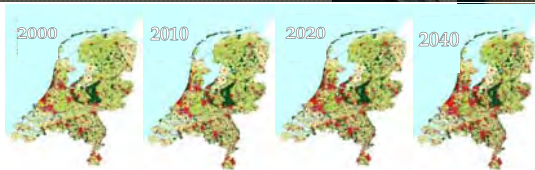


## Dealing with uncertainty: Scenarios...



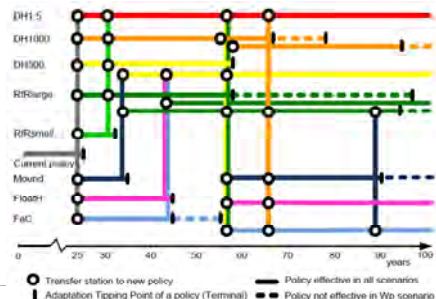
- Climate change scenarios
- Socio-economic development scenarios



## ...and Adaptive Delta Management

No Master Plan (exactly defining what where and when)

But: which decision is needed on which moment based on which data? (adaptation tipping points)

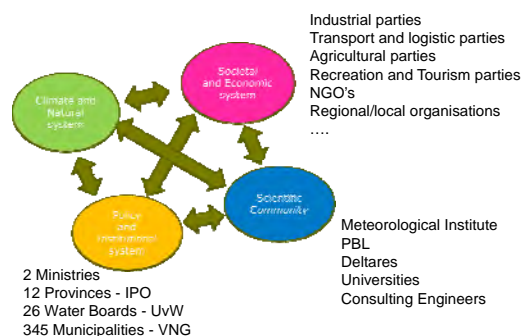


## Participation and design

- Use specific authorities
- Joint fact finding
- Input of creative ideas: Delta Design Studio
- Combine with local developments
- Ensure that input is included in plans and reports



## Who are at the table?



**Deltares**

## Innovations on all levels

### In policy discourse:

- from sectoral to integrated/inclusive development
- connect long-term visions and short-term decisions
- from technical to spatial solutions (Room for the River)

### In planning and design processes

- organise active stakeholder involvement : co-creation
- mainstreaming CC
- legislation and financing mechanisms – remove barriers

### In techniques:

- warning systems,
- dykes, building with nature,
- climate proof infra-structure and building constructions

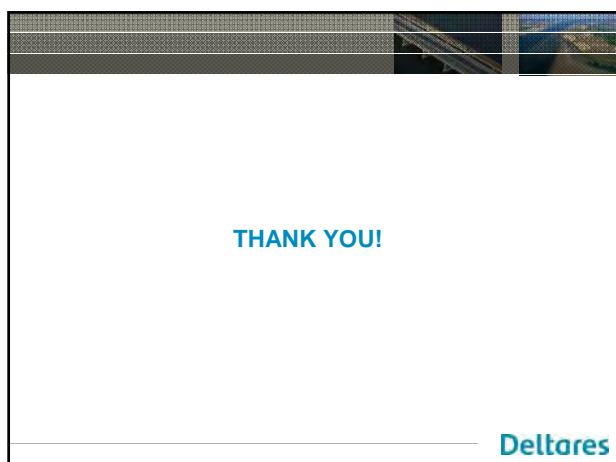
**Deltares**

## Delta Decisions

- ✓ 2011: Principle decision safety standards of dike rings
- ✓ 2014: Strategy for freshwater supply from 2040
- ✓ 2014: Decision on safety and flood protection of Rotterdam and Drechtsteden area
- ✓ 2014: Decision on water level rules for Lake IJssel
- ✓ 2015: Spatial Adaptation
- ✓ 2017: Final decision on safety standards for flood risk



**Deltares**



## **'Delta planning' (Day 2; Tuesday 22 October)**

Day 2 - Introduction groupwork: issues and solutions - Wim Douven

Day 2 - Salinity management in agriculture in deltas - Catharien Terwisscha van Scheltinga

Day 2 - Lower GBM Delta water Planning, Bangladesh - Saiful Alam

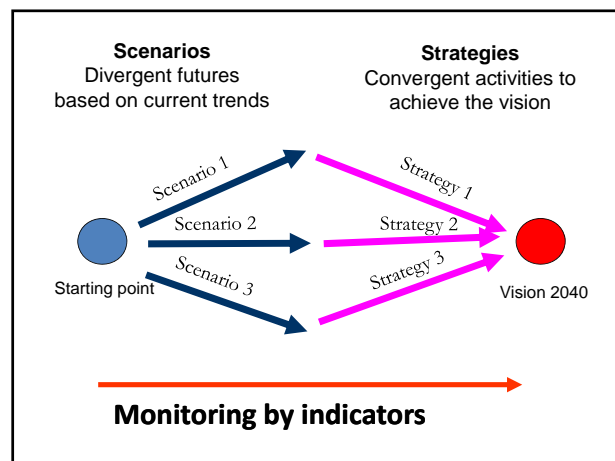
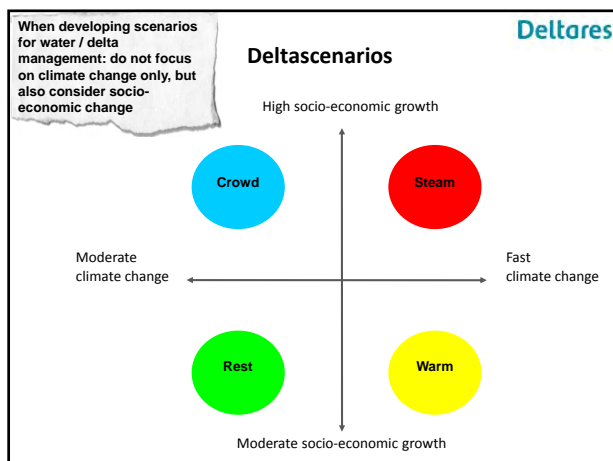
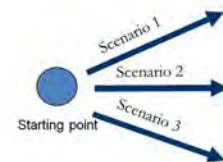
Day 2 - Biophysical and Socio-economic Scenarios for long term delta plans - Fulco Ludwig and Henk Wösten

Day 2 - Sustainable Development of Ayeyarwady Delta - Toe Aung Lin and Toe Aung

## Flow Myanmar training workshop

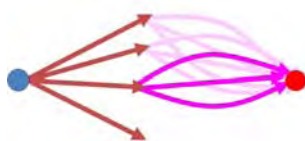
## Scenarios

- When facing deep uncertainty, decision makers can consider multiple plausible outcomes.
- Scenarios present a set of different, plausible future conditions (or 'states of the world').



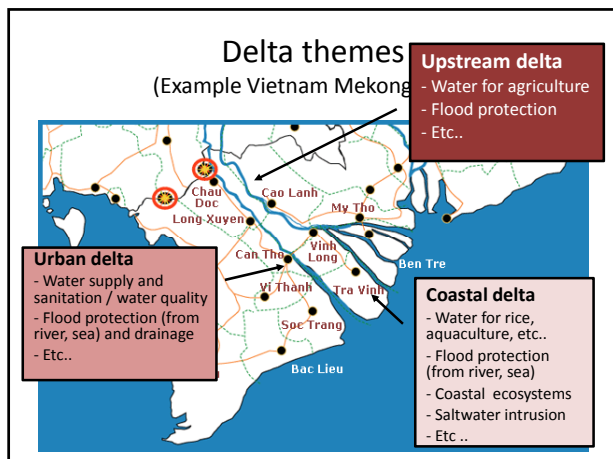
## Robust or resilient strategies

- Identify strategies that will work reasonably well across a wide range of alternative futures.



## Criteria to evaluate strategies

- **Effectiveness:** to what extent does the measure address the problem (from not at all to very much)
- **Economic effects:** what are the investment/operational/transaction/social costs (as a function of GDP?, from very high to very low)
- **Side-effects:** which other positive or negative effects other than reduced the problem and economic impacts does the measure have? (from primarily very negative to primarily very positive)
- **Flexibility:** to what extent can the measure be adjusted/complemented/reversed when resulting to be inadequate or inappropriate (from very rigid to very flexible)
- **Acceptance:** how feasible is the implementation of the measure taking into account issues such as public acceptance? (from not to very acceptable)



### Assignment Tuesday: Scenario development

1. four scenarios
  1. Axis 1 High – low economic growth
  2. Axis 2 Moderate – Fast Climate Change
2. Develop Story lines for each of the four scenarios
3. Describe the most important water related issues for each of the four scenarios
4. 1 group GBM delta, Bangladesh
5. 1 group Indonesian delta – select one delta
6. 1 group Ayeyarwady delta

### Second Assignment Tuesday

1. Chose one scenario and identify three key water issues relevant in all deltas represented in your group (you can focus on an area; coastal, urban, upstream).
2. Analyse the causes of the three issues
3. Identify for one of the selected issues solution strategies. Describe the strategies in terms of concept behind strategy, and type of measures included.
4. Assess / evaluate the strategies (criteria can be used as guidance)

Make differences and similarities between deltas explicit.

### Assignment Wednesday

Stakeholder analysis : MOTA



### Assignment Thursday

1. Develop a roadmap for the implementation of your preferred strategy (e.g. what measures within 10 YR, 50 YR, beyond 50YR)
2. Who should be involved in developing this roadmap? And how?
3. (How to monitor the roadmap? What could be tipping points, how would you know?)

Input: presentations, MOTA session, discussions, ..

