

Basin-wide Climate Change Impact and Vulnerability Assessment for Wetlands of the LMB for Adaptation Planning

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Wetland Vulnerability and Adaptation – Approach and Method

Prepared for the Mekong River Commission
By ICEM • WorldFish • IUCN • SEA START

Overview of presentation

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1. Working principles
2. Regional review of Mekong wetland assets
3. Using climate change models to develop regional trends
4. Case studies of wetland vulnerability and adaptation
5. Upscaling of case study findings to regional level



Working Principles

- Focus on natural wetlands – not man-made or converted wetlands
- Recognise that the natural wetlands of the Mekong are valuable and are worth conserving
- The main output of this study will be regional guidance and priorities for action for maintaining Mekong wetland ecosystems.
- Case studies will be used to develop generic adaptation measures for use in other wetlands in the basin.
- The study will not develop wetland management plans for each case study site.
- The focus of the study is upon the impacts of climate change, distinguished from other development trends and threats to the wetland
- **First** consider the adaptation of the wetland ecosystems themselves, **then** the adaptation of human uses and livelihoods of the wetlands.

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Regional review of Mekong wetland assets

Scales

Wetland classes

Ecological and climatic analysis

Assessment done at two scales:

- **Basin-wide:** Analysis at this scale will focus on identifying and characterizing the wetlands into categories based on their characteristics.
- Using IPCC SRES scenarios and internationally accepted downscaling and modeling techniques, quantify the threat posed by climate change in terms of changes to basin hydrology and meteorology.
- **Case study sites:** the vulnerability to climate change will be assessed in greater detail at the case-study site.
- Interpretation of downscaled climate and hydrological data to assess the threats to wetland sites

MRC Wetland Types

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Seasonally flooded

- Flooded forest
- Floodplain marshes and swamps
- Floodplain grasslands
- Peat lands

Permanently flooded

- lakes
- ponds

Man-made/regulated

- Reservoirs
- Rice fields
- Fish ponds and aquaculture
- Urban

Rivers

- River/streams
- River /streams with pools and rapids

Coastal and marine

- Saline lakes/ ponds/ marsh/ swamp
- Mangrove forest

Wetland type analysis

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- Using the most detailed MRC wetland classification – Level 5, separate the man-made and converted wetlands
- Using the MRC GIS database of Mekong wetlands, overlay with GIS layers
- Analyse
 - ▣ To compare similar types of wetland in different situations
 - ▣ To identify rare and unique types of wetland
 - ▣ To Identify wetlands that occur in small patches in special ecoregions or ecological zones
 - ▣ To Identify wetland types and locations that are at higher risk of climate changes than others

Layers of analysis of wetlands

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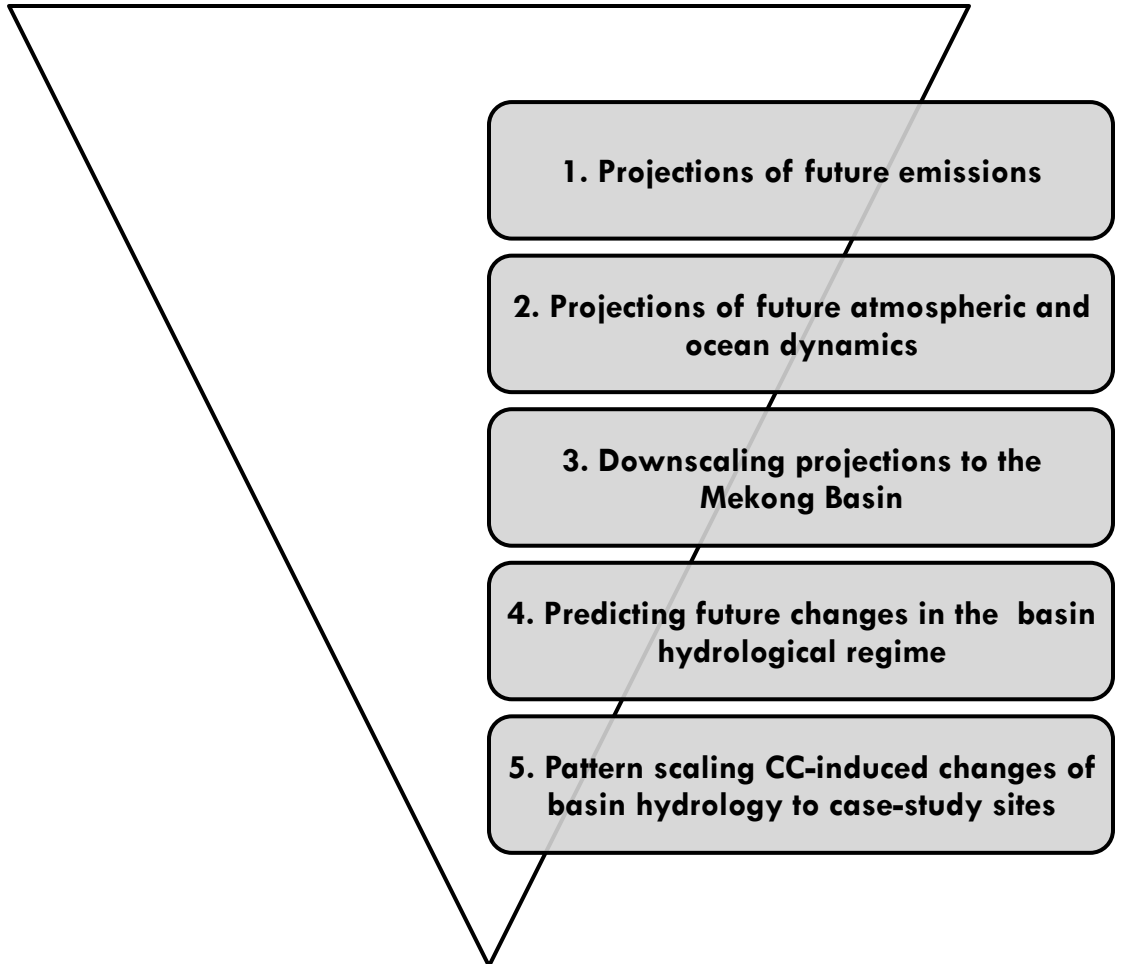
- **Sub-catchment** according to the MRC sub-catchment areas
- **Elevation** using the following elevation classes: 0 – 10 masl, 10 – 50 masl, 50 – 100 masl, 100 – 250 masl, 250 – 500 masl, above 500 masl.
- **Latitude** – dividing the Lower Mekong basin from 10°N to 22 °N in 3° intervals
- **Eco-Region**, using the WWF classification for the Mekong: The Greater Annamites, Central Indochina dry forests, Lower Mekong floodplains, Cardamon mountains
- **Ecological zone**, using a WWF classification based upon the natural vegetation that would be found with elevation, soils and climate – High, Medium and Low elevation, Moist and Dry broadleaved forests, Floodplain/Lake, Swamp forest and Mangrove/Delta
- **Current climate** – mean annual temperature and rainfall
- **Predicted changes** in mean annual temperature and rainfall

