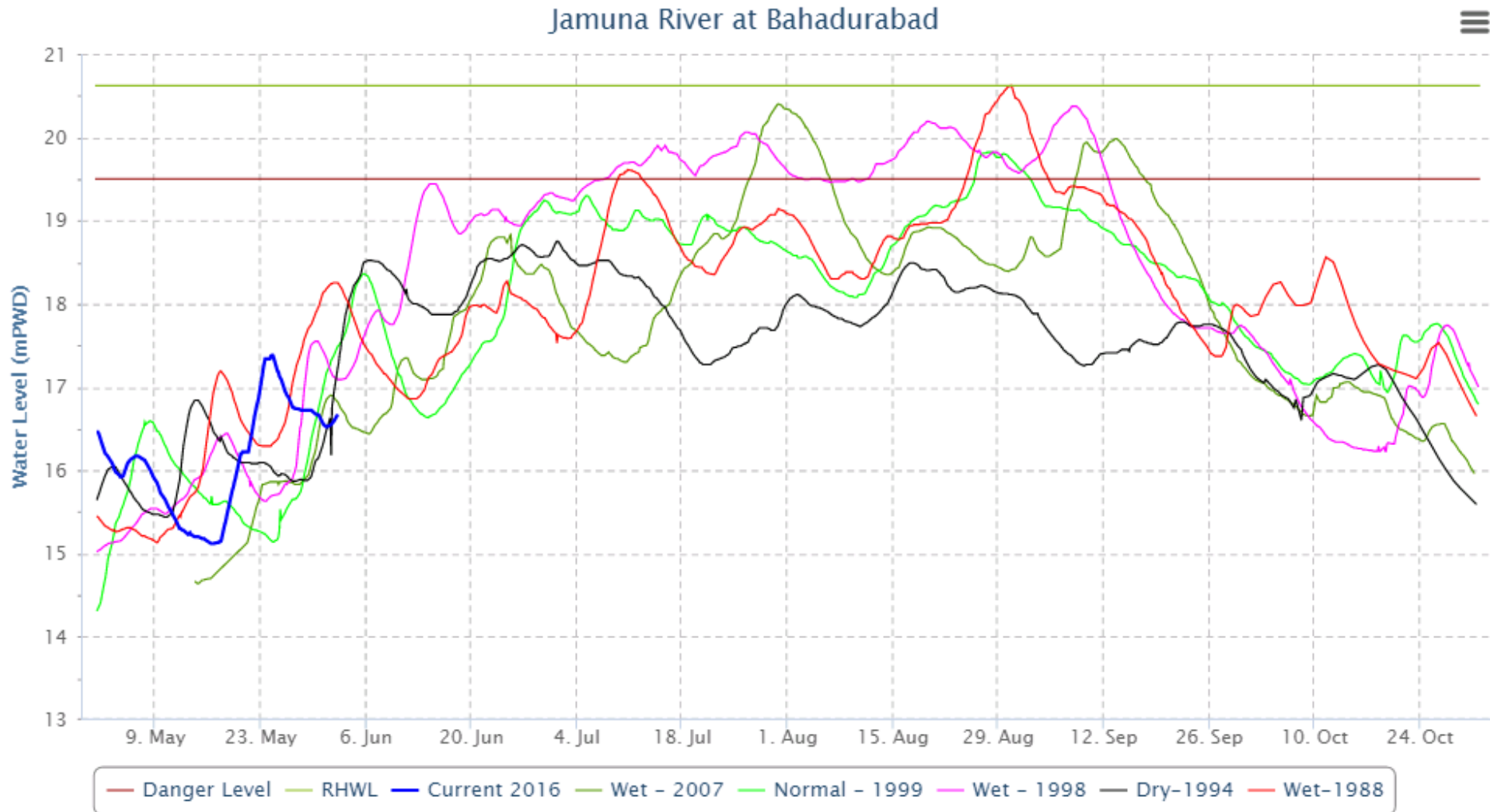
| SL | RIVER | STATION NAME | RHWL (m) | D.L. WATER LEVEL | | + Rise - Fall in cm | Above D.L. in cm |
|--------------------------|-------------|---------------|-------------|------------------|------------|---------------------------|------------------------|
| | | | | 01-06-2016 | 02-06-2016 | | |
| BRAHMAPUTRA BASIN | | | | | | | |
| 1 | DHARLA | KURIGRAM | 27.66 | 26.50 | 23.46 | 23.60 | + 14 -290 |
| 2 | TEESTA | DALIA | 52.97 | 52.40 | 51.44 | 51.80 | + 36 -60 |
| 3 | TEESTA | KAUNIA | 30.52 | 30.00 | 27.75 | 27.72 | -3 -228 |
| 4 | JAMUNESWARI | BADARGANJ | 32.92 | 32.16 | 28.04 | 28.00 | -4 -416 |
| 5 | GHAGOT | GAIBANDHA | 22.81 | 21.70 | 18.35 | 18.38 | + 3 -332 |
| 6 | KARATOA | CHAK RAHIMPUR | 21.41 | 20.15 | 15.72 | 15.65 | -7 -450 |
| 7 | KARATOA | BOGRA | 17.45 | 16.32 | 11.82 | 11.76 | -6 -456 |
| 8 | BRAHMAPUTRA | NOONKHAWA | 28.10 | 27.25 | 23.33 | 23.47 | + 14 -378 |
| 9 | BRAHMAPUTRA | CHILMARI | 25.07 | 24.00 | 21.08 | 21.19 | + 11 -281 |
| 10 | JAMUNA | BAHADURABAD | 20.62 | 19.50 | 16.55 | 16.70 | + 15 -280 |
| 11 | JAMUNA | SARIAKANDI | 19.07 | 16.70 | 14.08 | 14.16 | + 8 -254 |
| 12 | JAMUNA | SERAJGANJ | 15.12 | 13.35 | 10.46 | 10.49 | + 3 -286 |
| 13 | JAMUNA | ARICHA | 10.76 | 9.40 | 6.04 | 6.00 | -4 -340 |

Jamuna at Serajganj (year 2016)
As on 02-Jun



| River Name | Location | RHWL (mPWD) | Danger Level (mPWD) | 01-06 06:00 AM | 02-06 06:00 AM | 03-06 06:00 AM | 04-06 06:00 AM | 05-06 06:00 AM | 06-06 06:00 AM | 07-06 06:00 AM |
|------------|-----------|-------------|---------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| Jamuna | Serajganj | 15.12 | 13.35 | 10.46 | 10.48 | 10.59 | 10.71 | 10.78 | 10.79 | 10.77 |

Historical Flood Information



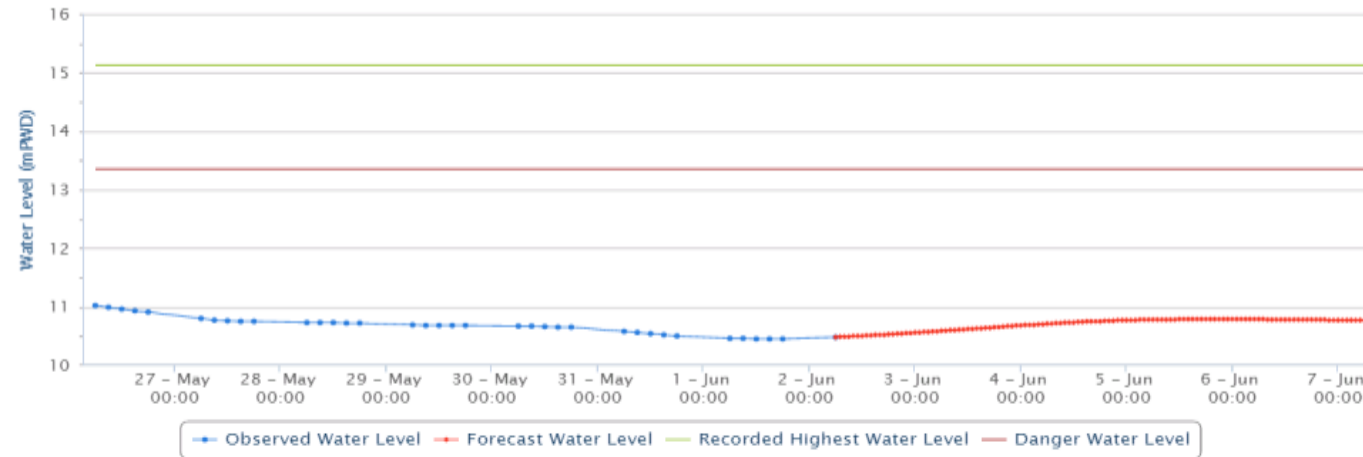
Comparison with big floods like 1988, 1998, 2004, 2007

Status of Flood Forecasting

- ❖ **5-days lead time deterministic forecast**
 - ❖ based on **real time observation and provides a definite value.**
- ❖ **10-days probabilistic forecast**
 - ❖ based on ensemble **discharge forecast** and provides a range of values.
- ❖ **Flash Flood forecast (48 h water level forecast; 12 h interval)**
 - ❖ based on **WRF weather forecast.**

5 days lead time deterministic forecast

Jamuna at Serajganj (year 2016)
As on 02-Jun



| River Name | Location | RHWL (mPWD) | Danger Level (mPWD) | 01-06 | 02-06 | 03-06 | 04-06 | 05-06 | 06-06 | 07-06 |
|------------|-----------|-------------|---------------------|----------|----------|----------|----------|----------|----------|----------|
| | | | | 06:00 AM | 06:00 AM | 06:00 AM | 06:00 AM | 06:00 AM | 06:00 AM | 06:00 AM |
| Jamuna | Serajganj | 15.12 | 13.35 | 10.46 | 10.48 | 10.59 | 10.71 | 10.78 | 10.79 | 10.77 |

Kushiyara at Sherpur-Sylhet (year 2016)
As on 02-Jun



| River Name | Location | RHWL (mPWD) | Danger Level (mPWD) | 01-06 | 02-06 | 03-06 | 04-06 | 05-06 | 06-06 | 07-06 |
|------------|----------------|-------------|---------------------|----------|----------|----------|----------|----------|----------|----------|
| | | | | 06:00 AM | 06:00 AM | 06:00 AM | 06:00 AM | 06:00 AM | 06:00 AM | 06:00 AM |
| Kushiyara | Sherpur-Sylhet | 9.68 | 9.00 | 9.10 | 9.03 | 8.95 | 8.92 | 8.89 | 8.86 | 8.83 |

Flood Forecasting Report (5 Days lead time)

EXPERIMENTAL 5 Days Forecast (24, 48, 72, 96 & 120 Hrs), FFWC, BWDB

Supported by CDMP-II

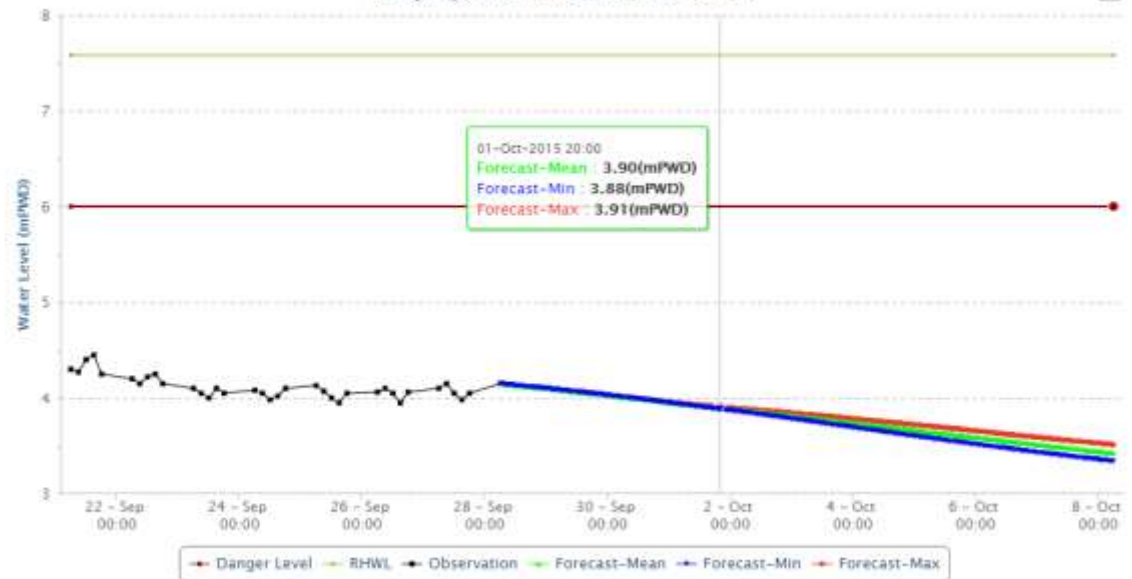
| Sl NO | River | Station | D.L. (meter) | Today | 24-hrs forecast | 24-hrs +Rise -fall | 24-hrs +above -below D.L. | 48-hrs forecast | 48-hrs +Rise -fall | 48-hrs +above -below D.L. | 72-hrs forecast | 72-hrs +Rise -fall | 72-hrs +above -below D.L. | 96-hrs forecast | 96-hrs +Rise -fall | 96-hrs +above -below D.L. | 120-hrs forecast | 120-hrs +Rise -fall |
|-------|-------------------|----------------------|-----------------|------------------|--------------------|--------------------------|------------------------------------|--------------------|--------------------------|------------------------------------|--------------------|--------------------------|------------------------------------|--------------------|--------------------------|------------------------------------|---------------------|---------------------------|
| | | | | 02-06 6:00 AM | 03-06 6:00 AM | 03-06 6:00 AM | 03-06 6:00 AM | 04-06 6:00 AM | 04-06 6:00 AM | 04-06 6:00 AM | 05-06 6:00 AM | 05-06 6:00 AM | 05-06 6:00 AM | 06-06 6:00 AM | 06-06 6:00 AM | 06-06 6:00 AM | 07-06 6:00 AM | 07-06 6:00 AM |
| | | | | (meter) | (meter) | (cm) | (cm) | (meter) | (cm) | (cm) | (meter) | (cm) | (cm) | (meter) | (cm) | (cm) | (meter) | (cm) |
| 1 | Atrai | Mohadevpur | 18.59 | 12.97 | 13.00 | +3 | -559 | 13.03 | +2 | -556 | 13.02 | -1 | -557 | 13.01 | -1 | -558 | 13.03 | +2 |
| 2 | Atrai | Atrai | 13.72 | - | 10.81 | - | -291 | 10.76 | -6 | -296 | 10.71 | -4 | -301 | 10.68 | -3 | -304 | 10.66 | -2 |
| 3 | Atrai | Singra | 12.65 | 9.26 | 9.20 | -6 | -345 | 9.15 | -5 | -350 | 9.12 | -3 | -353 | 9.09 | -3 | -356 | 9.07 | -2 |
| 4 | Karatoa-Atrai-GGH | Baghabari | 10.40 | 7.56 | 7.61 | +5 | -279 | 7.72 | +11 | -268 | 7.82 | +10 | -258 | 7.86 | +4 | -254 | 7.85 | -1 |
| 5 | Little Jamuna | Naogaon | 15.24 | 9.94 | 9.89 | -5 | -535 | 9.90 | +1 | -534 | 9.93 | +3 | -531 | 9.97 | +4 | -527 | 10.00 | +3 |
| 6 | Karatoya | Chakrahimpur | 20.15 | 15.65 | 15.74 | +9 | -441 | 15.83 | +9 | -432 | 15.91 | +8 | -424 | 16.02 | +10 | -413 | 16.10 | +8 |
| 7 | Karatoya | Bogra | 16.32 | 11.77 | 11.84 | +7 | -448 | 11.87 | +3 | -445 | 11.88 | +1 | -444 | 11.88 | 0 | -444 | 11.88 | -1 |
| 8 | Teesta | Kaunia | 30.00 | 27.76 | 28.58 | +82 | -142 | 28.62 | +4 | -138 | 28.55 | -6 | -145 | 28.50 | -6 | -150 | 28.46 | -4 |
| 9 | Ghagot | Gaibandha | 21.70 | 18.38 | 18.38 | 0 | -332 | 18.37 | -1 | -333 | 18.37 | 0 | -333 | 18.36 | -1 | -334 | 18.35 | -1 |
| 10 | Dharla | Kurigram | 26.50 | 23.57 | 23.59 | +2 | -291 | 23.58 | -1 | -292 | 23.56 | -2 | -294 | 23.54 | -2 | -296 | 23.51 | -3 |
| 11 | Brahmaputra | Chilmari | 24.00 | 21.18 | 21.30 | +12 | -270 | 21.34 | +5 | -266 | 21.33 | -2 | -267 | 21.30 | -3 | -270 | 21.27 | -3 |
| 12 | Jamuna | Bahadurabad | 19.50 | 16.67 | 16.81 | +14 | -269 | 16.92 | +11 | -258 | 16.93 | +2 | -257 | 16.91 | -2 | -259 | 16.89 | -3 |
| 13 | Jamuna | Sariakandi | 16.70 | 14.15 | 14.25 | +10 | -245 | 14.34 | +9 | -236 | 14.37 | +3 | -233 | 14.36 | -1 | -234 | 14.34 | -2 |
| 14 | Jamuna | Kazipur | 14.85 | - | 11.69 | - | -316 | 11.81 | +12 | -304 | 11.87 | +6 | -298 | 11.87 | 0 | -298 | 11.84 | -2 |
| 15 | Jamuna | Serajganj | 13.35 | 10.48 | 10.58 | +10 | -277 | 10.70 | +12 | -265 | 10.77 | +7 | -258 | 10.78 | +1 | -257 | 10.76 | -2 |
| 16 | Jamuna | Porabari | 12.27 | - | 8.47 | - | -380 | 8.61 | +14 | -366 | 8.70 | +10 | -357 | 8.72 | +2 | -355 | 8.71 | -2 |
| 17 | Jamuna | Aricha | 9.40 | 6.00 | 6.04 | +4 | -336 | 6.15 | +11 | -325 | 6.25 | +11 | -315 | 6.30 | +5 | -310 | 6.29 | -1 |
| 18 | Old Brahmaputra | Jamalpur | 17.00 | 11.37 | 11.45 | +8 | -555 | 11.68 | +23 | -532 | 11.83 | +15 | -517 | 11.86 | +3 | -514 | 11.84 | -2 |
| 19 | Old Brahmaputra | Mymensingh | 12.50 | 6.25 | 6.14 | -11 | -636 | 6.11 | -3 | -639 | 6.23 | +13 | -627 | 6.46 | +22 | -604 | 6.57 | +11 |
| 20 | Bangshi | Nayerhat | 7.32 | 3.50 | 3.49 | -1 | -383 | 3.49 | -1 | -383 | 3.48 | -1 | -384 | 3.47 | -1 | -385 | 3.45 | -2 |
| 21 | Old Dhalesari | Jagir | 8.23 | - | 4.49 | - | -374 | 4.49 | 0 | -374 | 4.50 | 0 | -373 | 4.52 | +3 | -371 | 4.59 | +6 |
| 22 | Dhaleswari | Kalagachia | 4.88 | - | 1.86 | - | -302 | 1.88 | +1 | -300 | 1.90 | +2 | -298 | 1.92 | +2 | -296 | 1.94 | +3 |
| 23 | Kaliganga | Taraghat | 8.38 | 4.11 | 4.05 | -6 | -433 | 4.17 | +12 | -421 | 4.36 | +19 | -402 | 4.50 | +14 | -388 | 4.54 | +4 |
| 24 | Tongi Khal | Tongi | 6.08 | 3.80 | 3.81 | +1 | -227 | 3.82 | +1 | -226 | 3.82 | 0 | -226 | 3.82 | 0 | -226 | 3.83 | +1 |
| 25 | Turag | Mirpur | 5.94 | 3.72 | 3.71 | -1 | -223 | 3.72 | +1 | -222 | 3.75 | +2 | -219 | 3.76 | +1 | -218 | 3.77 | +1 |
| 26 | Buriganga | Dhaka (Mill Barrack) | 6.00 | - | 1.95 | - | -405 | 1.96 | +1 | -404 | 1.99 | +2 | -401 | 2.01 | +2 | -399 | 2.03 | +2 |
| 27 | Buriganga | Dhaka (Hariharpara) | 5.79 | - | 1.94 | - | -385 | 1.96 | +1 | -383 | 1.98 | +2 | -381 | 2.00 | +2 | -379 | 2.02 | +2 |
| 28 | Balu | Demra | 5.75 | 3.60 | 3.62 | +2 | -213 | 3.63 | +1 | -212 | 3.64 | +1 | -211 | 3.65 | +1 | -210 | 3.70 | +5 |

Extended Range Forecast (10 days lead time)

Jamuna River at Serajganj (Year 2015)



Buriganga River at Dhaka (Year 2015)



Flood Summery

FLOOD INFORMATION CENTRE
FLOOD FORECASTING & WARNING CENTRE
BANGLADESH WATER DEVELOPMENT BOARD
WAPDA BUILDING, 8TH FLOOR, DHAKA.

