WHAT VALUE DOES CARE’s SHOUHARDO II ADD IN CURRENT FLOOD FORECASTING WARNING SYSTEMS IN BANGLADESH?

TOPS – Asia Regional Knowledge Sharing Meeting
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SHOUHARDO II Program
CARE Bangladesh
Overview

Bangladesh and Flood:

- Riverine Country
- Prone to Flood Risk – Geophysical setting, Low-lying, Experiencing flood - a common phenomenon
- Flash Flood, Rain Flood, Seasonal Monsoon Flood & Tidal Flood (due to storm surge)
Bangladesh is a Land of Rivers

6 Hydrological regions of Bangladesh

Total number of rivers 405
Topography of Bangladesh

- About 16% of the area below 1.50 m of MSL
- About 50% of the country is within 6-7 m of MSL
- 25-30% of the area is inundated during normal flood
- Max. 68% area inundated during 1998 flood

Source: FFWC, BWDB
Bangladesh rivers receive runoff from a catchment of 1.75 million sq-km, around 12 times its land area.

The total area of the three basins stands at 1.75 million km² covering areas of India, Nepal, Bhutan, the Tibetan region of China and Bangladesh, of which only 7% lies within Bangladesh.
Excessive rainfall in GBM basins is the principal cause of riverine floods in Bangladesh.

There are 57 rivers which originate outside the boundary of Bangladesh.

About 1.18 trillion cubic meters of water flows annually to the sea, of which 1.07 trillion cubic meters or 91 per cent enters Bangladesh from upstream catchments and the rest are contributed by total internal rainfall.
Flooded Area from 1954 to 2011

Sever flood frequency increasing

1998 is the most severe flood

Source: FFWC, Monsoon Forum 2012
So, Flood Forecasting is very important! Who does it?

**Institutional arrangements:**
Flood Forecasting and Warning Center (FFWC), established in 1972, a wing of Bangladesh Water Development Board (BWD) is officially mandated to generate and disseminate the flood forecasting and warning to appropriate authority for further dissemination down to the community.

**Time period:** Flood Information Center (FIC) of FFWC operates from 3rd week of May to October each year.
FFWC’s Current Capacity in Flood Forecast

**Very Short term flood forecast** – 24 hours (1 day)
**Short Range flood forecast** – up to 3 days
**Short Range flood Forecast** – up to 5 days *(started in 2013, supported by CDMP/UNDP)*
(These are deterministic type with specific values)

**Medium range forecast** – up to 10 days probability approach with upper band average and lower band

**Flash flood forecast** – *Started in 2012* (Experimental)

**Long Rang/Seasonal** – *Just started in 2014* (Experiment on going)
(Supported by CARE’s SHOUHARDO Program/USAID)
For Flood Forecasting Purpose 4-Basins considered
CARE/SHOUHARDO’s Contribution in Flood Forecasting
Enhancing Flood Early warning System for community based response in Bangladesh, SHOUHARDO II

Goal:
To increase lead time of flood forecasts for different scales and enhance resilience to and preparedness for flood risk in Bangladesh.

Objectives:

1. Expand medium range (1-10 days) flood forecast to other basin (i.e. Megna) and dissemination system to larger pilot area (i.e. 15 Unions);
2. Piloting flash flood early warning system at Sunamgang & Cox’Bazar area;
3. Operationalize long range (1-3 month) forecasts to five pilot areas.
<table>
<thead>
<tr>
<th>Year Range</th>
<th>Agency/Partners</th>
<th>Milestones</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000-2005</td>
<td>USAID/ADPC-CFAB</td>
<td>72 hrs day lead time&lt;br&gt;add predictive skills to current efforts&lt;br&gt;- Model Dev. and Experimental Forecasts&lt;br&gt;- improvements in data availability, predictive modeling&lt;br&gt;- promote Int’l cooperative efforts for sharing data</td>
</tr>
<tr>
<td>2006-2009</td>
<td>USAID/SHO U-I</td>
<td>Expanded lead time, 5 (five) piloting unions&lt;br&gt;- 1-10 days probabilistic flood forecasts&lt;br&gt;- 20-25 days medium range seasonal forecasts&lt;br&gt;- Conducted empirical study to develop flood forecasts model</td>
</tr>
<tr>
<td>2011-2014</td>
<td>USAID/SHOU II</td>
<td>Expanded area 15 unions&lt;br&gt;- Continued 1-10 days probabilistic flood forecasts&lt;br&gt;- 20 -25 days seasonal flood outlook&lt;br&gt;- 1-3 months long-range seasonal forecasts&lt;br&gt;- Enhance flash flood early warning&lt;br&gt;- Capacity building of FFWC and communities</td>
</tr>
<tr>
<td>2014-2016</td>
<td>RIMES/FFWC</td>
<td>RIMES will continue support for additional two years</td>
</tr>
</tbody>
</table>
## Project Locations

