



# Adaptation Planning: Identifying and Evaluating Options

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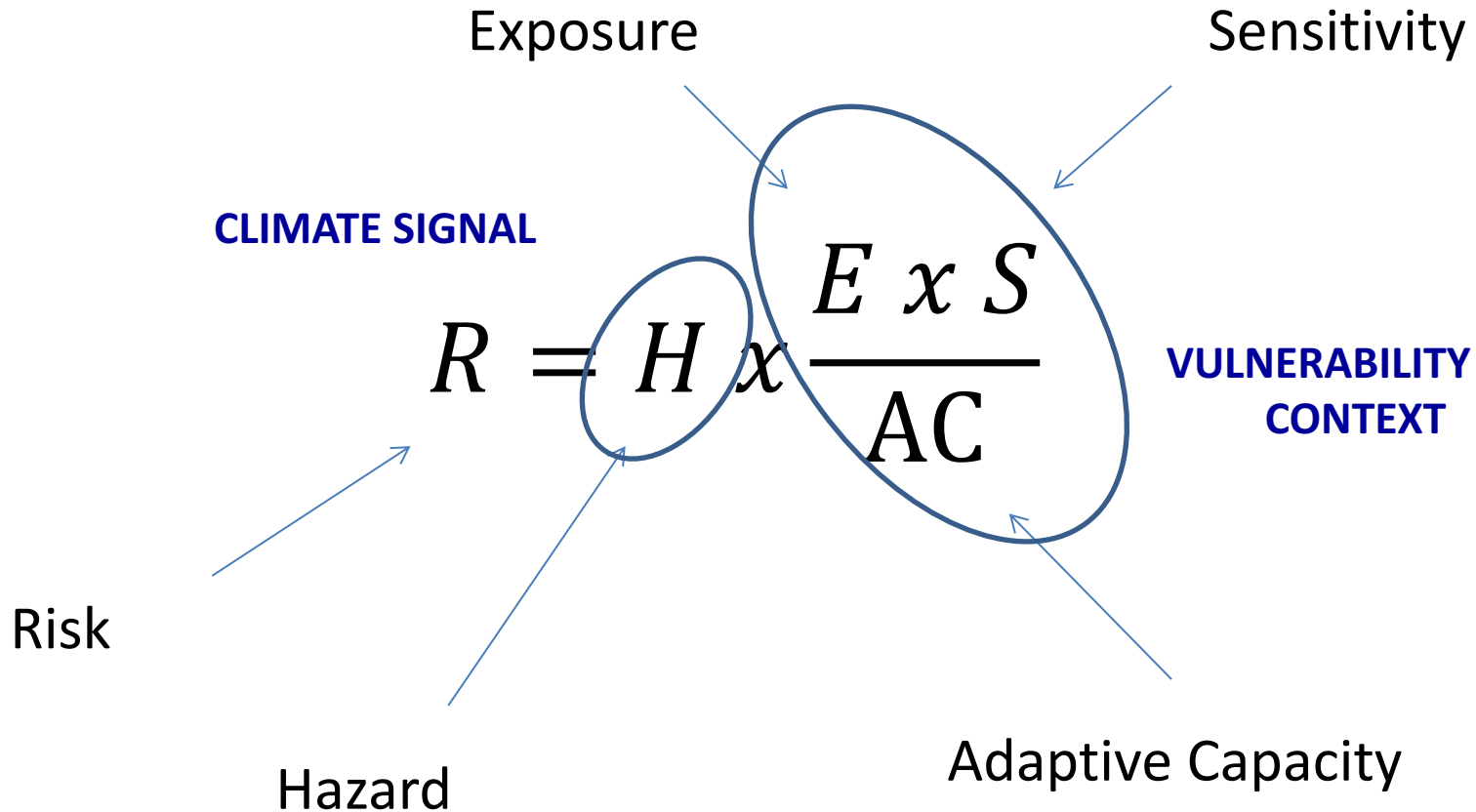


# Overview of Presentation

- 1. Risk, Vulnerability and Adaptation**
- 2. Identifying and Assessing Adaptation Needs and Options**
- 3. Evaluating Adaptation Options**
- 4. Adaptation Under Uncertainty**
- 5. Some Resources**



# 1. Understanding Climate Risk and Vulnerability



# Options for Managing Climate Risks

**Understanding climate-related risk allows us to select from among the basic risk management strategies:**

- Reduce the hazard (includes GHG mitigation)**
- Reduce exposure to the hazard**
- Reduce sensitivity (susceptibility to harm)**
- Increase adaptive capacity**



# 2. Assessing Adaptation Needs and Options

## Addressing Drivers of Vulnerability

*Enabling human development:* actions that reduce poverty and vulnerability; increase capability and coping capacity:

- Livelihood diversification
- Literacy and education
- Women's rights
- Community health
- Food security
- Water supply, sanitation

## Building Response Capacity

*Robust systems for problem solving:* actions that build institutional, technical and planning capacity:

- Natural resources management
- Weather data collection, forecasting
- Disaster early warning systems
- Communications systems

## Managing Climate Risks

*Climate risk management:* actions that incorporate climate information into decision-making to reduce risks:

- Climate proofing projects
- Disaster response planning
- Drought-resistant crops; cropping systems
- Robust, adaptive technologies

## Confronting Climate Change

*Addressing climate change impacts:* actions that target specific, anticipated impacts outside of historical experience:

- Relocation due to sea level rise (SLR)
- Coastal defenses from SLR
- Managing Glacial Lake Outburst Floods (GLOF)
- Extra storage to capture glacial melt

“soft”

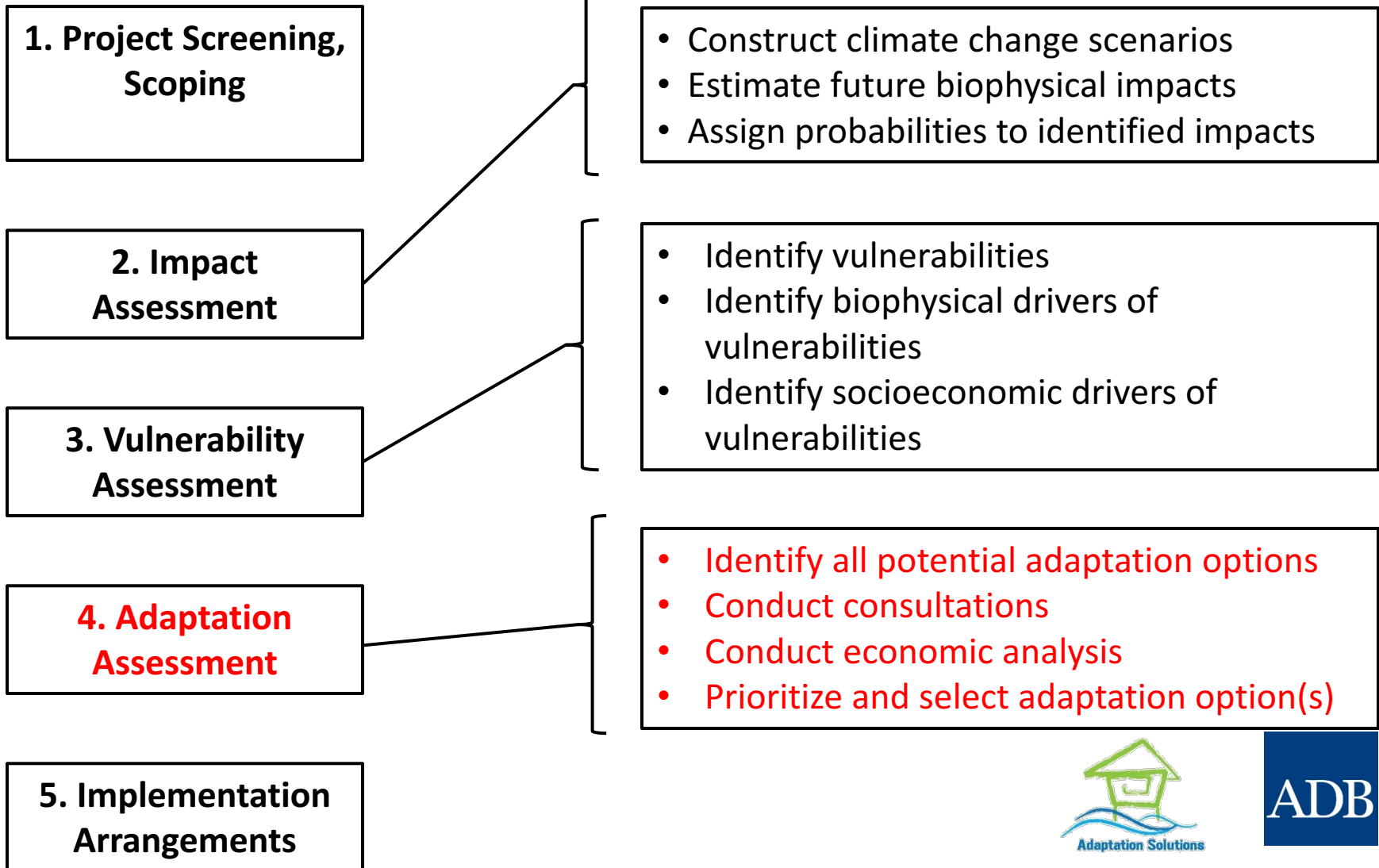
“hard”



# 2. Assessing Adaptation Needs and Options

## ACTIVITIES

## STEPS



# 2.1 Identifying Adaptation Options

The goal of the adaptation assessment is to identify and prioritize the most appropriate and cost-effective adaptation measures to incorporate into the project.