E-mail: ffwcbwdb@gmail.com, ffwc05@yahoo.com, Site: <http://www.ffwc.gov.bd> Tel: 9553118, 9550755 Fax: 9557386

RAINFALL AND RIVER SITUATION SUMMARY AS ON JUNE 02, 2016

OUTLOOK

- *Brahmaputra-Jamuna, Ganges -Padma river systems are in rising trend.*
- *The Brahmaputra-Jamuna river may rise while the Ganges -Padma river may remain steady in next 24 hours.*

Stations Above Danger Levels: As on 02 June 2016 09:00 am:

| Station name | River | Rise(+)/Fall(-) (cm) during last 24 hours | Above Danger Level (cm) |
|----------------|-----------|---|-------------------------|
| Sherpur-Sylhet | Kushiyara | -7 | +3 |

RAINFALL

Significant rainfalls recorded during last 24 hrs ending at 09:00 AM today:

| Station | Rainfall | Station | Rainfall |
|---------|----------|---------|----------|
| Rangpur | 40.0 | Khulna | 36.0 |

All data send to FFWC through mobile sms



Water Level

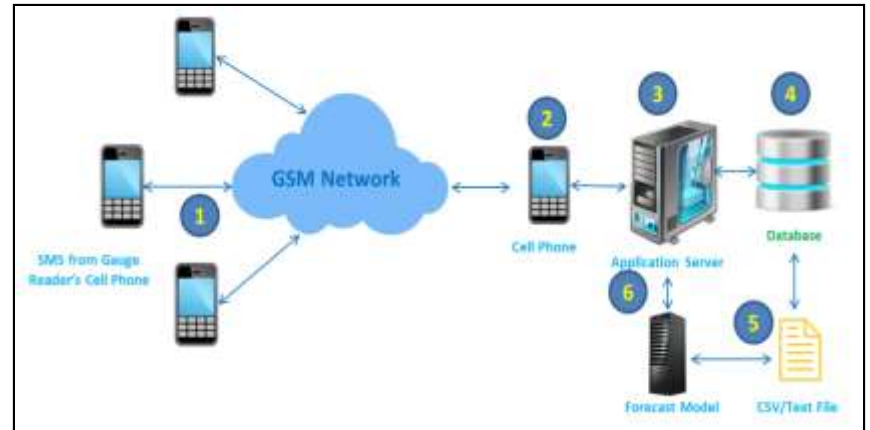
Gauge (5 times in a day; 6-9-12-15-18)



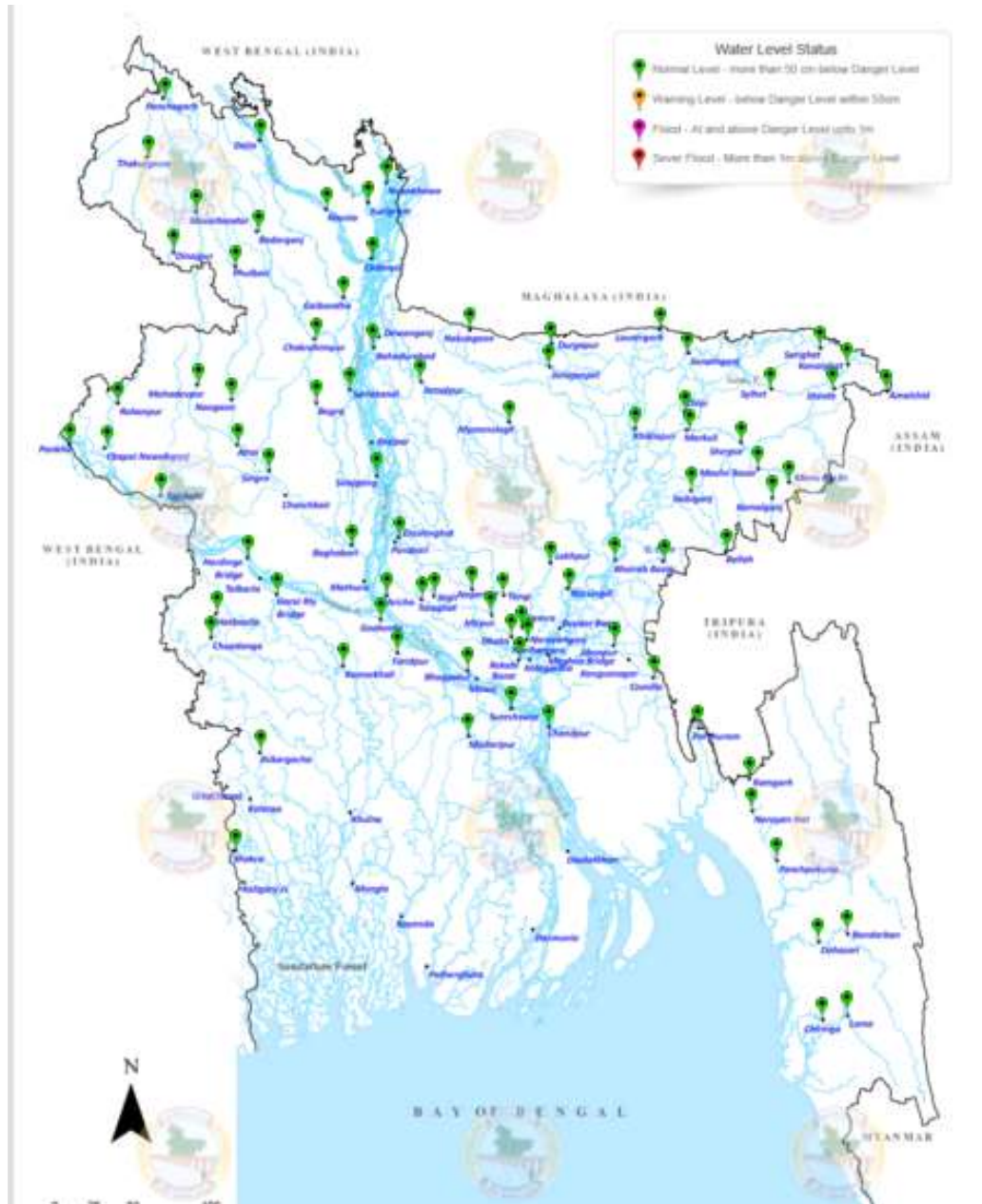
Rain

Gauge (once in a day; 9 am, 3 UTC)

Data Collection by Mobile SMS: Present System




Stations used for Flood Monitoring & Forecasting



**Water Level Station
= 90**

Rainfall = 59

Automatic Station List

| Water Level Stations | | Water Level & Rainfall Stations | Meteorological Station |
|---|----------------|---------------------------------|------------------------|
| Rayenda | Patuakhali | Shakra | Borguna |
| Dalia | Borguna | Shaheber alga | |
| Chandpur | Borhanuddin | Sarighat | |
| Chillagong Sadarghat | Mongla | Habiganj | |
| Kurigram | Barisal | Comilla | |
| Shaola | Cox's Bazar | Durgapur | |
| Patgati | Bishkhali | Nakuagaon | |
| Haridaspur | Nolianala | Benarpota | |
| Rahmatkhali | Bamni | | |
| Musapur | Kobadak Forest | | |
| Swarupkathi | | WMIP | |
| TOTAL | | | |
|  20 | | 9 | 1 |