Friday

Delt Alliance



# Delt Alliance


A global network for the resilience of deltas

Workshop  
Delta Planning and Management  
**Salinity management in agriculture in deltas**  
Catharien Terwisscha van Scheltinga  
WAGeningen UR  
October 2013

www.delta-alliance.org

Delt Alliance

## Salinity



Salinity as a threat: drinking water will not be available!

www.delta-alliance.org

Delt Alliance

1. Need for information on **salinity**: what is the matter?
2. Beyond newspaper news – there is a need for knowledge/understanding of a **complex system**:

www.delta-alliance.org

Delt Alliance

### Case study: Water Supply for the city of Khulna

- Local water is saline during the dry season
- Only deep groundwater can be used for drinking water
- Large parts of the Khulna resident drink saline water during part of the year
- ADB and Japanese gvt want to invest 250 million US\$ in a new drink water plant
- The question is where to build the plant and where to get the water from and *will this be affected by climate change*

www.delta-alliance.org

Delt Alliance


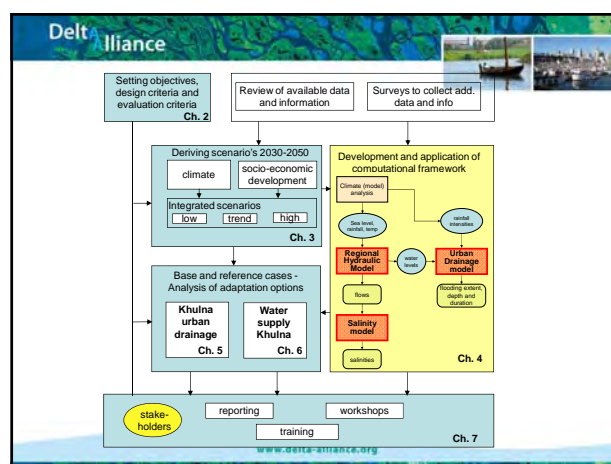


Figure 5.8 Location of Water Intake Points  
From: delta-ALLIANCE Report p.67

The two adaptation options selected were


1. Large reservoir to be used during periods of high water salinity periods
2. Move intake upstream – build pipeline

www.delta-alliance.org






**Delta Alliance**



1. Need for information on **salinity**: what is the matter?
2. Beyond newspaper news – there is a need for knowledge/understanding of a **complex system**:
  - natural salinity intrusion
  - water use in agriculture
  - rice versus shrimp cultivation
  - (power) struggle
  - struggle to survive
  - population pressure
  - decreased run-off
  - sea level rise – sedimentation – subsidence
3. Need to understand how **change** is occurring / will occur (among others climate change – but also other socio-economic changes)

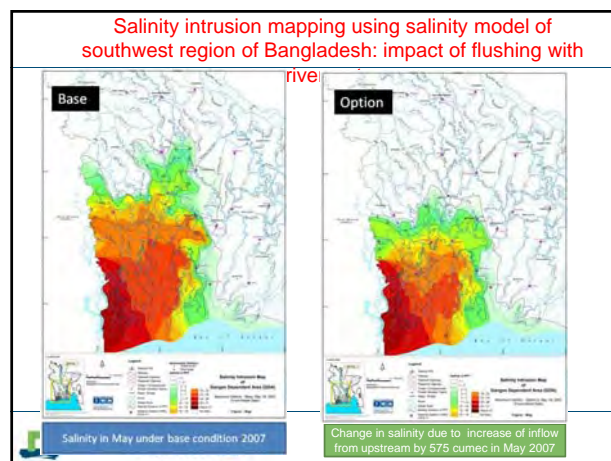
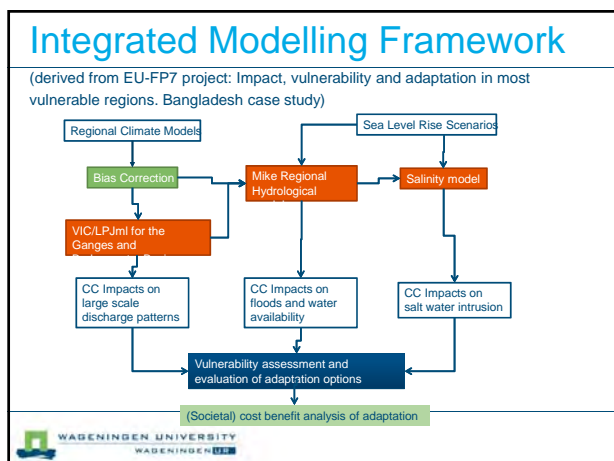
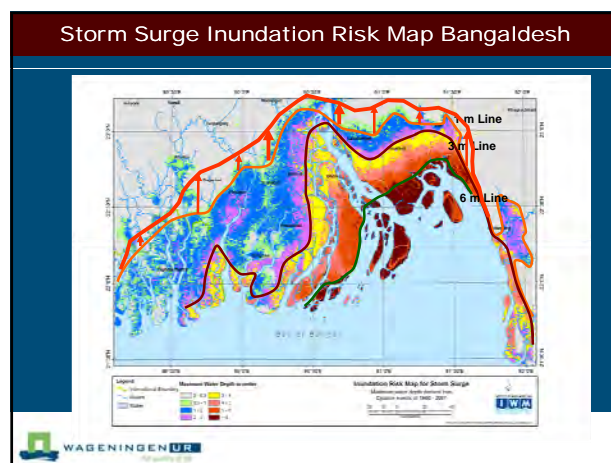
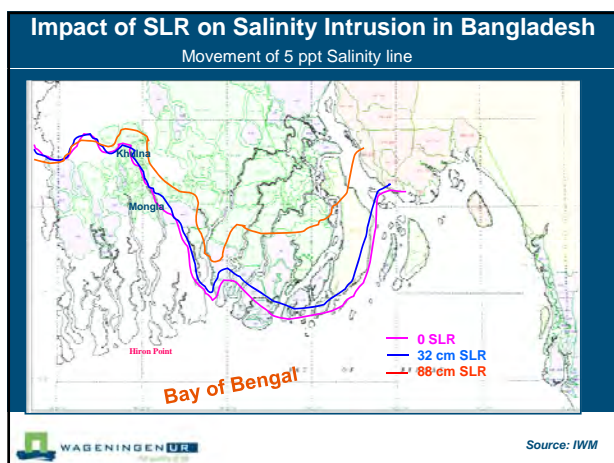
[www.delta-alliance.org](http://www.delta-alliance.org)

**Delta Alliance**



## Salinity map

[www.delta-alliance.org](http://www.delta-alliance.org)



**Delta Alliance**

## Salinity management

- Several assessments and studies/projects are indicating that salt intrusion will have a large impact on Asian deltas:
  - Fresh water supply availability
  - Food production: agricultural + aquaculture/fisheries
  - Ecosystems
- Salt intrusion caused by:
  - Sea level rise, more extreme storm surges
  - Changing rainfall patterns
  - Changed hydrodynamics, anthropogenic activities
  - Subsidence

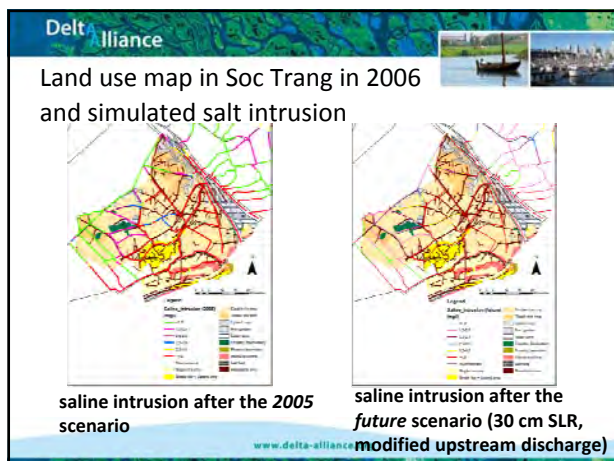
www.delta-alliance.org

## Climate Change (CC) and salt intrusion in the Vietnamese Mekong Delta

- Assessment shows huge impact on hydrology (water resources) – Saline, Brackish & Fresh
  - see level rise & typhoon surges
  - fresh water floods (peak river flows & run-off)
  - high intensity rainfall & dry spells
- How to cope with changing water conditions?
  - increase room for brackish water retention
  - increase high rainwater retention (reduce floods)
  - increase fresh water storage (flood protection & dry spell reserves)
  - increase coastal defence (high sea level & typhoon)



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## Climate Change Adaptation (CCA) challenges

- How to provide future water storage/regulation capacities?
- Where to provide for these water storage capacities?
- CC has potentially drastic impacts on agriculture/aquaculture/nature (AAN)
- Can we transform threats into opportunities?
- Change goal of Natural Resources planning and management:
  - In past: optimize land & water for production systems
  - Future CCA : optimize systems to water regulation requirements



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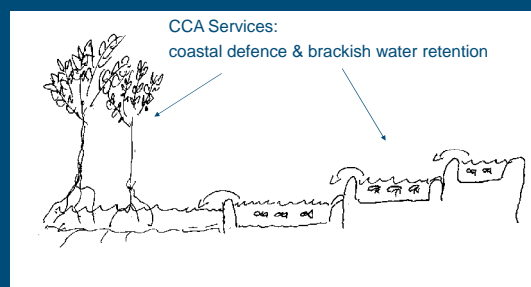
## Agricultural/Aquaculture systems in VMD

- Mangrove + Shrimp/clams/fish = Brackish aquatic environment (AE)
  - Transition zone Brackish ⇌ Fresh AE
  - Pangasius + rice = fresh water AE
- Adapt and optimize production systems to optimize CCA storage/regulation requirements



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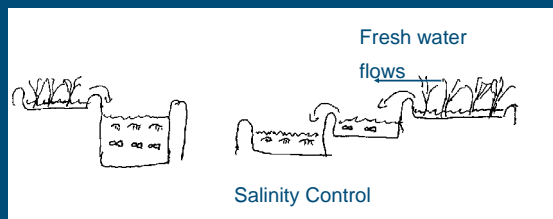
## Coastal Brackish Environment



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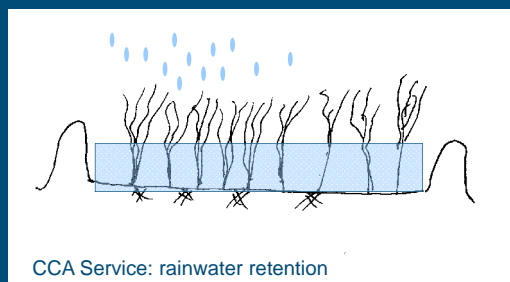


### Brackish-Fresh Transition zone



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### Fresh water zone - rice



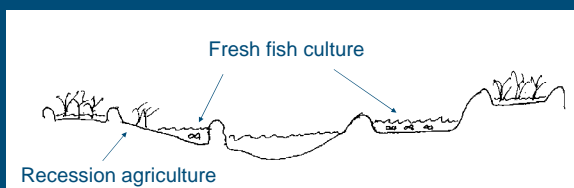
10 cm = 1000 Mm<sup>3</sup> @ 30% of Rice in VMD



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### Room for the Mekong Floods

CCA Services: seasonal flood retention & dry season reserves



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### Brackish AE production systems



Fishing in brackish



Intensive shrimp



Non-forest (sea)



Fish pond &amp;



Mangrove-shrimp



Mangrove-shrimp (separated)



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### Project Strategy

- Look at, and work with present water use(r)s in CCA relevant aquatic environments
- What changes/innovations are needed in today's water use systems to optimize:
  - the CCA water storage/regulation functions?
  - secure productivity/BD of the system?