These can include:

- Modifications in project location and/or scale
- Modifications in engineering materials and designs
- Alternative technology choices
- Biophysical- and Ecosystem-based measures
- Community-based adaptation
- Policy and Social options (institutional re-design)
- Business-as-usual (“do nothing”)

In many project settings, a combination of approaches may be most effective.



# Adaptation Options in Agriculture Sector Projects

## Engineering (Structural) Options

- Material specifications
- Dimension and capacity standards
- Drainage and soil conservation
- Protective engineering structures
- High efficiency irrigation

## Non-Engineering Options

- Water resources management
- Infrastructure operation
- Maintenance planning
- Master planning and land use planning
- Farm operation management
- Environmental management
- Training/capacity building
- Information systems

## Biophysical Options

- Plant breeding
- IPM
- .....

## “Do nothing” Option (wait and see)





# Adaptation Options in Road Transport Projects

## Engineering (Structural) Options

- Corridor location
- Subsurface conditions
- Material specifications
- Cross section and standard dimensions
- Drainage and erosion
- Protective engineering structures

## Non-Engineering Options

- Maintenance planning and early warning
- Alignment, master planning, and land use planning
- Environmental management

“Do nothing” Option (wait and see)



<b>Water Sector Adaptation Technology</b>	<b>Diversify Supply</b>	<b>GW Re-charge</b>	<b>Extreme Events</b>	<b>WQ Degradation</b>	<b>Storm-water control, capture</b>	<b>Water Conservation</b>
<b>Boreholes/Tubewells as a Drought Intervention for Domestic Water Supply</b>			<b>X</b>			
<b>Desalination</b>	<b>X</b>			<b>X</b>		
<b>Household Water Treatment, Safe Storage</b>				<b>X</b>		
<b>Improving Resilience of Wells to Flooding</b>			<b>X</b>	<b>X</b>		
<b>Water-efficient Fixtures and Appliances</b>						<b>X</b>
<b>Leakage Management, Detection and Repair in Piped Systems</b>				<b>X</b>		<b>X</b>
<b>Post-construction Support for Community-managed Water Systems</b>	<b>X</b>		<b>X</b>	<b>X</b>		
<b>Rainwater Collection, Ground Surfaces—Small Reservoirs and Micro-catchments</b>	<b>X</b>	<b>X</b>		<b>X</b>	<b>X</b>	
<b>Rainwater Harvesting from Roofs</b>	<b>X</b>	<b>X</b>			<b>X</b>	
<b>Water Reclamation and Reuse</b>	<b>X</b>	<b>X</b>		<b>X</b>		
<b>Water Safety Plans (WSPs)</b>			<b>X</b>	<b>X</b>		

**Source: TNA (2011), Technologies for Climate Change – The Water Sector. UNEP, GEF**

# Resources for Identifying Adaptation Options

Resource	URL	Uses	Products
Technology Needs Assessment (TNA): UNEP, GEF, partners	<a href="http://tech-action.org/">http://tech-action.org/</a>	Guidance in process, technology, finance and other resources	Guidebooks, national studies, databases, resources
WeAdapt: SEI and partners	<a href="https://weadapt.org/">https://weadapt.org/</a>	Identify, support adaptation good practices	Guidance materials and resources; case studies
Asia Pacific Adaptation Network (APAN): ADB, MoEJ, USAID, SEI, UNEP, IGES	<a href="http://www.apan-gan.net/adaptation-practices">www.apan-gan.net/adaptation-practices</a>	Identify, support adaptation good practices	Guidance materials and resources; case studies; adaptation technology database
Asian Development Bank (ADB)	<a href="http://www.adb.org">www.adb.org</a>	Climate risk management of investment projects, adaptation planning	Guidelines for Climate Proofing: Agriculture, Transport, Energy; Technology, case studies

# Resources, Adaptation Technologies



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Climate



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TECHNOLOGIES  
TO SUPPORT CLIMATE  
CHANGE ADAPTATION  
IN DEVELOPING ASIA



## 2.2 Climate Impact Pathways

**Climate impact pathways are analytical tools that help to identify adaptation choices by linking the impact and vulnerability assessments:**

- **Which climate change impacts are we concerned with in our project?**
- **Which infrastructure components and/or functions are exposed to these impacts?**
- **How sensitive is each component to specific changes in climatic conditions?**
- **Are there critical vulnerability thresholds?**
- **What type(s) of adaptation intervention will reduce exposure, sensitivity and/or increase adaptive capacity?**



# Climate Impact Pathways, Water Sector

## Climate Impact Assessment

## Project Vulnerability Assessment

### Meteorological Variables:

- Temperature (max, min, average)
- Precipitation (amount, timing, intensity)
- Humidity
- Windspeed, direction
- Radiation
- .....

### Hydrologic Variables:

- Runoff volume (seasonal patterns)
- Discharge depth, velocity
- Groundwater storage (recharge)
- Soil moisture
- Water temperature
- Water quality parameters
- .....

### Other environmental variables:

- Sea level
- .....

### Impacts:

Increased evapo-  
transpiration

Reduced low-  
season flows

Reduced raw  
water quality

Increased flood  
magnitude, freq.

( ..... )

### Project Components:

Catchment Area

Storage Reservoir

Raw water collection

Water purification

Water Storage

Distribution network

Pumping stations

Energy supply

Access (road, rail)

