Managing Climate Shocks through Investments in Early Warning Systems

RIMES

Regional Integrated Multi-Hazard Early Warning System for Africa and Asia

Investing in Agriculture and Natural Resource Management in the context of Climate Change

FAO-World Bank Meeting

14 May 2012

Bangkok

Structure of Presentation

1. Introduction & Rationale
2. Methodology
3. Case Study- Climate hazards
4. Results of case studies
5. Way Forward

1. Introduction & Rationale

Increasing Impacts of Climate Hazards on Agriculture

Natural disasters in Asia, 1900-2012

Hazard category	Examples	Number of events	Economic damage cost (million USD)
Climatological	Drought, extreme temperature, forest fire	367	69,963
Meteorological	Tropical cyclone, storm	1,428	170,618
Hydrological	Flood, rain-induced landslide	1,969	340,411
Geophysical	Earthquake, tsunami, volcanic eruption, landslide	763	535,428

Source: http://www.emdat.be/ Accessed 11 May 2012

Introduction

Basic Services vs. Value-Added Services

- NMHSs focused on basic services (life-saving)
- Additional investment to enable value-added services leads to enhanced lead time and saving of lives as well as livelihoods
- Case Studies demonstrate that in most cases the benefits outweigh the investment required

Case Studies: Hydro-meteorological hazards

- Group 1: very basic services

  - Lao PDR, Myanmar, Cambodia, East Timor, Afghanistan, Comoros, Seychelles, Yemen, Madagascar, Bhutan, Nepal, and Sri Lanka

- Group 2: EWS capabilities not fully operational

  - Bangladesh, Mongolia, Mozambique, Pakistan, the Philippines and Vietnam

- Group 3: Robust, but gaps in location-specific, products, interpretation and translation

  - China, India, Thailand

- Group 4: Demonstrated potential in seasonal forecasting and application

  - Indonesia, Philippines

2. Methodology for cost-benefit estimation

I. Benefit due to early warning

= A-B-C

where

A - Loss due to a disaster without early warning

B - Decreased loss incurred after appropriate measures due to early warning

C - Cost or investment for providing early warning services

I. Benefits

- Direct tangible benefits
  - damages avoided by households and sectors due to appropriate response

+

- Indirect tangible benefits
  - Avoidance of production losses, relief/ rehab cost

II. Cost of EWS

- **Scientific component costs:**
  - required for technical institutions to generate forecast information
- **Institutional component costs:**
  - costs of training and capacity development for institutions to be able to use forecast information
- **Community component:**
  - costs at community level to enable them to adopt forecast information and respond appropriately

III. Lead time

Application in Agriculture:

Forecast product	Lead time	Application
Weather	1-3 days	Securing lives
Medium range	5-10 days	Emergency planning, early decisions for flood and drought mitigation, preserving livelihoods
Extended range (sub-seasonal)	2-3 weeks	Planting/ harvesting decisions, storage of water for irrigation, logistics planning for flood management
Seasonal	1 month / beyond	Long-term agriculture and water management, planning for disaster risk management

Damage reduction due to Lead Time

Item	Lead time	Damage reduction (%)	Actions taken to reduce damages
Open Sea Fishing	24 hrs	**10**	Fishing net, boat damage avoided
	48 hrs	**15**	Fishing nets removed, boat damage avoided
School or office	24 hrs	**5**	Money, some office equipment saved
	48 hrs	**10**	Money, most office equipment saved
	Up to 7 days	**15**	Money, all office equipment, including furniture protected

IV. Probabilistic forecasts

- Short-term (less than 10 day) forecasts as 90% accurate i.e., correct in 9 out of 10 cases

	EW not heeded – response actions not taken	EW heeded – response actions taken
Correct (9 out of 10 cases)	x	√ x 9
Wrong (1 out of 10 cases)	√	x x 1

√ x **8** in 10 cases

To calculate benefit from each probabilistic forecast, factor =0.8

3. Case studies illustrate

- Economy of Scale
- Benefits of enhancing basic meteorological services
- Benefits of institutional and community involvement
- Benefits of emerging and new technologies

Cyclone Sidr Case Study

- **Possible early warning**:
  - – NWP with a high performance computing system and trained human resource
  - – Enhanced lead times of both landfall point and cyclone track beyond 5 days