<table>
<thead>
<tr>
<th>District</th>
<th>Upazilla</th>
<th>Union</th>
<th>Hazard type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunamganj</td>
<td>Derai</td>
<td>Jagaddal</td>
<td>Flash flood</td>
</tr>
<tr>
<td>Cox's Bazar</td>
<td>Teknaf</td>
<td>Baharchara</td>
<td>Rain fed flood</td>
</tr>
<tr>
<td>Cox's Bazar</td>
<td>Ukhiya</td>
<td>Jalia Palong</td>
<td>Rain fed flood</td>
</tr>
<tr>
<td>Jamalpur</td>
<td>Islampur</td>
<td>Kukandi</td>
<td>Monsoon flood</td>
</tr>
<tr>
<td>Bogra</td>
<td>Sonatola</td>
<td>Tekani Chulkainagar</td>
<td>Monsoon flood</td>
</tr>
<tr>
<td>Pabna</td>
<td>Bera</td>
<td>Haturia Nakalia</td>
<td>Monsoon flood</td>
</tr>
<tr>
<td>Kurigram</td>
<td>Chilmari</td>
<td>Chilmari</td>
<td>Monsoon flood</td>
</tr>
<tr>
<td>Kurigram</td>
<td>Kurigram Sadar</td>
<td>Mogalbachha</td>
<td>Monsoon flood</td>
</tr>
<tr>
<td>Kurigram</td>
<td>Ulipur</td>
<td>Hatia</td>
<td>Monsoon flood</td>
</tr>
<tr>
<td>Kurigram</td>
<td>Rowmari</td>
<td>Bondaber</td>
<td>Monsoon flood</td>
</tr>
<tr>
<td>Rangpur</td>
<td>Kaunia</td>
<td>Tepa Madhupur</td>
<td>Monsoon flood</td>
</tr>
<tr>
<td>Tangail</td>
<td>Nagarpur</td>
<td>Bekra</td>
<td>Monsoon flood</td>
</tr>
<tr>
<td>Gaibandha</td>
<td>Fulchhuri</td>
<td>Uria</td>
<td>Monsoon flood</td>
</tr>
<tr>
<td>Sirajganj</td>
<td>Shahjadpur</td>
<td>Kaizuri</td>
<td>Monsoon flood</td>
</tr>
<tr>
<td>Sirajganj</td>
<td>Kazipur</td>
<td>Maijbari</td>
<td>Monsoon flood</td>
</tr>
</tbody>
</table>

Legend:
- **Selected sites (unions) for monsoon flood forecasting**
- **Selected sites (unions) for rain-fed flood forecasting**
- **Selected sites (unions) for season forecasting**
- **Selected site (union) for flash flood forecasting**
- Thana boundary for pilot sites
- District boundary for pilot sites
Major activities

- Extend the forecast boundary to Meghna Basin
- Extend the forecasts locations from 18 stations to 38 water level stations of FFWC

- Determination of rainfall intensity thresholds using historical rainfall and impacts data
- Integration of thresholds into flash flood model
- Dissemination of forecasts to the community

- Packaging 1-3 months forecasts
- Dissemination of forecasts product to different stakeholders and community
- Capacity building of FFWC professionals on forecasts technology
- Early Warning Audits at Pilot Districts/ Upazila/Unions
Forecasts Dissemination

Website

E-mail (Nationals stakeholders, District and Union Information Centers)

SMS (SMS to DMC members in Pilot Unions)

400 stakeholders received flood early warning during monsoon through SMS

120 UISCs and 100 different stakeholders received flood early warning through e-mail in Bangla
Medium Range Forecasting System

Illicit forecasts (51 ensemble series) on Hardinge Bridge point and ECMWF rainfall standard deviation from the Mean and -1 standard deviation for the mean rainfall forecast of all models. The Board (BWDB) is acting as a background rought out in FFWC model for this 10-day period with extreme care.

