Water Project Training Modules and Capacity Building in Accessing Climate Finance

GREEN CLIMATE FUND

Deltares team: Ad Jeuken, Viviane Cavalcanti, Åse Johannessen

MENA Regional Dialogue
June 2024

International Panel on Deltas and Coastal Areas (IPDC)

UNITED NATIONS
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AGENDA

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DAY 1 – 11 AM to 17:30 PM

- Welcome, inventory & summary of training needs, Introduction (60 min –11:00 to 12:00)
  - Share ideas/projects among the participants.
- Climate Rationale (Theory)
  - Instruction Part I (30 min, 12:00 to 12:30) – by Ad Jeuken, Deltares
- Lunch & Networking – 60 min 12:30 to 13:30
- Climate Rationale (Theory and exercise)
  - Instruction Part I continued + exercise (30min + 30min, 13:30 to 14:30) – by Ad Jeuken, Deltares
  - Instruction Part II + exercise (30+30 min, 14:30 to 15:30) – by Ad Jeuken, Deltares
- Break (15 min) – 15:30 to 16:00
- Governance for Paradigm Shifts (Theory)
  - Instruction Part I (60 min 16:00 to 17:00) – by Ase Johannessen, Deltares
- Q&A Day 1 (30 min, 17:00 to 17:30) – By Ad Jeuken, Deltares

DAY 2 – 09 AM to 15:30 PM

- Recap of day 1 (30 min) – 09:00 to 09:30
- Governance for Paradigm Shifts (exercise)
  - Instruction Part II + exercise (15 min + 30 min 09:30 to 10:15) - by Åse Johannessen, Deltares
  - Wrap up (15 min – 10:15 to 10:30) by Åse Johannessen, Ad Jeuken and Viviane Cavalcanti, Deltares
- Break (30 min – 10:30 to 11:00)
- Theory of Change and investment criteria
  - Main elements of ToC (30 min, 11:00 to 11:30) – Deltares team
  - Instruction on how to implement investment criteria + Q&A (45 min + 15 min, 11:30 -12:30) – by Viviane Cavalcanti, Deltares
- Lunch (60 min, 12:30 to 13:30)
- Build your Concept Note Outline – exercise in small teams to analyse particular barriers and address investment criteria and ToC – (90 min – 13:30 to 15:00) - supported by all instructors
- Reflection and closing - Share results and experiences among the groups (60 min – 15:00 to 16:00)

LEARNING OBJECTIVES

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- Build a solid concept note for your proposal, following a structured approach of the Water Project Development Guidelines (WPDG)
- Learn how to apply the WPDG to different contexts of IWRM, WASH, Integrated Drought and Flood Management.
- Understand principles of water adaptation within the mission of GCF.
- Build a solid climate rationale to your proposal
- To be a knowledgeable contractor or counterpart for technical teams developing the proposals

WHAT WE WILL NOT DELIVER

- A training explaining GCFs system and procedures
- Training on stakeholder engagement
- Detailed training on climate economics finance analysis (EFA)
- An academic course on climate change and adaptation

SECTORAL AND PRACTICAL GUIDE: WATER SECURITY

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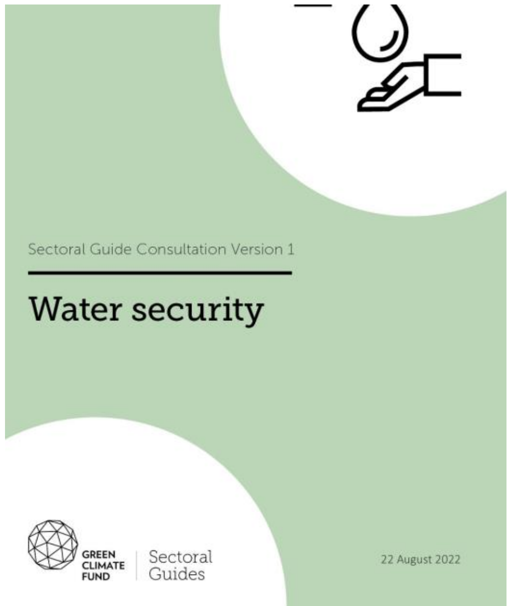