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**DeltAlliance**  
For the resilience of deltas worldwide

**Thank you!**  
Catharien.Terwisscha@wur.nl

WAGENINGEN UR  
University of Applied Sciences

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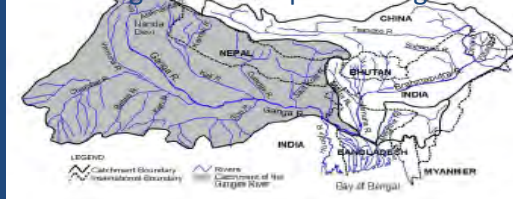
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## Lower GBM Delta water Planning, Bangladesh

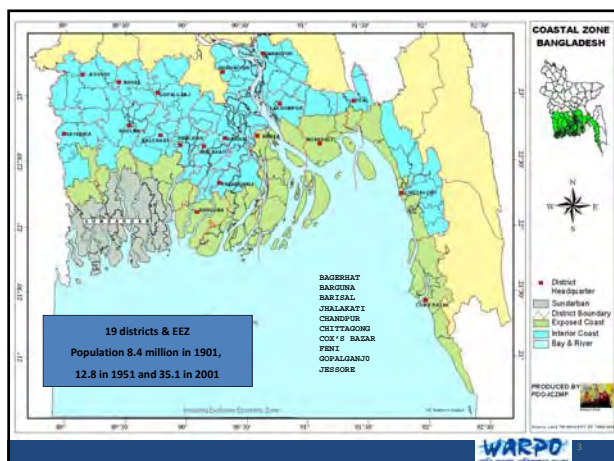
Saiful Alam

22 October 2013

## Ganges –Brahmaputra -Meghna



Country	Area (sq-km)	% of Total	Country	Area (sq-km)	% of Total	Country	Area (sq-km)
Bangladesh	39,726	4	Bangladesh	38,956	7	Bangladesh	31,859
India	770,197	77	India	197,504	35.7	India	44,034
Nepal	149,417	15	Nepal	1,324	0.2	Myanmar	690
China	36,941	4	Bhutan	41,324	7.5	Total	77,483
Total	996,281	100	China	273,539	49.6		
			Total	552,646	100		



## Zone of Fragile Ecosystem

- ☐ mangrove: Sundarbans
- ☐ wetlands
- ☐ island & marine ecosystem
- ☐ Coral bearing island
- ☐ Reserve forest
- ☐ Marine reserve
- ☐ fish sanctuaries
- ☐ wild life sanctuaries
- ☐ biodiversity hotspots

: 7 ECAs declared

Globally important

- ☐ Turtle breeding & nesting sites
- ☐ Ramsar sites
- ☐ World heritage sites



## Zone of development opportunities

- ☐ fisheries & shrimp
- ☐ marine fisheries
- ☐ agriculture
- ☐ forest
- ☐ salt pans
- ☐ ports & EPZs
- ☐ on shore & off shore gas
- ☐ beach minerals
- ☐ renewable and non-renewable energy
- ☐ tourism



## Coastal Zone Setting

- ☐ Zone of multiple vulnerabilities
- ☐ Zone of fragile ecosystem
- ☐ Zone of distinctive development opportunities
- ☐ combination of these settings calls for distinctive coastal management, internationally called ICZM, ICM, ICAM

## Integrated Coastal Zone Management Plan: Six Outputs

- ❑ Approaches and procedures for the improvement of **community capacities to enhance their livelihood.**
- ❑ Approaches and procedures for the development of **an enabling institutional environment.**
- ❑ **An Integrated Coastal Resources Knowledge Base (ICRKB).**
- ❑ **A Coastal Zone Policy (CZPo)**, which lays down GoB's vision and principles of ICZM.
- ❑ **Coastal Development Strategy (CDS).**
- ❑ **A Priority Investment Program** for infrastructure developments and improvements.

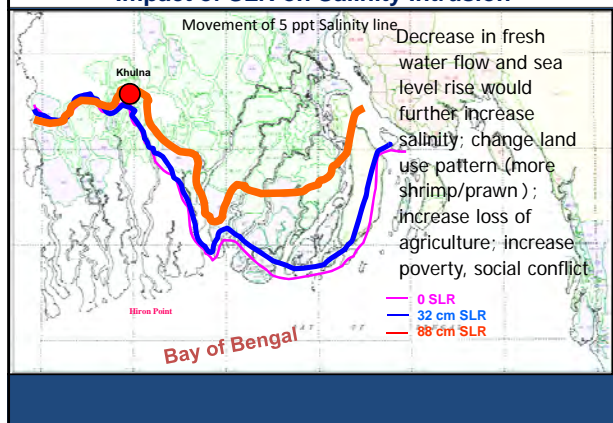
WARPO

## Zone of multiple vulnerabilities

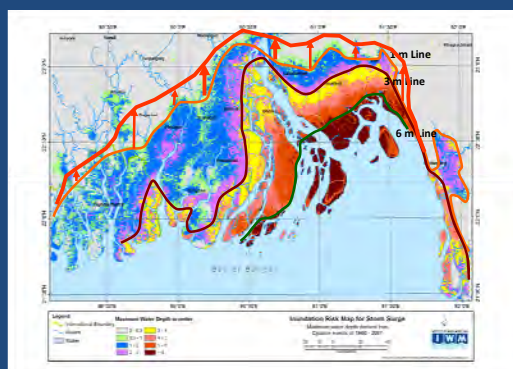
- ❑ Cyclones and storm surges: 8 million at risk
- ❑ Land erosion
- ❑ Drainage congestion
- ❑ Water & soil salinity
- ❑ Arsenic
- ❑ Climate change



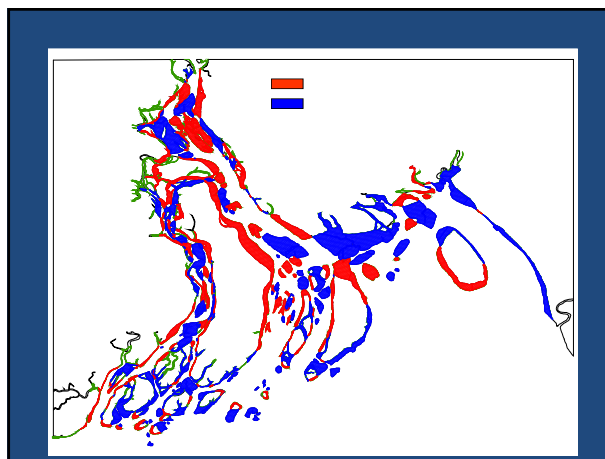
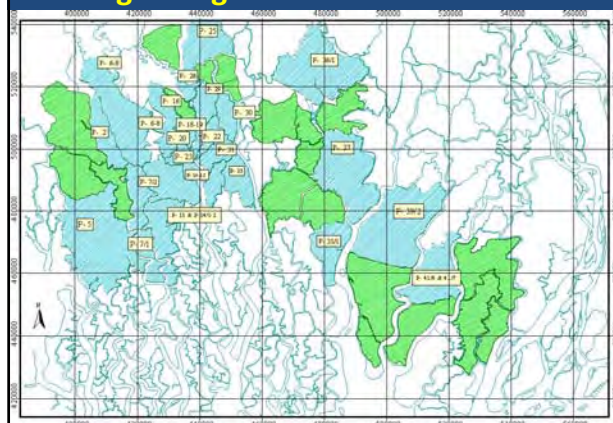
## Impact of SLR on Salinity Intrusion



## Storm Surge Inundation Risk Map Bangladesh



## Drainage Congestion in the Polders



### Socio-economic drivers for Scenarios

1. Future Population Growth and urbanisation;
2. Economic growth and future economic outlooks;
3. Future development in land-use; agriculture and aquaculture, industrial and urban developments;
4. Regional water cooperation;

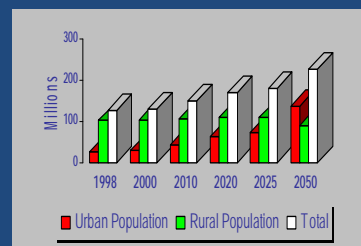
### Future Population

Population growth:  
162 million (2009)-

224 million (2050)

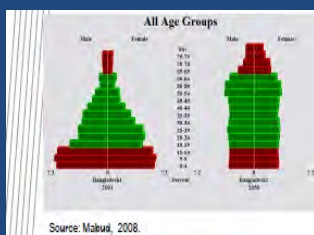
Stabilize to 250  
million in 2085;

1020 people/km<sup>2</sup>



Urban Population continues to rapidly increase, reaching 73 million by 2025, and exceeding rural by 2050

### Future Population

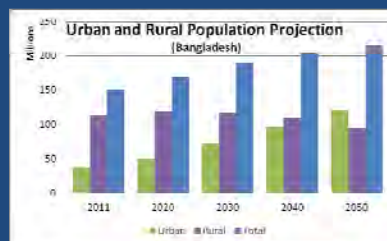


40% of population under 15 years old

65 million people will be over the age of 60 (ICDDR, 2011) by the end of this century

### Urban population

The latest population census in 2011 shows that urban population is 28% of total population (2011) and the rate of urbanization is 2.96% annual rate of change (2010-2015 est).

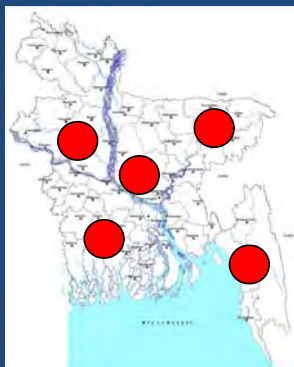


### Urban population

As per recent UN data, approx. 25% of current population lives in urban areas. More than half lives in the four largest cities: Dhaka, Chittagong, Khulna and Rajshahi.

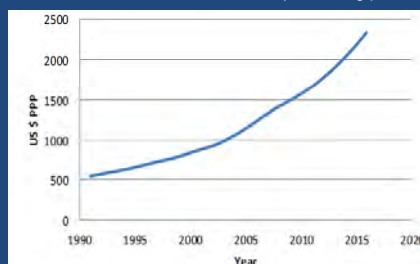
DHAKA (capital) 15.391 million;  
Chittagong 4.816 million;  
Khulna; 1.636 million;  
Rajshahi 853,000 (2011).

CIA World facts book



### Economic growth

Economic growth in 2009 was measured by a GDP rate of 5.7% (world Bank, 2011a). GDP per capita has been rising in an exponential fashion and is estimated to reach \$2340 USD (purchasing power parity) by 2016



GDP per capita purchasing power parity



## Economic growth

Table 1: Bangladesh's GDP Growth until 2021

	2010	2015	2021
Real GDP growth, %	6.1	8.0	10.0
As % of GDP			
Gross investment, %	24.4	32.5	38.0
Unemployment/underemployment rate, %	30.0	20.0	15.0

Source: Perspective Plan of Bangladesh 2010-2021, Planning Commission 2012

The above growth projection assumes that factor accumulation, especially capital, will act as the major stimulus to growth for which the gross investment rate will rise to about **38 percent of GDP in 2021** from a level of 24.4 percent in 2010. Moreover, productivity growth will begin to play an increasing role and will contribute about **20 percent of growth** by 2021.