### Vulnerabilities:

Damage to  
physical assets

Reduced service  
lifespan of assets

Increased  
operation,  
maintenance costs

Reduction in  
reliability;  
Interruption of  
services

Increase in input,  
operating costs

Reduction in  
efficiency

# Climate Impact Pathways, Road Sector

## Climate Impact Assessment

## Project Vulnerability Assessment

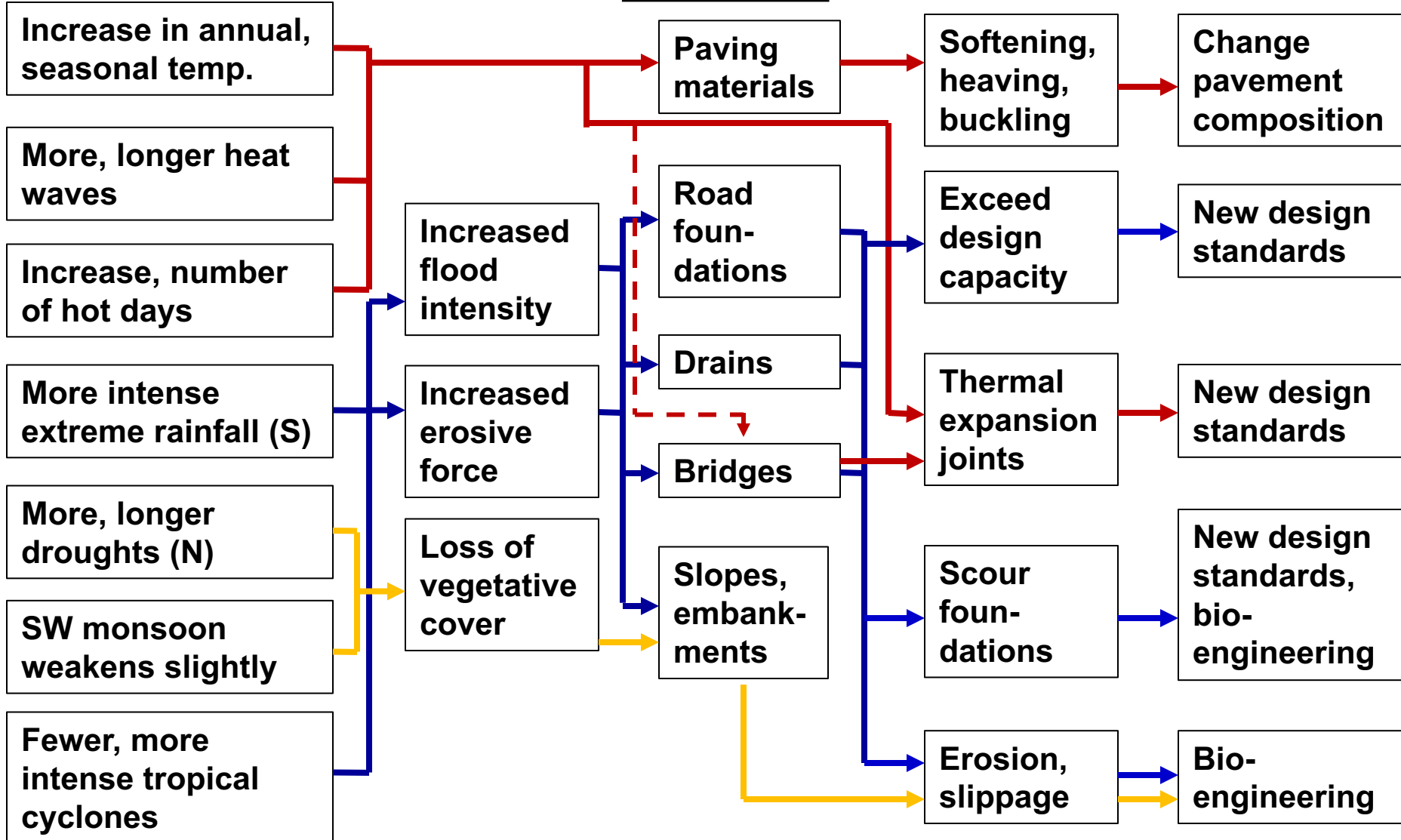
## Adaptation Assessment

### Climate Change:

### Impacts:

### Project Components:

### Vulnerabilities:



# Case Study: Combined Cycle Gas Power Plant (VIE)



**Keys to feature**

- Province centre
- O Mon Project
- Major road
- Canal
- Major river
- Province boundaries

**O Mon IV Climate Change Threat & Vulnerability Assessment**  
Location of the power plant

0 5 10 20  
Kilometers

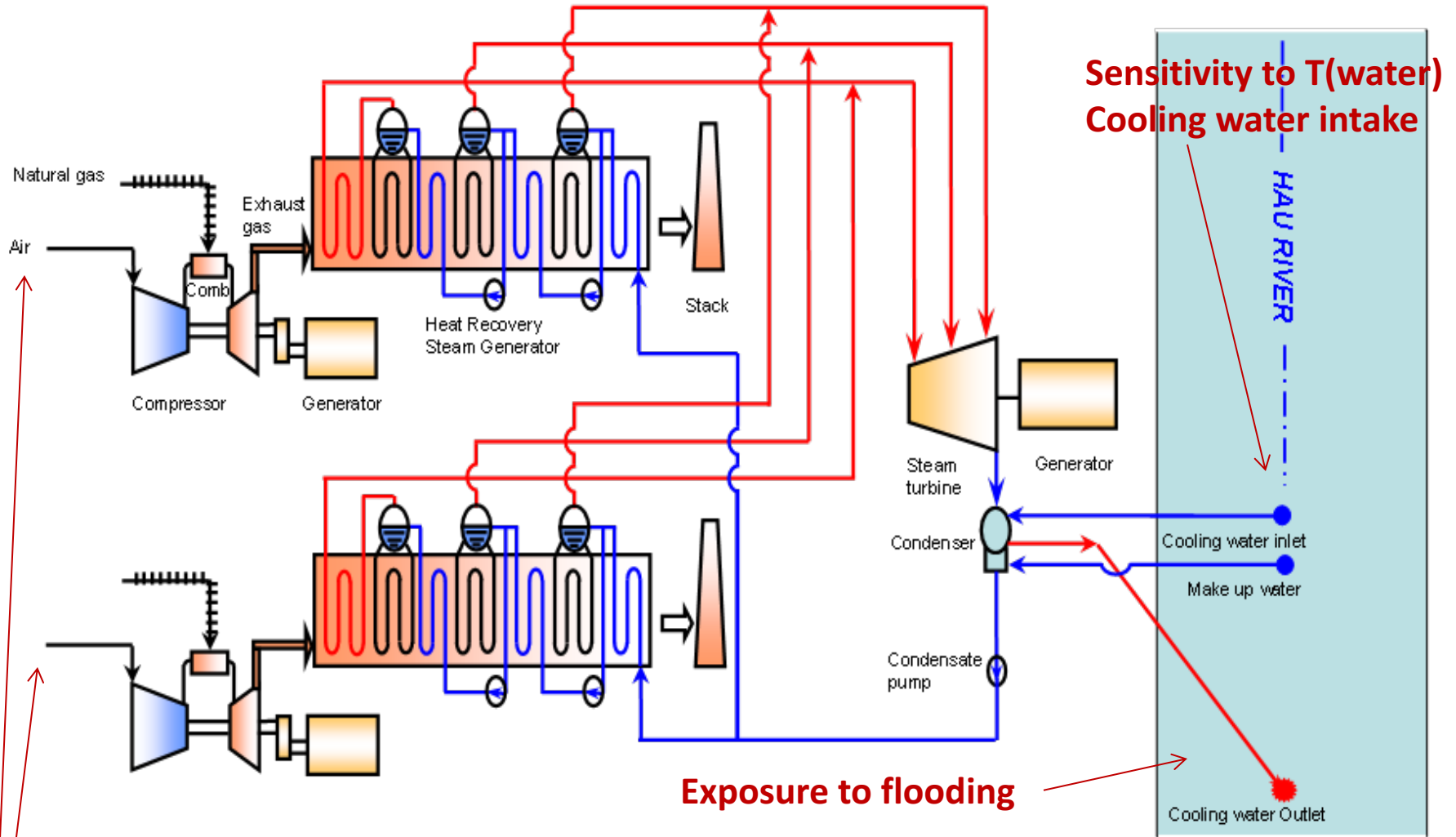
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for the Asian Development Bank & Can Tho Power Corporation