- https://www.greenclimate.fund/document/sectoral-guide-water-security

Annex I | Water Security Sectoral Guide

GCF Water Project Design Guidelines

Part 1: Practical guidelines for designing water-climate resilient projects

Annex II | Water Security Sectoral Guide

GCF Water Project Design Guidelines

Part 2: Applications of the Practical guidelines for designing water-climate resilient projects in IWRM, CR-WASH, and Drought and Flood management

- Aims to guide project proposal development in the water sector in line with GCFs investment criteria
- An inspirational document for the development of GCF funding proposals

TRAINING IS BASED UPON 3 PILLARS

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Key *science* on climate adaptation

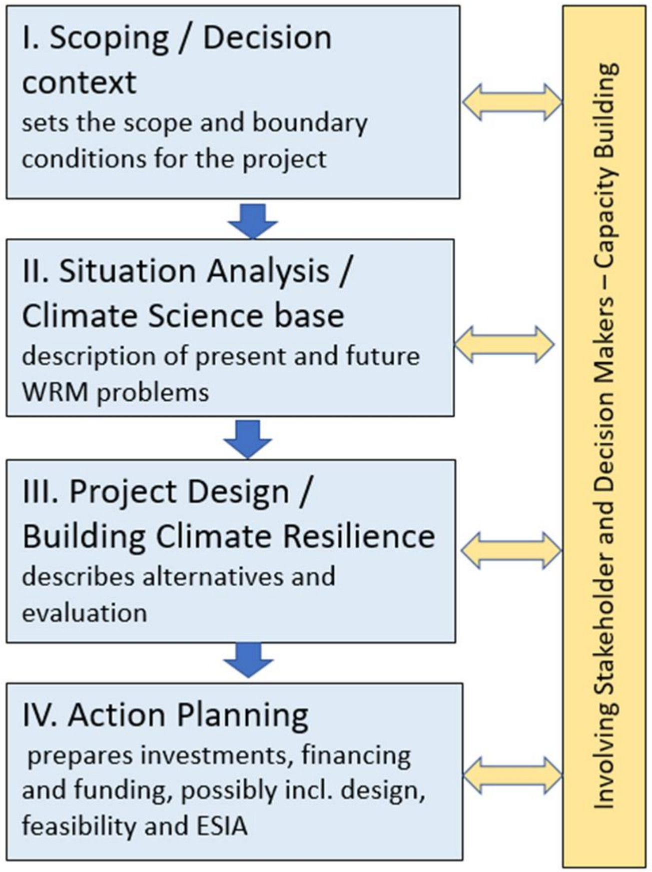
- Risk and vulnerabilities
- Effective adaptation
- Valuing adaptation