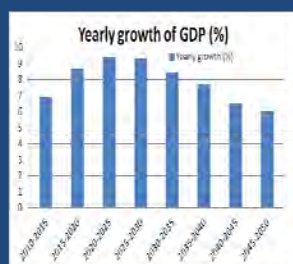
## Upstream Development/International cooperation/Governance

Country	GDP growth rate
Bangladesh	6.3
India	7.8
Nepal	
Bhutan	8.1
Pakistan	
Afghanistan	
(CIA World Factbook)	8.3

South Asia is now one of the fastest-growing regions in the world.

Many countries of the region registered high growth rate in 2011: Sri Lanka (8.3), Bhutan (8.1), India (7.8), and Bangladesh (6.3).

## Projected economic growth (assumptions)



Source: Bangladesh Integrated Water Resources Assessment (BIWRA, 2013)

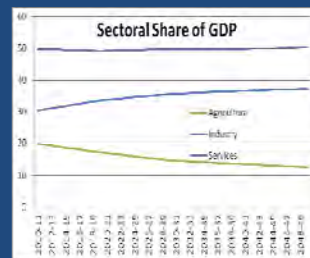
The growth in capital stock faster till 2025 and reach about 40 percent of GDP by 2025 after which the growth will slow down;

With rising capital stock, total factor productivity growth will become faster;

sound macroeconomic policies, well function socio-political institutions, high education and skill levels, effective integration into the world economy;

Rapid growth and development in India and China.

## Sectoral Share of GDP Growth



Remittances from Bangladeshis working overseas, mainly in the Middle East, are another major source of foreign exchange earnings

Sectoral growth are estimated based on trend growth rates over 20 years from FY 91 through FY 11;

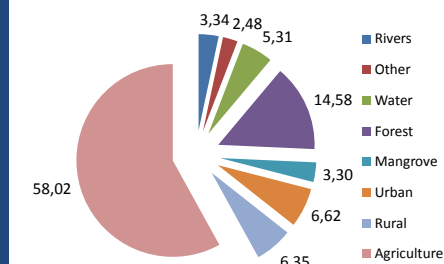
the trends being -1.6% for agriculture and +2.3% for industries sector;

It is assumed that agriculture share for the first 20 years will decline at the same rate as the previously estimated 20-year trend rate of growth; the share is assumed to decline at the rate of half of the 20-year trend rate of growth.

The share of industry is assumed to decline at the rate of one-fourth of the immediate previous rates, successively for every 10 years, starting from previously estimated 20-year trend rate of growth.

More than half of the GDP is generated by the service sector

## Land use in % of Total Area

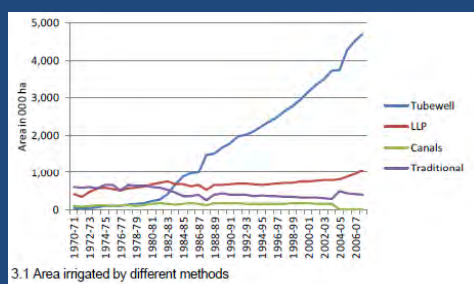


## Changes in land use (current)

If current trends in the growth of cities and rural settlements and activities such as fish pond development continue, and policies on the re-allocation of land to forestry are pursued, then these land use changes will reduce the area of land available for agriculture by some 1.4Mha (17%) over the next 25 years. A significant part of this is likely to be from the loss of agricultural land within areas already designated as urban land in Paurashavas.

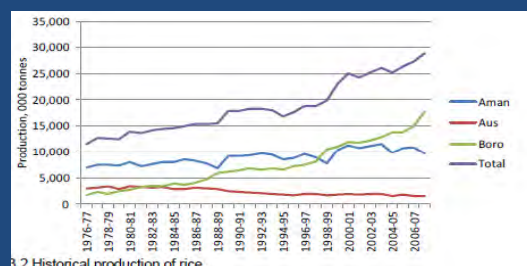
Agriculture land is converted @ 0.56 % to other multiple use (SFYP reports decrease @ 1%) .

### Land use for irrigated agriculture



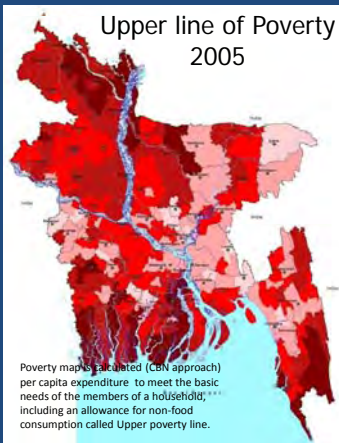
Area under Boro rice irrigation increased from 0.25 Mha (1985) to about 4.8 Mha (2007) using tubewell; surface water irrigation is almost constant to less than 1 Mha

### Crop production (Rice)



Irrigation, especially boro production has increased rice production from 11.9 million tonnes (Mt) in 1975 to 29 Mt (2007-2008)

### Upper line of Poverty: 2005



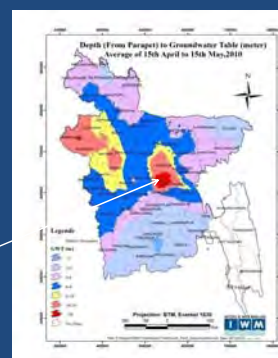
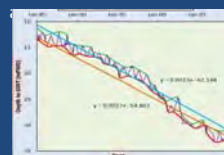
Area	Poverty line	2005	2010
Urban	Lower	14.60	7.70
	Upper	28.40	21.30
Rural	Lower	28.60	21.10
	Upper	43.80	35.20
Total	Lower	25.10	17.60
	Upper	40.00	31.50

Legend	
---	International boundary
---	District boundary
---	Coast line
River	Main river
	Other rivers
■	District Headquarter
Upper poverty line	
■	20% or less
■	21% - 36%
■	37% - 48%
■	49% - 60%
■	61% or greater

### GW and SW usage and food security

Groundwater recharge from rainfall and annual flooding in general is not likely to change under CC.

Future water demand increase (25% in 2050) may put pressure in areas with low rainfall/recharge constrained area/ dense urban



### Basin wise Water Resources Availability

	GBM	Ganges	Brahmaputra	Meghna
Surface Water Availability (Bm <sup>3</sup> )	1270 <sup>(i,ii)</sup>	585	600	85
Groundwater Availability (Bm <sup>3</sup> )	226 <sup>(i,ii)</sup>	178	40	8
Total Water Resources (Bm <sup>3</sup> )	1496	763	640	93
Population (million)	560	429	90	41
Resources in m <sup>3</sup> -per capita-year	2671	1779	7111	2268

Source: Estimates based on data (adjusted for present use) from (i) National Water Development Agency (NWDA) of India, (ii) Water Resources Planning Organization (WARPO) of Bangladesh

### Water Resources Availability

	Critical Dry Season (January-April)	Flooding Wet Season (June-September)
Water Availability (Bm <sup>3</sup> )	83	850
Water Availability m <sup>3</sup> per capita per year	597	6,115

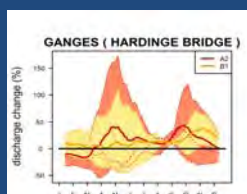
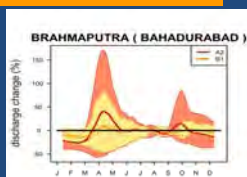
Being located at d/s end of the basins water resources availability in Bangladesh during critical dry period is about one third of the threshold level of 1700 m<sup>3</sup> per-capita while it is more than three times during monsoon. This alternate cycle of excess and scarcity exaggerated by upstream withdrawal leads to tension over water-sharing with its neighbor India.



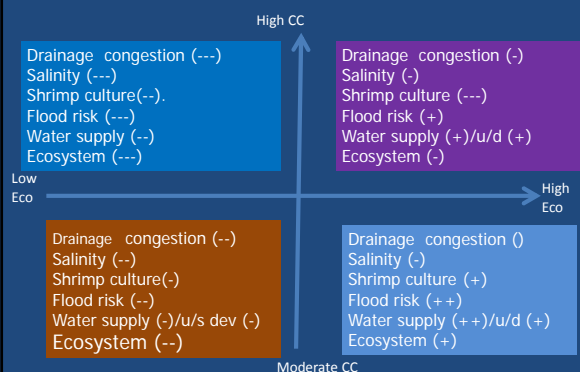
## Climate Change

*Flood Plain of the WRS alleviates peak river discharges.* Embankment and polders reduced flood plain area and thereby increase peak floodwater levels.

Majority CC scenario suggest increase flood and reduce dry season flow. Future urbanization with more flood protection works/ polders would reduce further flood storage and increase risk of embankment over topping, breach and infrastructure damage.



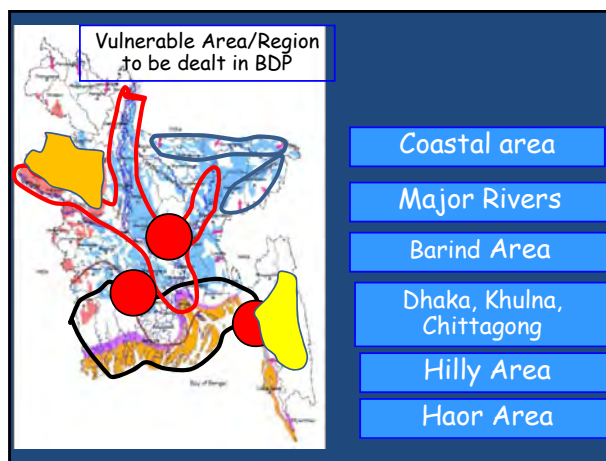
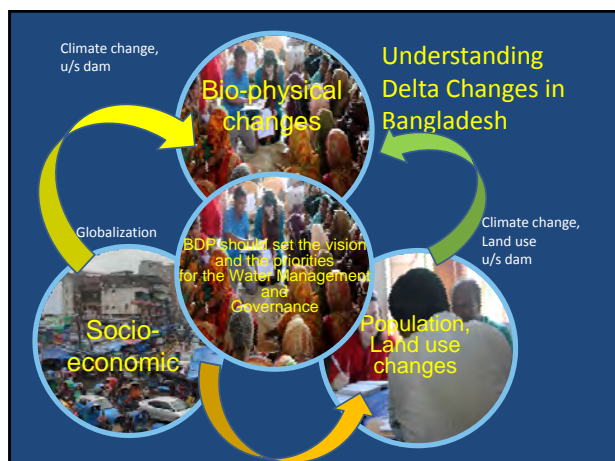
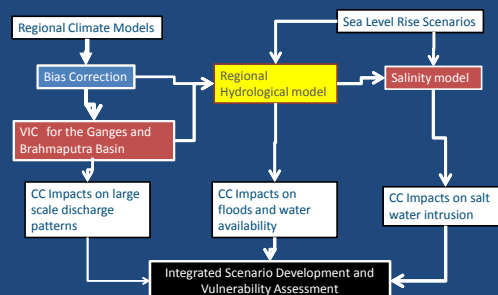
## Link between bio-physical with CC and Eco Scenario