# Schematic: Combined Cycle Gas Power Plant

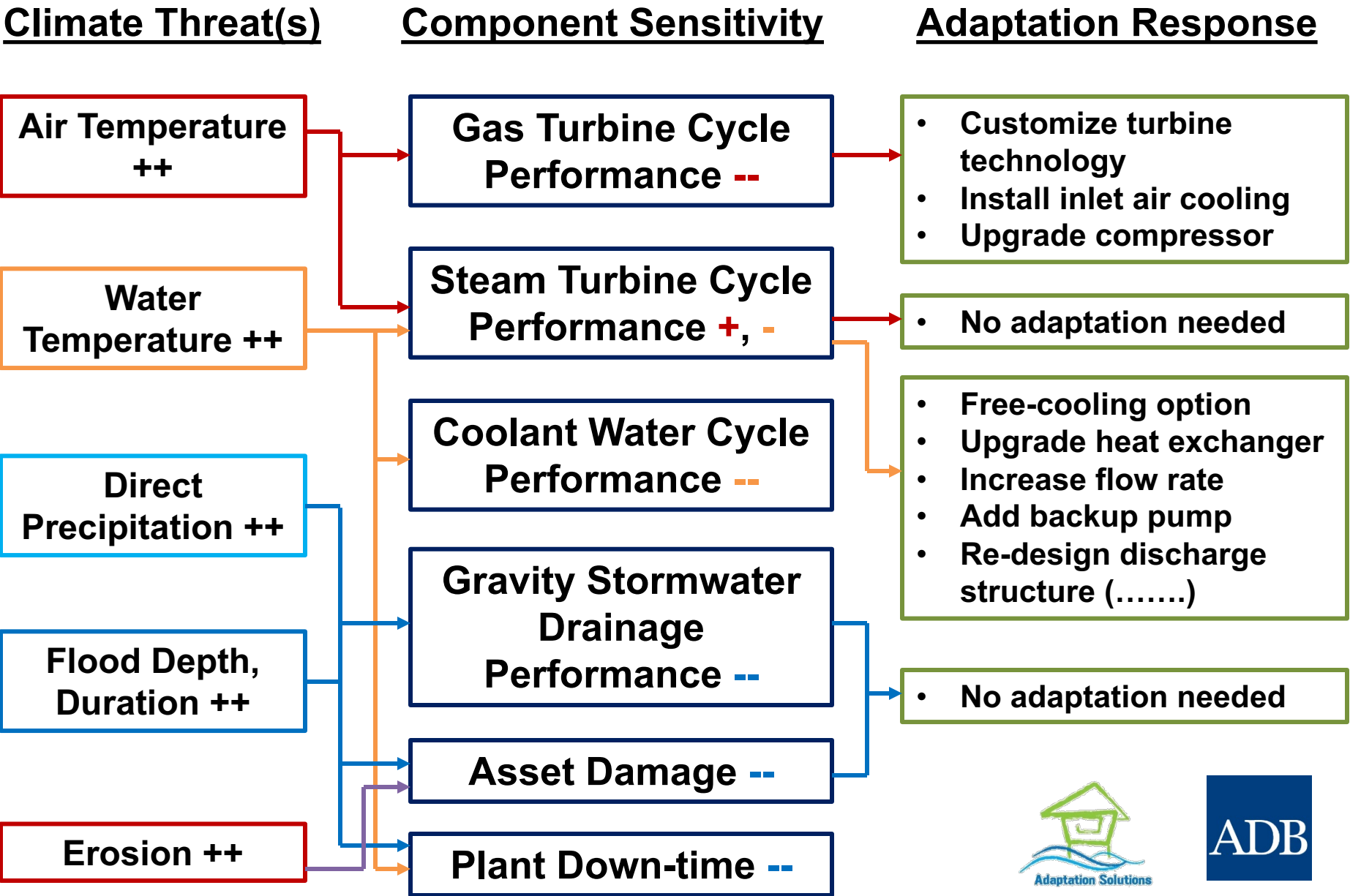


**Sensitivity to T(air)**

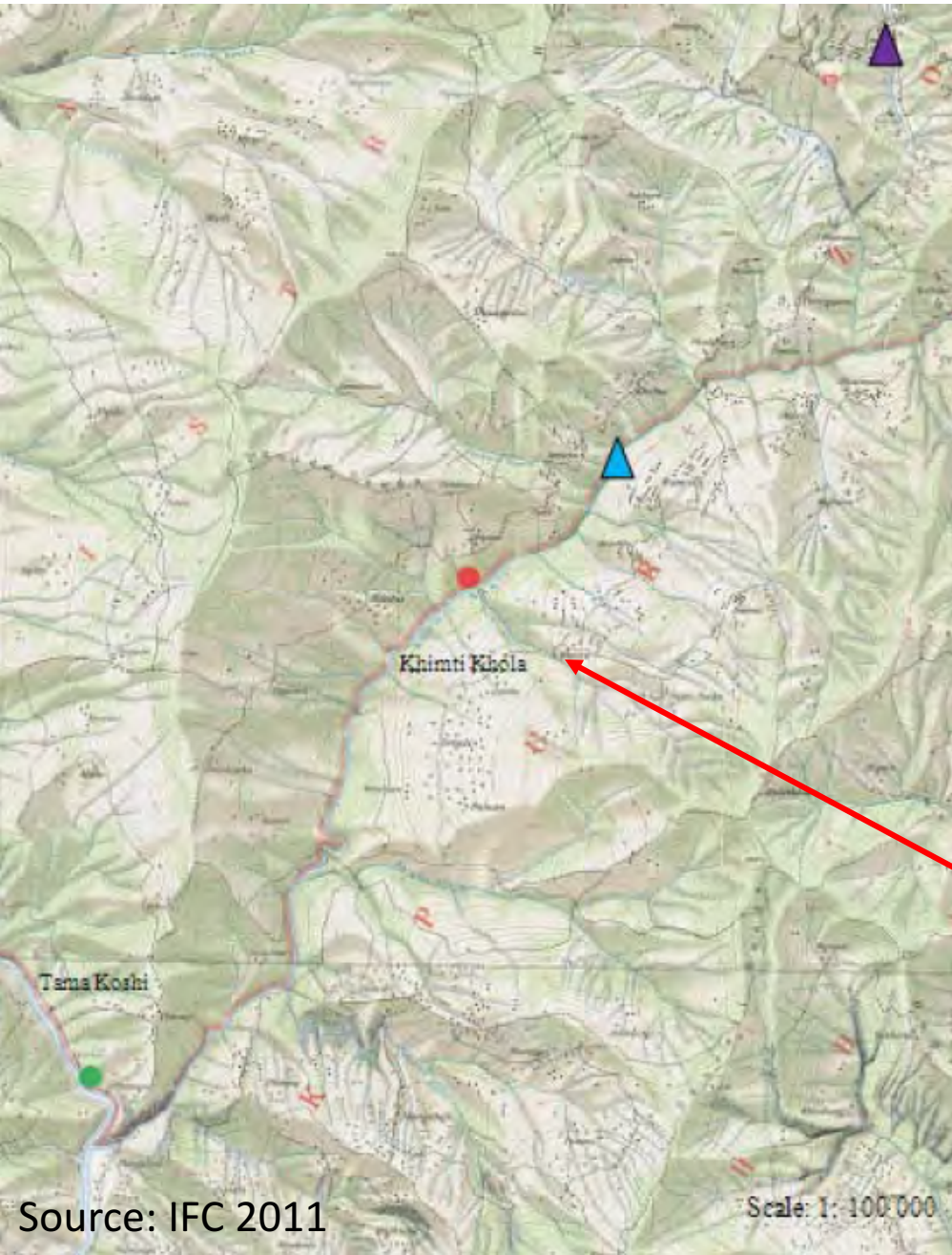
**Sensitivity to T(water)  
Cooling water discharge  
(environmental standard)**



# Impact Pathways: Combined Cycle Power Plant



# Case Study: Run-of-River Hydropower (NEP)



## Khimti 1 Hydropower Plant:

- Run-of-River
- Installed Capacity 60 MW
- Design flow 10.75 m<sup>3</sup>/sec
- 5 Pelton turbines
- Underground powerhouse
- Steel-lined penstocks
- Capital cost \$140 million
- Commercial operation July 2000

