Climate risk management/early warning information systems

S.H.M. Fakhruddin
Hydrologist
fakhruddin@rimes.int
www.shmfakhruddin.com
Outlines

- Early Warning Systems and climate risk management
- New developments in early warning system - RIMES
- Case Study- CRM & EWS
- Visit the facilities
- Group Discussion
Perceptions of Climate

- Climate as a resource
- Climate as a hazard
- Climate as a constraint

Every society’s climate has a mix of all three, but the proportions vary from one country to the next and one decade to the next.
Climate is a resource most of the time
Hazards of Societal Concern
(whether climate changes or not)

- Droughts
- Floods
- Hurricanes
- Ice storms
- Forest fires
- El Niño & La Niña
- Diseases
- Global warming
- Other
Keep in mind that Climate two faces: a bright side and a dark side

- **Bright side:**
  - People generally have enough water to drink, to grow food, to run factories, water for irrigating dry lands and even deserts

- **Dark side:**
  - Droughts, floods, fires, heat waves, hurricanes, tornadoes, etc.
WHAT GETS YOUR ATTENTION?

- The sunny side of climate
- or the dark side?

Tropical resort

Flood
Rationale for Climate Forecast Applications for Disaster Mitigation

- Impact of recurrent droughts and floods cause widespread damage and loss to assets, infrastructure and crop production
- Climate variability driven by large scale ocean-atmosphere phenomenon like ENSO causes significant number of droughts and floods
- Casualty, livelihood loss and damage are high and a major cause for concern
- Advances in the understanding of the climate system and increased ability in monitoring and forecasting weather events help to solve some of these problems
Application of climate information could reduce disaster risks

1. Past climate information (past) – high potential, but under-utilized

2. Climate information monitoring (concurrent) – moderate potential, satisfactory utilization

3. Climate forecast information (near future) – moderate potential, poorly utilized

4. Climate change scenario information (distant future) – ???
Potential & Actual Utilization of Climate Information Products

Potential Providers

Potential

Actual

Forecast Users
Relevance of climate forecast products depends on:

- Timeliness (efficiency of delivery, sufficient lead time)
- Clear, simple language
- Reliability
- Location-specific
- User-need based
Weaknesses in existing systems

- Absence of participatory mechanism for identifying user forecast requirements
- Available climate information not tailored to users’ needs and requirements
- Weak forecast producer-user communication channel
- Users have difficulty understanding forecast language
- Community level dissemination is weak
- Users have no mechanism for processing climate information once it is received

Feedback channel from forecast user to producer is weak or non-existent in most cases
El Niño as a Hazard-Spawned
Time Series for El Niño (red) and La Niña (blue)

Before 1976 more blue than red; after 1976 more red than blue.

Red: El Nino
Blue: La Nina
El Niño impact on rice production, Philippines

Year
Palay Production (x 1000 MT)
El Niño impact on rice production, Indonesia

National Rice Production

- **1988**: Withdraw subsidy for pesticide
- **1989**: Banned using 57 pesticides
- **1990**: Release of HY var., increase of rice price
- **1991**: El Niño
- **1992**: El Niño
- **1993**: Release of HY var., extensification of planting area to plantation areas
- **1994**: Improve technology and extensification
- **1995**: Crash program for irrigation, increase of rice price, upland rice
- **1996**-**1997**: El Niño
- **1998**: Withdraw subsidy, political crisis

**Crash Program for Irrigation**

**Withdraw Subsidy for Pesticide**

**Release of HY Varieties**

**El Niño Impact on Rice Production**

**Indonesia**
Developing Countries are Hit the Hardest...

(Source: CRED)
Climate Risk Management- Challenges

- Risk Communication
  - Dealing with uncertainties
  - Decision research and stakeholder involvement
  - Integrating climate information into decision making process

- RIMES experience in risk communication will be shared
The need:

Climate forecast information that:

- is localized
- timely
- in easily understandable language
- meets end user needs

The issues:

- Capacity to generate the localized information
- Experience in communicating probabilistic scientific information for practical use by end users
End-to-end climate information and application system

- Providing climate outlook
- Interpreting global climate outlook into local outlook
- Translating local climate outlook into impact scenarios
- Communication on farmers responses/ feedback
Early Warning Systems (EWS)

- **Till 1980’s:** EWS focused on saving lives

- **1990’s on:** Focus on saving lives + livelihood systems

- **Currently:** Opportunities through new, emerging forecast technologies
EW System Structure

Detection Subsystem
Monitoring, detection, data Assessment, data analysis, prediction