Predicting climate change

Approach to modeling climate change

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- **CC modelling**
 - ▣ allows for the quantification of future climate change threats
 - ▣ Is based on leading thinking on climate science
 - ▣ Assesses the impact of changes in the global climate system to local areas of interest



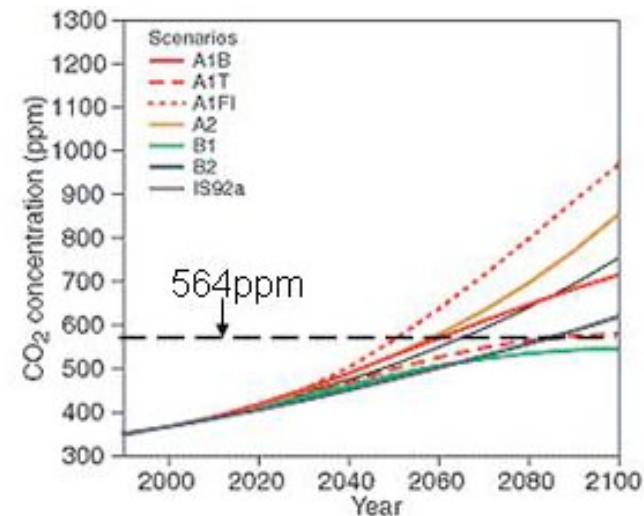
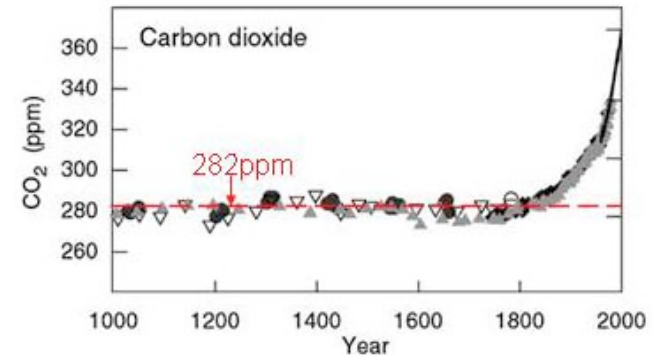
Basin wide climate change impact and vulnerability assessment for LMB wetlands

Steps in the CC approach

1 - Projections of future emissions and global GHG concentrations

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- SRES – Special Report Emissions Scenarios
- Four “story-lines” for alternative development pathways resulting in alternative future emissions scenarios
 - Homogenous emissions
 - Heterogeneous emissions
 - High & medium development
- Provide the forcing variables for Global Circulation Models (GCMs)
- A2 & B2 are most common in the Mekong



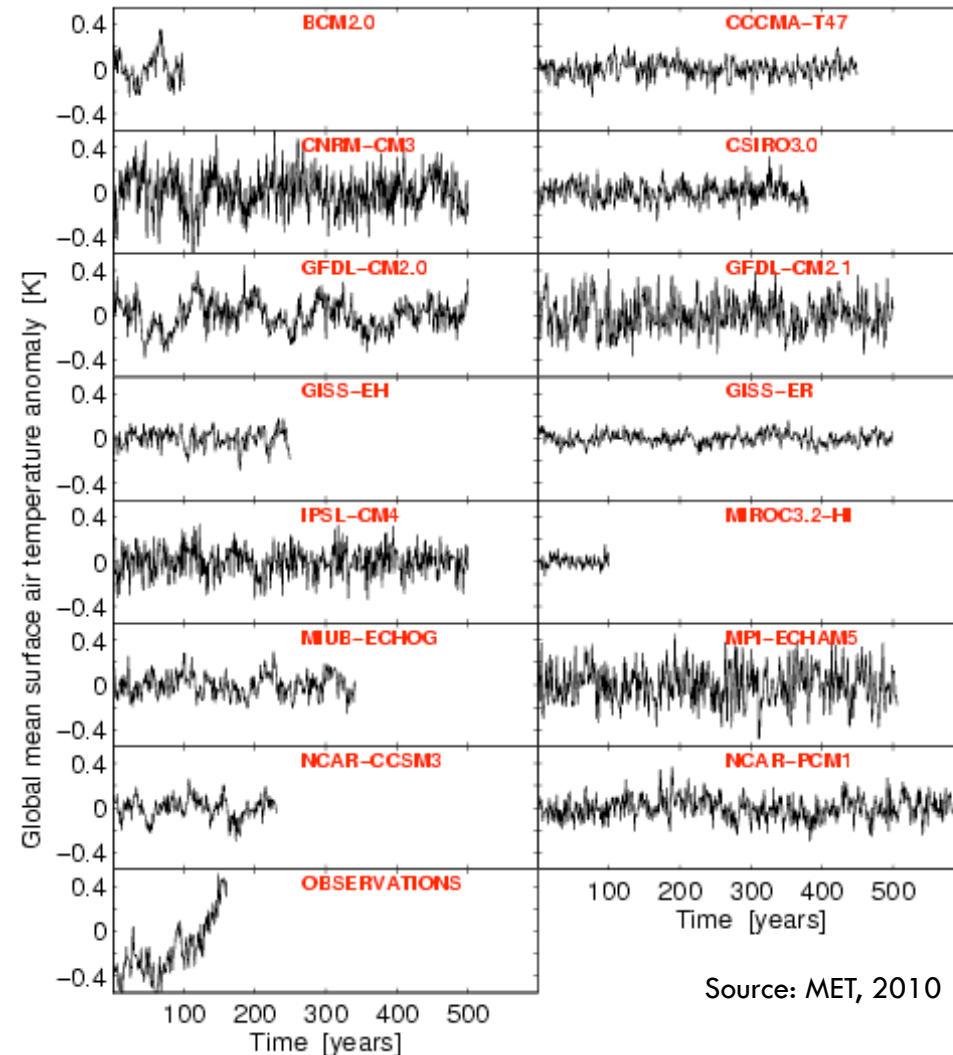
Source: IPCC, 2008

Steps in the CC approach

2 - Projections of future climate, atmospheric & ocean dynamics

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- GCMs provide a full description of atmospheric and ocean physics
- Coarse horizontal resolution (200-400km)
- ~40 vertical levels (half in atmosphere and half in the ocean)
- IPCC AR4 uses 24 GCMs
- 12 have been applied to the Mekong Basin



Steps in the CC approach

3 – downscaling projections to the Mekong basin

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3 approaches to downscaling:

1. **RCM (Regional Circulation Models)**
 - most sophisticated way to downscale GCM data
 - Physically based
 - 25-50km resolution

2. **Statistical**
 - local climate is conditioned by large-scale (global) climate but does not try to understand physical causality
 - GCM output is compared to observed information for a reference period to calculate period factors
 - Period factors are then used to adjust GCM time-series

3. **Pattern-scaling**
 - Uses high resolution observation data to scale GCM data to small areas or monitoring points
 - Suitable when there is extensive observation data
 - Cannot correct for statistical bias so should be used to assess relative changes



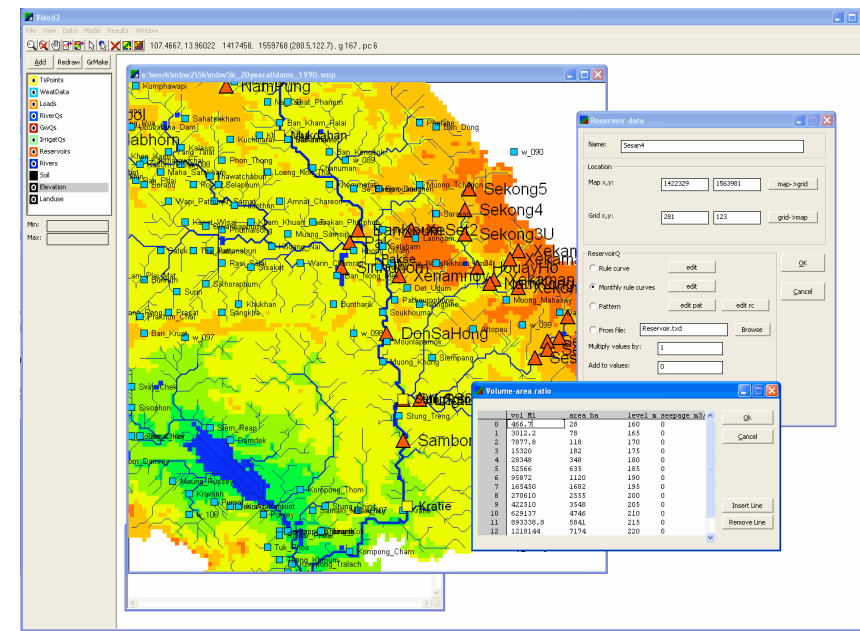
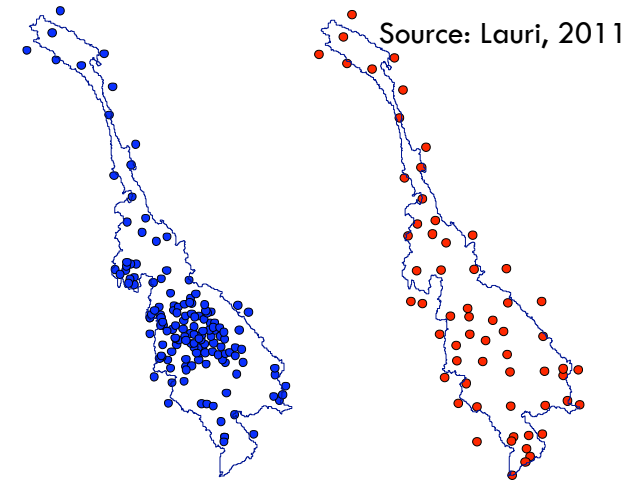
- Main applications for the Mekong
 - **RCM:** PRECIS (SEA START RC, 2008)
 - **Statistical :** Mekong Futures & this study (Aalto University, 2011)
 - **Pattern downscaling:** (CSIRO, 2009)

Steps in the CC approach

4 – Predicting future changes in the basin hydrological regime

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- VMod model
- area-based distribution of hydro-meteorological impacts of climate change
- Computes water balance for grid cells ~3kmx3km
- Utilizes 151 precipitation stations (blue) + 61 temperature stations (red)
- Baseline 1981 - 2005
- Can predict changes in:
 - Rainfall
 - Runoff
 - Flows
 - Infiltration
 - evapotranspiration



Steps in the CC approach

5 – Pattern scaling Basin-wide changes to case study sites

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- Uses statistical comparison of modelled and observed baseline data for case-study sites
- Translates relative change due to climate between modelled baseline and future scenarios to observed local climate

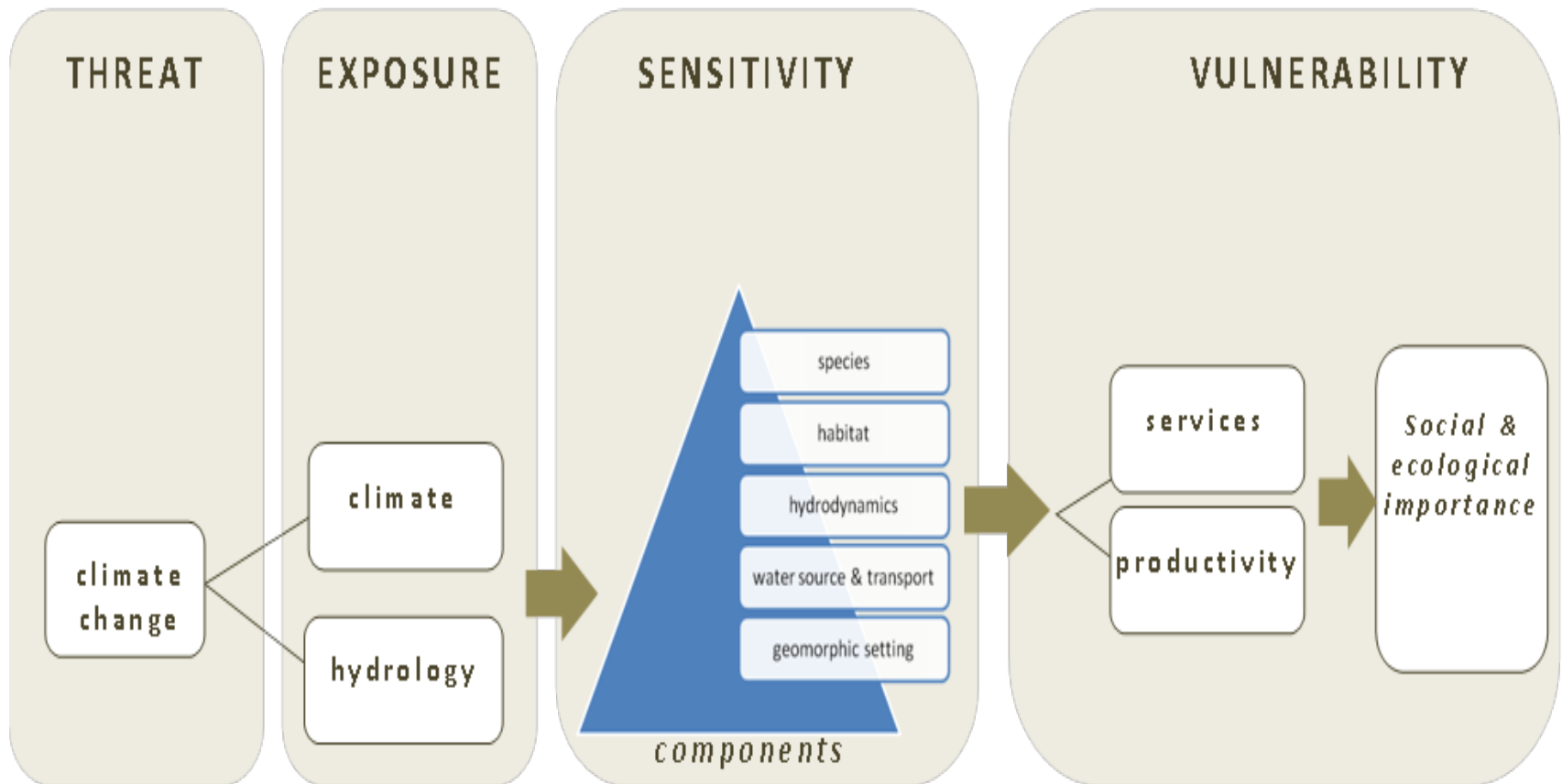
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Case studies of wetland vulnerability and adaptation