Cyclone Sidr Case Study: EWS Costs

Item	Fixed costs (million USD)	Yearly variable costs (million USD)	Other costs (million USD)
Scientific component			
EWS technology development costs	1.0	-	-
High performance computing system	1.0	0.10	-
Additional training	0.1	0.01	-
Institutional component			
Capacity building of national, district institutions for forecast application	-	0.20	-
Community component			
Training of Trainers	-	0.10	-
Total (million USD)	**2.1**	**0.41**	**-**

Cyclone Sidr Case Study: EWS Costs

For 10 years

- Fixed costs : USD 2.1 million
- Variable costs @ 0.41 million per year : USD 4.1 million
- Total costs for 10 years : USD 6.2 million

Total costs for 10 years (cyclone only, 50%)

(C) : USD 3.1 million

Cyclone Sidr Case Study: EWS Benefits

Type of Impact	Without EWS	With EWS	Included in analysis
Natural	Damage to coastal forests, ecosystems	Damage to coastal forests, ecosystems	No
Physical & Economic	Housing damaged; household possessions lost	Damage avoided in some cases (damage due to fallen trees reduced in **10%** of partially damaged houses by maintenance of trees), and household possessions saved	**Yes**. Possessions as 5% of housing damages avoided
	Agriculture: crops damaged; implements and equipment damaged or lost	Damage to crops avoided, where applicable, by early harvesting; agricultural implements and equipment saved	**Yes**
	Fishery: fish, shrimps lost; nets and other fishing equipment damaged	All fish, shrimps, prawns harvested; nets,; equipment saved (**70%** reduction in damages)	**Yes**
	Livestock: most poultry, farm animals, forages, and straw damaged or lost	All poultry, farm animals, forages, straw safely moved (**45%** damage reduction)	**Yes**
	Offices and schools: cash lost; equipment and furniture damaged	Cash saved; equipment and furniture protected (**15%** reduction in damages)	**Yes**
Human	Several lives lost	Many lives lost	No
	Several injuries sustained	Many injuries avoided	No
	Several affected people exposed to various illnesses	Many illnesses avoided as a result of increased preparedness measures	No
Social	Trauma, suffering among affected and their relatives	Reduced trauma and suffering due to anticipation and preparedness	No

Cyclone Sidr Case Study: EWS Benefits

Impact	Magnitude without EWS	Magnitude with EWS	Value	Total yearly benefit (avoided cost)
Fishery	BDT 324.7 million worth of fish, shrimp, fingerlings washed away	70% of damages could have been avoided	-	BDT 227.29 million ***(USD 3.29 million)***
	BDT 130.29 million worth of boats (1,855) and fishing nets (1,721) damaged	15% of damages could have been avoided	-	BDT 19.54 million ***(USD 0.28 million)***
Livestock	BDT 1.25 bi of damages due to dead animals (cow, buffalo, sheep, goat), poultry (chicken, ducks), and feed	45% of damages could have been avoided	-	BDT 562.5 million ***(USD 8.14 million)***
Schools and offices	BDT 16 mi of stationery, learning materials, etc. damaged	15% of damages could have been avoided	-	BDT 2.4 million ***(0.03 million USD)***
Total				**BDT 5,472.11 million** ***(USD 79.14 million)***

Total benefit considering probabilistic forecasting = 79.14 x 0.8 (b) = USD 63.31 mi

Cyclone Sidr Case Study: EWS Cost Benefit

Over a 10 year period

- Total costs (C) : USD 3.10 mi

- Total benefits, assuming 2 instances over 10 years
  (bx2) : 63.31 x 2
  (B) : USD 126.62 mi

$$\frac{\text{Total benefits}}{\text{Total costs}} = \frac{126.62}{3.10} = 40.85$$

For 1 USD invested in this EWS, there is a return of USD 40.85 in benefits.