Total = 37

HKH-HYCOS Project

Bangladesh

Bhairab Bazar

Lalon Shah Bridge

Sirajganj

Balah

Chatlaghat

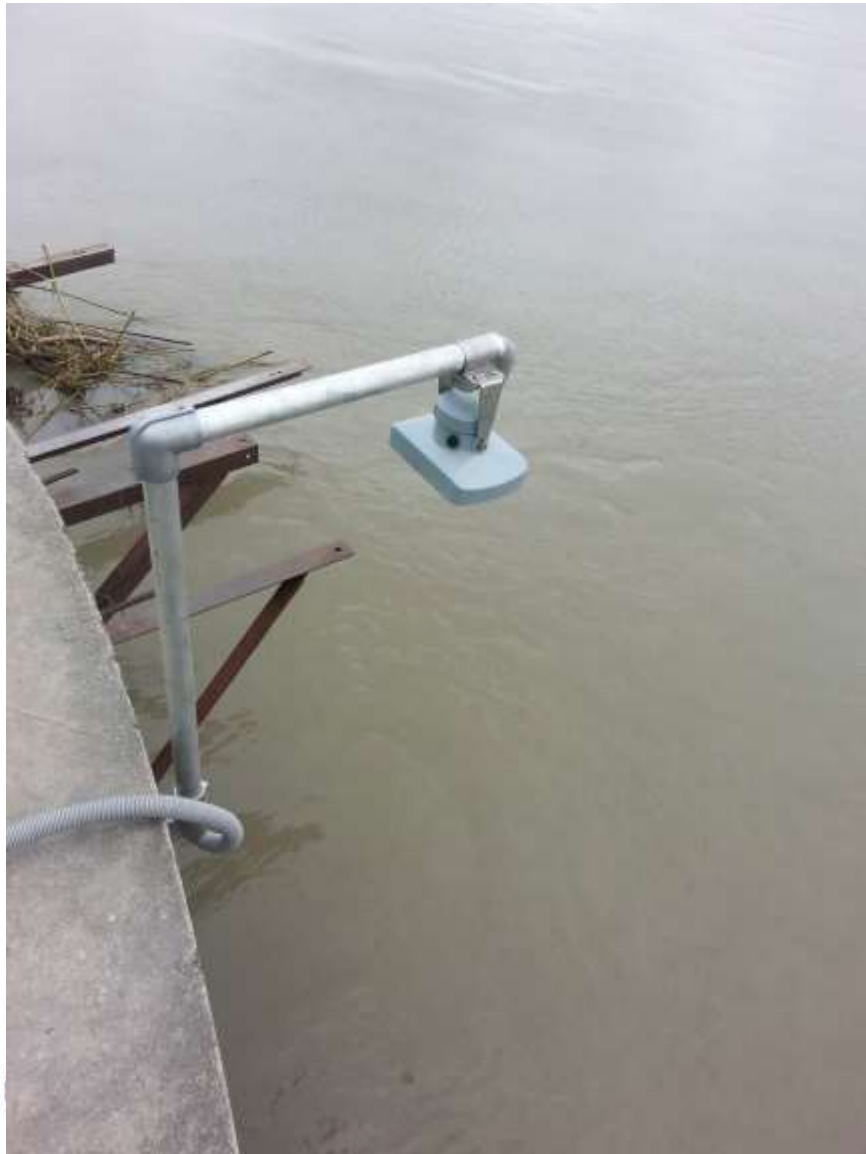
Sunamgunj

Zakigunj

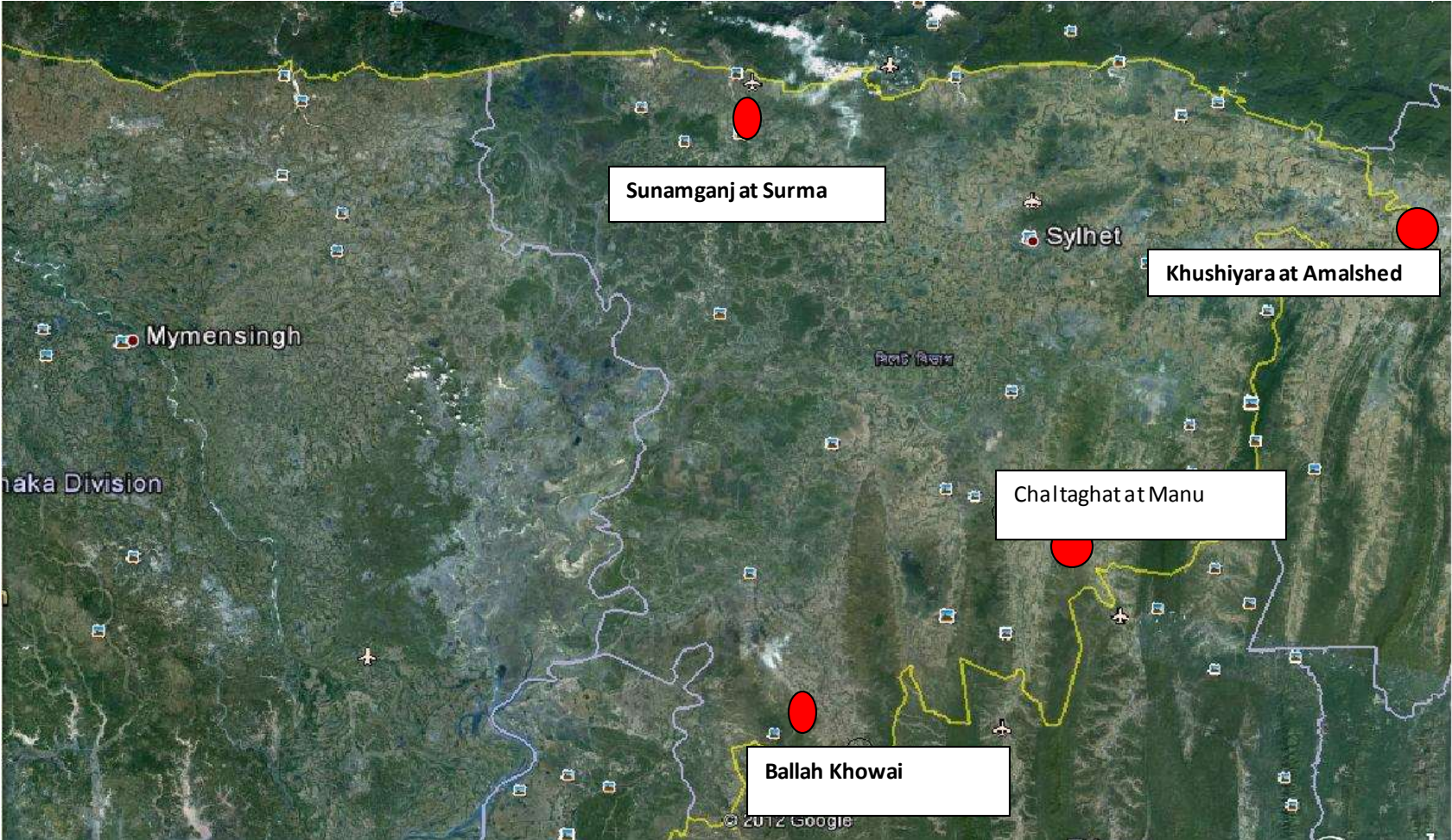
ICIMOD

Water Level & Rainfall Stations = 07

Dalia



Real time gauge stations



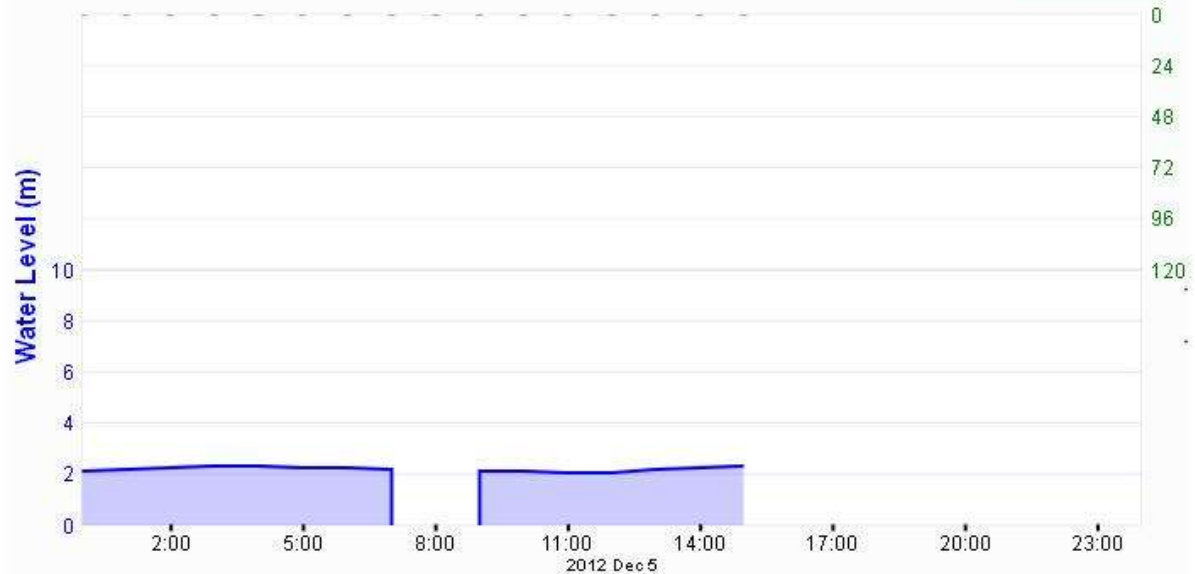
<http://www.hkhhycos.bwdb.gov.bd>



- Bangladesh
- Bhairab Bazar**
- Lalon Shah Bridge
- Sirajganj

Bhairab Bazar

Water Level (m) Rainfall (mm) Time range: One Day 2012 Dec 05



Flood Forecasting Stations: Monsoon Flooding

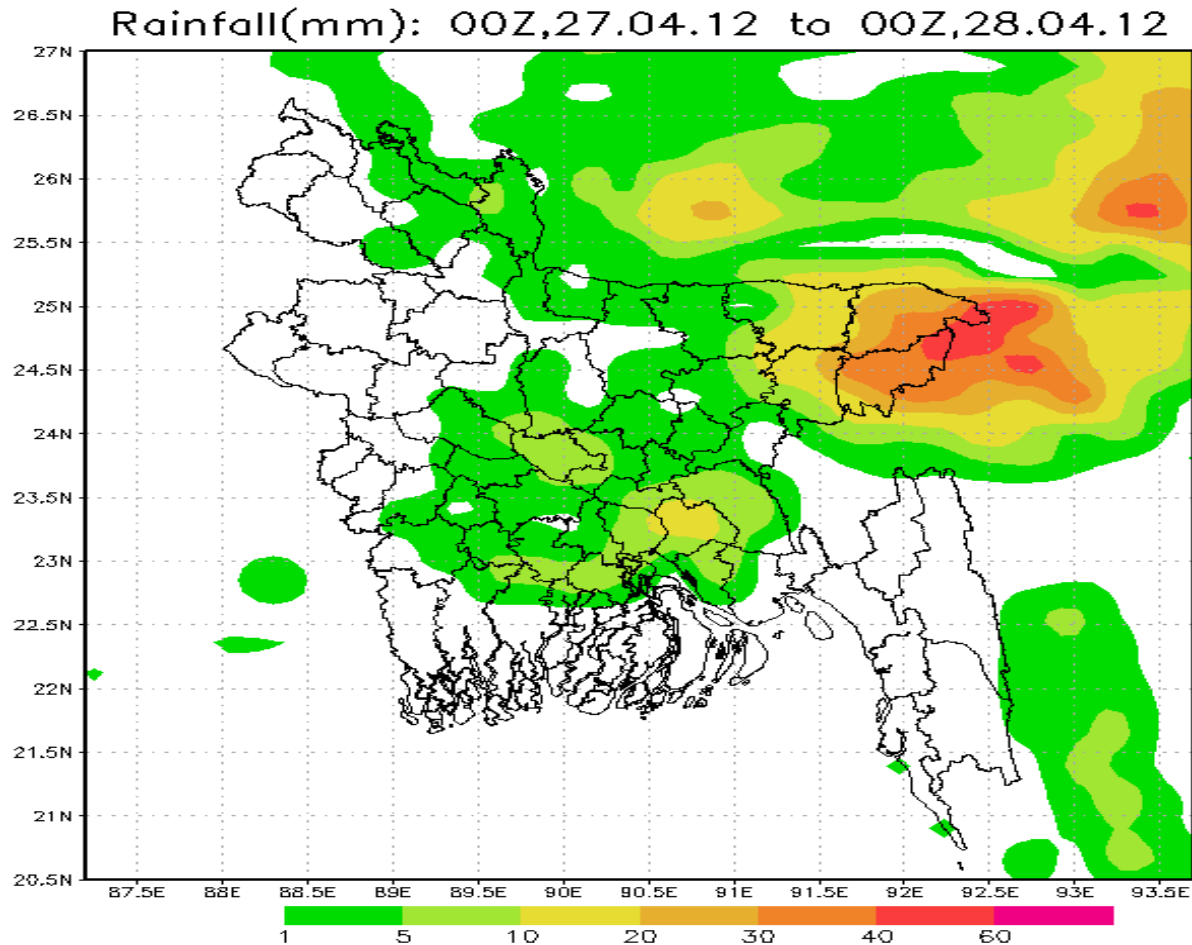


| River | Station | River | Station |
|-----------|-------------|-----------|------------|
| Jamuna | Sariakandi | Dharala | Kurigram |
| | Porabari | Lakhya | Lakhpur |
| | Mathura | Meghna | Narsingdi |
| Baulai | Khaliajuri | Mohanonda | C.Nwabgonj |
| Old Surma | Derai | Ghagot | Gaibandha |
| Kalni | Markuli | Atrai | Cankhair |
| Manu | Moulvibazar | Hurasagar | Baghabari |

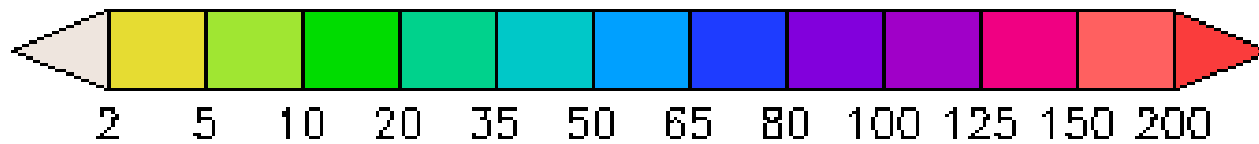
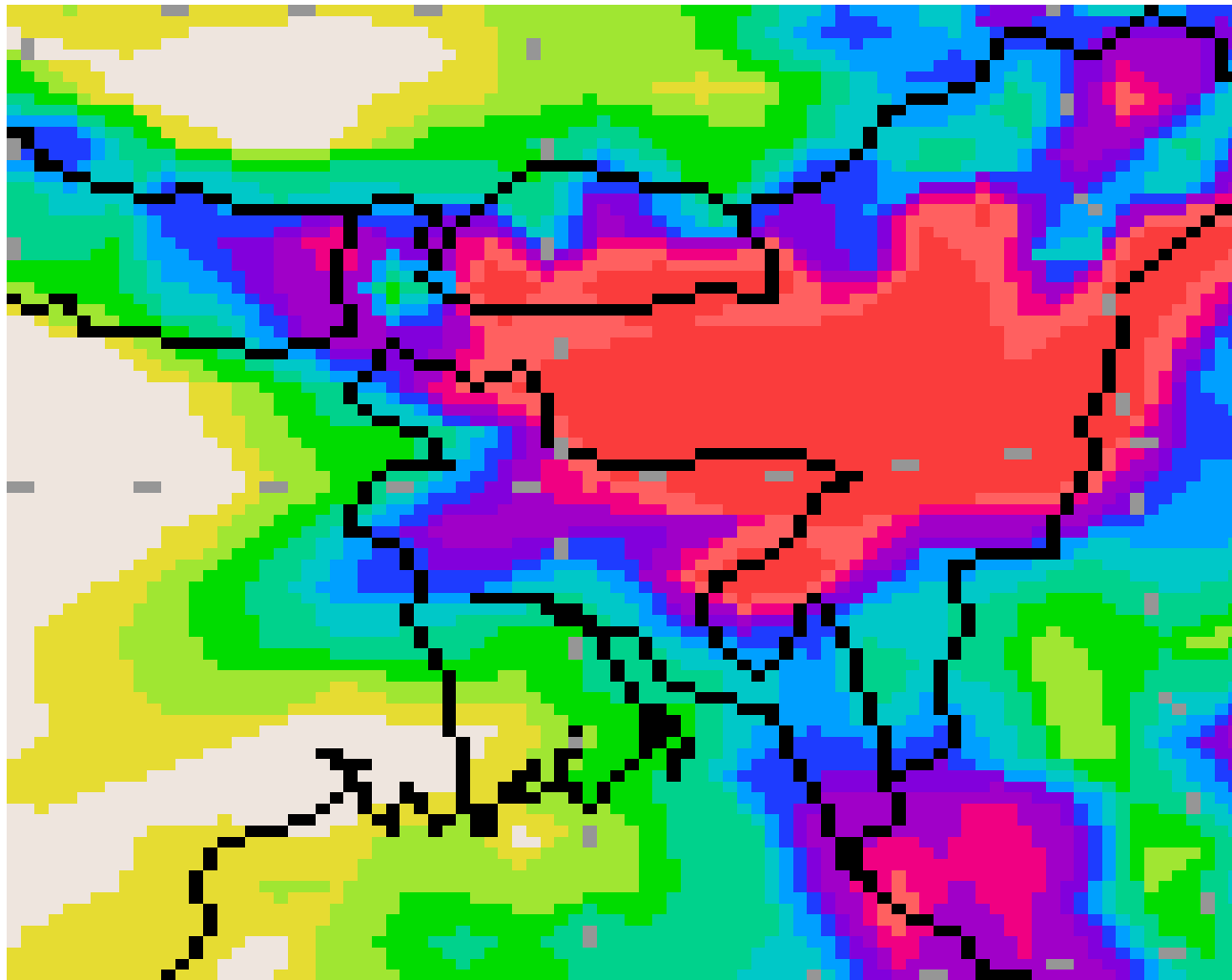
| River | Station | River | Station |
|-----------------|--------------|---------------|----------------|
| Atrai | Mohadevpur | Turag | Mirpur |
| | Atrai | Buriganga | Dhaka(South) |
| Little Jamuna | Noagaon | | Dhaka(West) |
| Karatoya | Chakrahimpur | Balu | Demra |
| | Bogra | Lakhya | Narayangonj |
| Teesta | Kaunia | Ganges | Rajshahi |
| Brahmaputra | Chilmari | | Harding Bridge |
| Jamuna | Bahadurabad | | Talbaria |
| | Kazipur | Padma | Goallondo |
| | Serajgonj | | Bhagyakul |
| | Porabari | | Mawa |
| | Aricha | | Gorai |
| Old Brahmaputra | Jamalpur | Kamarkhali | |
| | Mymensingh | Sylhet | |
| Bangshi | Nayerhat | Surma | Sunamgonj |
| Dhaleswari | Jagir | Kushyara | Sheola |
| | Kalagacia | | Meghna |
| Kaliganga | Taraghat | | |
| Tongi Khal | Tongi | Meghna Bridge | |

29 rivers 54 stations

Numerical Weather Products (WRF) from BMD, IMD

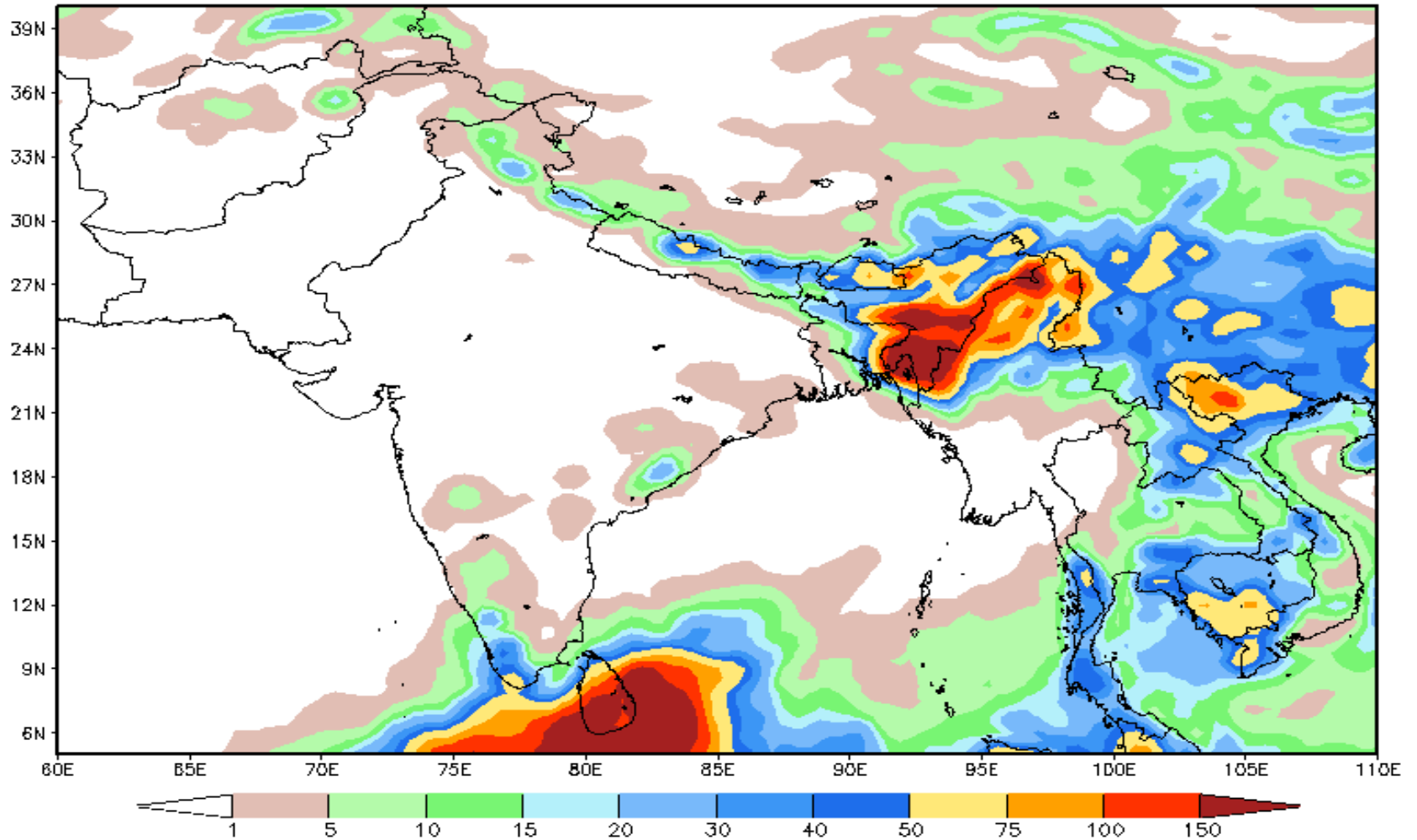


Extended outlook for the next week (ECMWF)



NOAA Precipitation Forecast

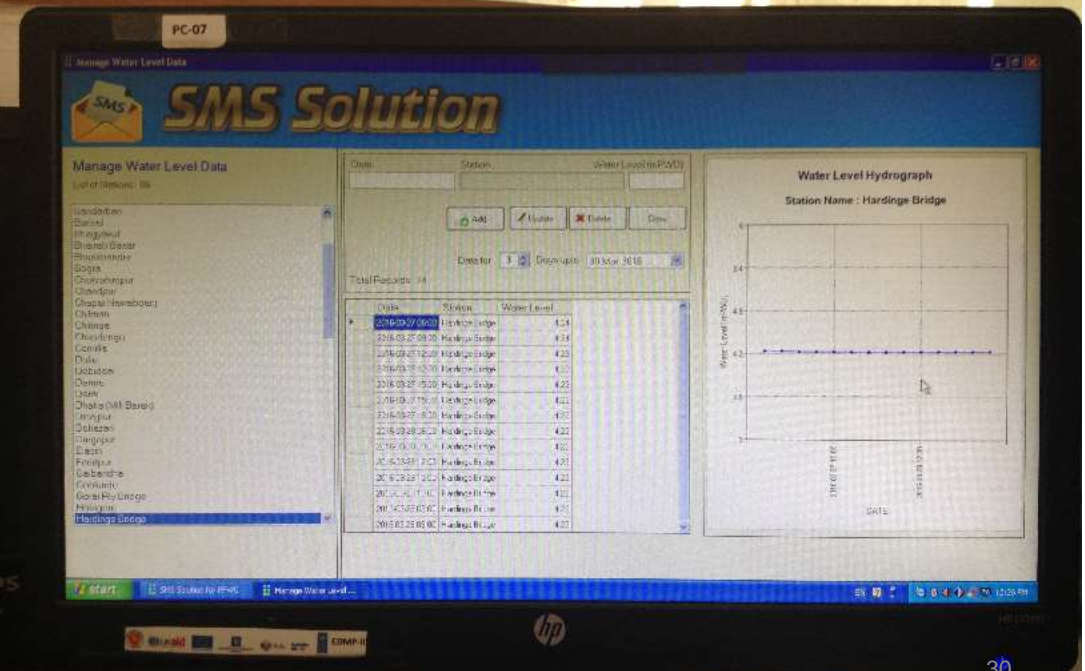
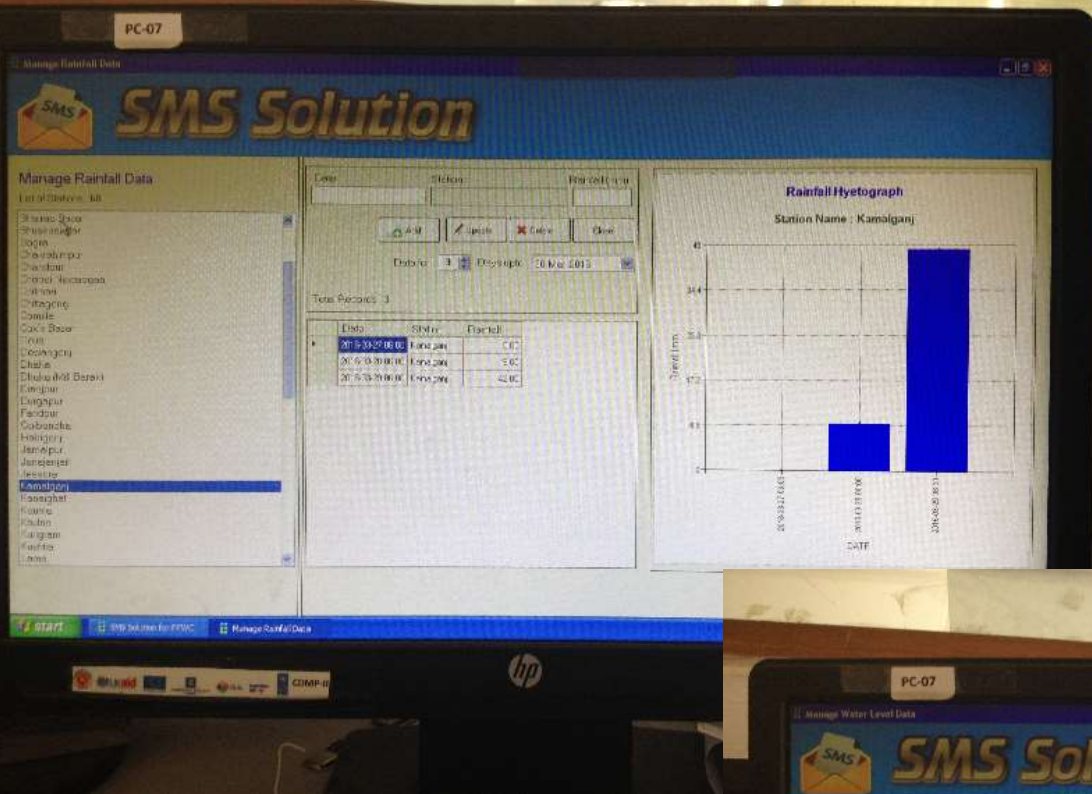
NOAA GFS 37.5 km Week 1 Total Precipitation (mm)
Issued at Apr 08 2007 00Z for the period ending at Apr 15 2007 00Z



Data Feed to Computer by Mobile Apps



Data Check and Processing



Flood Data Transmission (Contd.)