Based upon the Case Study Guidance

Overview of process of assessing wetland vulnerability

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Nine steps for case study process

1. Review **institutional and policy** framework for wetland management and climate change adaptation
2. Describe the **wetland case study areas** in terms of its biodiversity and habitats, ecosystem functions and services, livelihoods and values
3. Understand the **features that determine the character** of the wetland, especially climate and hydrology
4. Make inventory of **historic climatic events** and adaptation responses
5. Make **predictions** on how climate change will affect the character of the wetland by 2050
6. Describe the **other threats and development pressures** on the wetland
7. Identify **adaptation measures** needed to maintain or enhance existing levels of biodiversity and ecosystem services
8. **Wetland valuation** – current values and predicted changes in values of ecosystem services with climate change
9. Prepare a **road map** for progressive implementation of adaptation measures

Questions for the institutional and policy review

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- What policies and institutional arrangements for the conservation and management of wetlands ?
- What policies and institutional arrangements for enhancing wetlands to adapt to climate change ?
- What are the strengths, weaknesses and gaps?
- What other policies and institutional arrangements influence the maintenance and resilience of wetlands ?
- What opportunities exist for achieving wetland adaptation within the existing arrangements ?
- What reforms and innovations are required?

Instruments and structures		Institutional and policy level			
		Local level		National and sub-national	International (bilateral, regional and international)
		Site specific	Commune, district and provincial level		
Policies	Wetlands				
	Climate change				
Legislation	Wetlands				
	Climate change				
Strategies and Plans	Wetlands				
	Climate change				
Institutional structures	Wetlands				
	Climate change				
Admin procedures and guidance	Wetlands				
	Climate change				

Characterising the wetland

- Hydrology and geomorphic setting, water availability, and hydrodynamics – based upon HydroGeomorphic Methodology (HGM)
- Wetland habitat and biodiversity
- Wetland ecosystem services
- Wetland livelihoods
- Valuation of key ecosystem services

Wetland habitat and biodiversity vulnerability assessment

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- Wetlands are complex with several different types of habitat – a **mosaic** of riverine, swamp, flooded forest, rice fields
- Some habitats will be more vulnerable to climate change
- Species are dependent upon habitats and vulnerable to climate change
- Identify the different habitats in wetland
- Identify the key species that define the wetland – rare and endangered, common and economically useful, keystone species on which ecosystem depends
- Assess vulnerability to climate change
 - Exposure,
 - Sensitivity,
 - Potential impacts,
 - Adaptive capacity
 - Leading to Vulnerability
- Add in Vulnerability to other threats, e.g. other development threats

- THIS IS A NEW METHOD DEVELOPED FOR PROJECT

For example habitat vulnerability assessment in Xe Champhone

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Habitat type	Exposure	Sensitivity	Adaptation	Vulnerability	+ other threats
Deep pool	Med	Med	Low	High	High
Meander	Med	Med	Low	High	High
Oxbow	Med	Med	Med	Med	High
Flooded Forest	Low	Med	Low	Low	Low
Seasonally Flooded bamboo Forest	Low	Med	Low	Low	Med, over use no zone
Riparian vegetation zone	very few trees stand along the river.....				