Investment in early warning: agriculture sector, Bangladesh

Hazard		
Cyclone	Sidr 2007 damage to agriculture, fishery, and livestock	USD 23.4 million
	Investment in early warning technology, training over 10-year period	USD 3.1 million
	Total avoidable damage to agriculture using probabilistic forecasts, assuming 2 instances of such damages over 10 years: 23.4 x 0.8 x 2	USD 37.44 million
	Total benefit/ total cost: 37.44 / 3.1	USD 12.08 / USD 1 investment

Investment in early warning: Agriculture sector, Bangladesh

Hazard		
Flood	Jul-Aug 2007 damage to agriculture, forests, fishery, and livestock	USD 206.76 million
	Investment in early warning technology, training over 10-year period	USD 3.1 million
	Total avoidable damage to agriculture using probabilistic forecasts, considering severity, return period, event frequency over 10 years: 206.76 x 0.8 x 8.33	USD 1,377.85 million
	Total benefit/ total cost: 1,377.85 / 3.1	USD 444.47 / USD 1 investment

4. Results from Case Studies

Country	Hazard	Benefit/ Cost (*)
Bangladesh	Cyclones	40.85
Sri Lanka	Floods	0.742
Bangladesh	Floods	447.1
Thailand	Floods	1.76
Vietnam	Hydro-met	10.4

(*) For 10 years

Results from Case Studies- Seasonal Forecasts

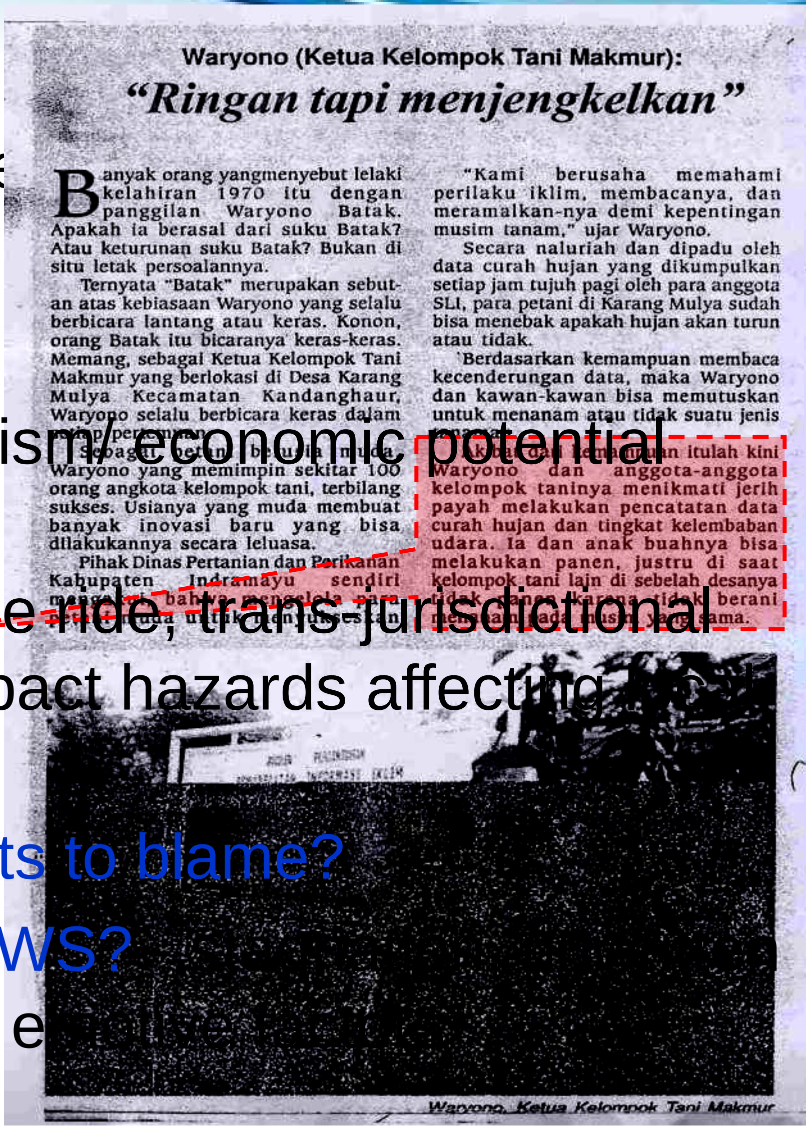
Country	Value of Forecast
Philippines *(2002-03 El Niño)*	USD 20 mi (one province in the season)
India *(2002)*	USD 80 mi (one state in the season) or USD 480 mi (one state over 30 years); USD 1.2 billion (India -2002 – input costs may be saved at farm level)
Indonesia	USD 1.5 mi (50 districts, CFA forecast); USD 7.5 mi (250 districts, potential) Benefit/Cost = 100

5. Constraints & Challenges in EWS

I. At Policy Level

- – Perception- 'Acts of God'; othe hard evidence
- – Not tangible enough?- Media
- ■ Unwelcome harbinger? – tourism/ economic potential impacted
- ■ Trans-boundary hazards?- free ride, trans-jurisdictional issues, low frequency, low impact hazards affecting lo areas are ignored
- ■ Damage and loss assessments to blame?
- ■ Essential EWS vs. effective EWS? disaster threshold tolerances, e

Farmers of Kelompok Tani Makmur got good harvest in dry season 2004, while neighboring villages did not get anything as they made a wrong decision not to plant.