Learning Center
Operative Board
Email: ffmcbwdb@gmail.com

Supported by USAID through CARE-Bangladesh with technical support from RIMES
Forecasts Dissemination.. Contd.

Flood outlook of the following unions under Kurigram, Rangpur, Gaibandha, Bogra, Sirajganj and Tangail for next 10 days as on 19.08.2014:

1. হাতিয়াঘাট বান্ধা পরিস্থিতির অবরুদ্ধ হতে পারে (+) (Flood situation may deteriorate)
2. চিপ দাঁড় বান্ধা পরিস্থিতির অবরুদ্ধ হতে পারে (+) (Flood situation may deteriorate)
3. বড়াঘাট বান্ধা পানি বাড়তে পারে এবং বিপদসীমা অতিক্রম করতে পারে (+) (Water level may rise and may cross danger level)
4. মোহন বান্ধা পানি বাড়তে পারে এবং বিপদসীমা অতিক্রম করতে পারে (+) (Water level may rise and may cross danger level)
5. টোপা বান্ধা পানি বাড়তে পারে (+) (Water level may rise)
6. উলিয়ায় বান্ধা পরিস্থিতির অবরুদ্ধ হতে পারে (+) (Flood situation may deteriorate)
7. ট্যালো বান্ধা পানি বাড়তে পারে এবং বিপদসীমা অতিক্রম করতে পারে (+) (Water level may rise and may cross danger level)
8. লাইনারি বান্ধা পানি বাড়তে পারে এবং বিপদসীমা অতিক্রম করতে পারে (+) (Water level may rise and may cross danger level)
9. হাদিয়াঘাট বান্ধা পানি বাড়তে পারে (+) (Water level may rise)
10. কুঁড়া বান্ধা পরিস্থিতির অবরুদ্ধ হতে পারে (+) (Flood situation may deteriorate)
11. বেঁকুনি বান্ধা পানি বাড়তে পারে এবং বিপদসীমা অতিক্রম করতে পারে (+) (Water level may rise and may cross danger level)
12. বোম্বটি বান্ধা পানি বাড়তে পারে (+) (Water level may rise)

নিবন্ধিত জনসাধারণ www.ffwc.gov.bd ও বাংলাদেশ টিভি কেলুন। (Please visit www.ffwc.gov.bd for details). প্রধান প্রধান লদ-লঘু বান্ধা পরিস্থিতি সম্পর্কে জানতে যে কোনো নোবাইন থেকে থেকে ১০৯৪১ নম্বরে ফোন করে ৫ চিপ ডাল (To know the flood situation of major rivers, dial 10941 from any mobile and press 5).
Community Capacity Building

Step 1: Problem analysis

Step 2: Preparation of check list: Literature review and consultation

Step 3: Field survey: Workshop with UDMC, Household survey, information from organization, visit to vulnerable areas