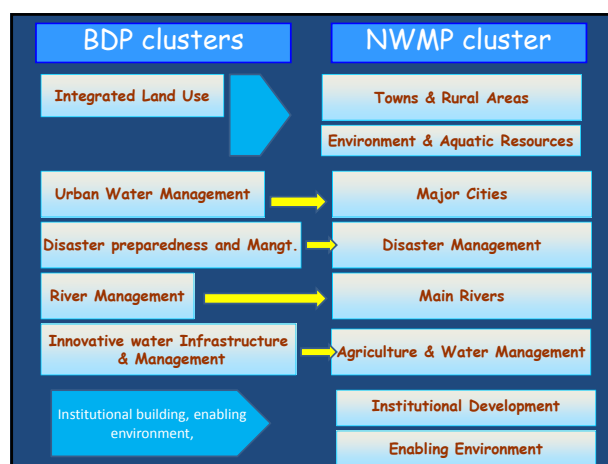


## Quantification

1. U/S water withdrawal and water availability (Ganges & Brahmaputra)
2. Salinity/ water quality
3. inundations;
4. Land use change
5. Sedimentation/drainage

## Modelling Framework for Scenarios quantification – Bangladesh





### Institutional arrangement for Water Management Planning

- National Water Resources Council (NWRC) and its Executive Committee is responsible for coordinating the activities in the water sector
- WARPO, secretariat to ECNWRC is responsible for Integrated Water Resources Management Planning in the country
- Inter-ministerial coordination under different ministries does day to day coordination
- ECNWRC is responsible to operationalise the Bangladesh water Act 2013

### Weakness of the country's planning system

- In the truest sense lack of strong political will and firm administrative direction is responsible for the unsuccessful implementation of the plans and processes.

*Thank you*

## Biophysical and Socio-economic Scenarios for long term delta plans

Fulco Ludwig and Henk Wösten

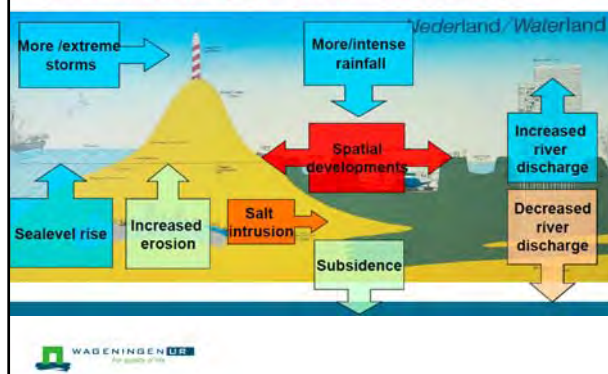
Wageningen University and Research Centre

22 October 2013



WAGENINGEN UR  
For smart delta

## The Delta under pressure: Future challenges



WAGENINGEN UR  
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## Quote from Ho Long Phi

“External impacts can be neither predicted nor controlled”

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## Why do we need scenarios

- Scenarios are plausible, and often simplified, representation of future state of socio-economic and biophysical parameters – scenarios are neither predictions nor forecasts;
  - There are no probabilities linked to different scenarios
- Both future climate and socio-economic development are uncertainty
- Key Uncertainties in climate change scenarios
  - Future greenhouse gas emissions
  - Carbon sensitivity
  - Impact of global warming on changes in hydrological cycle
- Key Uncertainties in socio-economic scenarios
  - Future economic development
  - Future national and local population density
  - Direction of development (rural vs. urban/agriculture vs industrial)

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## Key water related issues in urbanized deltas

- Too much water - more floods
  - changed run-off patterns and more local extreme events
  - Increased sensitivity for floods due to land use change and population growth
- Too little water - more droughts and water scarcity
  - changed run-off patterns
  - higher water demands
- Too dirty water – polluted and saline water
  - Salt water intrusion caused by sea level rise and changing run-off patterns
  - Pollution from industry, household and agriculture

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## Key features of climate change and water scenarios

- **Water availability and stress:** How much water will be available for different delta functions under C.C and development scenarios?
- **Sea-level rise and salinization:** To what extent SLR and resulting salinity intrusion change the delta's soil and water systems?
- **Climate and water related risks focusing on flood and drought:** How flood/drought patterns i.e. frequency, intensity, hot-spots change in future?

Boundary conditions for planning and testing robustness of proposed solutions

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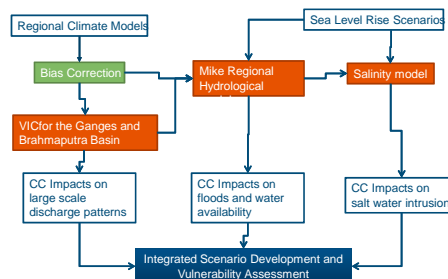
6

### Most important biophysical indicators for which we need scenarios in the deltas

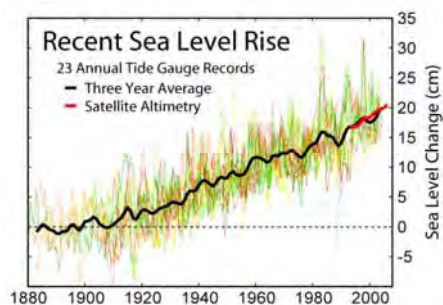
- Water availability and stress
  - changes in (upstream) river flow patterns
  - Changes in water demand
- Water quality – focussing on changes in salinity – driven by
  - changes of upstream flow - mainly dry season/ low flows
  - changes in sea level
- Future Flood risks
  - changes in sea level rise
  - local rainfall – wet extremes
  - upstream flows (high flows)

### Modelling Framework for Bangladesh Delta

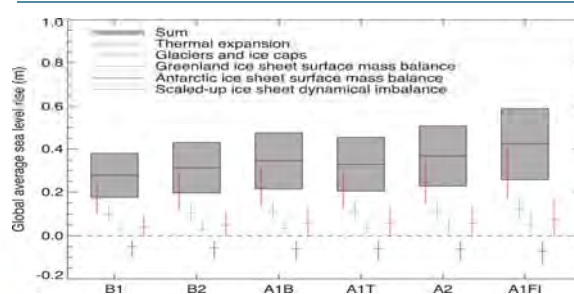
#### Scenarios



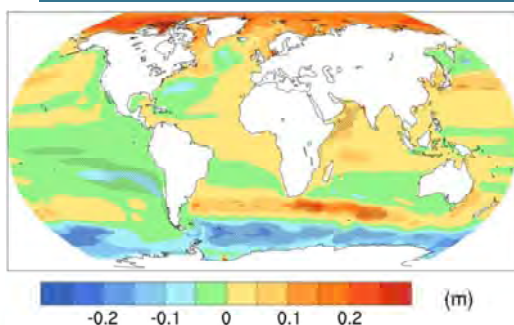
### Sea level rise



### Future Sea Level Rise according to the IPCC

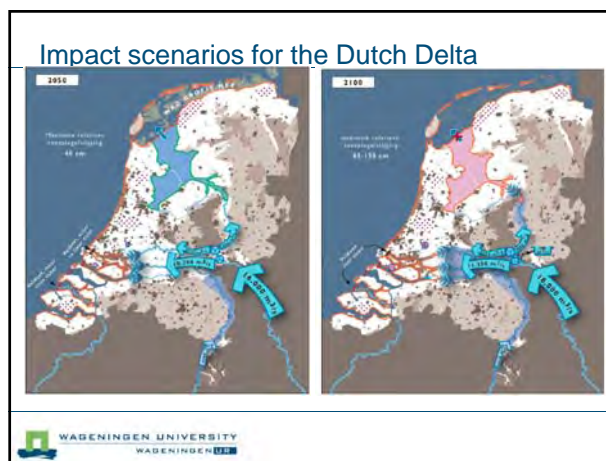
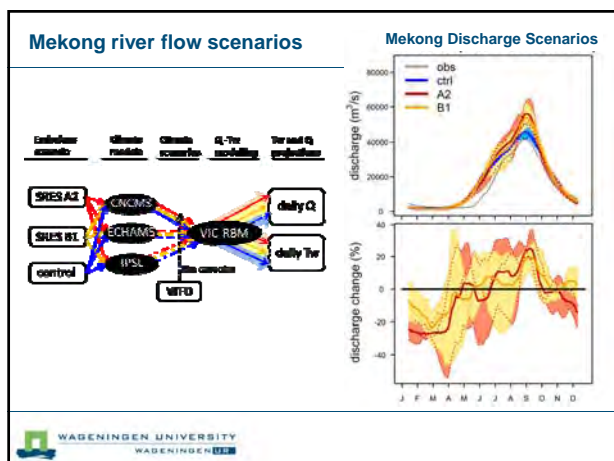
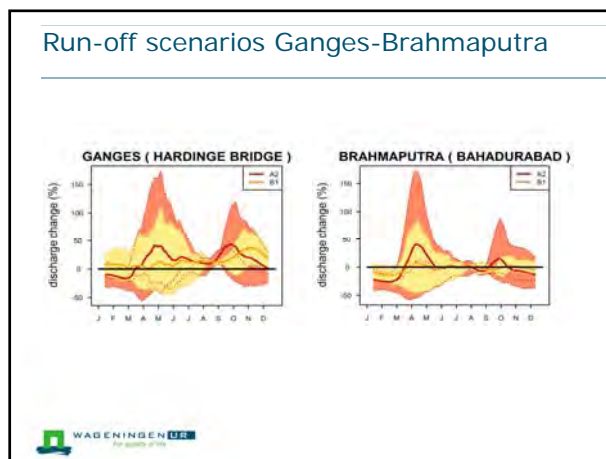
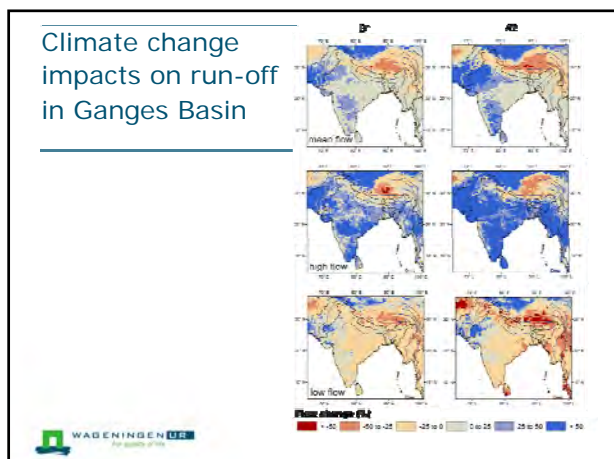
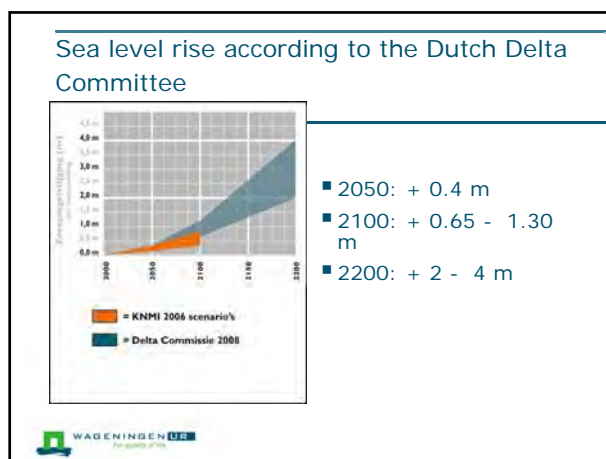