Management Subsystem
Risk Assessment, interpretation, communication

Response Subsystem
Interpretation, confirmation and response
Reasons for Warning Failure
Gaps

- Regulatory framework for warning
- Stakeholders involvement and roles
- Aging and insufficient observation and data communication facilities
- Data sharing among agencies
- Numerical prediction capability
- Skilled human resource
- Capacity to make use of new generation forecasts
- Local level potential impact assessment not done
- Language
- Localized, relevant
- Institutional mechanism, linkages
- SOPs
- Redundant communication systems
- Reach to special groups
- Public awareness
- Communication of forecast limitations
- Lack of trainers/ facilitators
- Resources to respond to warning
A regional cooperation of 26 countries in Africa and Asia on multi-hazard early warning. RIMES aims to cater to differential needs and demands of member states in addressing gaps in the end-to-end multi-hazard early warning system.
Formally established on 30 April 2009, with the signing of RIMES International Cooperation Agreement, by five countries:

- Cambodia
- Comoros
- Lao PDR
- Maldives, and
- Seychelles
RIMES Framework
Provision of 4 integrated services

- Establishment of Regional core observation networks
- Provision of Regional tsunami watch
- Research and development support to NHMS for providing localized hydro-meteorological disaster risk information
- Enhancing capacities to respond to early warning information at national and local levels for disaster preparedness and management
Regional Multi-hazards Early-Warning System (RIMES)

- National capacity building
- Community resilience
- Network integration and data sharing
- Participatory
- End-to-end Fill the Gaps

- Earthquakes And Tsunami
  - heavy precipitation
  - flashfloods
  - storm surge
  - landslide
  - drought
  - dry spell
  - flooding
RIMES, NMHS and Societal Application linkages

- Advantages
  - Greater cost effectiveness in the use of scarce resources
  - Continuous support in addressing common problems of NMHSs;
  - Connecting Global research to NHMS needs.
System Configuration

Severe Weather Sub-system

- IBM System p5-575 HPC Server
  - 128 CPU 256GB
- High Performance Switch (HPS) Dual Network
- Compute node 3
- Compute node 2
- Compute node 1
- I/O node 1
- Compute node 4
- Compute node 5
- Compute node 6
- I/O node 2

Common Elements

- High Capacity Storage (RAID)
- SAN Fabric (2 x IBM SAN4-E)
- Management Network
- CSM/HM Server
  - IBM System p5-550Q
  - 4 CPU 186B

Tsunami Sub-system

- GPS Antenna
- To Satellite Gateway
- Network Interface Card
- Seismic Data from Global, Regional and National Networks
- Internet
- GTS
- SMS
- FAX
- WEB
- PC
- SUN Micro
- Large Format Printer
- B/W Laser Printer
- Color Laser Printer
- Alarm Bell

Funding from Danida

Funding from UNRTTF
RIMES Governance
RIMES Governance

- Presidential Task Force
  - Chaired by His Excellency Vice President of the Republic of Maldives and comprising of Minister of Foreign Affairs, Minister of Housing, Transport and Environment
  - To provide highest level guidance and advice, facilitate institutional establishment and consolidation

- Council
  - Composed of heads of National Hydro-Meteorological Services and national scientific and technical agencies generating multi-hazard early warning information
  - Empowered to make policy decisions concerning regional early warning arrangements
RIMES Governance cont.

- **Executive Board**
  - Implement policies and decisions of the Council for resource mobilization
  - Formulate an action plan to provide cost-effective services to each Member State
  - India as Chair; China as Vice-Chair

- **Secretariat**
  - Carries out the decisions and tasks assigned by the Council
  - Supports the Program Unit in the management of the regional early warning facility
  - Maldives is the RIMES Secretariat
RIMES Governance cont.

- **Program Unit**
  - Responsible for the day-to-day operation and management of the regional early warning facility
  - Has financial and administrative autonomy through delegated powers and the financial and staff regulations approved by the Council
  - Is co-located with the regional EW facility at the campus of the Asian Institute of Technology, Thailand
RIMES Endorsement by UN

- RIMES has been registered with United Nations Treaty Office of Legal Affairs, as per Article 102 of the Charter of United Nations, on 14 September 2009, effective from 01 July 2009.
Integration of RIMES with IOC IOTWS Framework

- RIMES Integration with IOC IOTWS approved in principle by IGC IOTWS Steering Group in its meeting in Perth Australia on 3-4 December 2009
- As per this decision RIMES will invite ICG/IOTWS to join the RIMES Council.
- 2. RIMES is invited to send a representative to ICG/IOTWS
Integration of RIMES with WMO