Step 4: Data compilation and analysis

Step 5: Report preparation
## Sectoral Preparedness Plan

<table>
<thead>
<tr>
<th>Sl.</th>
<th>Sector</th>
<th>Early warning effect on flood preparedness</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Agriculture</td>
<td>• steady starting of crop harvesting  &lt;br&gt;• UDMC could do meeting with the head of Para (segment of village) regarding preparation to rescue the assets and life from flood  &lt;br&gt;• arrangement of seed bed on high land</td>
</tr>
<tr>
<td>2</td>
<td>Fisheries</td>
<td>• repairing and heightening the pond dyke  &lt;br&gt;• harvesting and selling of fish in the market  &lt;br&gt;• no immediate new recruitment</td>
</tr>
<tr>
<td>3</td>
<td>Livestock and Poultry</td>
<td>• raising of farm house plinth  &lt;br&gt;• stocking of fodder for emergency period  &lt;br&gt;• arrange higher and safer places to shift their lives</td>
</tr>
<tr>
<td>4</td>
<td>Households &amp; Homestead</td>
<td>• making arrangement of shifting the valuable assets to higher and safer places (e.g. embankment, school /madrasa)  &lt;br&gt;• raising the plinth level of dwelling house</td>
</tr>
<tr>
<td>Sl.</td>
<td>Sector</td>
<td>Early warning effect on flood preparedness</td>
</tr>
<tr>
<td>-----</td>
<td>----------------------</td>
<td>-----------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>5</td>
<td>Business</td>
<td>• steady storage of daily commodities (e.g. rice, pulse, salt, oil, etc.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• repairing the shops and heightening the godown/warehouse</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• arrangement of boat for carrying goods</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• regular selling of goods</td>
</tr>
<tr>
<td>6</td>
<td>Health and life</td>
<td>• formation of medical team by NGO</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• collection of emergency and medicine</td>
</tr>
<tr>
<td>7</td>
<td>Drinking water sources</td>
<td>• steady arrangement of more water reservoirs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• heightening the tube well head by adding extra pipes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• collection of water purification tablet (Halotab) and potash alum</td>
</tr>
<tr>
<td>8</td>
<td>Sanitation</td>
<td>• arrangement of bamboo chati /jute carpet, rope, steel wire, spike, bamboo, etc. for making temporary latrine</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• arrangement of sanitary facility at nearby safer places (e.g. embankment)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• arrangement of boat</td>
</tr>
<tr>
<td>9</td>
<td>Communication</td>
<td>• arrangement of bamboo to construct bridge from one house to another and to connect high land</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• arrangement of small boat</td>
</tr>
</tbody>
</table>
## Damage Reduction Based on EWS

<table>
<thead>
<tr>
<th>Item</th>
<th>Lead time</th>
<th>Damage reduction (%)</th>
<th>Actions taken to reduce damages</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Household items</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>24 hrs</td>
<td>20</td>
<td>Removal of some household items</td>
</tr>
<tr>
<td></td>
<td>48 hrs</td>
<td>80</td>
<td>Removal of additional possessions</td>
</tr>
<tr>
<td></td>
<td>Up to 7 days</td>
<td>90</td>
<td>Removal of all possible possessions including stored crops</td>
</tr>
<tr>
<td><strong>Livestock</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>24 hrs</td>
<td>10</td>
<td>Poultry moved to safety</td>
</tr>
<tr>
<td></td>
<td>48 hrs</td>
<td>40</td>
<td>Poultry, farm animals moved to safety</td>
</tr>
<tr>
<td></td>
<td>Up to 7 days</td>
<td>45</td>
<td>Poultry, farm animals, forages, straw moved to safety</td>
</tr>
<tr>
<td><strong>Agriculture</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>24 hrs</td>
<td>10</td>
<td>Agricultural implements and equipment removed</td>
</tr>
<tr>
<td></td>
<td>48 hrs</td>
<td>30</td>
<td>Nurseries, seed beds saved, 50% of crop harvested, agricultural implements and equipment removed</td>
</tr>
<tr>
<td></td>
<td>Up to 7 days</td>
<td>70</td>
<td>Nurseries, seed beds saved, fruit trees harvested, 100% of crop harvested, agricultural implements and equipment removed</td>
</tr>
</tbody>
</table>
Elements of Flash Flood Warning System

1. Risk Knowledge
2. Monitoring
3. Analysis & Forecasting
4. Warning
5. Response

- Identification of Flash Flood Prone Areas
- Monitoring of triggering factors
- Data acquisition (Real Time, Forecast)
- Data archiving
- Threshold assessment
- Are data above thresholds?
- Yes: Issue warning
- No: Emergence plans
- Emergency plans
Methodology

- Assessment of rainfall intensity-duration thresholds
- Analysis of flash flood potential using observed and forecasted rainfall and thresholds
- Development of web-based system for flash-flood advisory by integrating thresholds with rainfall forecast
Assessment of rainfall intensity – duration thresholds