### Regional Sea Level

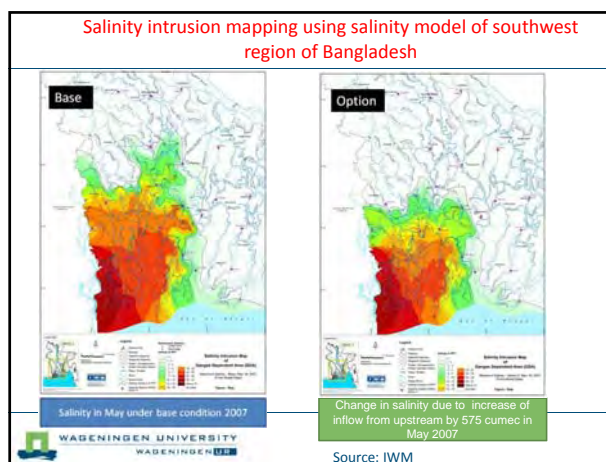
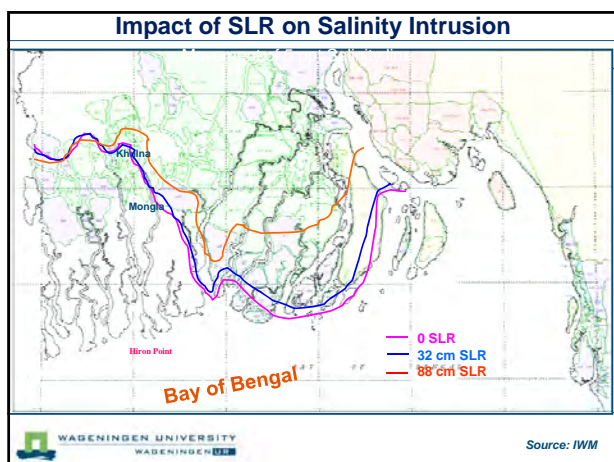


### Could sea level rise be much higher than estimated by the IPCC

- The IPCC estimates of global sea level rise exclude possible rapid melting of the Greenland (and Antarctic) ice-sheet
  - Recent research shows that model estimates used in the IPCC report are too conservative (low)
- It is unknown how stable the ice sheets are







### Summary climate change scenarios Mekong

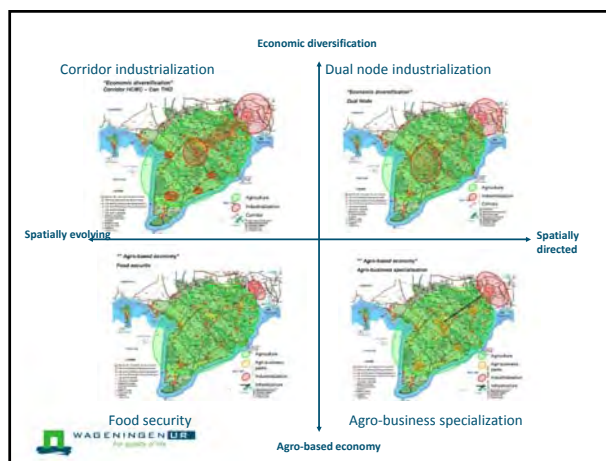
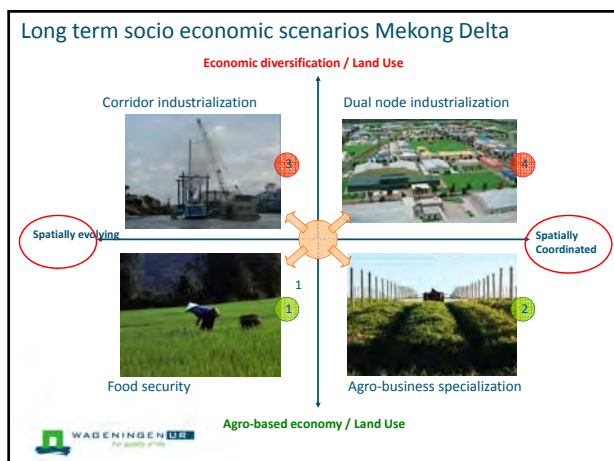
Impact	Moderate scenarios		High Scenario	
	2050	2100	2050	2100
Sea Level Rise	20-30cm	30-50cm	40-60 cm	100-200 cm
Temperature	+1°C	+2°C	+2°C	+4°C
Dry season rainfall	0-10%	-5% - -15%	-10% - -20%	-20% - -40%
Wet season rainfall	0 - +5%	+5%- +10%	+10 - +20%	+10 - +30%
Dry season flow of Mekong	-5%- +5%	-15- +5%	-10%- -30%	-30%- - 60%
Wet Season flow	No change	+10%	0 ---+10%	+20% - +50%
Salinity intrusion	Slight increase	Moderate increase	Moderate increase	Dramatic increase
Extreme rainfall events	No change	Moderate increase	Moderate increase	Rapid increase of number and severity
Typhoons	No change	Moderate increase in severity	No change	Increase in frequency and severity

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WADENINGEN

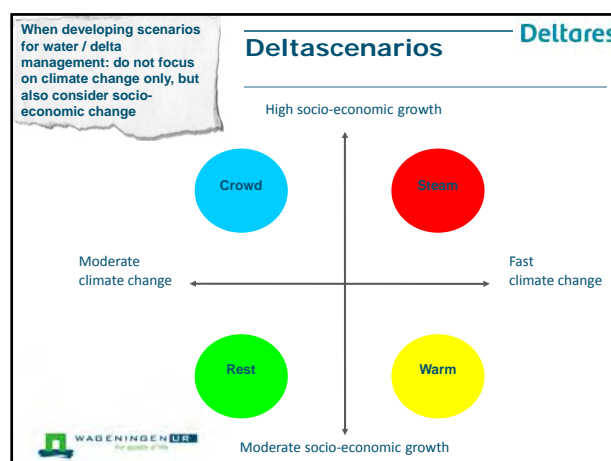
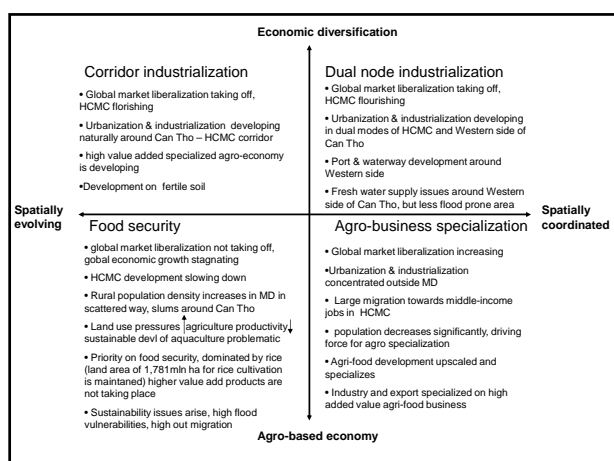
### Interactions between socio-economic and climate change scenario

- **Flooding events** may be worse if there is a larger **population** living on the flood plain as a result of planning decisions.
- The effect of climate change on **crop yields** will depend on how many farmers have planted the crops, whether their **farm income** is dependent on that crop, in turn depending on agricultural subsidies, access to technology and so on.
- Some **technological developments**, such as improvement of weather forecasting, may better **enable precautions** to be taken to diminish vulnerability to extreme weather events.

Source: Lu 2006







## Scenario development

- four scenarios
  - Axis 1 High – low economic growth
  - Axis 2 Moderate – Fast Climate Change
- Develop Story lines for each of the four scenarios
- Describe the most important water related issues for each of the four scenarios
- 1 group GBM delta, Bangladesh
- 1 group Indonesian delta – select one delta
- 1 group Ayeyarwady delta

## Schedule

- until lunch: develop 2 flip overs with story lines and issues
- After lunch presentation for each of the four groups

## Sustainable Development of Ayeyarwady Delta



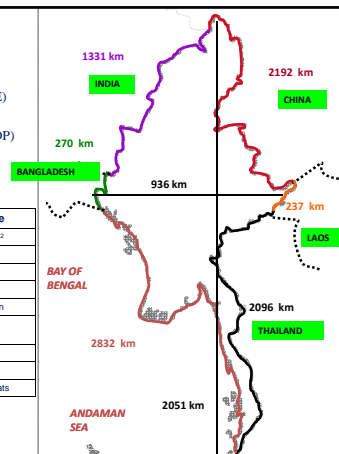
Presented by  
Toe Aung Lio (DWER)  
Dr. Toe Aung (NWMD, FD)



### MYANMAR OVERVIEW

- Location  
(9° 32' N & 28° 31' N, 92° 10' & 101° 11' E)
- divided into 7 Divisions & 7 States
- Agriculture based country (40.2 % of the GDP)
- Tropical climate with three seasons

SN	Indicator	Value
1	Total area	676,578 km <sup>2</sup>
2	Coastline	2832km
3	Number of Districts	67
4	Number of Townships	330
5	Estimated population (2006-07)	56.52 million
6	Percentage of population in rural areas	70
7	Population Density	77 (sq.kms)
8	% of work force in agriculture	64.1
9	Per capital GDP Product (2005-06)	221,799 kyats