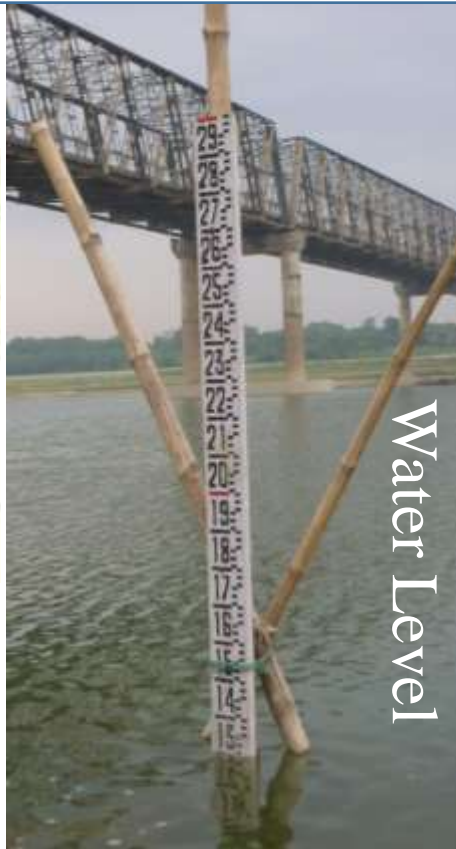
Flood Bulletin and Forecast, Twice in a day; Morning and Afternoon

Forecast sent to Gauge Point by SMS

Gauge Point



Rainfall



Water Level



Received at Mobile & transferred to PC

FFWC

SMS received from Gauge point

Steps in Generating Forecast

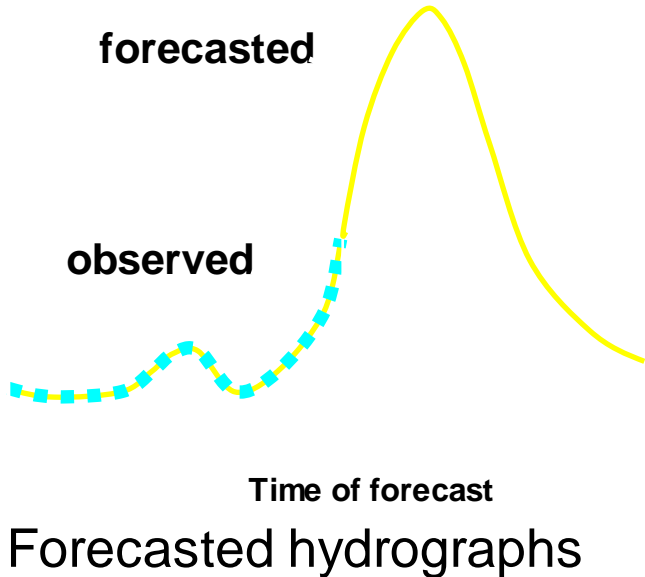
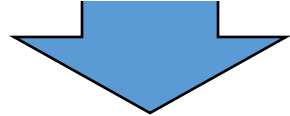
Rainfall Forecast (NOAA, IMD, WRF)



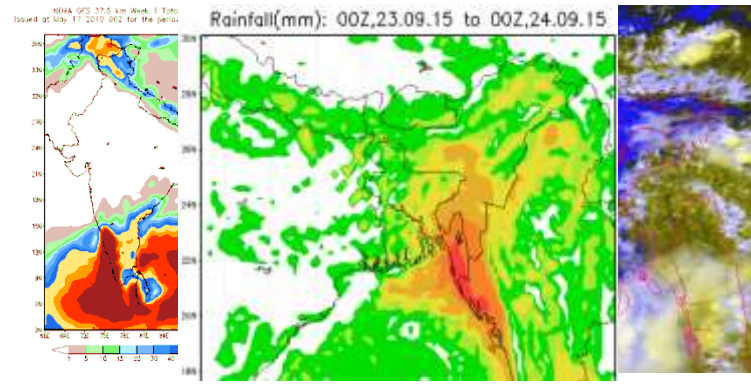
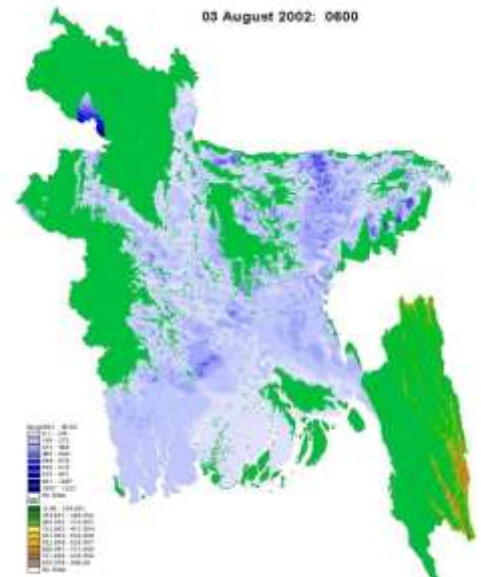
Real-time
Rainfall,
Water Level
Data
collection by
mobile sms



MIKE 11 Flood Forecasting

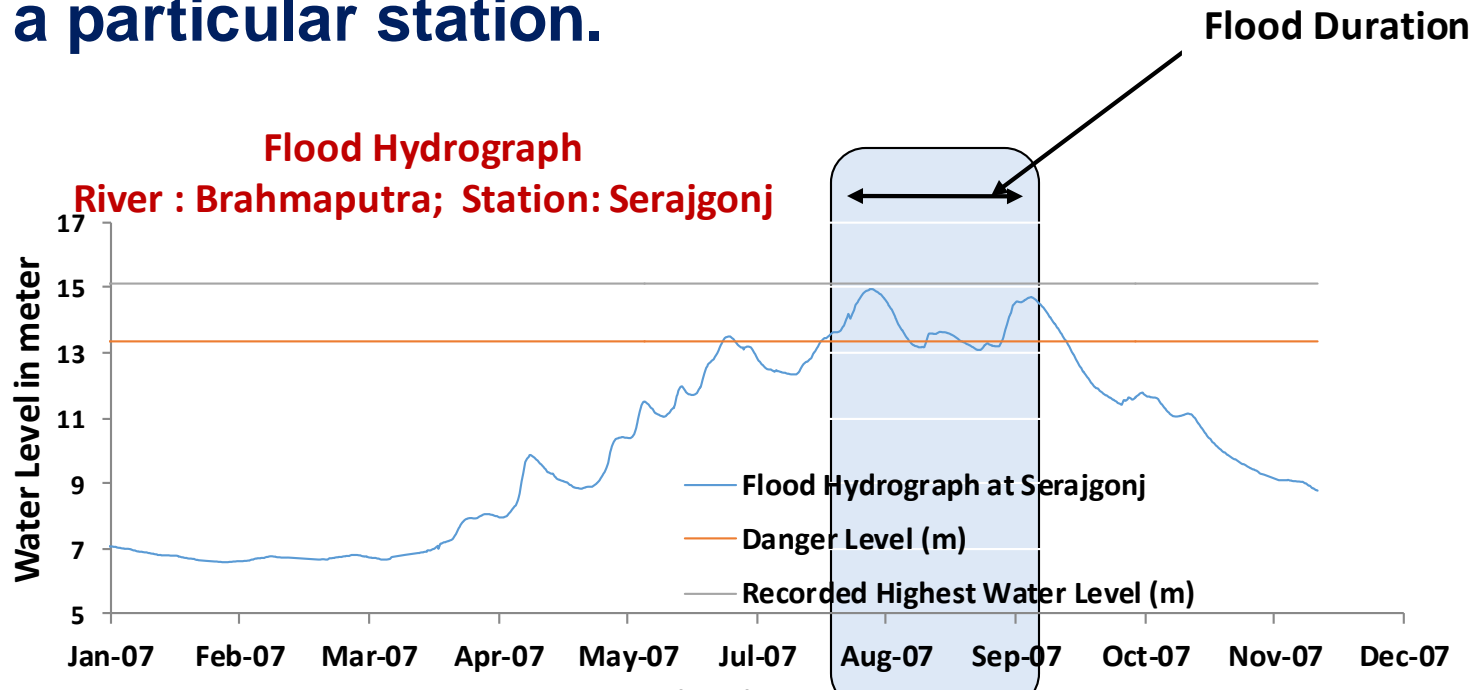


Flood Map



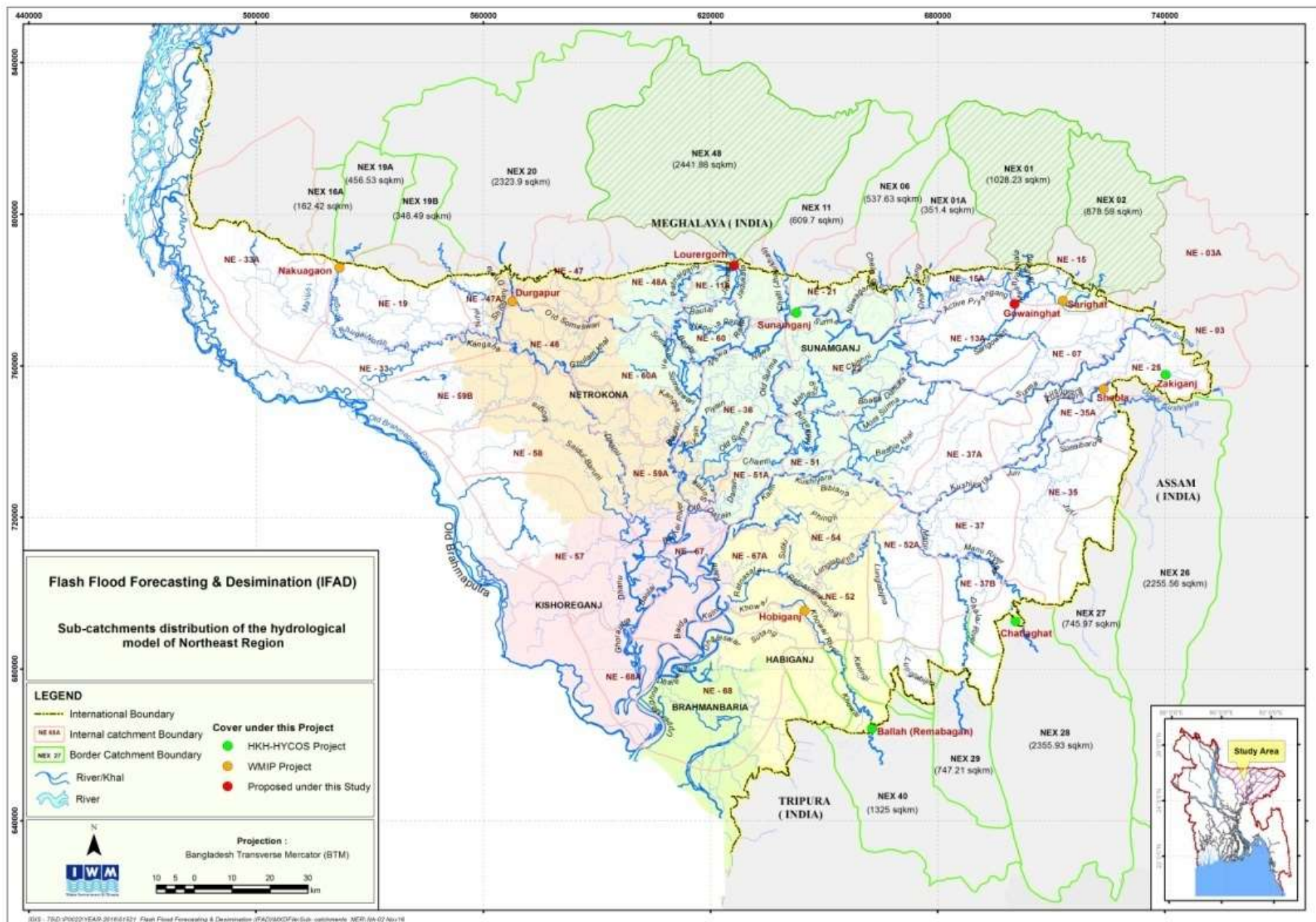
Selection of time for Issuing Flood Warning

Flood Warning is issued when water level exceeds danger level in a particular station.



| River Name | Location | RHWL (mPWD) | Danger Level (mPWD) | 05-07 | 06-07 | 07-07 | 08-07 | 09-07 | 10-07 | 11-07 |
|------------|----------|-------------|---------------------|----------|----------|----------|----------|----------|----------|----------|
| | | | | 06:00 AM | 06:30 AM | 06:00 AM | 06:00 AM | 06:00 AM | 06:00 AM | 06:00 AM |

Flash Flooding Regions : 9 Districts ; 5 most vulnerable



Activities and preparedness of Flash Flood Forecast

Background Information

- Occurs Northeast part of Bangladesh (Haor region)
- Pre monsoon Events
- Hilly Terrain outside Bangladesh
- Adjacent to world highest rainfall recorded place (Cherapongi)
- Affect boro Harvesting

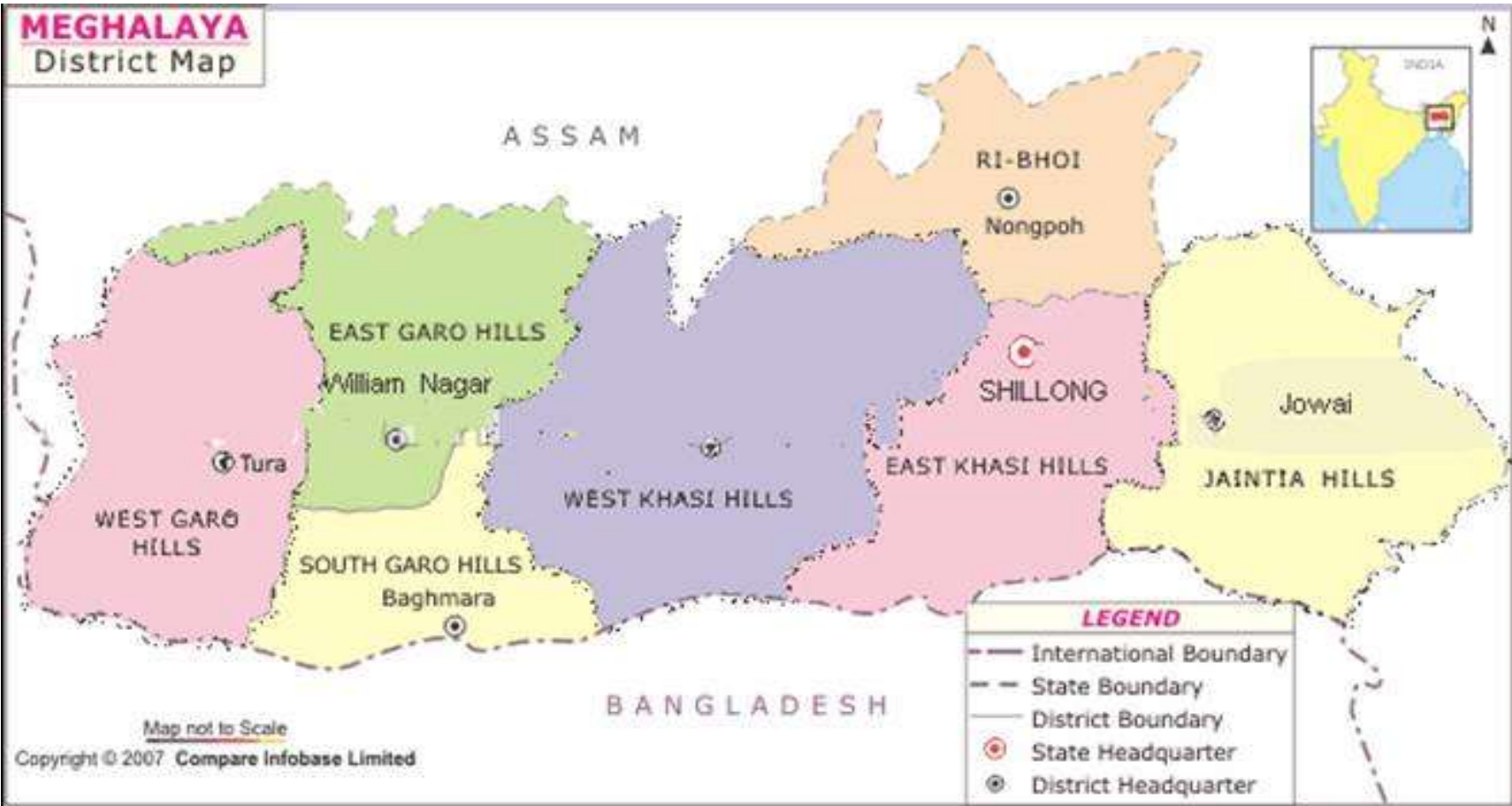
Recent Flash Flood Event

- **2010**
- **2012**
- **2017**

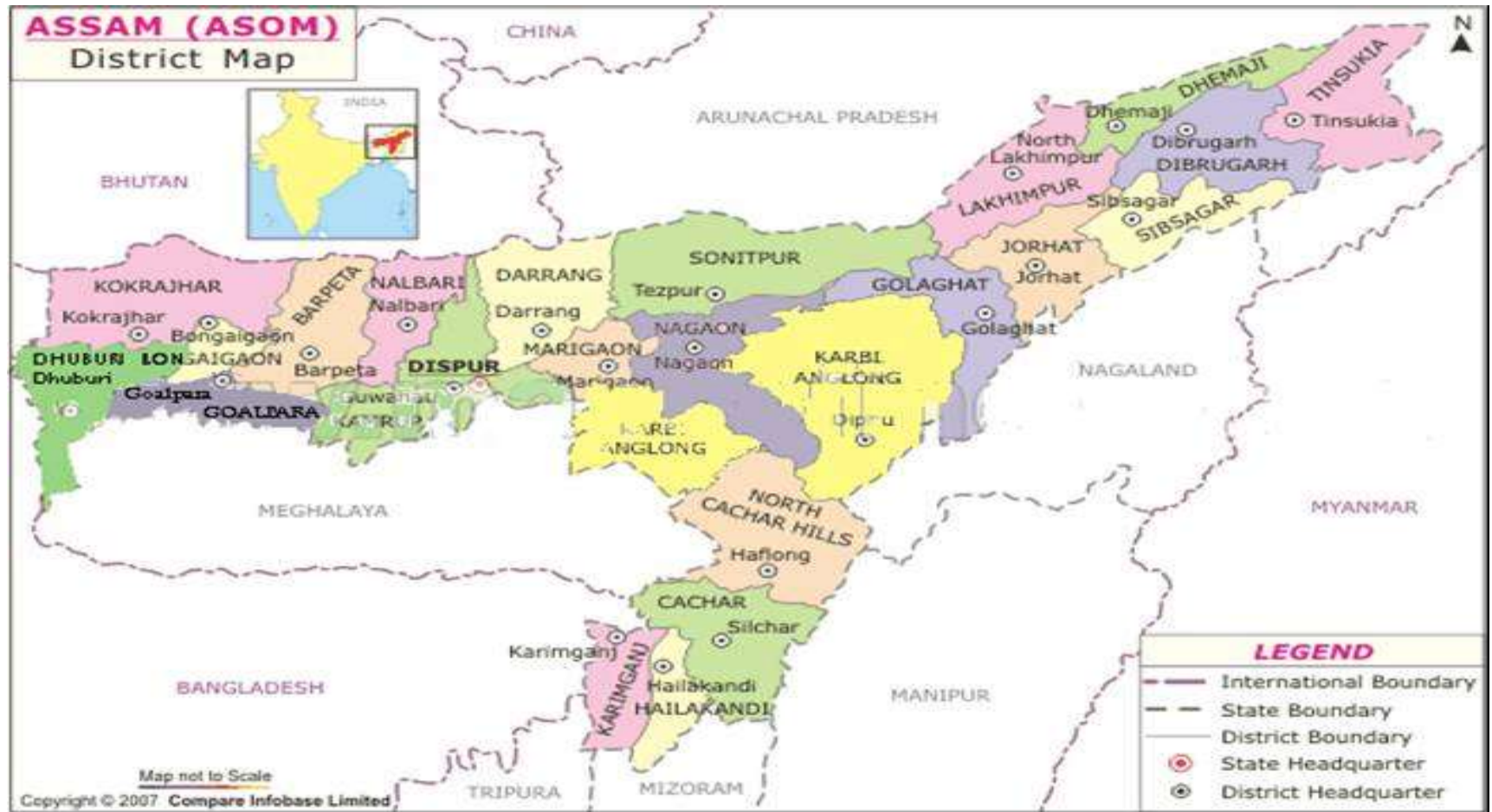
Present Activities/Status

- Based on Meteorological and Hydrological Observation
- No Hydrological Model since 2015. From 2016, an experimental model is operational.
- Qualitative forecast based on Satellite images (BMD, IMD and NOAA rainfall forecast)
- ECMWM Weather Forecast
- Long-range weather Forecast from BMD (Monthly forecast)
- Dissemination nationwide