- An MoU between RIMES and WMO under finalization
- RIMES Will translate WMO Mandate into Operational Program
- RIMES and WMO Will develop Join Projects to build capacity of NHMS
- WMO will facilitate GTS direct connection to RIMES through one of the Member States
- RIMES will provide Research and Development support to NHMS.
RIMES Products
Providing Localized severe weather information

- Track, intensity and time of land fall of Cyclones/Typhoons
- Heavy rainfall, Strong winds
- Riverine and Flash floods
Heavy rainfall, Strong winds
Multi-Model Brahmaputra Discharge Quantile Forecasts
7-10 day using ECMWF Precipitation Forecasts
Forecasts Initialized June 16 - August 29, 2010
Climate Change Impact Analyses

- Analyses of IPCC Scenarios
- Statistical Downscaling
- Analyses of observed Climate trend and future projections
- Development of Regional Climate Models
10 cm less in North, North East; Central and South
RIMES Seismic Monitoring

- Makran Trench
- Java-Sumatra Trench
- Manila Trench
Seismic waveforms from virtual networks

SeisComP3

IRIS Network

Geofon Network

Antelope

IRIS / IDA Network

IRIS / USGS Network
Decision-support Tools

- Real-time Seismicity Monitoring

- Tsunami Travel Time Calculation (TTT)

- Email and SMS Alert Applications

- Generation of bulletins and warning updates
Inundation Depth

0 m.
1 m.
2 m.
3 m.
4 m.
> 5 m.

Probability of Building Collapse

0% 0-20%
20-40%
40-60%
60-80%
80-100%

Death Rate

0% 0-20%
20-40%
40-60%
60-80%
80-100%
Group Discussions- establishing what exist and what is needed

- What do people already know and believe about climate risk?
- What information is being used and who/where is the source of information?
- What has been the past experience/outcomes of information use?
- What kind of “new” information is needed to reduce climate risk (current and near future)
Case Study: Climate Information System
Countries needed timely, usable climate information to manage resources effectively & reduce disaster risks. However, localized & usable climate information was not available to resource managers.
Reasons why climate information was not available

- Absence of participatory mechanism for identifying user forecast requirements
- Available climate information not tailored to users’ needs and requirements
- Weak forecast producer-user communication channel
- Users have difficulty understanding forecast language
- Community-level dissemination is weak
- Users have no mechanism for processing climate information once it is received
- Feedback channel from forecast user to producer is weak or nonexistent in most cases
CFA Methodology: Six step process

1. Need/capacity assessments
2. Assessment of available technology
3. Capacity building through partnerships
4. Institutionalization of end-to-end system: pilot demonstrations, replication
5. Apply information to enable pro-active decision making
6. Monitor and evaluate applicability of information
Focused Intervention:

Global climate information providers

National institutions

End-users
End-to-end climate information generation and application system

- Providing climate outlook
- Interpreting global climate outlook into local outlook
- Translating local climate outlook into impact scenarios
- Communication of response options/feedback
Major Achievements of CFA
Indonesia & Philippines
The CFA program is instrumental in establishing institutional mechanisms that connect hydro-meteorological communities, risk management institutions, & societies.

Farmers in Liquiça district learning basic rainfall observation at the Climate Field School for Farmers.
Institutional Framework for Climate Forecast Application

Provision of Climate Outlook
In “meteorological language”

Translation of Climate Outlook
Scientific Language → Operational Language
(“Below Normal”) = (Lack of water)

Conversion of Operational Language into e.g. Crop Management Strategies

Change Crop Pattern!
Change Planting Time!
Change Crop Variety!

Dissemination of Information to Farmers and evaluation of Farmers Response
Institutional innovation at Indonesian Ministry of Agriculture

*Subdivision on Climate Analysis and Mitigation*
A pool of meteorologists has been formed & trained to provide tailored climate information for risk management in program countries. Through their interactions with institutions & communities under the Program, they understand that meteorologists should not just produce information but have to relate the information to the user context.
Institutional and community-level dissemination channels in demonstration sites have been strengthened. Community capacity to use climate information have been built primarily through Climate Field Schools, climate forum, & community-level workshops.
Indramayu Climate Field School

Women farmers participating in the Climate Field School work with extension workers in understanding rainfall graphs.