Waryono (Ketua Kelompok Tani Makmur):

"Ringan tapi menjengkelkan"

Banyak orang yangmenyebut lelaki kelahiran 1970 itu dengan panggilan Waryono Batak. Apakah ia berasal dari suku Batak? Atau keturunan suku Batak? Bukan di situ letak persoalannya.

Ternyata "Batak" merupakan sebutan atas kebiasaan Waryono yang selalu berbicara lantang atau keras. Konon, orang Batak itu bicaranya keras-keras. Memang, sebagai Ketua Kelompok Tani Makmur yang berlokasi di Desa Karang Mulya Kecamatan Kandanghaur, Waryono selalu berbicara keras dalam setiap pertemuan.

Sebagai petani berusia muda, Waryono yang memimpin sekitar 100 orang angkota kelompok tani, terbilang sukses. Usianya yang muda membuat banyak inovasi baru yang bisa dilakukannya secara leluasa.

Pihak Dinas Pertanian dan Perikanan Kabupaten Indramayu sendiri mengakui bahwa mengelola para petani muda untuk menyukseskan

"Kami berusaha memahami perilaku iklim, membacanya, dan meramalkan-nya demi kepentingan musim tanam," ujar Waryono.

Secara naluriah dan dipadu oleh data curah hujan yang dikumpulkan setiap jam tujuh pagi oleh para anggota SLI, para petani di Karang Mulya sudah bisa menebak apakah hujan akan turun atau tidak.

Berdasarkan kemampuan membaca kecenderungan data, maka Waryono dan kawan-kawan bisa memutuskan untuk menanam atau tidak suatu jenis tanaman.

Akibat dari kemampuan itulah kini Waryono dan anggota-anggota kelompok taninya menikmati jerih payah melakukan pencatatan data curah hujan dan tingkat kelembaban udara. Ia dan anak buahnya bisa melakukan panen, justru di saat kelompok tani lain di sebelah desanya tidak panen karena tidak berani menanam pada musim yang sama.

Waryono, Ketua Kelompok Tani Makmur

Constraints & Challenges in EWS

II. At political level

- Political disincentives- lack of continuity? *(Dumangas, Ilo Ilo)*
- Political system? – Accountability
- Relief and rehabilitation offers more visibility?
- Accountability- Bird Flu- Thailand; Heat Wave- France
- Poor have no voice?- Jakarta, Shanghai

Constraints & Challenges in EWS

III. At technical institutions

- Uncertainty of science? – lack of incentive for identifying, experimenting, and operationalizing technologies
- Bureaucratic psyche towards uncertainty of information?
- Multi-disciplinary?- longer-lead, probabilistic forecast information encompasses multiple sectors, greater coordination
- Lack of accountability?- accuracy as % of forecast vs.observed
- No early warning for surprises!- Tsunami’04, Nargis, Kosi vs. risk knowledge
- Disconnect of early warning with response- Evaluation of early warning is wrt dissemination, not wrt resultant response

Constraints & Challenges in EWS

IV. At community level

- Responses guided by recent experiences – false tsunami alert before Sidr; Simeulue;
- User-friendliness of early warning– personalised; context
- Channel is as important as warning content