Basin Contribution



Indian Map adjacent to Northeast of Bangladesh



Flash Flood in Bangladesh



Name of Rice Crop in Bangladesh) : Boro (Largest food grain supply crop

Production Time/ Duration : Nov/Dec to April/May

Flash Flood at April/ May period is the only threat to the production of this crop.

Flash Flood in Haor Area

Haor Flood : Flash Flood hit haor region in 2010, 2012 and 2017

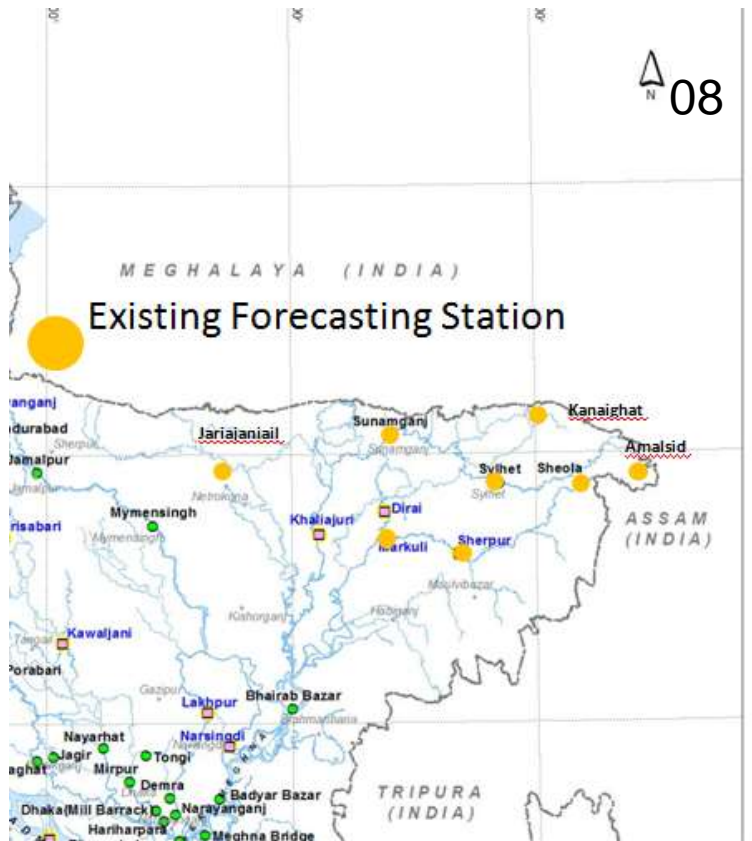


To provide flash flood early warnings well before of flash flood events for the farmers to save boro crops i.e get sufficient time to harvest crop.

Statistics of Damages in 2017 Flash Flood (Source : DDM, 2017)

| No of Affected Districts | No of Affected Families | Damaged Rice Crop Land | No of Totally Damaged house |
|--------------------------|-------------------------|------------------------|-----------------------------|
| 6 no; 62 Upazilla | 850, 088 | 219840 hectare | 2860 |

Flash Flood Forecasting Stations



| River | Station |
|-----------|------------------------|
| Kalni | Markuli |
| Kangsha | Jariajanjail |
| Surma | Sylhet |
| | Sunamgonj Kanaighat |
| Kushiyara | Sherpur |
| | Amalshid Sheola |

4 rivers 08 stations
Up to 2015

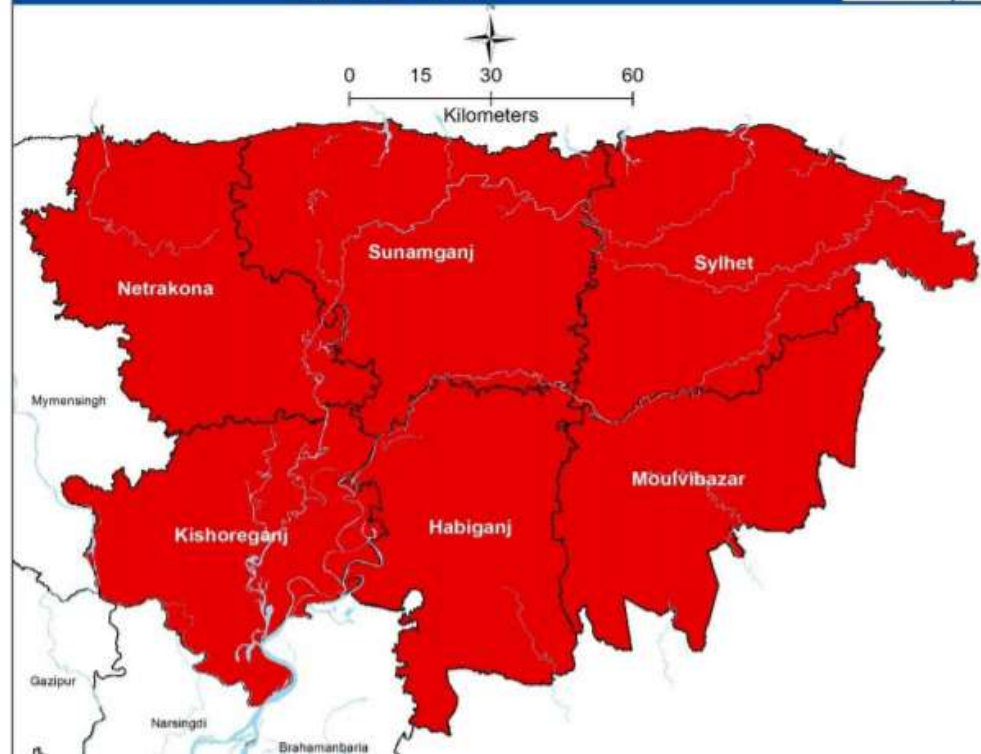
Flash Flood Forecasting Stations

● New 17 = Total 25

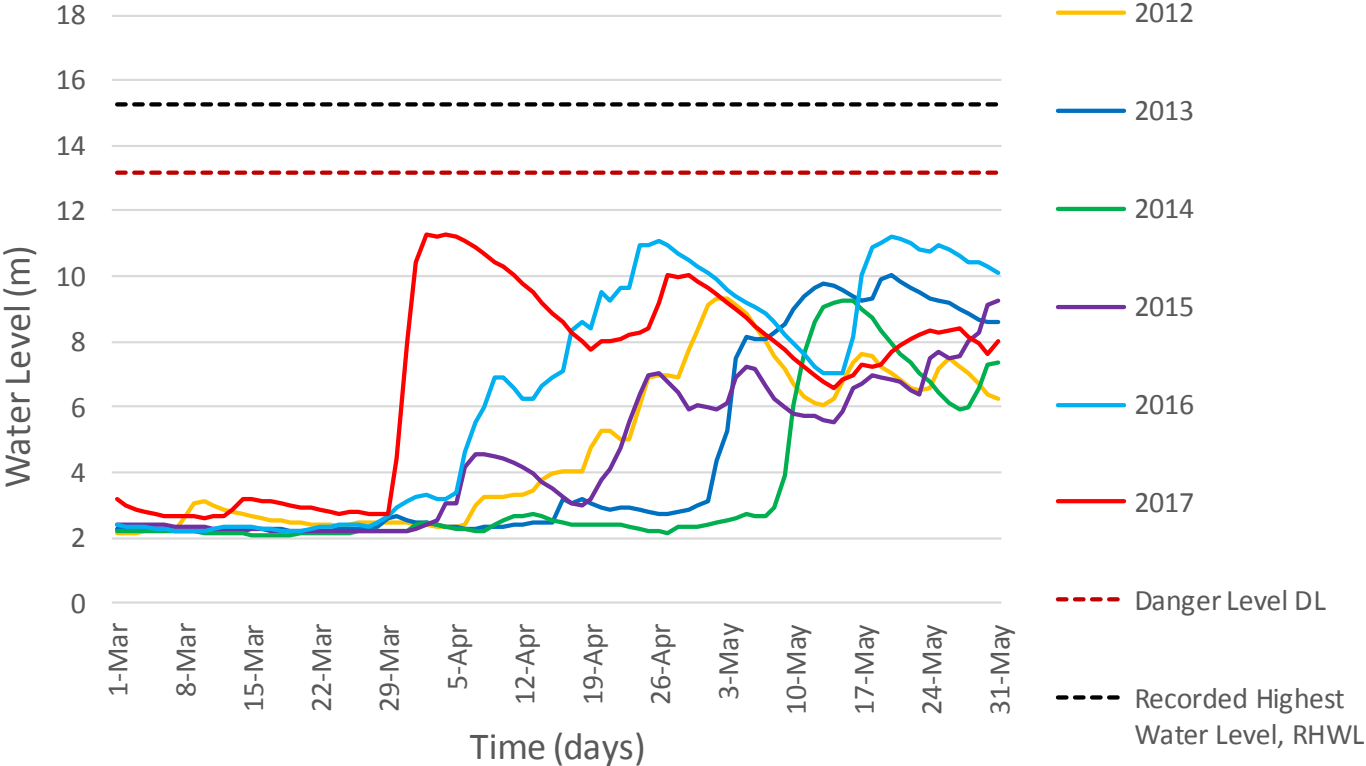


| River | Station |
|----------|-----------------------------|
| Manu | Maulavibazar Railway Bridge |
| Kowai | Habigonj |
| Sarighat | Sarigowain |
| Manu | Moulvibaza |
| Meghna | Narsingdi |
| Kalni | Ajmirigonj |
| | Astagram |
| Kushyara | Sheola |
| Kalni | Bhairab Bazar |
| | Baidder Bazar |
| | Meghna Bridge |

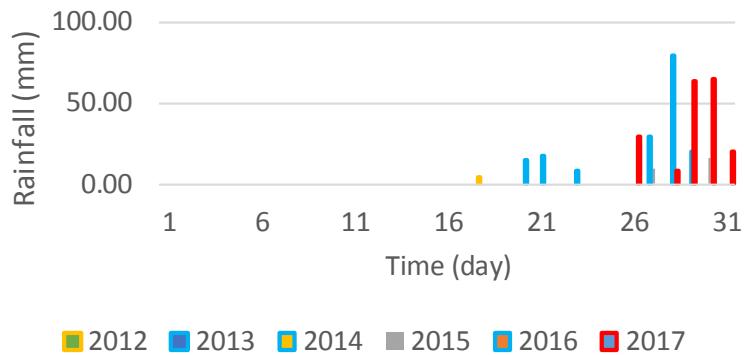
Flash Flood Affected Districts April, 2017



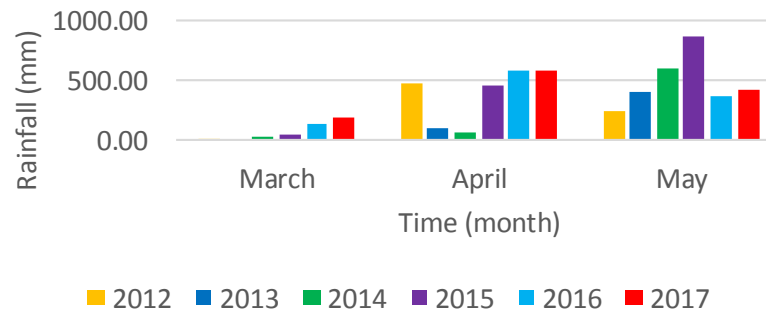
River Surma near Sylhet



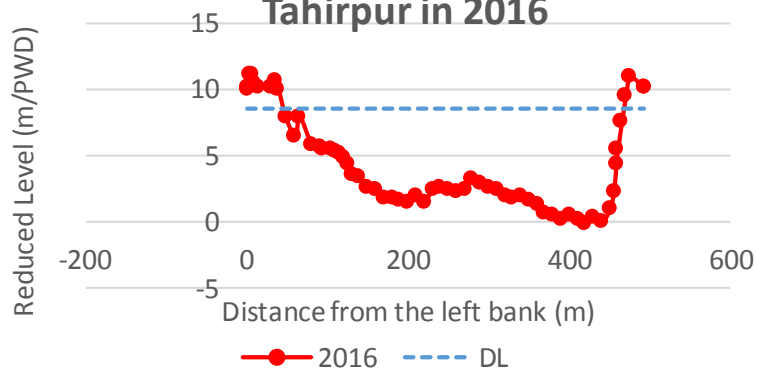
Daily Rainfall in Laurergarh



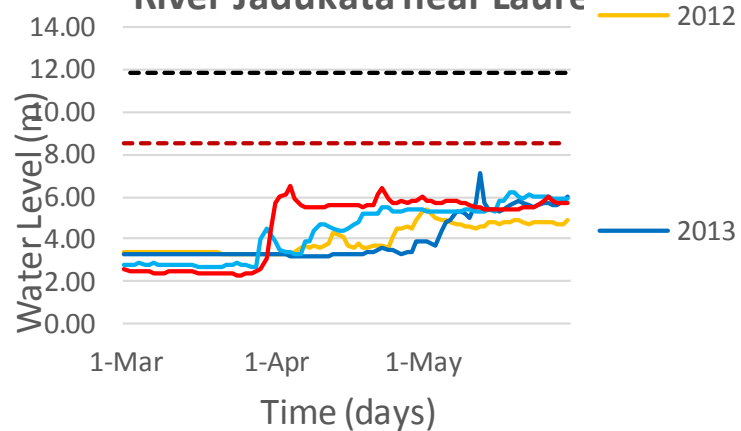
Monthly total rainfall near Laurergarh



River Jadukata near Laurergarh, Tahirpur in 2016



River Jadukata near Laurergarh



Rainfall Scenerio : Sunamgonj District

| Year | 3 Days Maximum Rainfall (mm) | Date (m/d/yyyy) |
|------|------------------------------|-----------------|
| 2000 | 278 | 5/18/2000 |
| 2001 | 175 | 4/30/2001 |
| 2002 | 210 | 5/1/2002 |
| 2003 | 200 | 4/4/2003 |
| 2004 | 300 | 5/23/2004 |
| 2005 | 160 | 3/22/2005 |
| 2006 | 420 | 5/30/2006 |
| 2007 | 98 | 4/9/2007 |
| 2008 | 150 | 4/19/2008 |
| 2009 | 151 | 5/31/2009 |
| 2010 | 263 | 5/23/2010 |
| 2011 | 170 | 5/4/2011 |
| 2012 | 113 | 4/30/2012 |
| 2013 | 144 | 5/1/2013 |
| 2014 | 166 | 5/9/2014 |
| 2015 | 217 | 5/16/2015 |
| 2016 | 172 | 5/19/2016 |
| 2017 | 274 | 4/1/2017 |

Flash Flood 2017 : Rainfall Scenario

Indian Rainfall (mm) Data from IMD

| Station | 3/29/2017 | 3/30/2017 | 3/31/2017 | 4/1/2017 | 4/2/2017 | 4/3/2017 | 4/4/2017 | 4/5/2017 | 4/6/2017 | 4/7/2017 |
|-----------------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|
| AIZAWL | 0 | 1 | 6 | 0 | 1 | 3 | 65 | 26 | | 0 |
| SILCHAR | 0 | 81 | 242 | 35.2 | 18.3 | 66 | 57.7 | 21.6 | 0.4 | 0.2 |
| Kailasahar/Manu | 0 | 57 | 41 | 15 | 3 | 5 | 19 | 61 | 95.7 | 0 |
| Cherrapunjee | 48 | 151 | 165 | 280 | 237.4 | 164 | 136.8 | 2.2 | 2 | 0 |
| Agartala A/P | 0 | 44 | 15 | 0 | 0 | 0 | 2 | 3 | 30.3 | 0 |
| shillong | 1 | 19 | 35 | 35.2 | 5.4 | 21 | 24.1 | 4.2 | 7.8 | 0 |