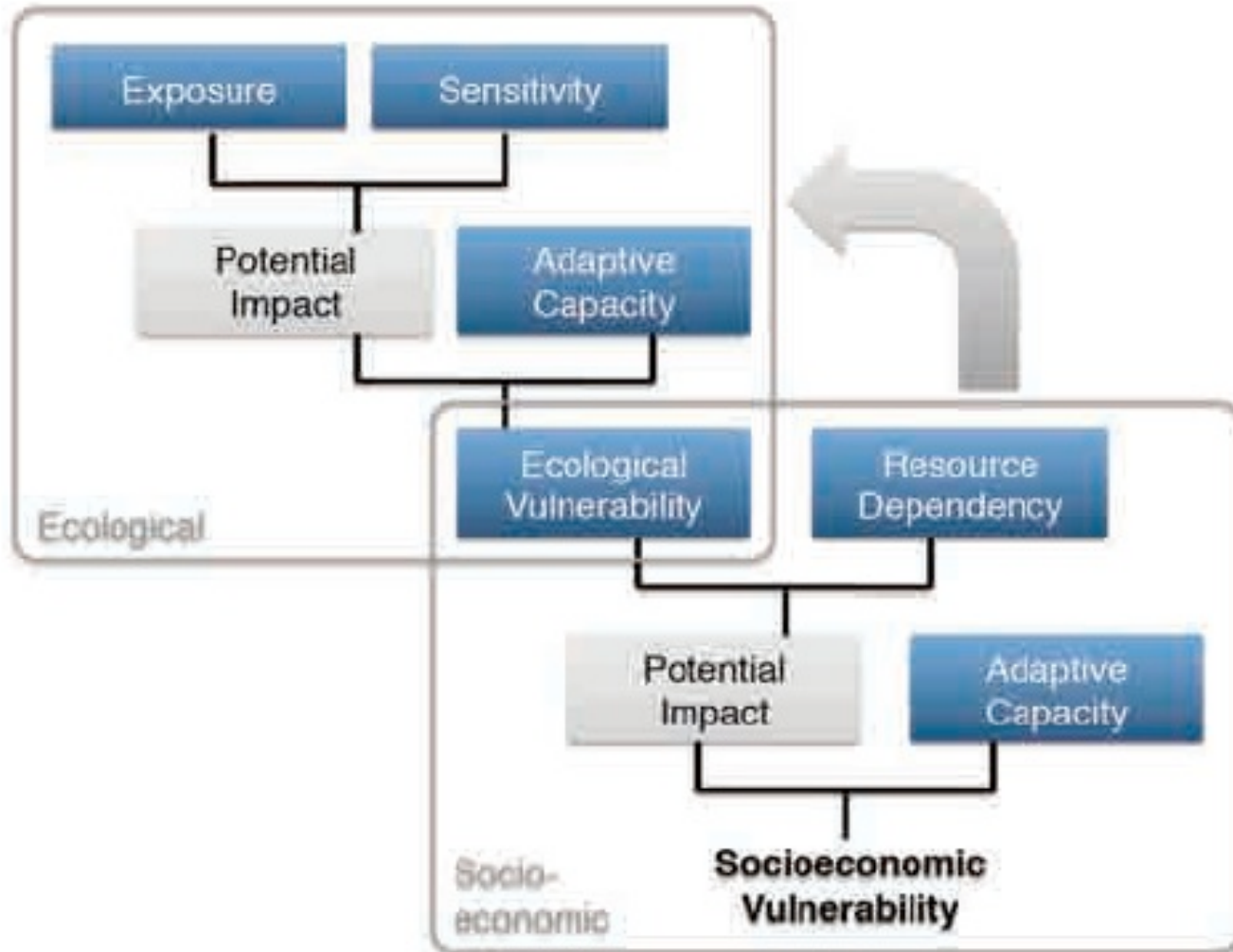
Wetland Ecosystem services

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- Wetland ecosystem services defined in terms of
 - ▣ Provisioning
 - ▣ Regulating
 - ▣ Cultural
 - ▣ Supporting
- Qualitative Analysis of the ecosystem services for wetland, the importance and the trends
- Analysis of the impacts of climate change upon these trends – importance decreases, increases or is maintained

Linking Ecological to Socio-economic vulnerability

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Livelihood vulnerability

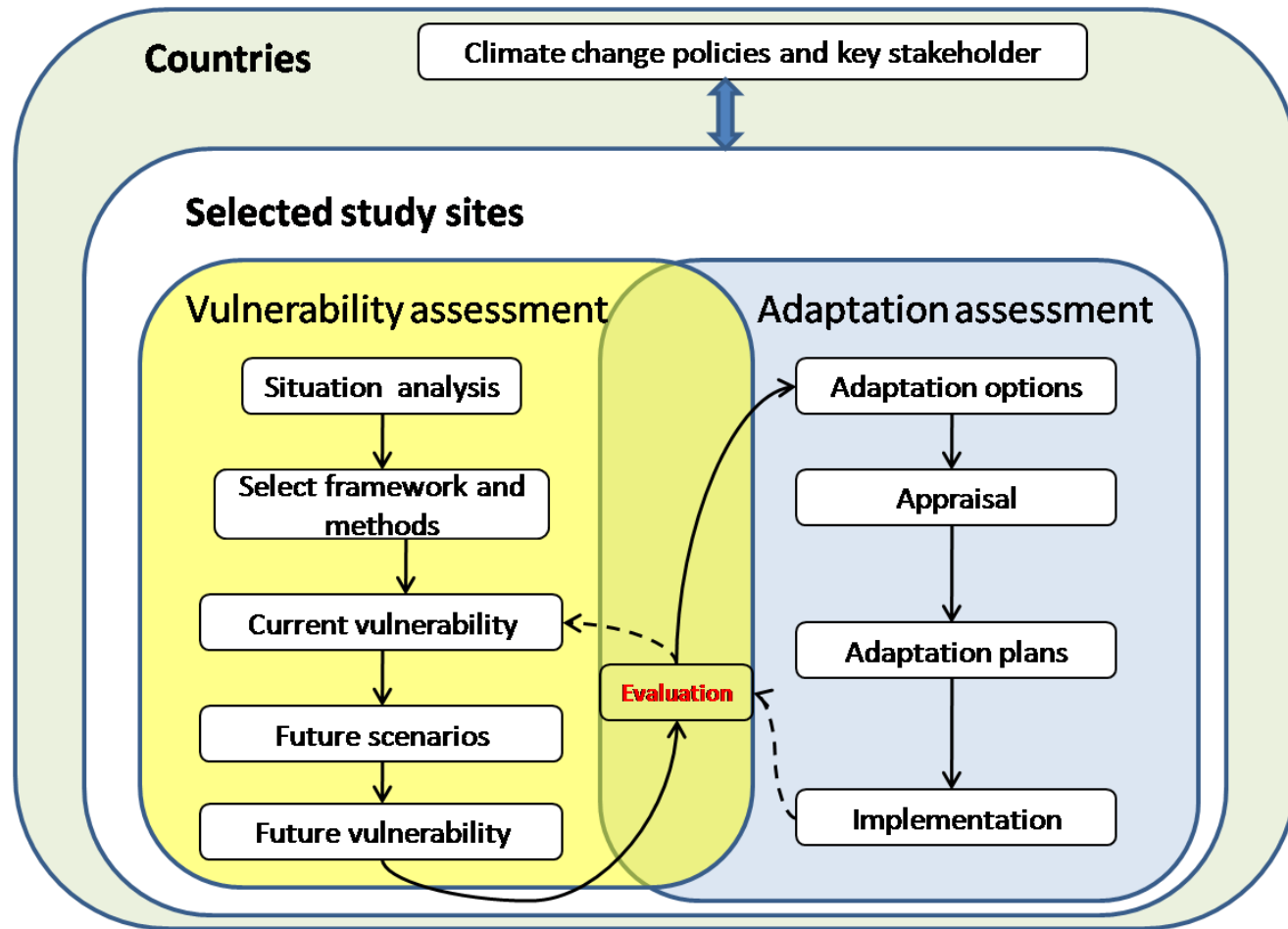
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Based upon interviews and focus group discussions with wetland users and communities, livelihood vulnerability assessment for case study sites includes a series of tasks

- Task 1 – Situational analysis
- Task 2 – Exposure
- Task 3 – Dependency
- Task 4 – Potential impact of climate change on wetland livelihoods
- Task 5 – Adaptive Capacity
- Task 6 – The full picture: vulnerability at the community level