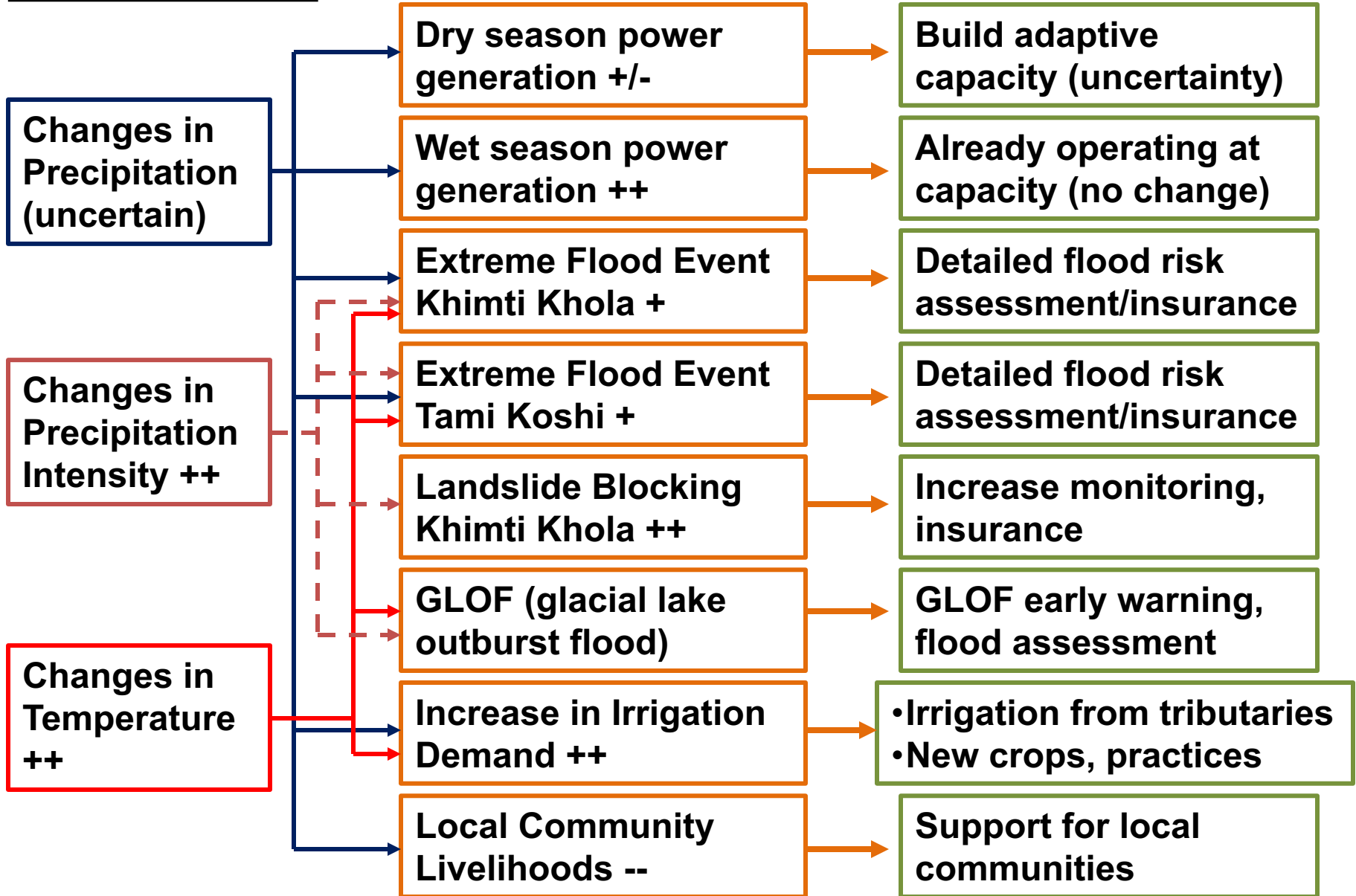


# Impact Pathways Run-of-River Hydropower

## Climate Factors:

## Impacts:

## Adaptation Actions:



# Review: Adaptation Assessment Questions

- **What climatic and biophysical parameters are likely to change, and by how much?**
- **How much confidence do I have in this information?**
- **Which of the climate change impacts and hazards is the investment exposed to?**
- **What are the projected magnitude and duration of this exposure?**
- **Which operational, management, and infrastructure components are sensitive to the impacts and why?**
- **What are the financial impacts of each?**
- **What type(s) of adaptation interventions will reduce exposure, sensitivity and/or increase adaptive capacity?**



## 2.3 Timing of Adaptation Interventions

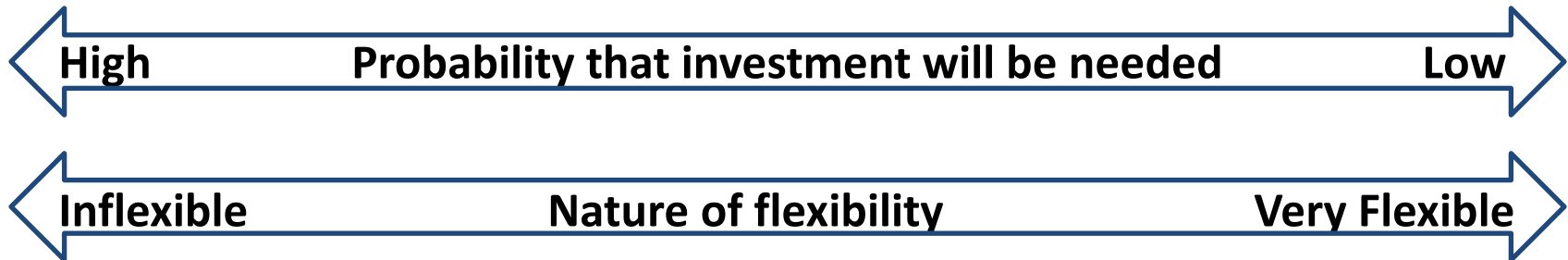
A menu of climate-proofing decisions:

**Type 1:  
Invest  
Now**

**Type 2:  
Be ready and  
invest later if  
needed**

**Type 3:  
Do nothing and  
invest later if  
needed**

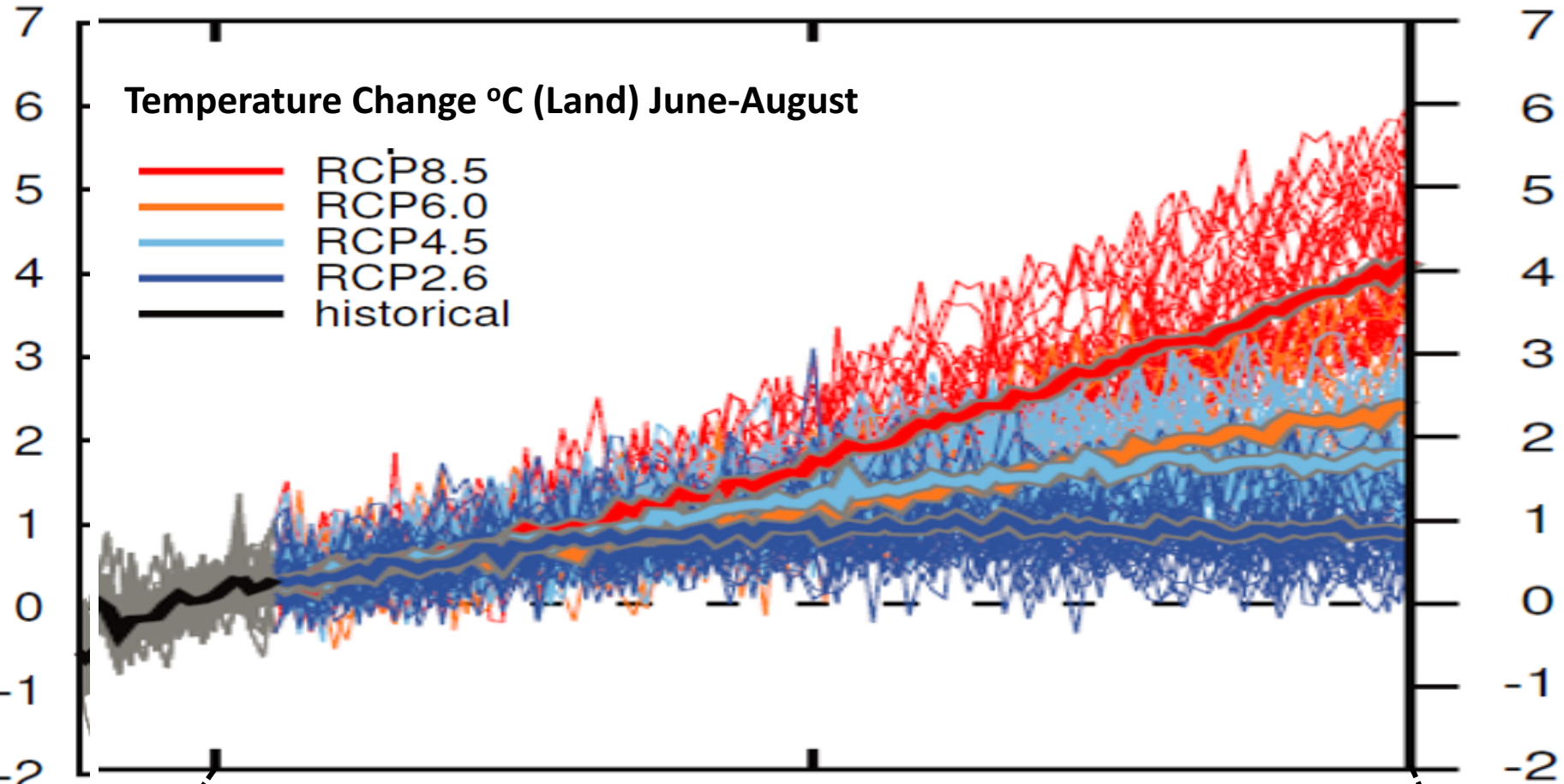
**Important determinants:**



- It is not always necessary to act now; although it is important to assess now!