Bangladesh Rainfall (mm) Data

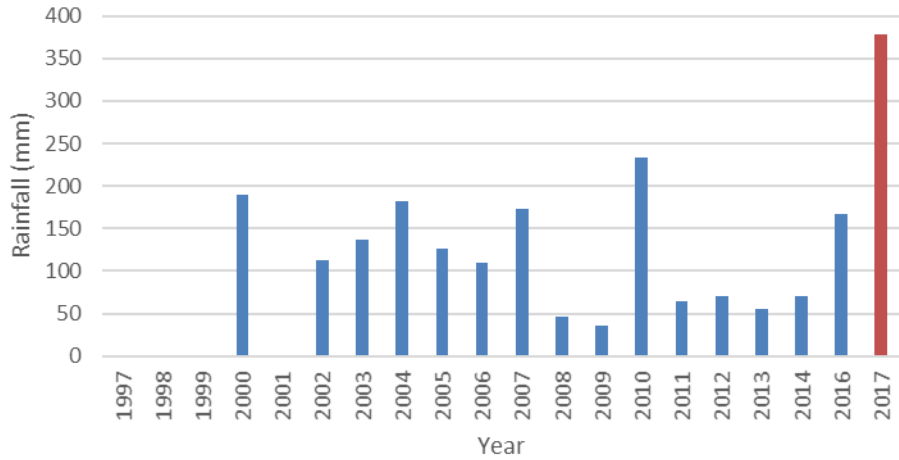
| Station | 3/29/2017 | 3/30/2017 | 3/31/2017 | 4/1/2017 | 4/2/2017 | 4/3/2017 | 4/4/2017 | 4/5/2017 | 4/6/2017 | 4/7/2017 |
|--------------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|
| Durgapur | 18 | 28 | 53 | 33 | 1 | 21 | 21 | 8 | 27 | 0 |
| Habiganj | 15.7 | 95 | 10 | 3.5 | 0 | 0 | 5.5 | 95 | 49 | 0 |
| Jariajanjail | 79 | 75 | 10 | 10 | 0 | 18 | 8 | 12 | 38 | 0 |
| Kanaighat | 3 | 135 | 150 | 93 | 72 | 47 | 98 | 24 | 2 | 0 |
| Louregorh | 63 | 65 | 20 | 116 | 108 | 23 | 52 | 0 | 0 | 0 |
| Manu Rly Br. | 0 | 46 | 18 | 0 | 0 | 40 | 28 | 62 | 46 | 0 |
| Moulvi Bazar | | 124 | 5 | 3 | 0 | 0 | 15 | 50 | 145 | 0 |
| Nakuagaon | 183 | 22 | 6 | 10.5 | 8.5 | 13.5 | 24 | 2 | 75.5 | 0 |
| Sheola | 0 | 182 | 92 | 142 | 162 | 62 | 65 | 34 | 1 | 0 |
| Sherpur | 7 | 125 | 20 | 0 | 10 | 75 | 35 | 38 | 94 | 0 |
| Sunamganj | 35 | 102 | 38 | 134 | 86 | 37 | 50 | 8 | 8 | 0 |
| Sylhet | 10 | 142 | 61 | 121 | 154 | 77 | 76 | 17 | 6 | 0 |

Flash Flood 2017 : River Situation

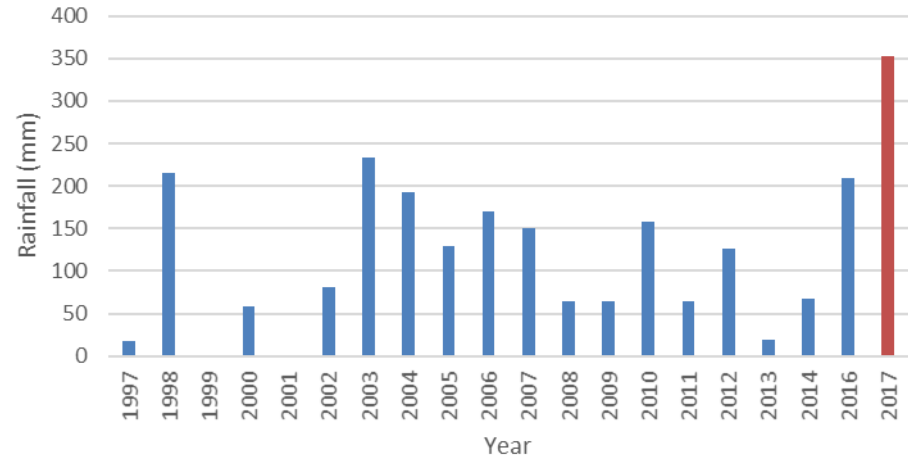
| Station | 3/29/20 17 | 3/30/20 17 | 3/31/20 17 | 4/1/20 17 | 4/2/20 17 | 4/3/20 17 | 4/4/20 17 | 4/5/20 17 | 4/6/20 17 | 4/7/20 17 |
|--------------|---------------|---------------|---------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| Amalshid | 6.9 | 8.27 | 12.31 | 14.93 | 15.77 | 15.7 | 15.99 | 16.01 | 15.79 | 15.32 |
| Kanaighat | 4.64 | 7.87 | 10.89 | 13.36 | 14.34 | 14.4 | 14.19 | 13.77 | 13.41 | 13.07 |
| Sylhet | 2.75 | 5.3 | 8.14 | 10.71 | 11.19 | 11.16 | 11.28 | 11.17 | 11.04 | 10.83 |
| Sunamganj | 2.47 | 4.07 | 5.75 | 7.19 | 7.58 | 7.74 | 7.99 | 8.1 | 8.04 | 7.94 |
| Sheola | 4.85 | 5.23 | 9.77 | 12.6 | 13.52 | 13.57 | 13.89 | 13.76 | 13.59 | 13.28 |
| Sherpur | 3.22 | 3.4 | 5.06 | 7.22 | 7.85 | 8.24 | 8.37 | 8.62 | 9.01 | 8.95 |
| Markuli | | | | 6.74 | 7.21 | 7.41 | 7.63 | 7.78 | 7.96 | 8.27 |
| Manu Rly Br. | 13.23 | 13.27 | 15.25 | 14.65 | 14.14 | 13.78 | 13.78 | 15.08 | 17 | 15.3 |
| Kamalganj | 16.22 | 16.26 | 18.4 | 17.58 | 16.94 | 16.63 | 17.1 | 17.5 | 19.54 | 18.38 |
| Moulvi Bazar | | 7.09 | 8.69 | 9 | 8.93 | 8.83 | 9.05 | 9.92 | 11.65 | 10.72 |
| Ballah | | 21.82 | 21.08 | 20.36 | 20.15 | 20.06 | 20.16 | 21.13 | 21.87 | 20.91 |
| Habiganj | | 6.53 | 7.53 | 6.64 | 6 | 5.76 | 5.73 | 5.95 | 10.05 | 7.35 |
| Sarighat | 5.81 | 10.55 | 10.75 | | 12.75 | 12.92 | 12.75 | 11.99 | 11.28 | 11.04 |
| Durgapur | 9.8 | 9.74 | 9.72 | 10.05 | 9.98 | 10.02 | 10 | 9.85 | 9.49 | 9.37 |
| Nakuagaoan | 20.62 | 19.02 | 18.97 | 19.3 | 19.57 | 19.32 | 19.2 | 19.12 | 19.47 | 19.15 |
| Jariajanjail | 4.4 | 5.83 | 6.98 | 8 | 8.2 | 8.35 | 8.21 | 8.1 | 8.07 | 7.96 |
| Lourergorh | 2.62 | 3.42 | 4.6 | 5.77 | 6.09 | 6.08 | 6.47 | 5.9 | 5.58 | 5.48 |

Flash Flood 2017 : Rainfall Comparison

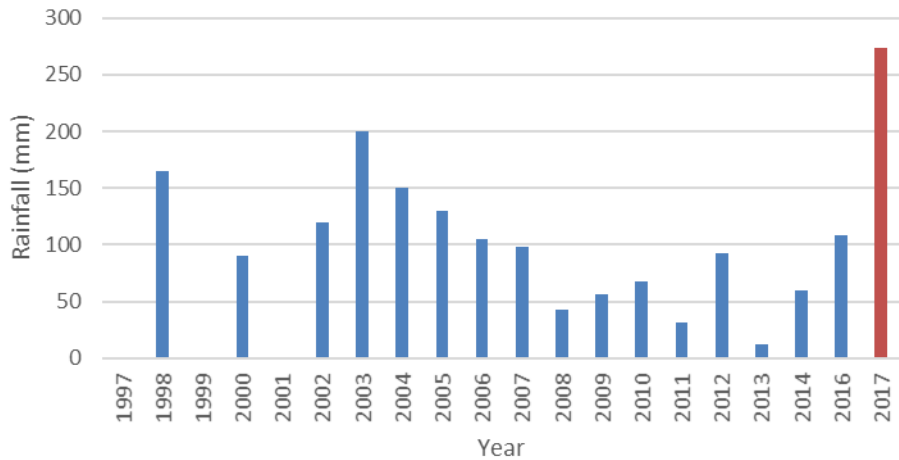
3 day max at Kanaighat (Mar 15- Apr 20)



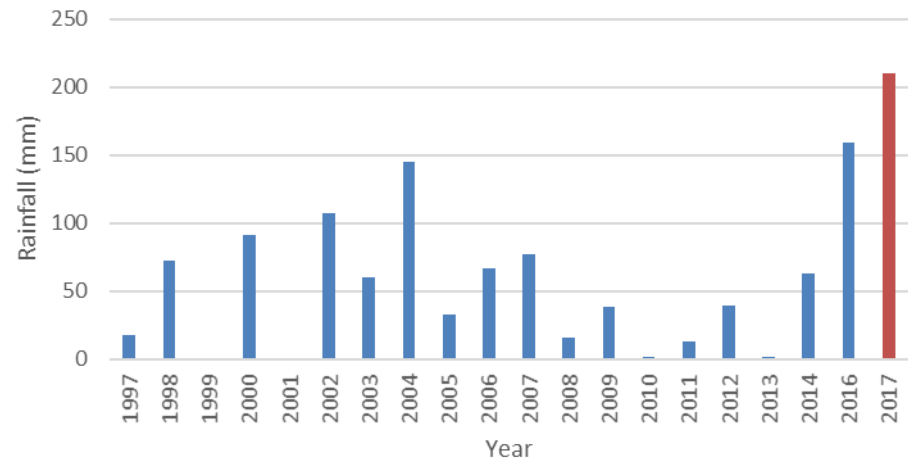
3 day max at Sylhet (Mar 15- Apr 20)



3 day max at Sunamgnaj (Mar 15- Apr 20)

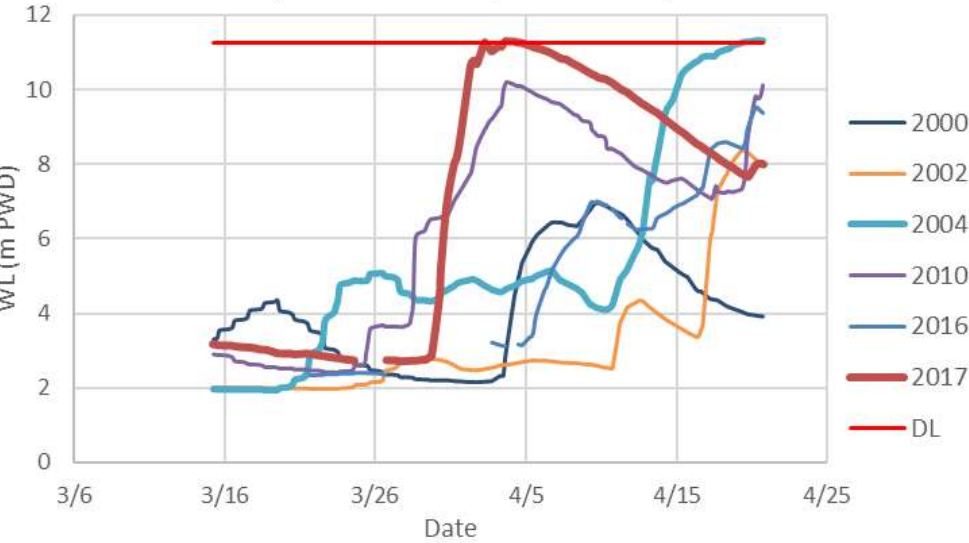


3 day max at Moulvi Bazar (Mar 15- Apr 20)

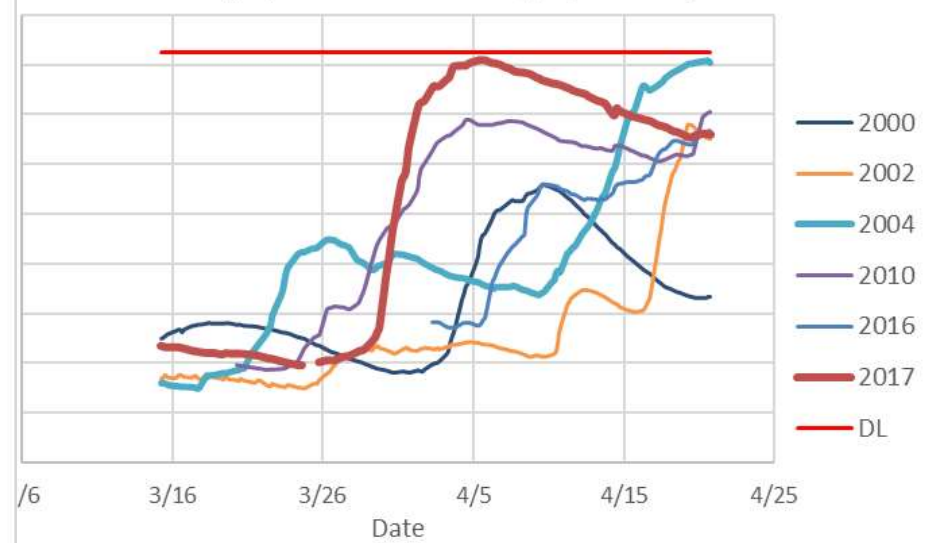


Flash Flood 2017 : River Water Level Comparison

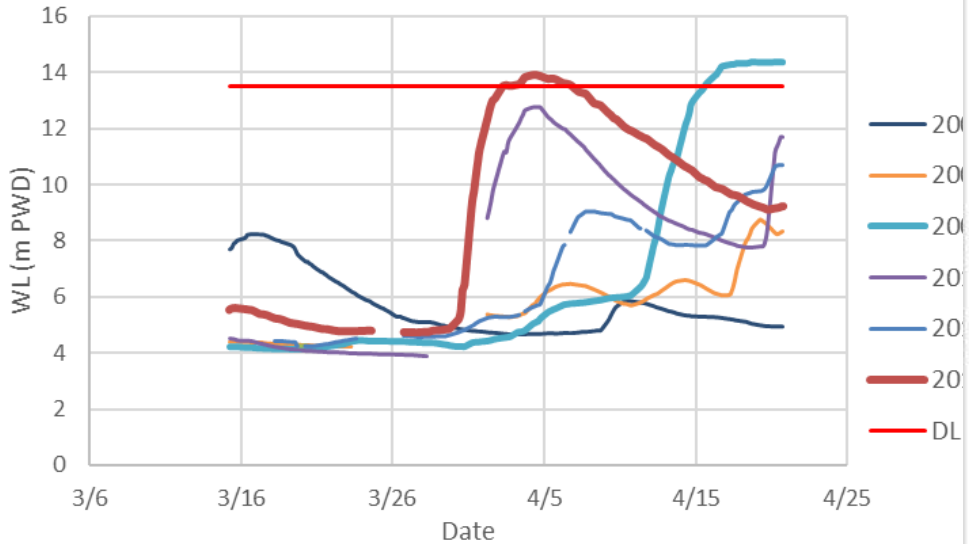
Sylhet:- Surma at Sylhet -3 hourly WL



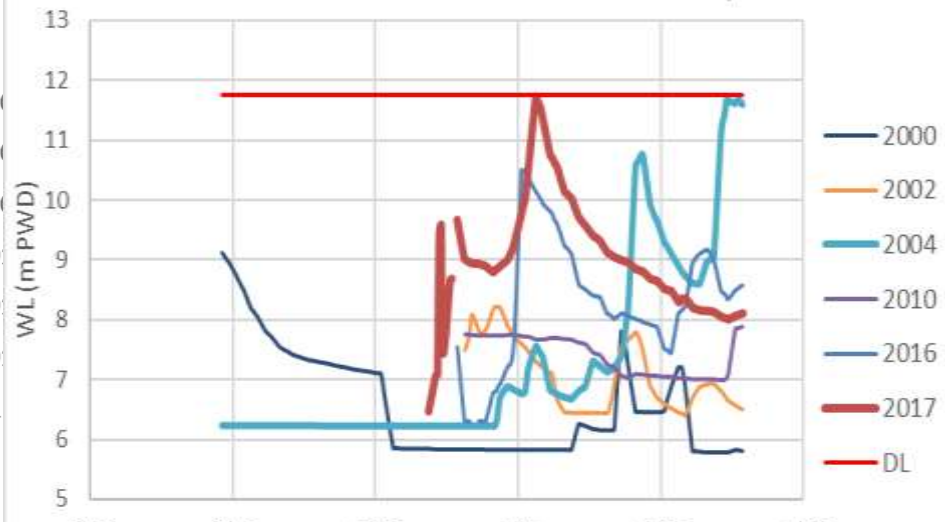
Sunamganj:- Surma at Sunamaganj -3 hourly WL

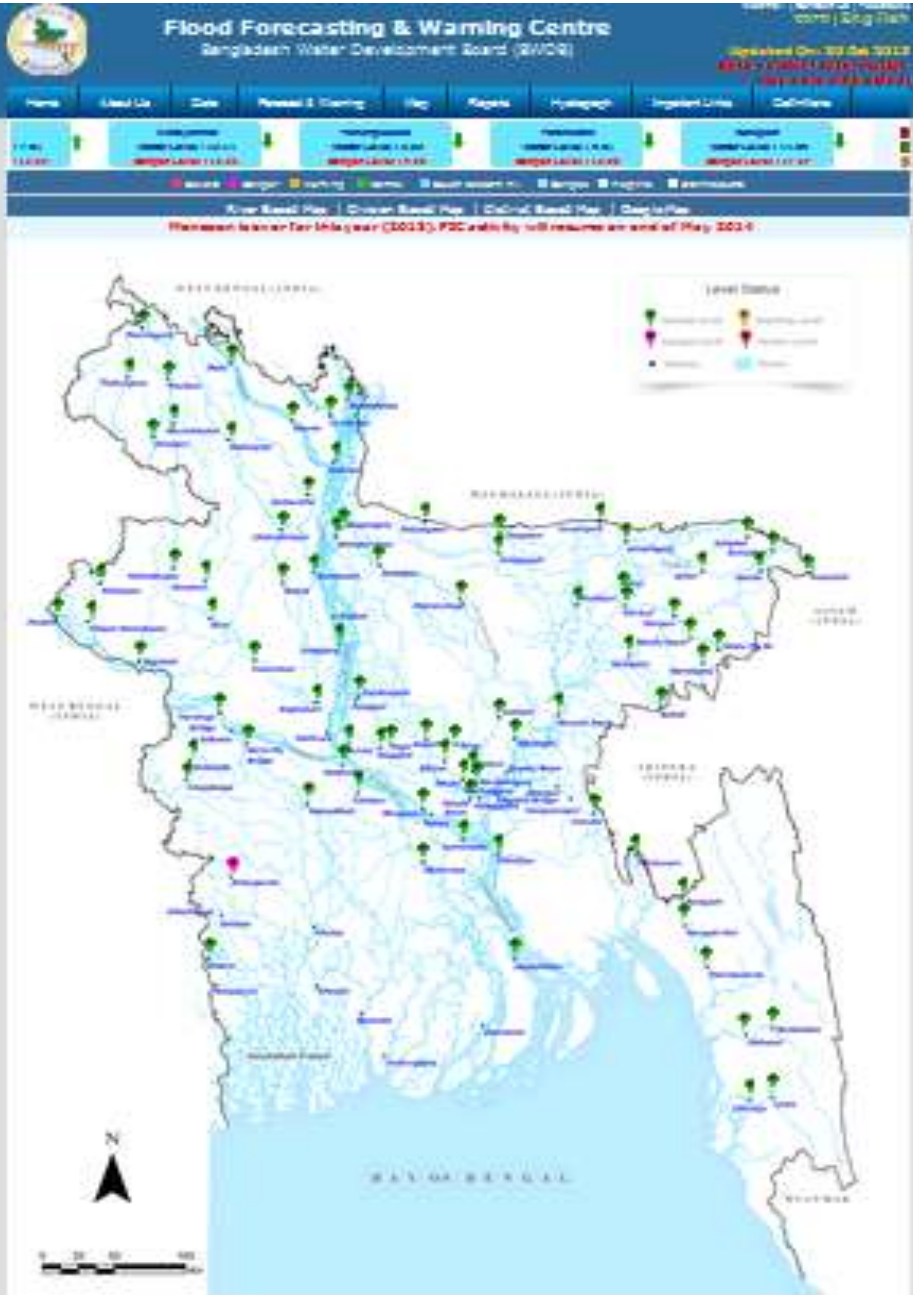


Sheola:- Kushiara at Sheola -3 hourly WL



Moulvi Bazar:- Manu at Moulvi Bazar -3 hourly WL





Contents:

1. Daily flood and rainfall outlook.
2. 5 and 10 days flood forecast.
3. Daily and historical flood hydrograph.
4. Flood inundation map of whole Bangladesh and Dhaka city.
5. Annual flood report.
6. Real-time water level data of 4 stations.