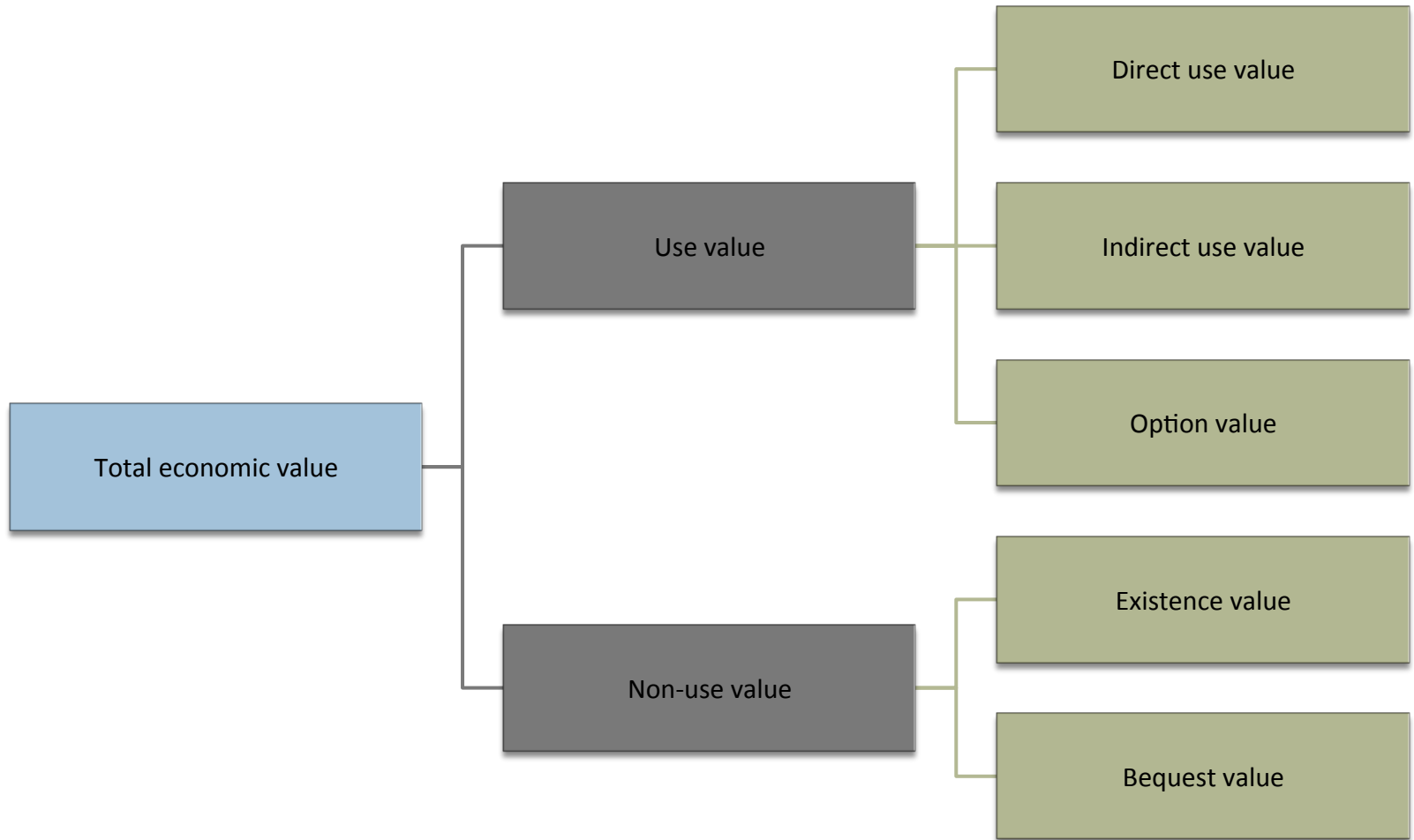
Moving from vulnerability to adaptation

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Wetland valuation

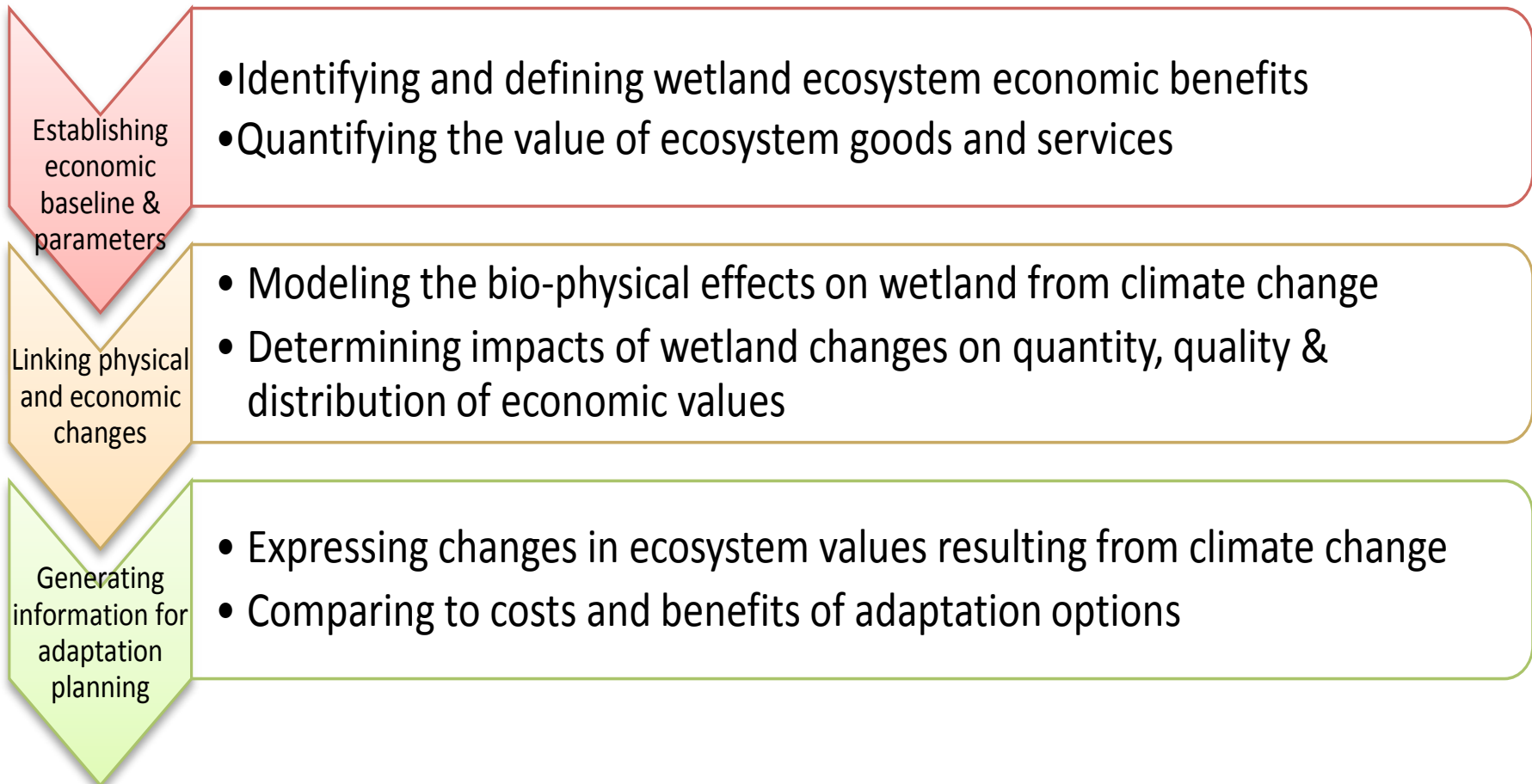
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We are NOT assessing total economic value – probably direct use values