Summer

mid-February to mid May



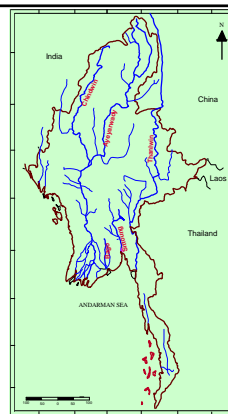
rainy season

Mid-May to mid-October

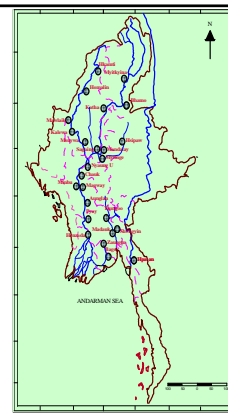


cold season

Mid-October to mid-February



Rivers in Myanmar



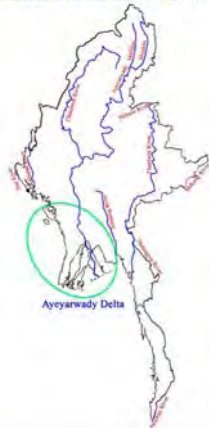
River forecasting stations  
in Myanmar

### The Ayeyarwady Delta of Myanmar

- Area 35,000 square kilometer
- Including 26 townships
- The population is estimated at about 7.0 million
- Population density 194 person/sq km



THE REPUBLIC OF THE UNION OF MYANMAR



- Ayeyarwady river flows into the Andaman sea through nine large distributaries as follow:

- ❖ Patheingyi,
- ❖ Thetkethaung,
- ❖ Ywe,
- ❖ Pyamalaw,
- ❖ Ayeyarwady,
- ❖ Bogale,
- ❖ Pyapon,
- ❖ Toe and
- ❖ Yangon rivers



### Ayeyarwady Delta, Rice Bowl of Myanmar



- Ayeyarwady Delta which is one of the rice granaries of Myanmar (26 % of total Paddy field acreage of the nation)
- Major crops other than paddy are
  - Pulse, Groundnut, Jute, Vegetable
- New Crops
  - Coffee, Thitsein, Rubber, Pepper
- Cropping area 4 million acres.

### Transportation Network in Ayeyarwady Delta

- The Waterways Transport (most applicable mode)
- Road Transport
  - Union Highway ( Patheingyi-Monywa, Yangon-Monywa)
  - Main Road
  - Feeder Road
  - Village Road
- 2400 km navigable waterway
- 24 station pontoons to embank
- Patheingyi out port
- cross river bridge
  - 57 (over 180 ft)
  - 16 (over 1000 ft)
- Air Transport
  - Patheingyi Airport

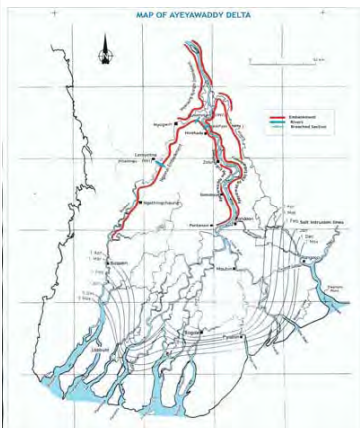
### Floods in Ayeyarwady Delta (2011)



### Flood Mitigation and Preparedness in Myanmar

- Dept. of Meteorology and Hydrology (DMH)
- Dept. of Irrigation (DI)
- Directorate of Water Resources and Improvement of River System (DWIR)
- Dept. of Relief and Resettlement (DRR)

### Flood Protection Embankments in Delta



#### Dykes

- Constructed by Irrigation Department

#### Challenges

- Lack of budget
- loose soil
- Easy erosion
- Winding river pattern

### Economic Potentials in Ayeyarwady Delta Area

- ❑ Ayeyarwady Delta Area is rice granary of the country
- ❑ Agricultural products can upgrade to the maximum potential associated with irrigation facilities.
- ❑ On the basis of soil type, weather and temperature; orchard, paddy - fish farming and seasonal crops are recommended for the investors.
- ❑ Prawn farming and fish farming are distinguished potential in aqua cultural sector

### Tourism Attraction

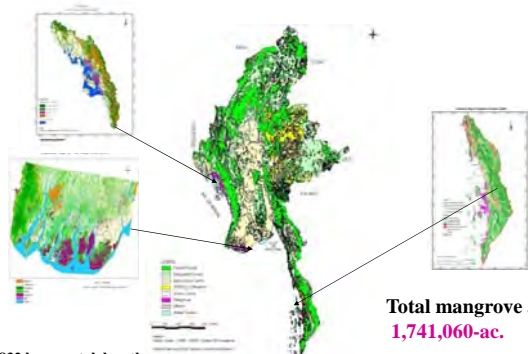
Beautiful estuaries  
Unspoilt beaches  
Tidal forest  
Wildlife sanctuary  
Chaung Tha Beach, Ngwe Saung Beach, Meinmahla Kyin



Water, Land, Climate, Workforce and Technology are necessary for development of a region.  
It can be said that Ayeyarwady Delta possesses these foundation.

### Myanmar Policy in Coastal and Delta Zone Management

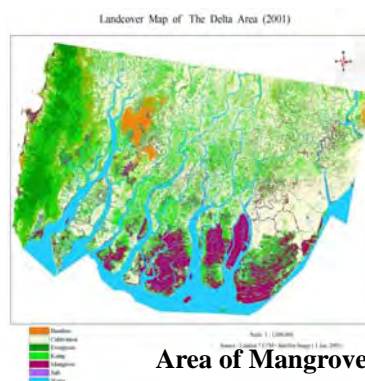
### Coastal line in Myanmar



2,832 km coastal length  
(Rakhine Coast, Delta Region, and along the Tanintharyi Coast)

Total mangrove area  
**1,741,060-ac.**

### Land Use Map in Ayeyarwady



Area of Mangrove: **679,019ac**

### Mangrove in Ayeyarwady



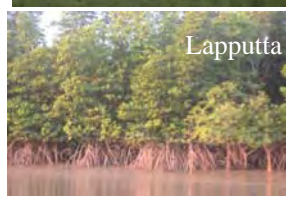
Ngaputaw



Pathein

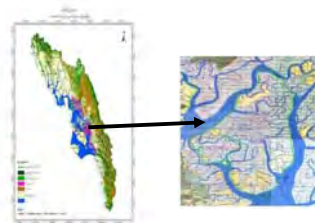


Bogalay



Lapputta

### Mangrove in Rakhine

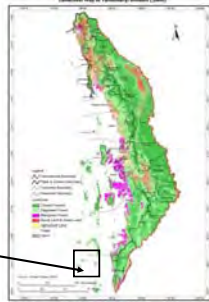


Total area: **414,470 ac**

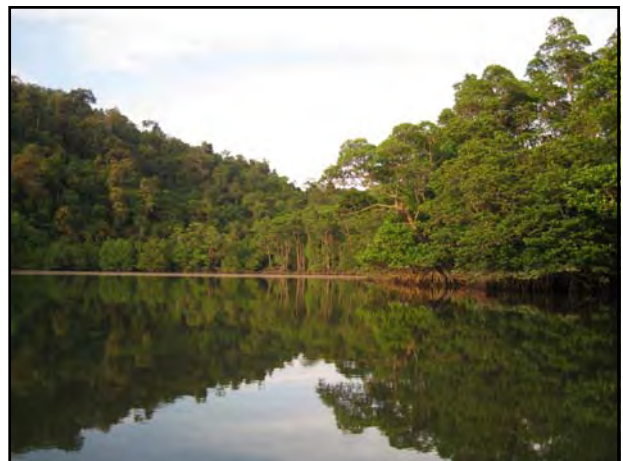




**Mangrove of Mergui Archipelago in  
Taninthayi (Untouch Coastal Line)**



**Total area: 647,571 ac**



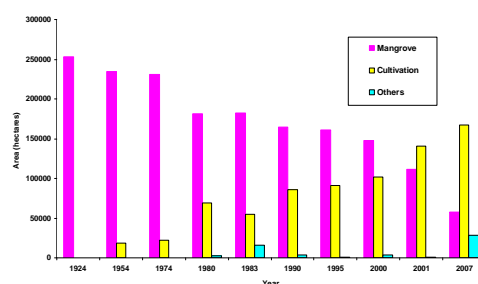


### Degradation of Coastal line resources (mangrove) in Myanmar

Sr.	Region	Area (Acres) 1980	Area (Acres)
1	Rakhine State	414,470	159999.19*
2	Ayeyarwaddy Division	679,019	223255.89**
3	Tanintharyi Division	647,571	346000.07*
	<b>Total</b>	<b>1,741,060</b>	<b>729,255.15</b>

Source - \*Progress Report on Ecological Mangrove Restoration Project, 2006  
 \*\* Japan International Cooperation Agency (JICA), 2003

### Degradation of natural resource (mangroves) in the Ayeyarwady Delta (1924 to 2007)



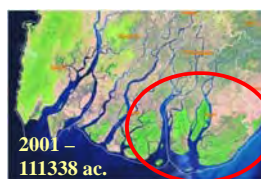
Forest Department, Ministry Of Forestry

### Mangrove in Bogalay and Laputta before Cyclone Nagis (JICA pilot study, 2005)

RF	Study area	1995	2001
Pyindaye	77000	58000	34000
Meinmahla	14000	12000	12000
Kadonkani	61000	34000	21000
Pyinalan	44000	28000	25000
Kyakankwinp auk	29000	15000	10000
<b>Total</b>	<b>223000</b>	<b>147000 (66%)</b>	<b>103000 (46%)</b>

**20% of mangrove disappeared between 1995 and 2001**  
**Mangrove will be totally lost by 2015 under this rate of destruction**

### Landuse change in the Ayeyarwady Delta



11/26/2013



Forest Department, Ministry Of Forestry

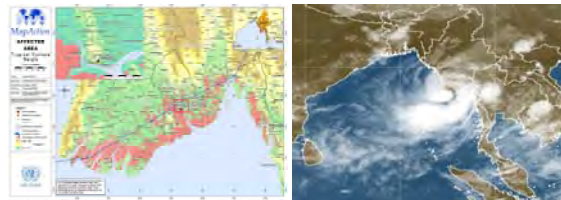


### Causes of Mangrove Degradation in delta area



### Cyclone Nargis

- The Cyclone Nargis struck Myanmar on 2 and 3 May 2008 affecting more than 50 townships, mainly in Yangon and Ayeyarwady Divisions.
- Nargis was the worst natural disaster in the history of Myanmar, and the most devastating cyclone to strike Asia since 1991
- 10<sup>th</sup> deadliest cyclone in the world
- Almost 200,000 dead and missing



### Pre & Post Cyclone Nargis situation of Mangrove forests in Meinmahla Wildlife Sanctuary, Bogalay township



### Pre & Post Cyclone Nargis situation of Mangrove forests in Byone Mwe Island, Bogalay township



### Natural Mangrove after Nagis in Laputta



### Natural mangrove after Nagis in Bogalay



### Mangrove Plantation after Nagis in laputta



### Nursery after Nagis

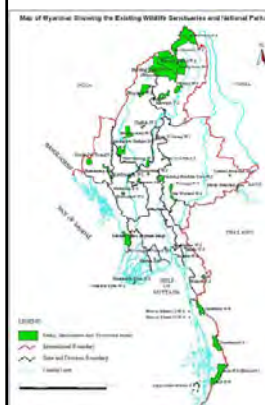


### Policy and Strategy in Coastal and Delta Management



- Establishment of **Protected Areas System (PAS)**
- Notification of coastal and mangrove forests as **Reserved Forests**
- Rehabilitation
- **Community Forestry** Programs (People Participation)
- **Private sector** participation
- **Cooperation** with national and International organizations

### Establishment of Protected Areas System (PAS)



- Up to December 2010, 43 Protected Area System had been notified which area constituting about 6.676% of the total land area of the country.
- PAS targets are 10% the total land area.