Farmers in Losarang subdistrict Indramayu showing rainfall graphs.
Climate field school: implementation process

Stage 1: training of agricultural extension specialists (district level)

Stage 2: training of agricultural extension workers (sub-district)

Stage 3: training of heads of farmers groups

Stage 4: dialogue with farmers
Key coping strategy: crop substitution

El Niño 2002-2003

As reported by the Iloilo Provincial Agriculturist, due to early dissemination of the El Niño forecast, farmers in the province were able to mitigate its adverse impacts by switching to alternative crops (e.g. rice to watermelon)

El Niño damage - 64.00 M

Production of other crops - 732.02 M

Difference Php 688.02 M
Case Study: Long Lead Flood Forecast Application
Institutional Collaboration For Sustainable End-to-end Flood Forecasts System

- Climate (rainfall and discharge) forecasting technology (EAS)/ADPC
- Agro met translation
- FFWC Discharge translation
- IWM Interpretation
- ADPC Climate forecast
- FFWC Interpretation
- DMB, DAE Communication
- End users
- ADPC, CARE, CEGIS

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*Regional Integrated Multi-Hazard Early Warning System (RIMES)*
CFAB Model Area
Discharge Forecast Schemes

Hydrological Model
- Lumped
- Distributed
- Multi-Model Discharge Forecasting

- Accounting for uncertainties
- Final error correction
- Generation of discharge forecast PDF
- Critical level probability forecast

(I). Initial Data Input
- Discharge data
- Hydrologic model parameters
- NOAA and NASA (i.e. CMORPH and GPCP) satellite precipitation & GTS rain gauge data

(II). Statistical Rendering

(III). Hydrological Modeling

(IV). Generation of Probabilistic Q

(V). Forecast Product

Downscaling of forecasts Statistical correction

ECMWF Operational ensemble forecast
2007 Brahmaputra Ensemble Forecasts and Danger Level Probabilities

7-10 day Ensemble Forecasts

7-10 day Danger Levels
Plumes and probability pies for the first Brahmaputra flood July 28-August 6, 2007

High probabilities of exceedance of the danger level by the Brahmaputra at the India-Bangladesh border
Accomplishments


The flood forecasts provide onset of flood, duration, and dates of receding of floods.
1-10 Days Forecasts at Bahadurabad 2010
1-10 Days Forecasts in the FFWC Website

http://www.ffwc.gov.bd/

<table>
<thead>
<tr>
<th>Station</th>
<th>10-day Water Level Forecasts in Bangladesh: Forecasts from CFAB-FFS Model using Climate Forecast Applications in Bangladesh (CPAB) prediction data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tangail</td>
<td>8.88   8.88 8.88 8.88 8.88 8.88 8.88 8.88 8.88 8.88 8.88 8.88 8.88 8.88 8.88 8.88 8.88 8.88 8.88 8.88 8.88 8.88 8.88 8.88 8.88 8.88 8.88 8.88 8.88 8.88 8.88 8.88 8.88 8.88 8.88 8.88</td>
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<td>Tungipara</td>
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Forecast made on: 19-08-2009
Pilot Areas
# Flood risk management at community level decisions and forecast lead time requirement (Eg. Rajpur Union, Lalmunirhat district)

<table>
<thead>
<tr>
<th>Target groups</th>
<th>Decisions</th>
<th>Forecast lead time requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farmers</td>
<td>Early harvesting of B.Aman, delayed planting of T.Aman</td>
<td>10 days</td>
</tr>
<tr>
<td></td>
<td>Crop systems selection, area of T. Aman and subsequent crops</td>
<td>Seasonal</td>
</tr>
<tr>
<td></td>
<td>Selling cattle, goats and poultry (extreme)</td>
<td>Seasonal</td>
</tr>
<tr>
<td>Household</td>
<td>Storage of dry food, safe drinking water, food grains, fire wood</td>
<td>10 days</td>
</tr>
<tr>
<td></td>
<td>Collecting vegetables, banana</td>
<td>1 week</td>
</tr>
<tr>
<td></td>
<td>With draw money from micro-financing institutions</td>
<td>1 week</td>
</tr>
<tr>
<td>Fisherman</td>
<td>Protecting fishing nets</td>
<td>1 week</td>
</tr>
<tr>
<td></td>
<td>Harvesting fresh water fish from small ponds</td>
<td>10 days</td>
</tr>
<tr>
<td>DMCs</td>
<td>Planning evacuation routs and boats</td>
<td>20 – 25 days</td>
</tr>
<tr>
<td></td>
<td>Arrangements for women and children</td>
<td>20 – 25 days</td>
</tr>
<tr>
<td></td>
<td>Distribution of water purification tablets</td>
<td>1 week</td>
</tr>
<tr>
<td>Char households</td>
<td>Storage of dry food, drinking water, deciding on temporary accommodation</td>
<td>1 week</td>
</tr>
</tbody>
</table>
## USER MATRIX on Disasters, Impacts and Management Plan for Crop, Livestock and Fisheries sector