Water Level Status



Normal level (more than 50 cm below the danger level)



Warning level (within 50 cm below of the danger level)



Danger level (at or above danger level up to 1 m)



Severe level (more than 1 m above the danger level)

Flood Forecasting & Warning Centre

Bangladesh Water Development Board (BWDB)

NEW! Experimental Flash Flood Forecast - North East Region

Updated On: 8 Mar 2018

Beta version! Information may vary with actual

Home

About Us

Data

Forecast & Warning

Map

Reports

Hydrograph

Important Links

Definitions

Rainfall Table

Water Level Table

Severe ■ Danger ■ Warning ■ Normal ■ South Eastern Hill ■ Ganges ■ Meghna ■ Brahmaputra Unit (mPWD)

River Based Map | Division Based Map | District Based Map | Google Map

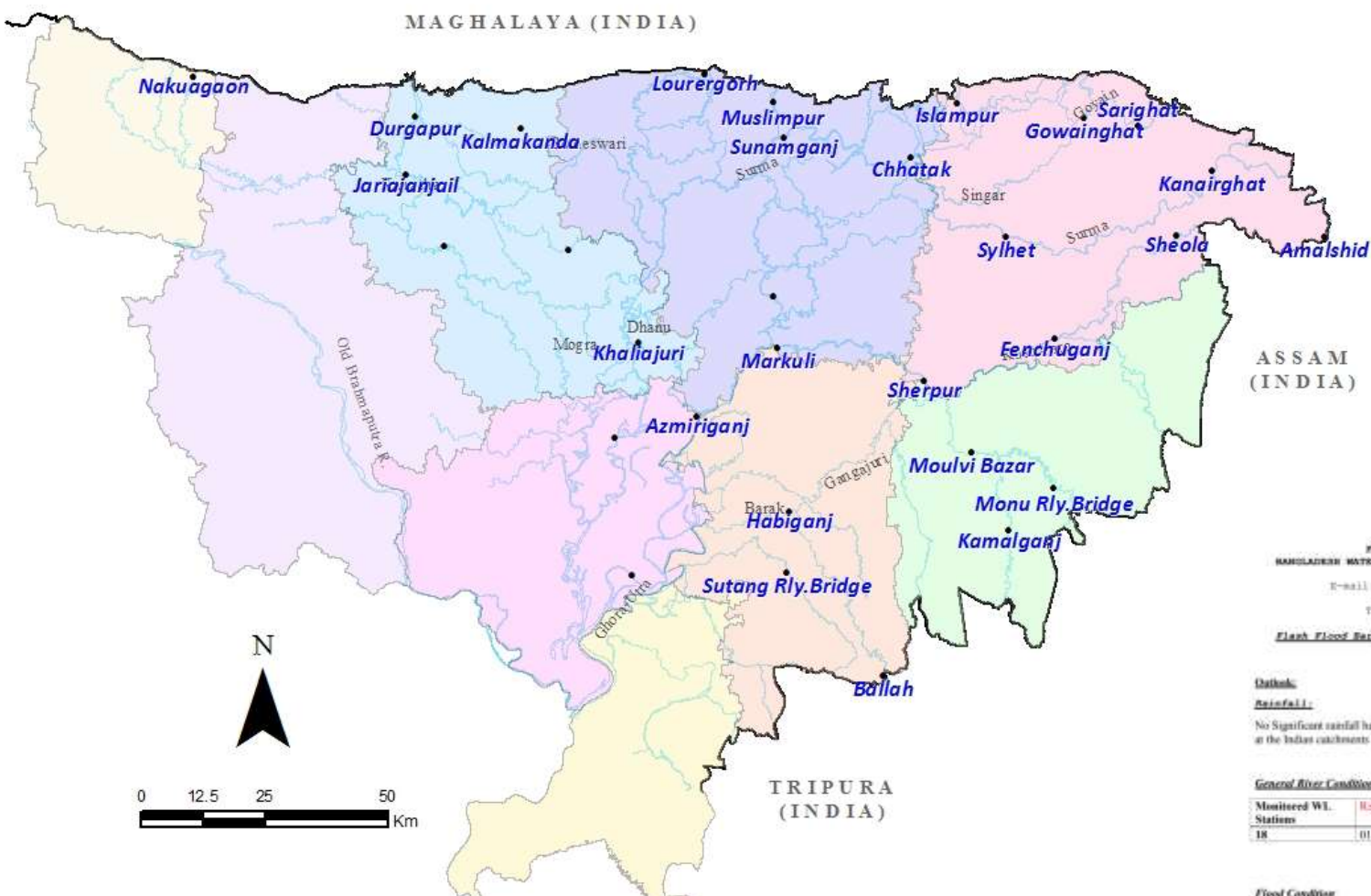




Experimental Flash Flood Early Warning

Flood Forecasting and Warning Center (FFWC)

Bangladesh Water Development Board (BWDB)



Level Indicator/Marker

- Normal Level
- Warning Level
- Flood Level
- Severe Level

Warning Level

- Normal Level** – More than 50 cm below Danger Level
- Warning Level** – Below Danger Level within 50 cm
- Flood Level** – At and above Danger Level upto 1 cm
- Severe Level** – More than 1 meter above Danger Level

FLOOD INFORMATION CENTRE,
FLOOD FORECASTING & WARNING CENTRE
BANGLADESH WATER DEVELOPMENT BOARD, NAJDA BUILDING, 6TH FLOOR,
DHAKA.

E-mail: ffwc@bwdb.com, ffwc@yaboo.com
Website: <http://www.ffc.gov.bd>
Tel: 9551118, 9550755 Fax: 9557388

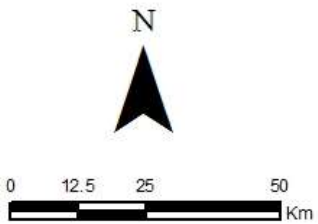
Flash Flood Early Warning Bulletin for North East Region as on April 17, 2017

Date:
Rainfall:
No Significant rainfall has been recorded during last 24 hours and no forecast of heavy rainfall at the Indian catchments for the next 72 hours.

General River Condition:

| Monitored WL Stations | Rise | Fall | Steady | Not Reported | Stations above DL |
|-----------------------|------|------|--------|--------------|-------------------|
| 18 | 01 | 14 | 01 | 02 | 0 |

Flood Condition:



Flash Flood Bulletin

FLOOD INFORMATION CENTRE
FLOOD FORECASTING AND WARNING CENTRE
BANGLADESH WATER DEVELOPMENT BOARD
WAPDA BUILDING, 8TH FLOOR MOTIJHEEL C/A, DHAKA-1000
e-mail-ffwcbwdb@gmail.com; web site-www.ffwc.gov.bd, phone 9550755
EXPERIMENTAL FLASH FLOOD CONDITION IN THE NORTH EAST REGION AS ON
7 MAY 2013

RAINFALL

No significant rainfall (more than 50mm) observed in the region and its adjoining areas in India during last 24 hours. There is possibility of occurring slight rainfall today and tomorrow(8 May 2013) in the adjoining Meghalya area.

OUTLOOK

The Surma, Kushiyara and Kangsha Rivers are in normal condition. Model indicated rising trend of Water Level for Today and Tomorrow in Surma, Kushiyara & Kangsha rivers. Possibility of No Flash Flood for next two days in Sylhet & Sunamgonj areas.

STATIONS ABOVE DANGER LEVEL(DL)

No Water Level stations of the rivers observed above DL during last 24 hrs ending at 06:00 hrs today

GENERAL RIVER CONDITION

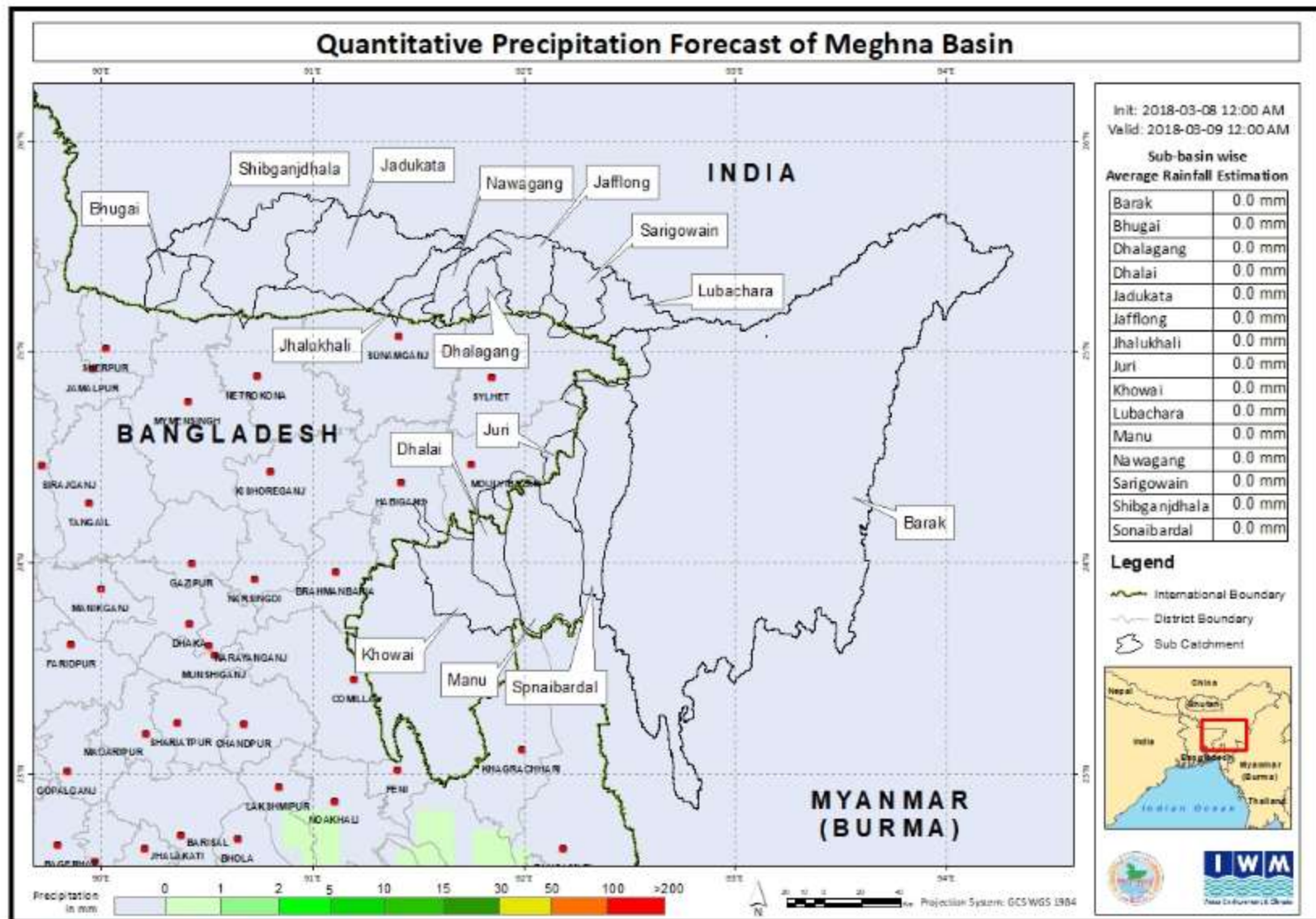
| | | | |
|--------------------------------|----|--------------------|---|
| Monitored Water Level Stations | 17 | Steady | 0 |
| Rise | 12 | Not Reported | 1 |
| Fall | 4 | Above Danger Level | 0 |

Model Forecast : 6, 12, 24, & 48 hours

| River | Station | DL(m) | 07 May 2013 | | | | 08 May 2013 | | 09 May 2013 | |
|-----------|--------------|-------|-------------|----------------------|----------------------|----------------|---------------------|----------------|---------------------|----------------|
| | | | Today | 6-hr. | 12-hr. | 12-hr. | 24-hr. | 24-hr. | 48-hr. | 48-hr. |
| | | | 06:00hrs | Forecast 12:00hrs | Forecast 18:00hrs | +rise -fall | Forecast 6:00hrs | +rise -fall | Forecast 6:00hrs | +rise -fall |
| | | (m) | (m) | (m) | (cm) | (m) | (cm) | (m) | (cm) | |
| Kushiyara | Amalshid | 15.85 | 12.19 | 12.23 | 12.23 | 4 | 12.33 | 14 | 12.34 | 15 |
| Kushiyara | Sheola | 13.50 | 10.16 | 10.23 | 10.26 | 10 | 10.32 | 16 | 10.40 | 24 |
| Kushiyara | Sherpur | 9.00 | 5.58 | 5.64 | 5.69 | 11 | 5.81 | 23 | 5.98 | 40 |
| Surma | Kanaighat | 13.20 | 10.07 | 10.14 | 10.20 | 13 | 10.30 | 23 | 10.47 | 40 |
| Surma | Sylhet | 11.25 | 8.05 | 8.07 | 8.09 | 4 | 8.14 | 9 | 8.31 | 26 |
| Surma | Sunamgonj | 8.25 | 5.88 | 5.89 | 5.90 | 2 | 5.95 | 7 | 6.05 | 17 |
| Kalni | Markuli | - - | 6.13 | 6.18 | 6.23 | 10 | 6.32 | 19 | 6.47 | 34 |
| Kangsha | Jariajanjail | 9.78 | 6.98 | 7.04 | 7.13 | 15 | 7.30 | 32 | 7.63 | 65 |

This activity Supported by the CDMP-II

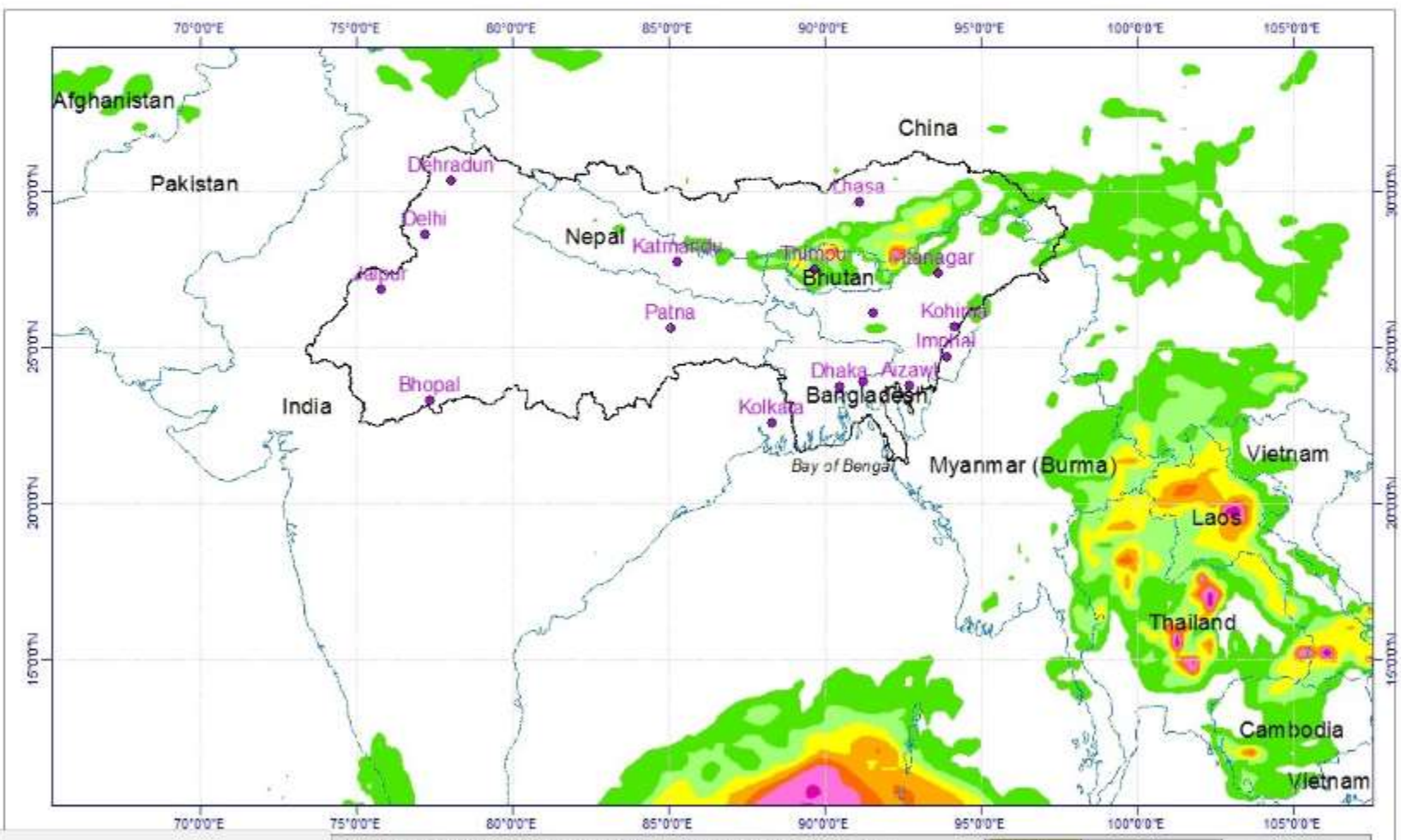
Forecast for Today



WRF Forecast GBM Basin

- Today
- 2nd day
- 3rd day
- 4th day
- 5th day
- 6th day

Forecast for Today



Flood Warning Dissemination Modes

Hard Copy – Limited, policy makers and top officials

e-mail – over 600 address, in different groups, Ministries, BWDB, Disaster management agencies, NGO, Research Organ, Development partners, DC, Media