#### Along the coastal line

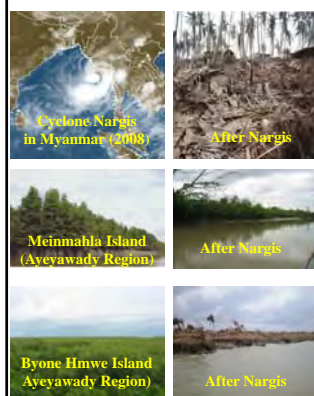
- Including Meinmahla Kyun W.S, Thamihla Kyun W.S, Moscos Island W.S and Lampi Marine National Park in Mangrove area.
- Wunbaik RF, Mingyaung PPF and other critical Mangrove RF will be formed as PAS.

Source: Forestry in Myanmar, 2011

### Notification of Reserved Forests

Sr.	Region/State	Reserve Forest	Area (Acres)	Date of Establishment
1	Ayeyawady Delta	Kyakankwinpauk	66,650	339(27-9-1901)
2	--	Pyinalan	97,809	103(23-2-1900)
3	--	Kakayan	66,471	195(14-5-1896)
4	--	Labutkwe	12,846	101(23-2-1900)
5	--	Kalayaik	21,345	142(9-4-1896)
6	--	Nyinaung	16,465	102(23-2-1900)
7	--	Kadonkani	133,563	11(1-7-1937)
8	--	Meinmahla	31,115	231(24/7/1895) 1(5-1-1994)
9	--	Pyindaye	179,958	11(1-7-1937)
<b>Total</b>			<b>625,222</b>	
1	Rakhine State	Wunbaik	56,600	232(15-2-1931)
2	--	Minkyaung	11,000	1(16-6-2009)
<b>Total</b>			<b>67,600</b>	
1	Taninthayi Region	Kyun Su	64,000	47(24-6-1920)
2	--	Myeik	68,278	32(16-4-1932)
3	--	Auklan Bay	44,995	6(16-4-1932)
<b>Grand Total</b>			<b>870,095</b>	

### Rehabilitation of Cyclone Nargis affected area



- Forest Department prepared a “**Action Plan for Rehabilitation of the Cyclone Nargis Affected Areas and Prevention from Future Natural Disasters**”
- Mangrove forests in the cyclone affected areas is being **rehabilitated**:
- In each Township, **short-, medium-and long-term plans** have been prepared and implemented.

### Extent of Reforestation in Delta Area after Cyclone Nargis

Between 2008-09 to 2012-13 fiscal year

Township	A/R (Ac)	N/R (Ac)	ARP (Ac)	CF (Ac)	Private (Ac)	NGOs (Ac)	FD(other) (Ac)	Total
Laputta	3700	2350	765	90	475	4196	46	11622
Bogalay	3650	1100	517	240	–	625	26	6132
Pyarpon	2000	–	305	525	758	5513	23	9124
<b>Total</b>	<b>9350</b>	<b>3450</b>	<b>1587</b>	<b>940</b>	<b>1233</b>	<b>10334</b>	<b>95</b>	<b>16,655</b>

Remark:

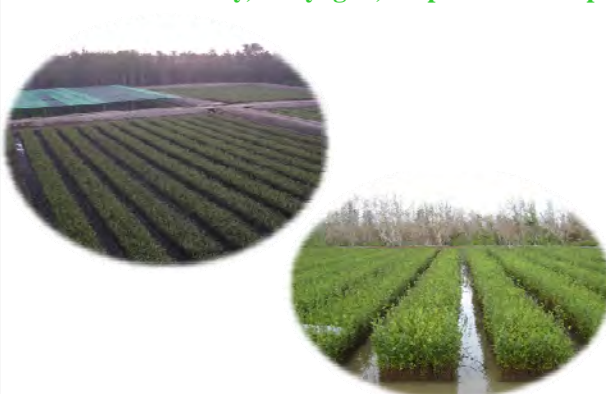
AR-Artificial Regeneration  
N/R- Natural Regeneration  
ARP- Action Research Plantation  
CF- Community Forestry

FD (other) – Distribution to local communities  
for road side plantation, school plantation and etc.

### Mangrove Rehabilitation in Delta



### Permanent Nursery, Thayagon, Laputta township



### Community Forestry (CF)



- Local People Participation
- CFI-1995 was issued for the participation of the local people in the delta management activities.
- Some of CF had been saved many lives during the Cyclone Nargis in the Ayeyawady Delta.

### Coastal Conservation in Rakhine State

#### Thandwe District

1. **Coastal Environment Sustainability (CES) Project**
  - CES project is being carried out by Oikos and BANCA
  - The overall objectives: to improve knowledge and management of forest and marine resource.
  - A total of 1230 acres of four CF had been established.
2. **Coastal Livelihood and Environmental Assets Restoration in Rakhine (CLEAR) Project**
  - Three years project (1<sup>st</sup> July 2011 to 30<sup>th</sup> June 2014)
  - Provided by UNOPS and ECCDI, a member of MERN (funding by LIFT)
  - The goal is to ensure food security and livelihood of local community

### Coastal Conservation in Rakhine State

#### KyaukPhyu District

1. **Sustainable Community-based Mangrove management in Wunbike Reserved Forest**
  - A joint venture of FAO and FD Project
  - A total of 1165 acres of mangrove forest plantations had been established from 2007 to 2011.
  - 600 acres of natural regeneration have been conserved (2006 to 2011).
2. **Mangrove Forest Restoration and Protection Project**
  - Funded by Daewoo International Cooperation
  - Implemented by Mangrove Service Network (MSN)
  - 25504 trees has been planted in Pyinpyumaw village
  - 15692 mangrove trees has been planted in Ngalapwe.
  - Mangrove nursery at Kalabartaung near Ngalapwe village: 88 nursery beds to raise 555000 mangrove seedlings.



### Private Sector Participation



- Private plantation programme since 2006.
- Being suffered from the impact of Cyclone Nargis, local people realized the value of mangrove forests, and consequently, interest in private plantation has been growing.
- Up till now, private mangrove plantations have been established 1,233 acres in Pyarpon and Laputta townships of Ayeyawady Region.
- Many Foreign Companies are negotiating for investment in forestry sector of the Mangrove area.

### Recent Activities to Coastal Management

#### Strengthening Institution

- Forming a Mangrove Division under FD as a mean of coastal management
- Mobilizing human resources for Mangrove Management
- Coordination with Local Governments

#### Legal Aspect

- Preparing a mangrove forest conservation law
- Enforcement of existing forest law in Mangrove area
- Collaboration with other concerned Ministries

#### Management Aspect

- Surveying the current land use status
- Preparing the land use policy and land use plan
- People participation in Mangrove forest management

### Cooperation with International Organizations



- "The Study on Integrated Mangrove Management through Community Participation in the Ayeyawady Delta" has been launched by JICA from 2002 to 2005.
- Major project activities include Socio-economic survey, Biophysical Survey, Database construction, Formulation of Integrated Mangrove Management Plan (IMMP) for the Ayeyawady Area.
- "Integrated Mangrove Rehabilitation and Management Project through Community Participation in the Ayeyawady Delta" has been launched by JICA from 2007 to 2013.
- Major project activities include construction of CF extension centers and nurseries, community forestry, action research plantation and oyster culture (trial) .
- "Mangrove Rehabilitation Project for Enhancement Disaster Prevention in the Ayeyawady Delta" is recently launched by JICA from 2013 to 2017. Now, Detail Design Survey are being implemented.
- Major project activities will include Establishment of Mangrove Plantations, construction of 2 cyclone shelters, Provision of vehicles and boats, Extension activities to local people and so on.

### Cooperation with International Organizations



- FAO and Forest Department implemented a project in Rakhine State: "Sustainable Community-based Mangrove Management in Wunbaik Forest Reserve"
- FD also closely cooperating with local NGOs of Myanmar; FRED, BANCA, MSN, Minglar Myanmar, ECCDI, ECODEV, Metta Foundation, MERN (Meals) etc.
- FRED grows 1155 hectare of mangrove forest in 2008 and 2009 in cooperation with Action for Mangrove Reforestation (ACTMANG) of Japan.
- MOECF is still cooperating with International Organizations and local NGOs.

### Challenges and Issues

#### Socio-economic Aspect

- Uncontrolled and increased population growth
- Inadequate efforts to reduce poverty of local people
- Low education and awareness
- Mobile workers and frequent migration

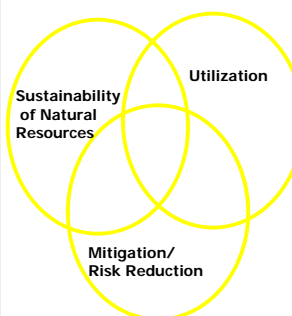
#### Natural Resources Aspect

- Limited technology and utilization of natural resources
- Lack of suitable land for integrated land use.
- Land use conflicts among stakeholders (Private, CF and shrimp culture)

#### Management Aspect

- Lack of proper land use policy
- Insufficient resources of FD ( Man, material, money, machine, method)
- Emphasize on agriculture & fisheries due to economic policy.

### Intergrated approaches



#### Integrated Natural Resource Management Plan is essential

- to be sustainability of mangrove resources and ecosystem and also aquatic resources and ecosystem
- to improve community livelihood
- to protect and mitigate the risk from natural disaster

**Intergraded approaches      cont:**

- **Forest Department and related Organizations of DoF, DoA, SLRD, community and all level of authorities need to be working together for the coastal and delta managment**

**Thanks for your attention**