<table>
<thead>
<tr>
<th>Disasters</th>
<th>Crop</th>
<th>Stages</th>
<th>Season/month</th>
<th>Impacts</th>
<th>Time of flood forecast</th>
<th>Alternative management plans</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early flood</td>
<td>T.Aman</td>
<td>Seedling and Vegetative stage</td>
<td>Kharif II Jun – Jul</td>
<td>Damage seedlings, Damage early planted T.Aman, Delay planting Soil erosion</td>
<td>Early June</td>
<td>Delayed seedling raising, Gapfilling, skipping early fertilizer application</td>
</tr>
<tr>
<td></td>
<td>T.Aus</td>
<td>Harvesting</td>
<td>Kharif I Jun – Jul</td>
<td>Damage to the matured crop</td>
<td>Early June</td>
<td>Advance harvest</td>
</tr>
<tr>
<td></td>
<td>Jute</td>
<td>Near maturity</td>
<td>June-July</td>
<td>Yield loss, Poor quality</td>
<td>May end</td>
<td>Early harvest</td>
</tr>
<tr>
<td></td>
<td>S.Vegetables</td>
<td>Harvesting</td>
<td>June-July</td>
<td>Damage yield loss, Poor quality</td>
<td>Mar - Apr</td>
<td>Pot culture (homestead), Use resistant variety</td>
</tr>
<tr>
<td>High flood</td>
<td>T. Aman</td>
<td>Tillering</td>
<td>Kharif - II July-Aug</td>
<td>Total crop damage</td>
<td>Early June</td>
<td>Late varieties, Direct seeding, Late planting</td>
</tr>
<tr>
<td>Late flood</td>
<td>T. Aman</td>
<td>Booting</td>
<td>Kharif II Aug-Sep</td>
<td>Yield loss and crop damage</td>
<td>Early July</td>
<td>Use of late varieties, Direct seeding, Early winter vegetables, Mustard or pulses</td>
</tr>
<tr>
<td></td>
<td>Cattle</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>For livestock, Special diets</td>
</tr>
</tbody>
</table>
Risk Communication of flood forecasts 2007-2008
Risk Communication for Flood Forecasts

Sending SMS to Mobile

Flag hoisting
Risk Communications

- 1-10 days forecasts shared with the decision makers at national and district level through fax and e-mail.
- 1-4 days forecasts information communicated to the pilot communities through SMS and flag network. If danger level probability exceed 85%, 10 days forecast communicate to the pilot areas and appropriate actions take place.
Institutional and community responses on 2007 flood forecast: ADPC Field Team

- Flood forecast issued for two boundary locations
- Incorporated into customized local model
- Communication to project partners
- Communication to stakeholders and local DMC members
- Networks
- Communication to Disaster Emergency Group
- Information to relief agencies about the extent of flooding

21 Jul
- Flood forecast issued for two boundary locations

22 Jul
- Incorporated into customized local model

23 Jul
- Communication to project partners

24 Jul
- Communication to stakeholders and local DMC members

25 Jul
- Networks

26 Jul
- Communication to Disaster Emergency Group

28 Jul
- Flood water exceeded danger level

29 Jul
- Low lying areas are flooded

30 Jul
- Aid agencies arranged logistics and began dialogue with district administration

2 Aug
- Relief distribution started in affected locations

- Local institutions prepared response and relief plans
- Community in low lands reserved their food, drinking water, fodder requirements
- Local Disaster Management Committee and Volunteers prepared for rescue
Community responses to flood forecasts

(a) Shelter for human and livestock on road
(b) Collection of drinking water
(c) Raising net around pond to protect fish
(d) People living on macha (bamboo made structure) during flood
Community responses to flood forecasts
Economic Benefits

- In 2008 Flood, Economic Benefits on average per household at pilot areas:
  - Livestock's = TK. 33,000 ($485) per household
  - HH assets = TK. 18,500 ($270) per household
  - Agriculture = TK 12,500 ($180) per household
  - Fisheries = TK. 8,800 ($120) per households

- Experiment showed that every USD 1 invested, a return of USD 40.85 in benefits over a ten-year period may be realized (WB).
Group Work: Establishing the relevance and usefulness of EWS

- Is the new information *relevant* for decisions in your sector? Why?
- Are the sources/providers of information *credible* to the intended user? Why and How?
- Are practitioners (or users of information) *receptive* to the information? What factors hinder or enable?
- Is the information *accessible* to the decision maker? Describe gaps if any
- Is the information *compatible* with existing decision models e.g. for agriculture, water management practice? Describe gaps if any.
- Does the community (or users) have the *capacity* to use information? Describe gaps if any.