# Temperature Change °C (Land) June-August

- RCP8.5
- RCP6.0
- RCP4.5
- RCP2.6
- historical



2000 2050 2100

Annual Crops  
Farm Planning  
Road Maintenance  
Irrigation Rehabilitation  
New Irrigation  
Transport Infrastructure  
Major Urban Infrastructure  
Large Dam  
Bridge Design Lifetime

Time Horizon (Years from Present)

# 3. Evaluating Adaptation Options

Adaptation options selected for implementation in the project must be scientifically sound, socially beneficial, and economically viable. In prioritizing and selecting adaptation options, the following general considerations apply:

- Effectiveness in achieving adaptation objective(s)
- Technical feasibility (in the project context)
- Economic feasibility (analysis of benefits and costs)
- Social acceptability
- Ancillary or co-benefits (dis-benefits)
- Opportunities for synergies with national, sectoral priorities

In a specific project setting, one or more of these factors may be given greater weight, reflecting stakeholder consensus





# Approaches Used in Selecting Adaptation Options

- **Benefit-Cost Analysis (BCA):** Provides framework for organizing information about the consequences of alternative adaptation options. Widely used; many guidance materials available.
- **Cost Effectiveness Analysis (CEA):** primary use of CEA is to identify the lowest cost option to achieve a specified adaptation objective
- **Multi-Criteria Analysis (MCA):** used in situations where some project costs and/or benefits cannot be measured in monetary units. Adaptation options can be scored against multiple criteria selected by consensus.
- **Robust Decision-Making (RDM):** useful in the face of significant uncertainty (e.g., future climate) and complex decision environments (although often high data requirements)
- **Expert Judgment:** flexible and widely used; but subjective



# Example - Checklist for Evaluating Adaptation Options

## Policy and Institution:

## Options

- Consistency and relevance with adaptation in national and sector policy
- Acceptability by implementing agency (e.g., agriculture extension)
- Technical capacity of institution to implement adaptation options
- Physical capacity of institution to implement adaptation options
- Financial capacity of institution to implement adaptation options

## Socio-Economic:

- Acceptability by the community
- Sustainability of adaptation
- Probability of success in increasing adaptive capacity
- Financial and technical affordability
- Economic returns

## Environmental:

- Applicability and compatibility with local area farming system
- Soil characteristics
- Land use
- Water availability
- New pests and diseases



# 4. Strategies for Adaptation Under Uncertainty

- ***Resilient Strategies:*** identify approaches that will provide reasonable adaptation over the likely range of future conditions
- ***Adaptive Strategies:*** identify approaches that can be modified or amended as new information (including diagnostic feedback) becomes available
- ***Precautionary Strategies:*** identify approaches that minimize the down-side (e.g. impacts of severe, low-probability scenarios)
- **No-regret, low-regret and win-win**
- ***Quantification of Risk***

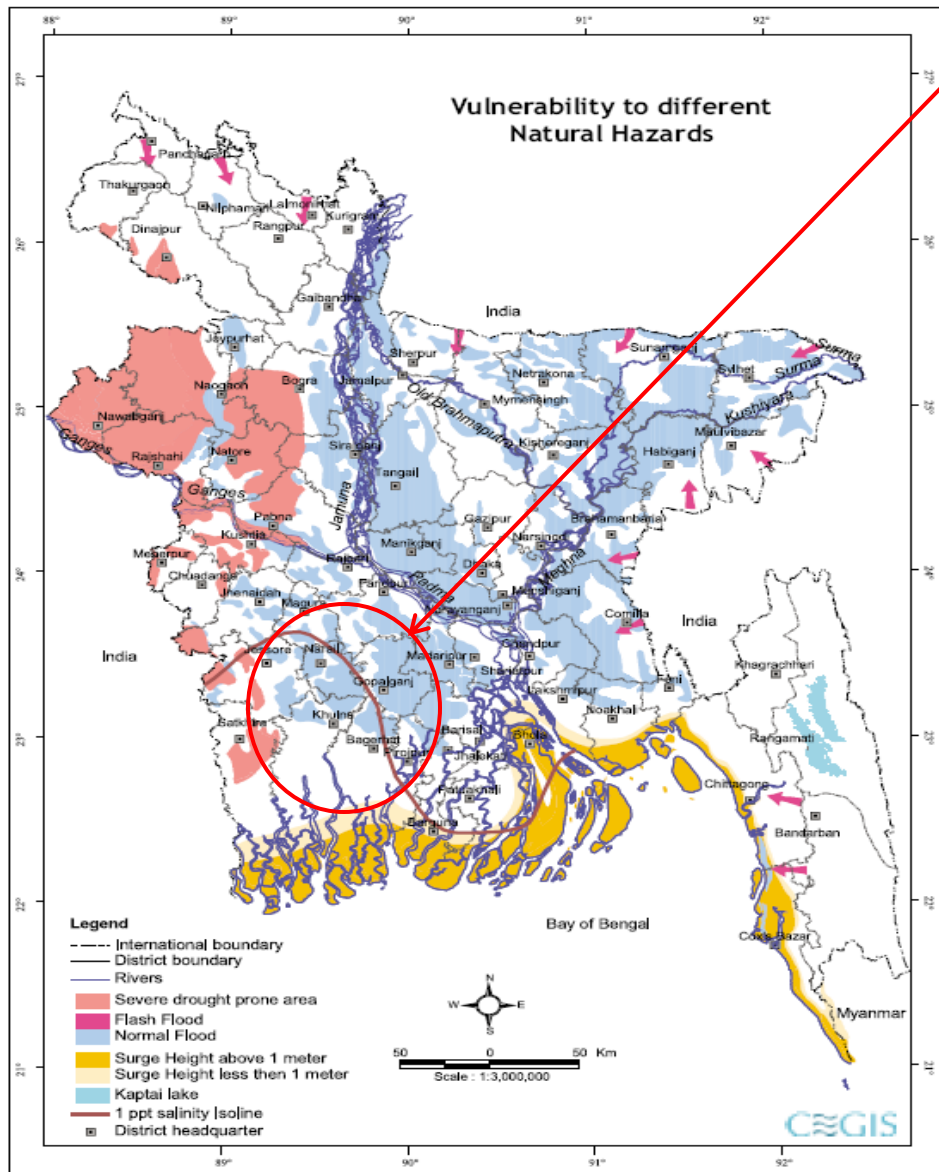


# Adaptation Strategies in the Water Sector

Adaptation Measure	Regrets	Cost	Technical Difficulty
<b>Supply Side:</b>			
Diversification of sources	Low	High	Medium
Construct additional storage	Medium-High	High	Medium
Watershed management, source protection	Win-Win	Low	Low
Advanced water treatment (recycling, desal)	Low	High	Medium
Reduce non-revenue water	Low	Medium	Medium
<b>Demand Side:</b>			
Metering	Low	Low-Medium	Medium
Low-use appliances	Low	Medium	Medium
Consumer behavior change	Low	Low	Low