and

- Governance for Paradigm shifts

CLIMATE RATIONALE

Structured approach of the WPDG



Concept note input

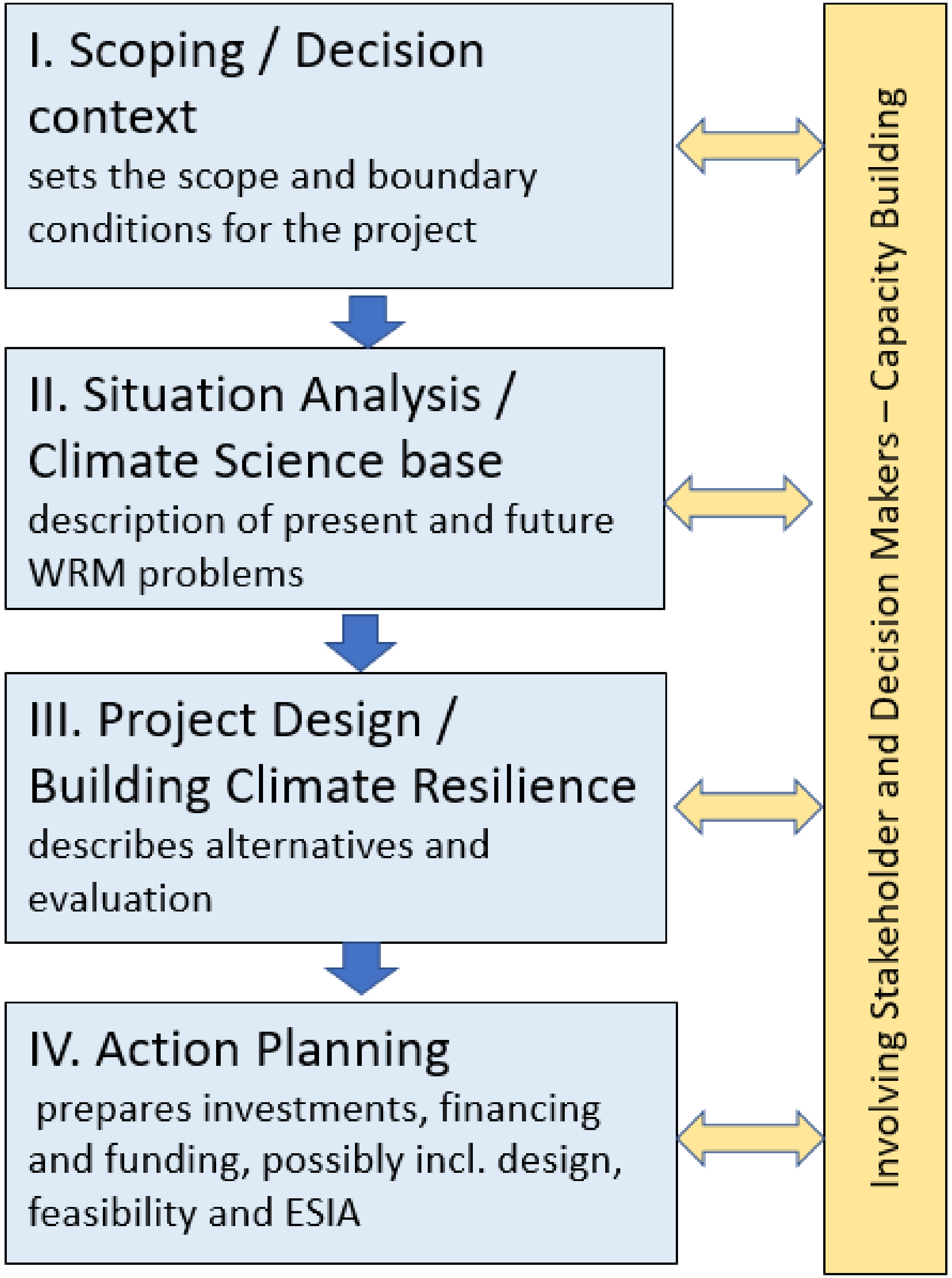
- How to underpin the ***investment criteria*** with *science*
- How to develop a sound ***Theory of Change*** for your project

STRUCTURED PROCESS IN DESIGN OF WATER PROJECTS

The structured approach ensures

- All analysis steps are addressed
- Consistency between analysis steps
- Stakeholders can follow the analysis process
- Alternatives are considered

Each phase is concluded with a decision moment to ensure that all involved agree with the result of that phase