Steps in economic valuation

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Limitations to wetland valuation

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- Wetland economic valuation is very complex
- Often requires lengthy statistical household surveys

We do not have the resources for this, so:

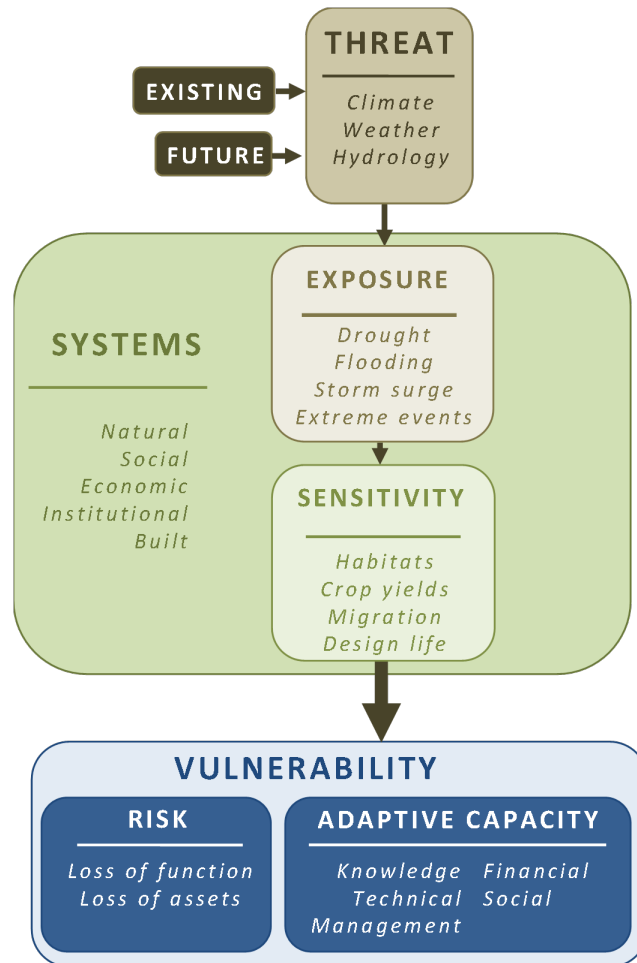
- Depend upon earlier work on the site or on similar sites
- Focus on valuing the main direct uses or ecosystem services
- Link with ecological vulnerability assessment to assess the change in value as result of climate change

We will NOT do a Cost-Benefit Analysis of the adaptation options at all sites

We will attempt a Cost Effectiveness assessment of adaptation options at one site only

Moving to adaptation

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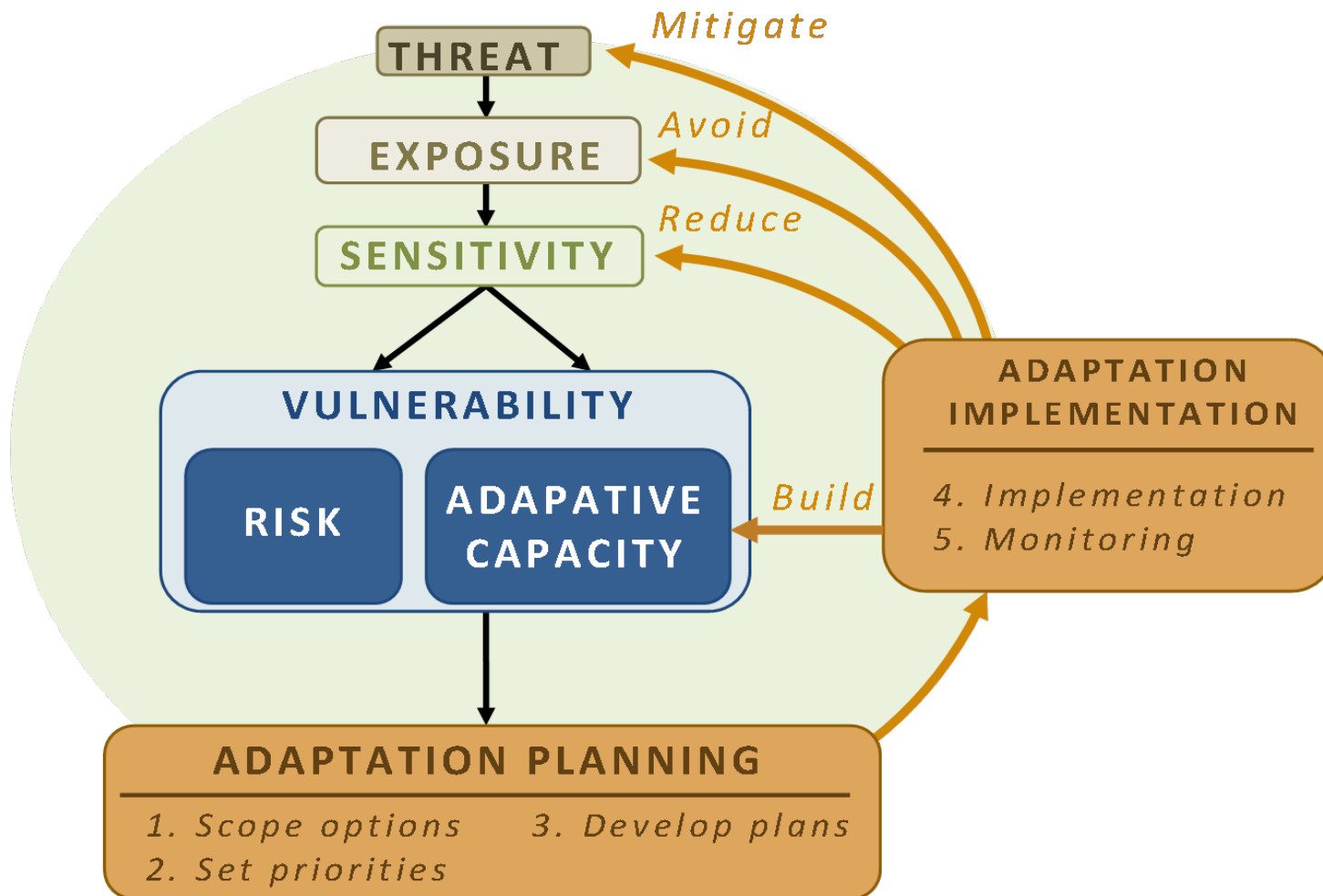