- Collection of historical flash flood event data
- Matching of historical flash flood event with rainfall event
- Finding peak rainfall intensities that have initiated flash floods in the area
- Plotting intensity-duration values in log-log scale
- Finding the lower limit of intensity-duration relationship as threshold intensity
Flash Flood Analysis

Accumulated Rainfall (in mm)
Forecast Length in Hours: 20140817:12 + 72 Hours.
# Flash Flood Analysis

## Accumulated Rainfall of Sylhet (mm)

<table>
<thead>
<tr>
<th>Duration (hrs)</th>
<th>18-08-2014</th>
<th>19-08-2014</th>
<th>20-08-2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>28</td>
<td>87.91</td>
<td>56.78</td>
</tr>
<tr>
<td>48</td>
<td>56</td>
<td>115.91</td>
<td>140.68</td>
</tr>
<tr>
<td>72</td>
<td>56</td>
<td>142.81</td>
<td>170.68</td>
</tr>
<tr>
<td>120</td>
<td>56</td>
<td>143.91</td>
<td>200.68</td>
</tr>
<tr>
<td>168</td>
<td>56</td>
<td>142.91</td>
<td>200.68</td>
</tr>
<tr>
<td>240</td>
<td>56</td>
<td>142.91</td>
<td>200.68</td>
</tr>
<tr>
<td>Advisory</td>
<td>RFF</td>
<td>FFA</td>
<td>FFA</td>
</tr>
</tbody>
</table>

## Flash Flood Advisory

- **RFF**: Flash Flood Warning on 19-08-2014 to 20-08-2014
- **FFA**: Flash Flood Alert
- **RFF**: No Flash Flood
- **RFF**: No Flash Flood on 18-08-2014

[Create Advisory]
Web-based Dissemination System

Select Station: Sylhet
Select Users: Md. Jabeed Hossain
Select Date: 10 September 2014

Create Advisory

Name: Md. Jabeed Hossain
Email: jabeed@rimes.int
Mobile: 8801746482207
Station: Sylhet

Weather Update:
Rainfall: mm
Temperature Min: °C
Temperature Max: °C
Source: Bangladesh Meteorological Department

Advisory:
Built from model Chart: 142/160
No Flash Flood on 10-09-2014 to 12-09-2014 Based on ECMWF Forecast.
No Flash Flood on 10-09-2014 to 12-09-2014 Based on WRF Forecast.
Capacity Building of FFWC

- Training on 20-21 August 2013 at FFWC
- Secondment Training on 12 January – 11 March 2014 at RIMES, Bangkok
- Training on 28-29 April 2014 at FFWC
Training and Capacity Building at Community Level

- Community consultation meeting on 18 July 2012 at Jagdal
- Training workshop on 26 February 2014 at Sunamganj
- Training workshop on 15 June 2014 at Sunamganj
- Training workshop on 17 June 2014 at Jaliapalong, Cox’s Bazaar
Community Capacity Building

About 150 people trained on flood early warning system including community representatives (LGI) and NGO representatives
Major Outcomes: SHOUHARDO II

- Expansion of medium range (1-10 days) probabilistic forecast coverage
  - Modification of forecast models
  - Extension of forecast stations (18 to 38 points)
  - Calibration and validation of models
  - Automation of model

- Development of Flash flood forecasting system
  - Rainfall threshold analysis in flash flood pilot areas
  - Establishment of Real Time rainfall station in Sylhet and Cox’s Bazar
  - Web based flash flood guidance and dissemination system development

- Innovative seasonal flow outlook generation system development
  - Use of ECMWF seasonal rainfall forecast to generate seasonal flow outlook
  - Web-based decision support system for advisory generation and dissemination

- Enhanced capacity of FFWC/BWDB in operational medium and long range flood forecasting
  - Technology transferred for improved computation (models, equipments e.g server)
  - Training on newly evolved technologies and refresher training before monsoon

- Extended reach of flood forecast
  - Dissemination of forecast through FFWC website, e-mails (Bangla & English) and text SMSs to LGIs, UDMC, UDC, NGO representatives and volunteers
  - Training of LGIs, UDMC, UDC, IP representatives on new probabilistic forecast products