Incentives for EWS

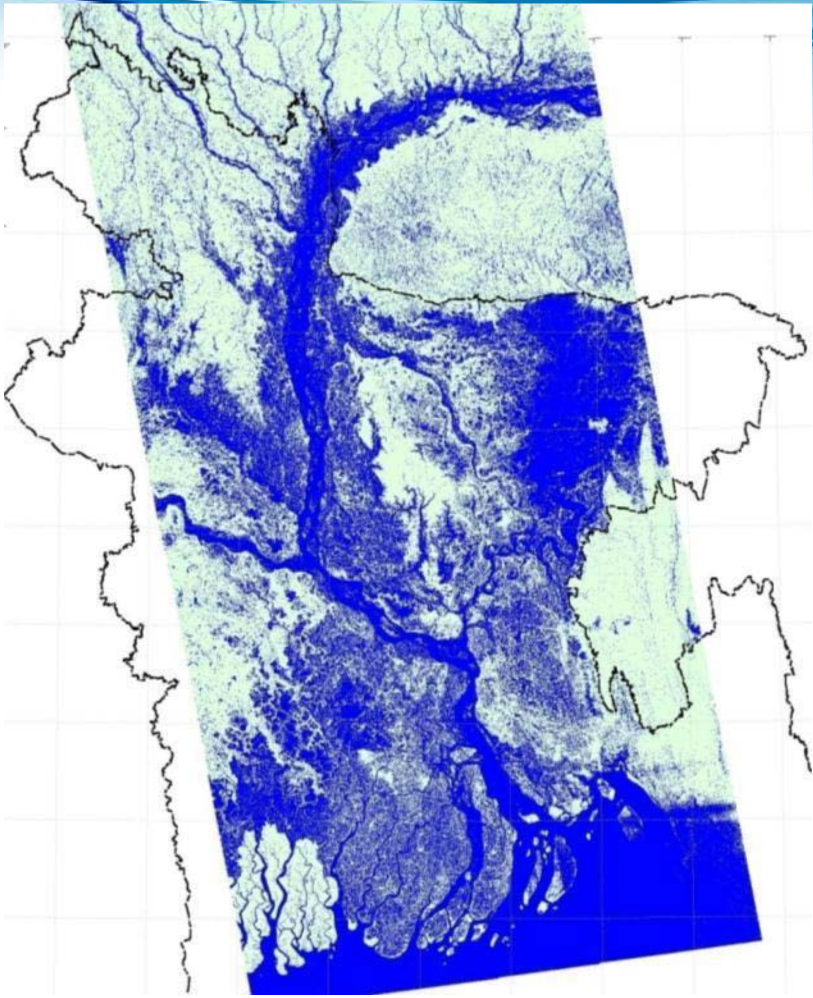
- **Public awareness-** with awareness of advances in technologies, many disasters preventable an empowered civil society
- **Accountability**
- **Economic sense-** advocacy
- **Removal of barriers –** EWS to incorporate economic and social aspects; pre-impact outlooks/ potential damage assessments
- **Financial instruments** – demonstration through donor support
- **Avoidance of free-rider syndrome** - RIMES