Source: World Bank (2006) internal document

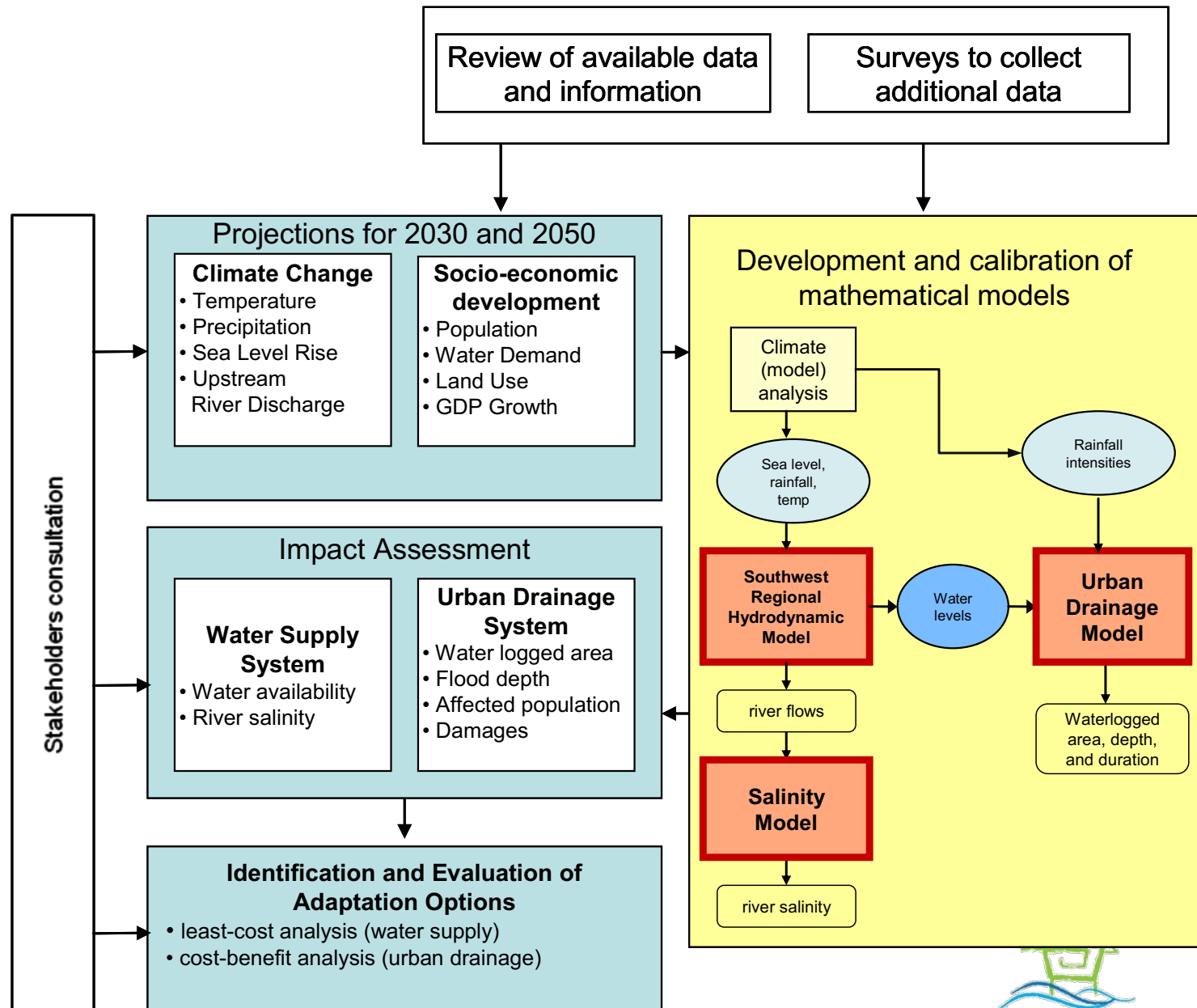
# Strengthening the Resilience of the Khulna (BAN) Water Sector to Climate Change



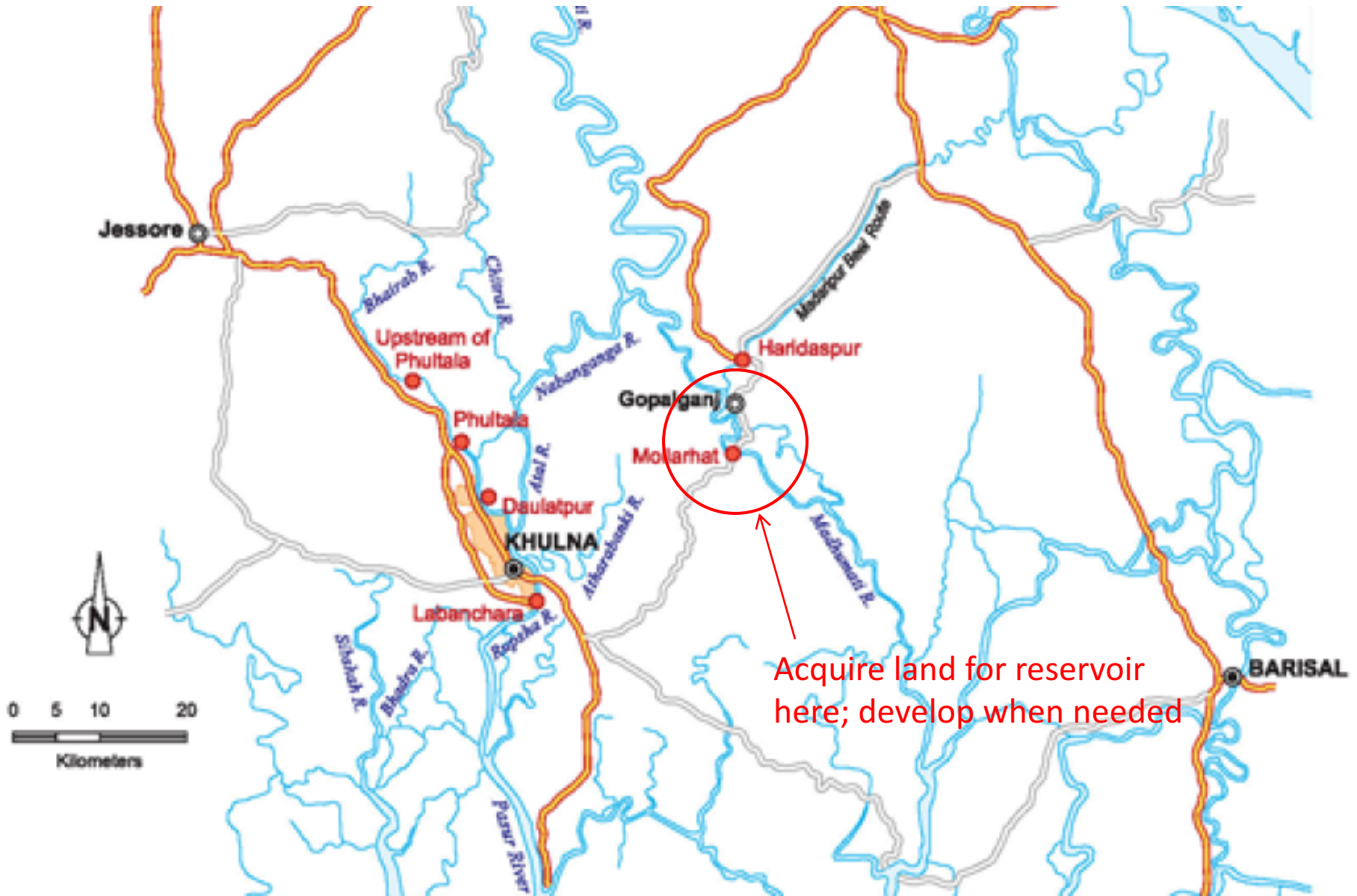
- Khulna: 1.4 m population
- Near saline/freshwater interface
- Sea level rise and saline intrusion of groundwater (currently relying on shallow groundwater)
- Increased urban flooding
- Drainage congestion
- CRVA identified “climate readiness” strategy



# Methodological Approach, Khulna Water Supply



# Adaptation Approach: Climate Readiness



# 5. Support and Resources

Source	URL	Resources
Nairobi Work Programme (UNFCCC)	<a href="http://unfccc.int/adaptation/knowledge_resources/databases/items/6996.php#NWP">http://unfccc.int/adaptation/knowledge_resources/databases/items/6996.php#NWP</a>	Databases on tools and methods, best practices, case studies (including EBA); others
Convention on Biological Diversity	<a href="https://www.cbd.int/ecosystem/sourcebook/">https://www.cbd.int/ecosystem/sourcebook/</a>	Database of case studies emphasizing biological, agro-ecological and ecosystem-based Adaptation
Adaptation Learning Mechanism (UNDP)	<a href="http://undp-alm.org/explore">http://undp-alm.org/explore</a>	Adaptation project profiles
PROVIA (UNEP, SEI & partners)	<a href="http://www.unep.org/provia/">http://www.unep.org/provia/</a>	Framework, guidelines
Asia Pacific Adaptation Network (APAN): ADB, MoEJ, USAID, SEI, UNEP, IGES	<a href="http://www.apan-gan.net/adaptation-practices">www.apan-gan.net/adaptation-practices</a>	Guidance materials and resources; case studies; adaptation technology database
WeAdapt: SEI and partners	<a href="https://weadapt.org/">https://weadapt.org/</a>	Guidance materials and resources; case studies





**Questions welcome, looking forward to the discussion**  
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# Case Study: Central Mekong Delta Region

## Connectivity Project

The proposed project:

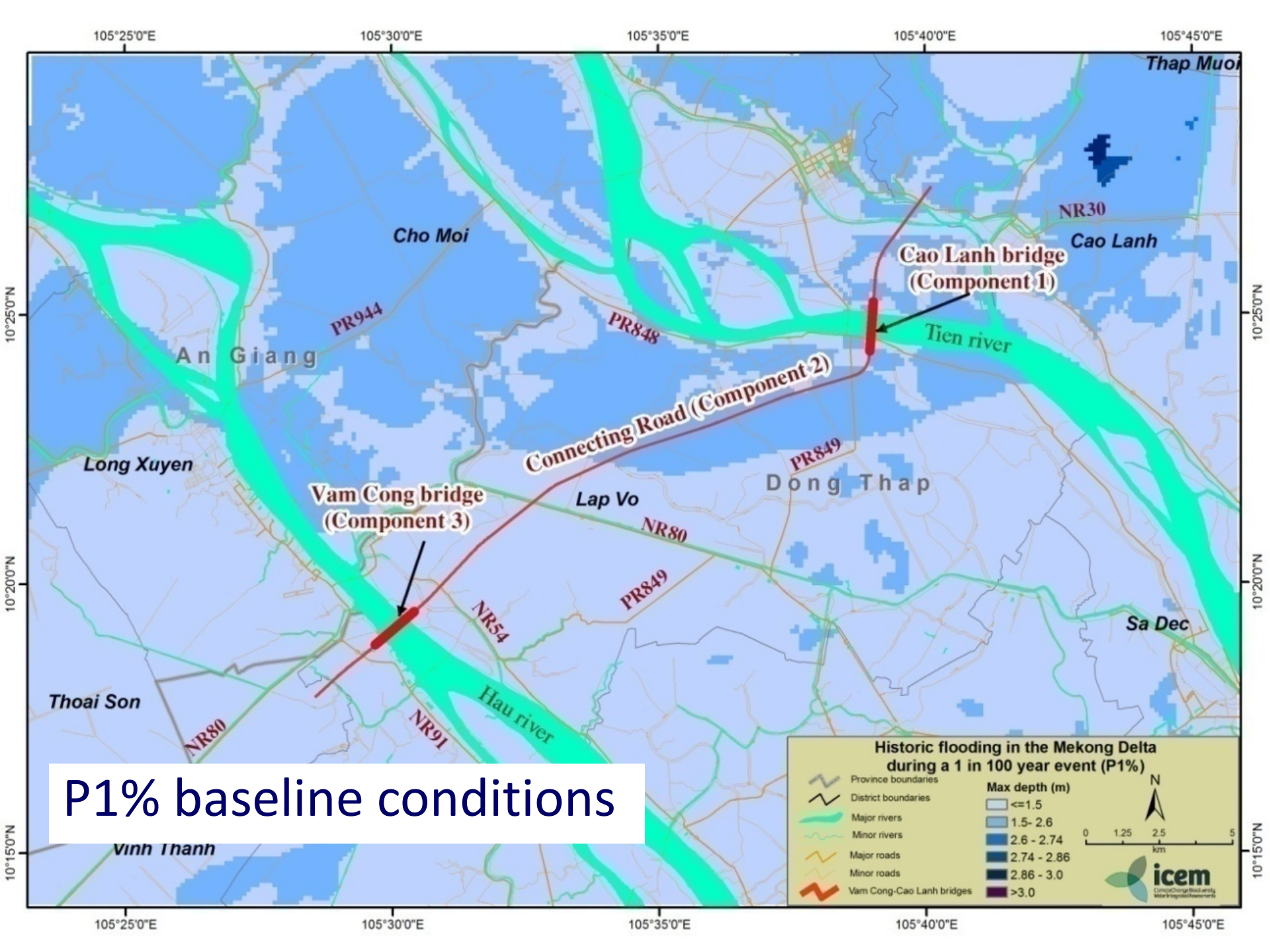
Improve connectivity in the Mekong Delta region by extending highway from HCMC to Mekong Delta:

1. Two cable stayed bridges to replace current ferry services (combined length of 5.4km);
2. 25-km associated highway link between the two bridges

Detailed climate change impact and vulnerability study conducted by ICEM (\$170,000), including:

- Downscaled climate projections
- Hydrologic, hydraulic modeling

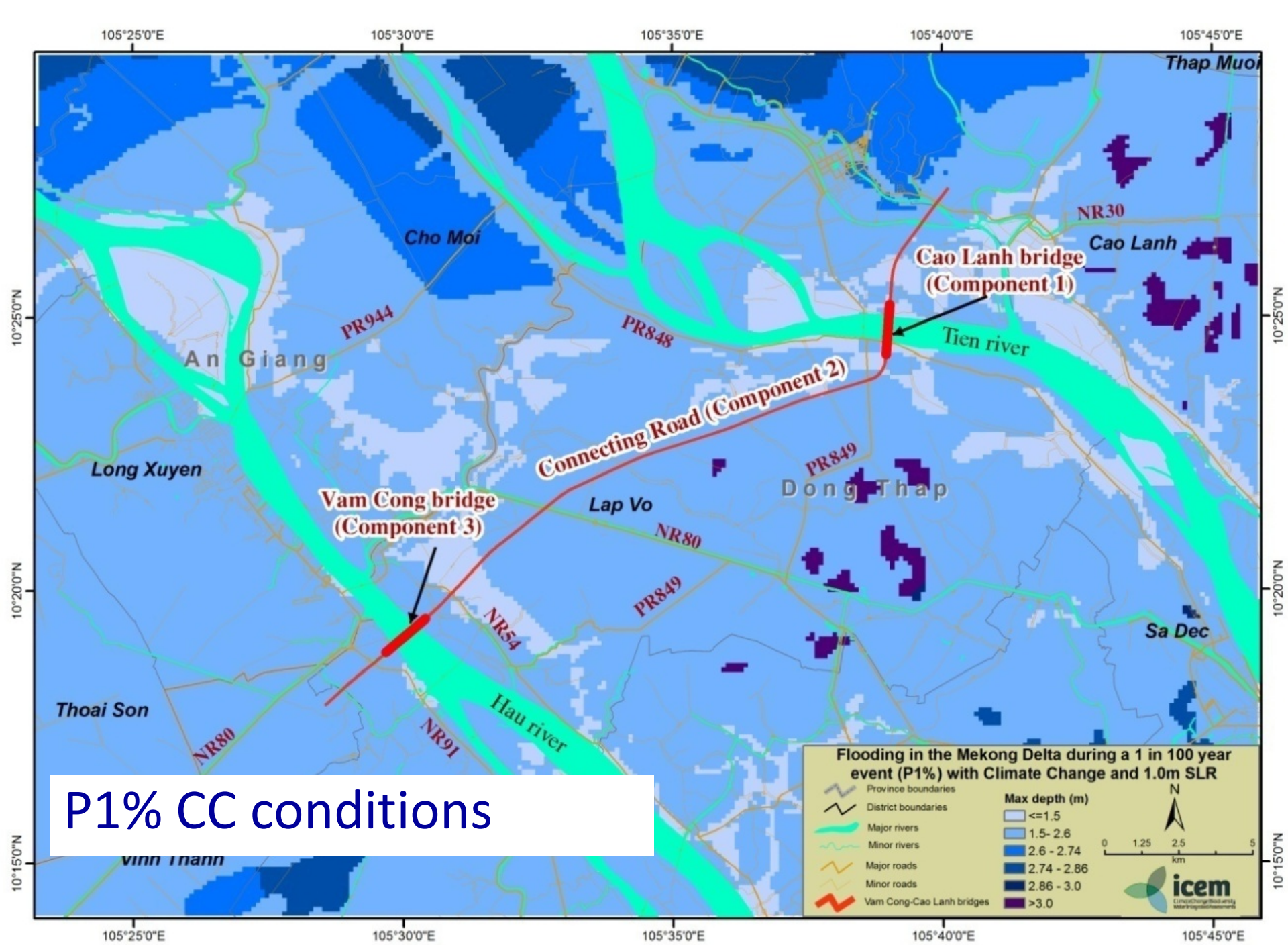




P1% baseline conditions

**Historic flooding in the Mekong Delta during a 1 in 100 year event (P1%)**

	Province boundaries		Max depth (m)	
	District boundaries		<=1.5	  <small>Chulalongkornrajavidyalaya Water Engineering Institute</small>
	Major rivers		1.5 - 2.6	
	Minor rivers		2.6 - 2.74	
	Major roads		2.74 - 2.86	
	Minor roads		2.86 - 3.0	
	Vam Cong-Cao Lanh bridges		>3.0	



# Recommendations of Study:

Two primary concerns were identified:

1. **Bridge clearances would be impacted by combination of sea level rise, upstream flooding; complicating navigation by largest traffic**
2. **Connector roads might over-top during largest (1%) floods, leading to erosion of road embankments and scour of road foundations**

In consideration of the costs of addressing risks:

- **Navigation clearance, though impinged by larger (P5%) events, was determined to be sufficient to allow passage of most vessels – no modification to bridge design required**
- **The design height for embankments should be raised by 0.6m to reflect climate change impacts on flooding, adding \$4.5 m to project costs (less than 1% of baseline finance)**