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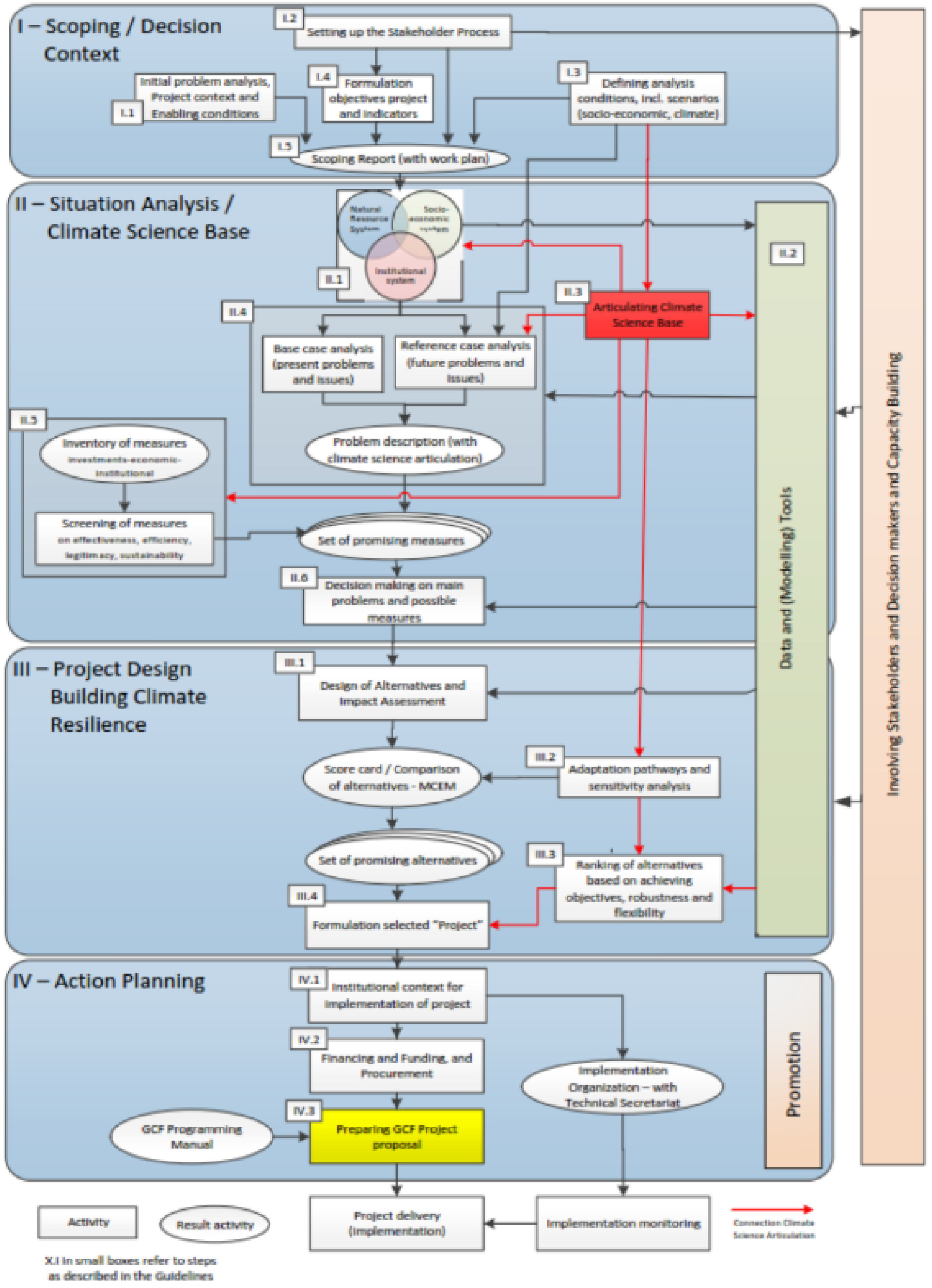
STRUCTURED APPROACH

In the actual project proposal to GCF only the results of the activities need to be included

This training has an **emphasis on information needs**



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WITH AN INTEGRAL SCOPE- SYSTEMS THINKING

Components of systems thinking approach in Water Projects Planning

Natural Resource System (NRS):

- Natural and engineered infrastructure (e.g. water collection, treatment, and disaster protection).
- Hydrometeorological boundary conditions (derived from models on day 1)

Socio-Economic System (SES):