6. Way Forward

- **Replication of Bangladesh 10-day Flood Forecast Applications**

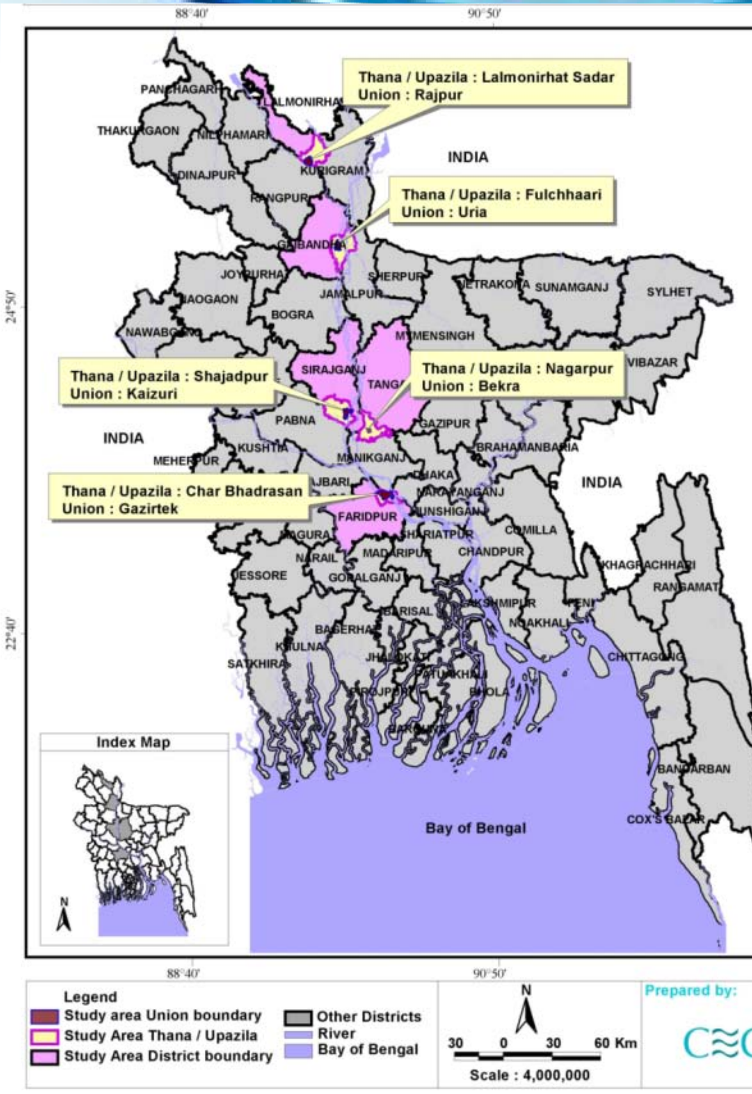
Problem Identification

- 'Normal' Floods are an annual occurrence
- Severe Floods return 2- 5 years
- 24-48 hrs forecast is insufficient lead time to address community needs
- Optimum lead time requirement -10 days