Adaptation for wetlands can include measures to:

- avoid or reduce exposure to the change
- reduce sensitivity or increase resilience to the change
- avoid or reduce negative effects or enhance those which are beneficial
- increase adaptive capacity

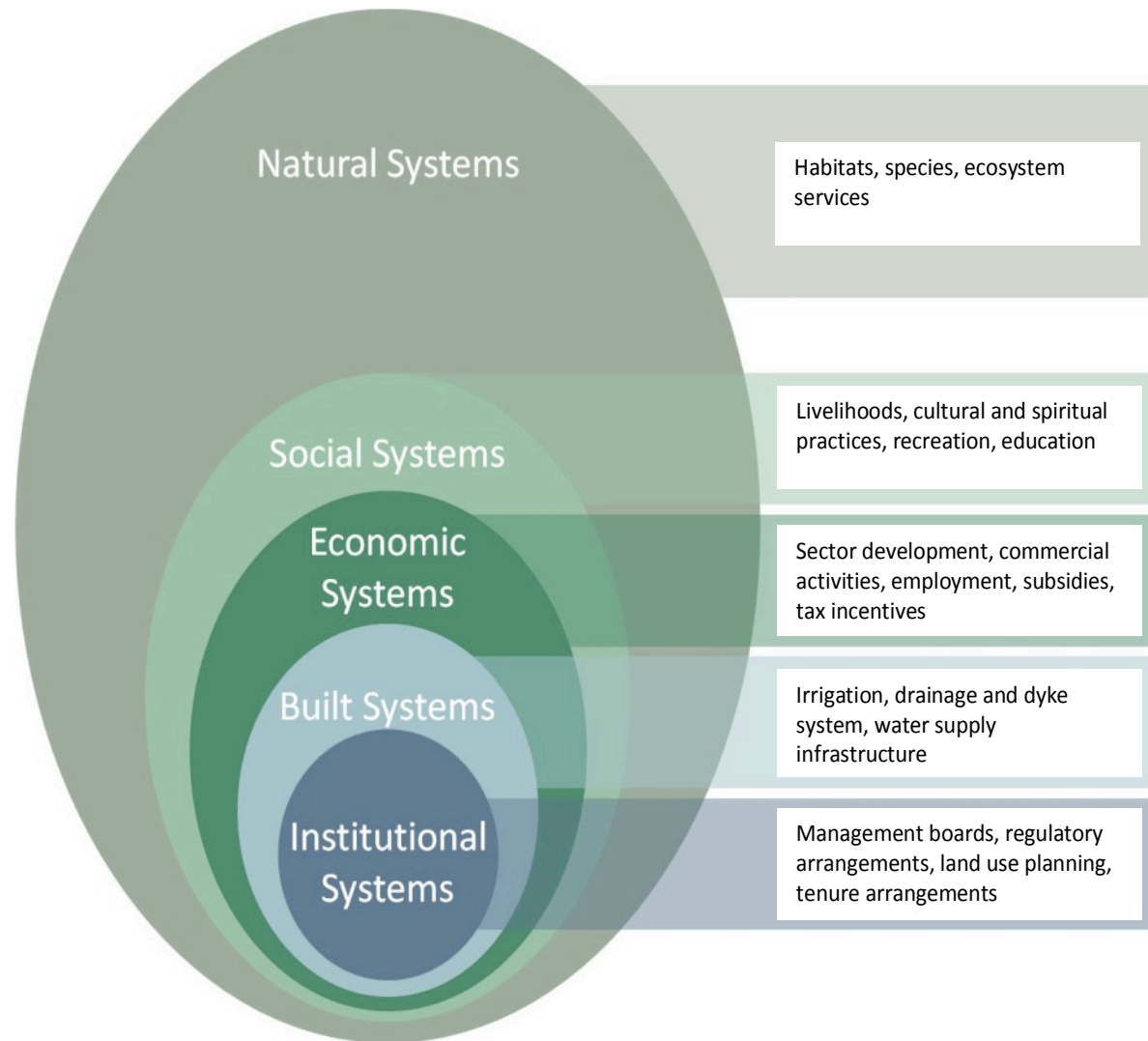
Adaptation is a response to actual or predicted climate change impacts

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Adaptation options must work at different levels

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Adaptation options

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Adaptation based on one approach is **unlikely** to succeed.

Options need to be integrated, including:

- ❑ Engineering options (eg sea walls and drainage systems)
- ❑ Traditional local strategies
- ❑ Social responses (including resettlement and “autonomous” actions)
- ❑ Land use planning (eg zoning and development controls)
- ❑ Economic instruments (eg subsidies and tax incentives)
- ❑ Natural systems management (eg rehabilitation, enhancement)
- ❑ Sector specific adaptation practices (eg agricultural regimes to reduce water demands)

Wetland adaptation options may depend upon improving existing wetland management and protection measures – **they may not be very new ideas!**

Adaptation planning

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Adaption planning is a cyclical and iterative process

Actions are planned, enhanced, developed and implemented

- ***Set priorities:***
- ***Be phased in implementation***
- ***Learn and adjust over time:*** monitoring and feedback

Upscaling of case study findings to regional level

We are NOT up-scaling climate change back to regional level!

We are up-scaling wetland vulnerability and adaptation options to the regional level

From the case studies:

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We will have a better idea of:

- Which wetland habitats are more vulnerable
- Which wetland species are more vulnerable
- Which wetland species may become more invasive
- Which ecosystem services are likely to be affected
- What are the most important wetland livelihoods and their values
- What are the adaptation options to protect and enhance the wetland ecosystem and its values
- What is the range of adaptation options

From the regional wetland analysis

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- We will have a better idea of where the different wetland types are clustered
- What are the climate predictions for these wetlands

Together the case studies and regional analysis allows predictions to be made:

- The regional spread of wetland types at risk
- The regional spread of wetlands affected by different types of climate change risk
- The range of adaptation options that are available to address these risks

Development of regional adaptation options for Mekong wetlands

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Adaptation planning needs to:

- *be **integrated*** across all wetland systems and with development planning at local, provincial and national levels
- *take an **area wide/spatial approach***
- *be **participatory*** (because so much depends on judgements and assumptions)
- *recognise its **natural systems foundation*** (ecological sustainability)
- *include **adaptation from day one*** – communities and governments can start thinking about adaptation now, without waiting for more predictions
- *seek to **improve the science evidence base** as it becomes available*

The final product

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A synthesis report containing:

- Recommendations for regional policies for wetland protection and enhancement in the light of climate change
- A menu of adaptation options suitable for different types of wetland and different types of climate change risk for use in wetland planning and management