- Strengthening of community preparedness and response
  - Guidance on the use of probabilistic forecasts in making decisions to reduce flood risks to livelihoods
  - Trainings and Refresher trainings before the monsoon season and transfer of knowledge on how longer lead forecast can add value and building confidence over time
Community Preparedness and Response

- Plan to evacuate and identify high grounds
- Plan to store dry food and safe drinking water
- Secure cattle, poultry birds, homestead vegetables, protect fishery by putting nets in advance
- Secure cooking stove, small vessels, firewood and animal dry fodder
- Plan for alternative livelihood options immediately after flooding (e.g. Small scale fishing, boat making)
Sustainability

- **Sustainability of transferred technology:** RIMES is going to assist FFWC through a handholding approach until these systems and tools are fully integrated into FFWC's operational systems.
- **Sustainability of transferred equipments:** FFWC/BWDB has taken the responsibility of operation and maintenance of equipments like telemetry rain gauges and server system.
- **Sustainability of data management system:** Besides other assistances to FFWC, RIMES will be backing up with necessary data in their own server to support any operational failure at FFWC.
- **Sustainability of community linkage:** The email addresses of the 172 union digital center of the SHOUHARDO-II working area has been incorporated in the FFWC system by RIMES to ensure continued future dissemination of forecast.
- RIMES shall integrate support for monitoring of local level application activities into ongoing and pipeline projects.
- RIMES shall advocate for up-scaling of project initiatives to cover larger areas in Bangladesh.
Areas of Improvements

- More frequent calibration of models at FFWC is required for better forecast
  - yearly calibration is required to keep pace with the river dynamics
- **Limited capacity of flash flood forecasting system**
  - requires research and development for incorporating factors other than rainfall and considering transboundary basin properties
  - requires consideration of basin average rainfall rather than point rainfall
  - bias-correction of forecast rainfall
- **Downloading different data for models was tedious**
  - enhancement of internet capacity at FFWC
- **Unable to interpret forecast messages by some receivers at local level**
  - illiteracy & language: voice and Bangla SMS is preferred
  - more vigorous and longer term training required for potential message receivers
  - stronger linkage and interaction between FFWC and volunteers/Digital Center entrepreneurs working at the root level is necessary
- **Limited application of forecast at some areas**
  - generation of advisory based on the forecast products is necessary
  - stronger involvement of other government stakeholders like Department of Agricultural Extension (DAE) is required
  - adequate time is required for piloting seasonal forecast and storm surge inundation model results
- **Limited monitoring and documentation of community responses**
Major Challenges

- Retaining trained personnel is a major challenge in capacity building
  - trained professionals from other relevant divisions of BWDB in addition to FFWC professionals
  - motivated young professionals to get involved in research in the newly evolved probabilistic flood forecasting

- Continuous training and capacity building of FFWC professionals

- Downloading large volume of data required for models with limited internet capacity is another major challenge
  - one dedicated internet connection is provided exclusively in the server provided by RIMES at FFWC
  - alternate downloading options have been explored depending on the data availability

- Frequent change of mobile phone numbers of the stakeholders receiving forecast/early warning message in the pilot areas

- Communicating uncertainty associated with the probabilistic forecast to the end users
Recommendations

- Continuous improvement of flood forecasting system model based on regular evaluation and addition of alternative computational schemes
- Development of decision support system involving multiple models and on a more localized scale and generation of flood maps
- Develop institutional mechanism to retain staff whom capacity built within FFWC a FFWC to technically and technologically equipped to respond to user needs
- Explore the use of preferred dissemination mechanisms like Bangla voice message broadcast/SMS broadcast, community radio etc.
- Continuous training of local level disaster managers before monsoon onset
- Testing of seasonal flow model results for several years
- Increase access of women to forecasts and undertake special awareness program on flood early warning targeting women
- Improve infrastructural (e.g. flood/cyclone shelters) and resource (e.g. rescue boats) capacity of the community to make quicker response and utilize the maximum lead time
- Advisory generation for different sectors (e.g. agriculture, livestock, fisheries, health) at upazila level based on medium range flood forecast or seasonal flow outlook to increase practical implication
- Improve linkage of FFWC/BMD and Department of Disaster Management with the grass root communities throughout the year
Thank You!

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