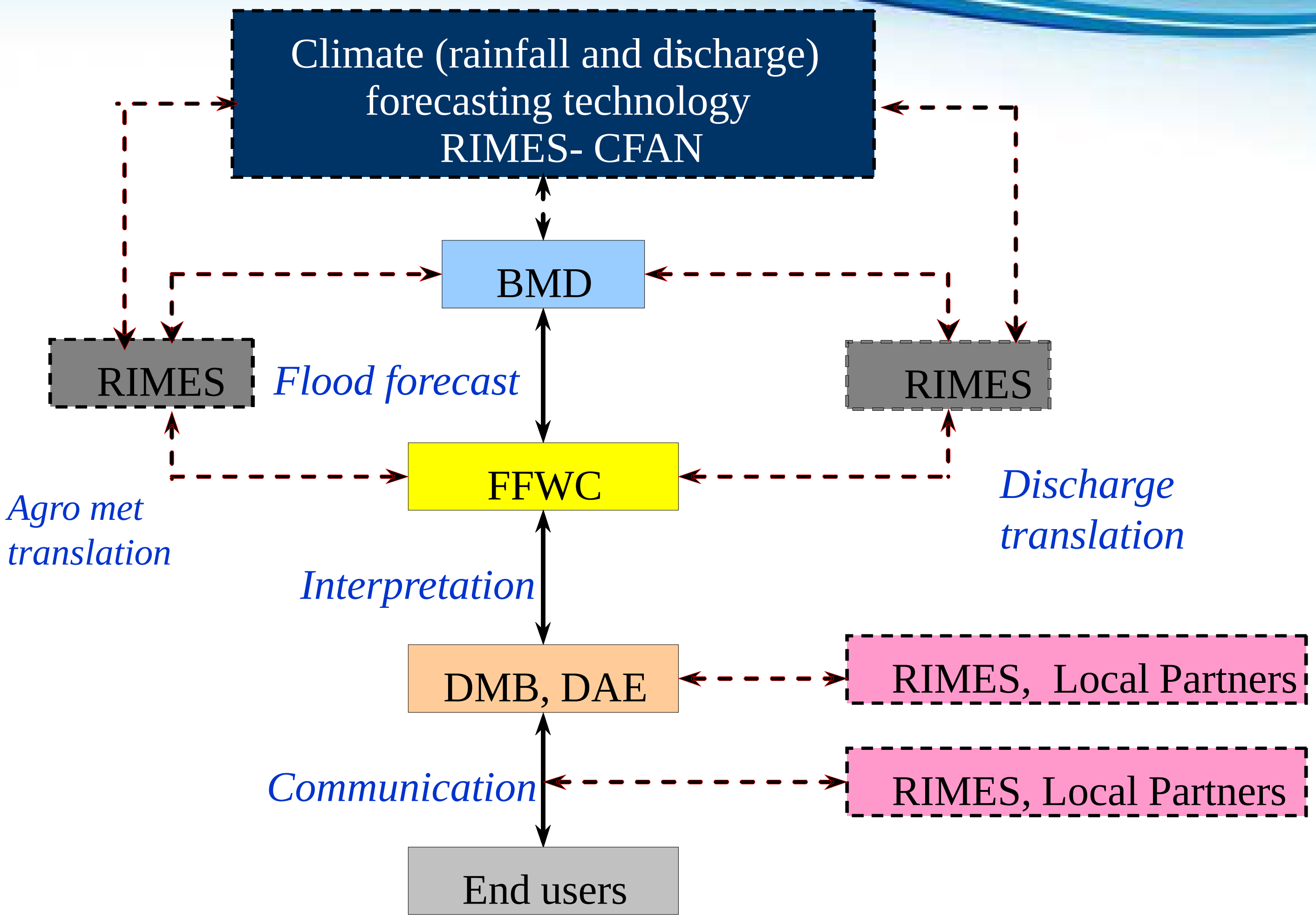


Long Lead Flood Forecasting and Applications

- Research Project initiated since 2000 and completed in 2007
- GoB requested RIMES to continue to provides support
- RIMES provides 10 days lead time flood forecast to GoB and build capacity



Institutional Collaboration For Sustainable End-to-end Flood Forecasts System



Community level Decisions and Lead Time Requirement

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

USER MATRIX on Disasters, Impacts and Management Plan for Crop, Livestock and Fisheries

Disasters	Crop	Stages	Season/ month	Impacts	Time of flood forecast	Alternative management plans
Early flood	T.Aman	Seedling and Vegetative stage	Kharif II Jun – Jul	Damage seedlings Damage early planted T.Aman Delay planting Soil erosion	Early June	Delayed seedling raising, Gapfilling, skipping early fertilizer application
	T.Aus	Harvesting	Kharif I Jun – Jul	Damage to the matured crop	Early June	Advance harvest
	Jute	Near maturity	June-July	Yield loss Poor quality	May end	Early harvest
	S.Vegetables	Harvesting	June-July	Damage yield loss Poor quality	Mar - Apr	Pot culture (homestead) Use resistant variety
High flood	T. Aman	Tillering	Kharif - II July-Aug	Total crop damage	Early June	Late varieties Direct seeding Late planting
Late flood	T. Aman	Booting	Kharif II Aug-Sep	Yield loss and crop damage	Early July	Use of late varieties Direct seeding Early winter vegetables Mustard or pulses
Flood (early, high	Cattle	-	Jun-Sep	Crisis of food and shelter. Diseases like	Early June	Food storage, flood shelter, vaccination de-warming

Risk Communication for Flood Forecasts

Mobile phone

Flag hoisting

Risk Communication

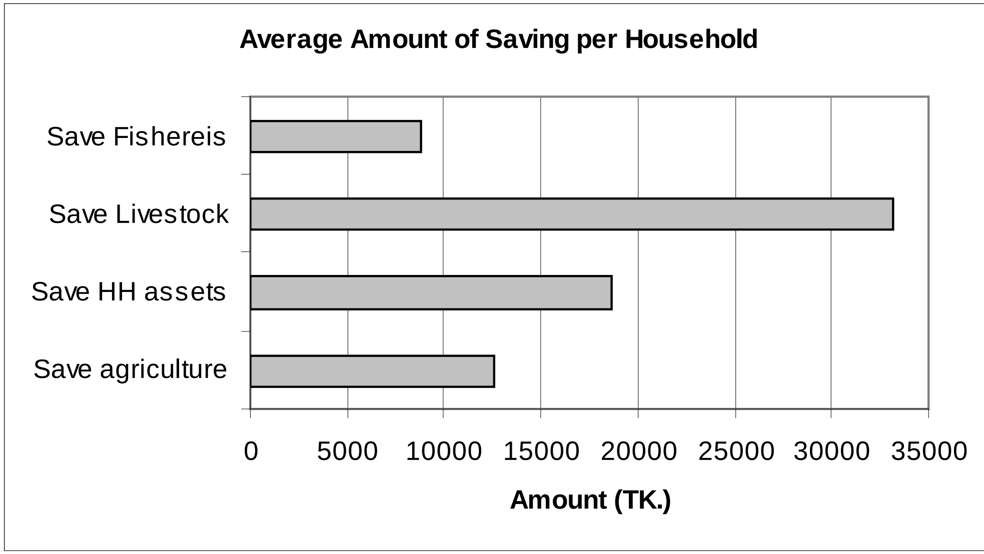
- 1-10 days forecasts shared with the decision makers at national and district level through fax and e-mail
- 1-10 days forecasts information communicated to the pilot communities through SMS and flag network. If danger level probability exceed 85%, 10 days forecast communicate to the pilot areas and appropriate actions take place



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).