Fax – Limited, policy makers and top officials

Phone – Continuous response

Web-site – www.ffwc.gov.bd

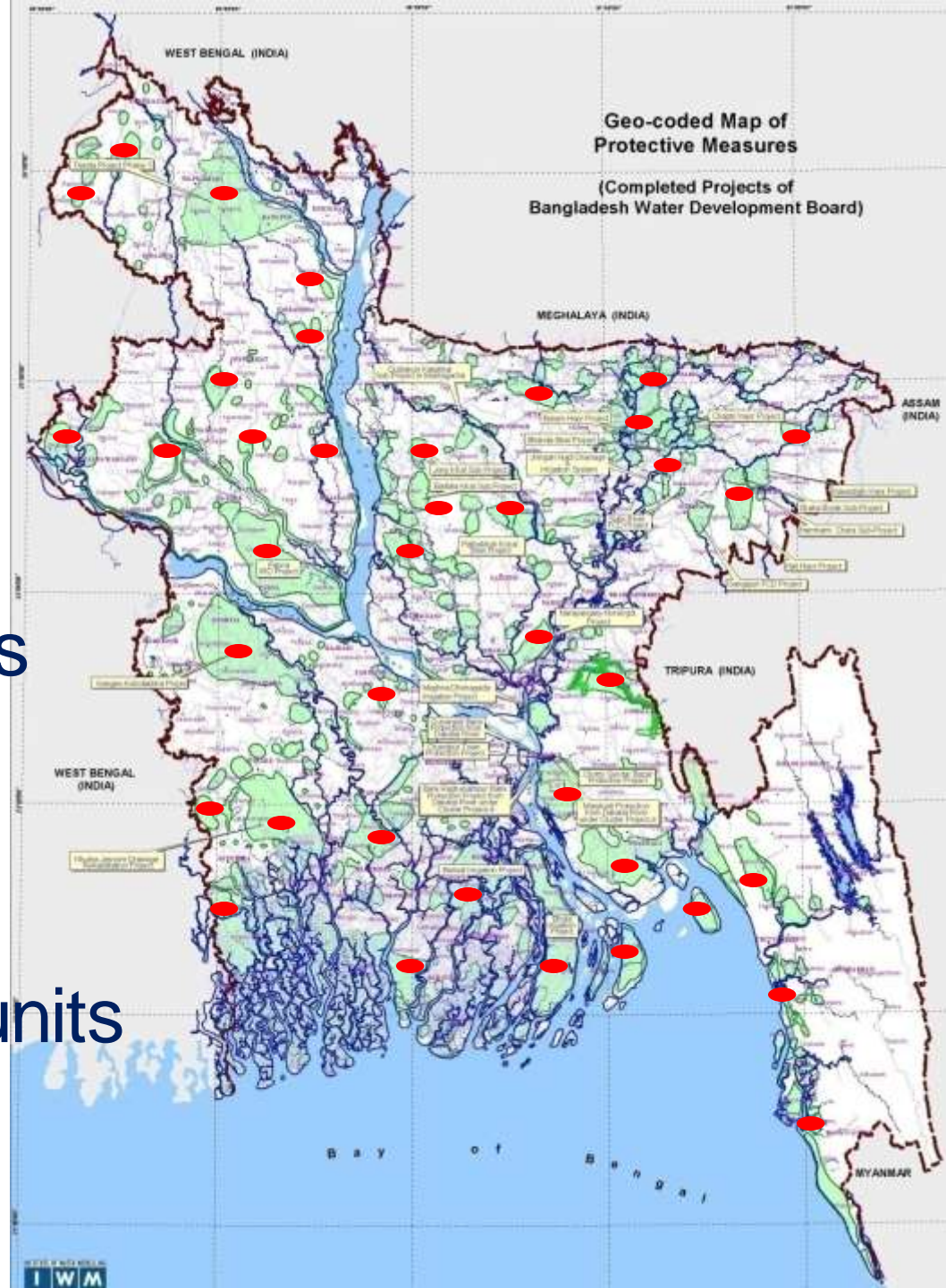
SMS – Very limited



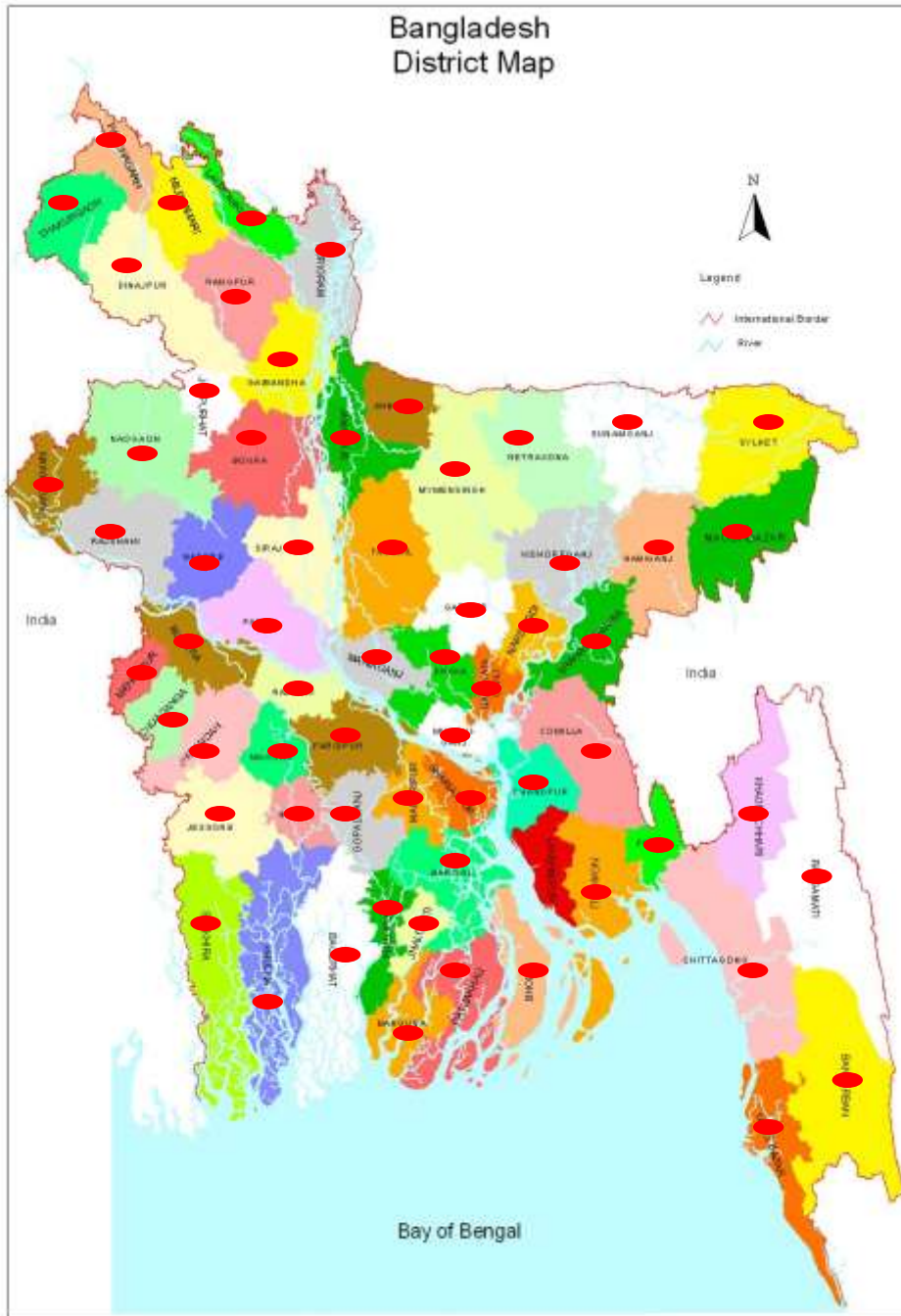
IVR using mobile – Started from July-2011, call **1090-5** from mobile (then dial 5) Bangla Voice Message can be heard, charge applicable

E-mail –
all water
management
project authority

Zonal Chief Engineers
Superintending Engr
Executive Engr
Sub-Divisional Engr
Water Management units



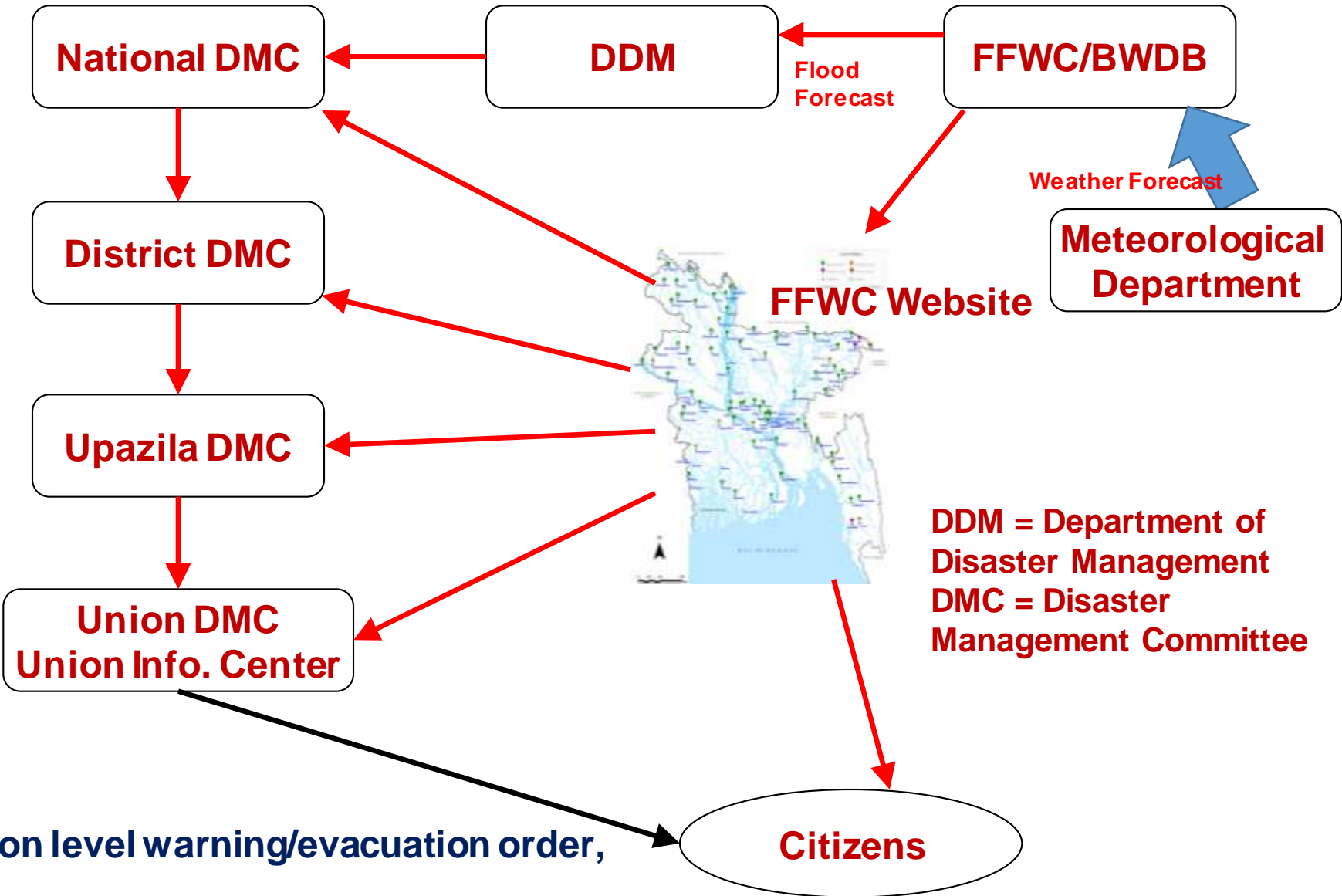
Bangladesh
District Map



E-mail –
all districts 64 nos

District Disaster
management
Committees

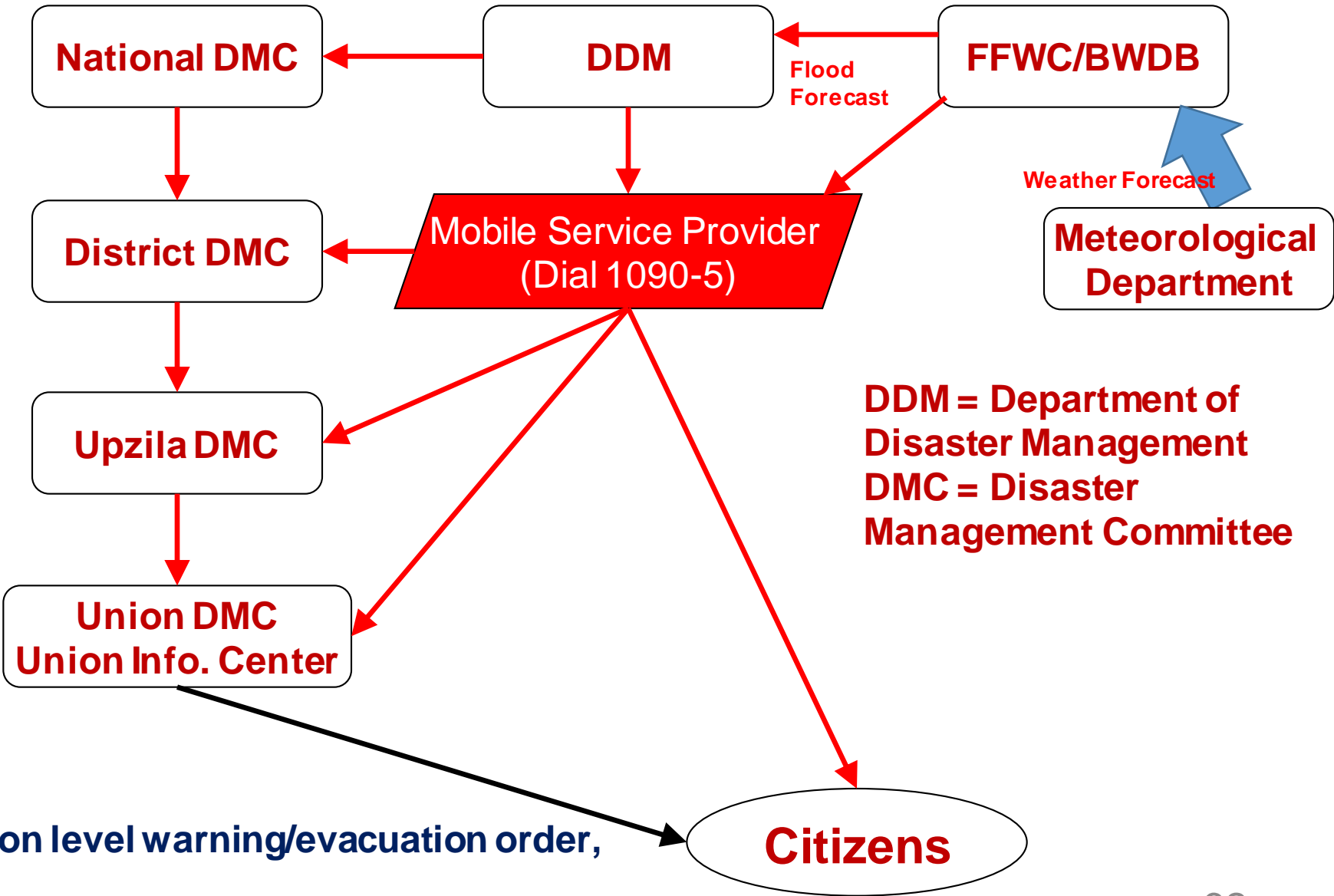
Flood Forecast Dissemination Strategy: National Protocol



DDM = Department of Disaster Management
DMC = Disaster Management Committee

Union level warning/evacuation order, etc by human, through speaker at mosque,

Flood Forecast Dissemination Strategy: Cell Broadcasting



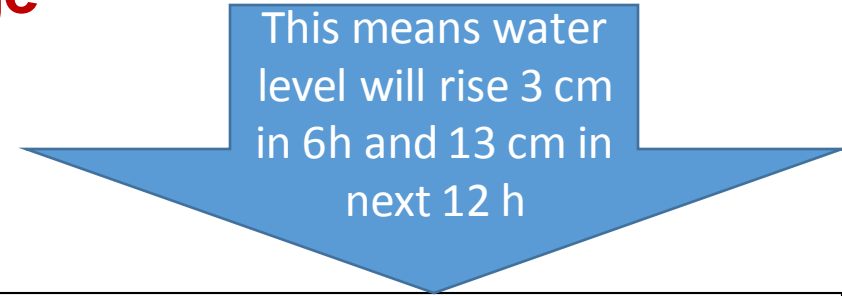
Union level warning/evacuation order, etc
by human, through speaker at mosque,

Warning Dissemination to the Local Level: Recent

Initiative

FFWC

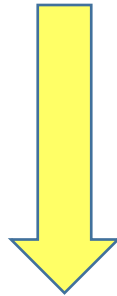
**Forecast Message
in Bangla**



This means water level will rise 3 cm in 6h and 13 cm in next 12 h

Dhaka*170815* 1w`#b cvwb 3†mwg Kg#e, 5w`#b cvwb 13†mwg Kg#e

Water Level



Forecast sent to Gauge Point by SMS

www.bwdb.gov.bd



Thank you very much

Thank you