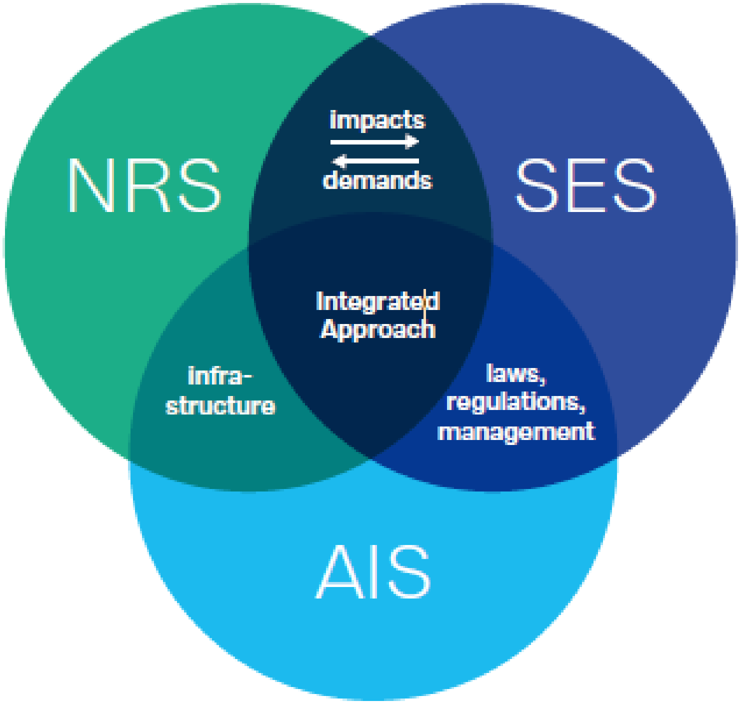
- Assessment of economic situation related to project development
- Past trends that might support impacts identification and future developments
- Identification of diverse benefits people derive from the project.

Administrative and Institutional System (AIS):

- Legal, regulatory or institutional constraints.
- Interactions and arrangement between authorities.

Interconnectedness and Integration, A Multi-Layer Model:

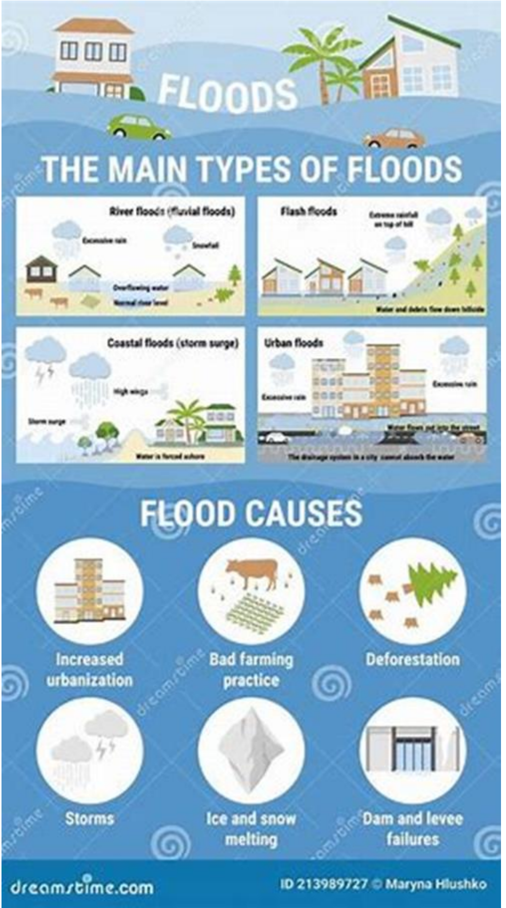
- The interplay between SES and NRS.
- Highlights the importance of strategic planning considering these dynamics (Integrated approach).



Source: Strategic Water Systems Planning, Deltares, 2021

THE SUB-SECTORS

- GCF has identified four water sub-sectors
  - IWRM
  - Climate resilient WASH
  - Integrated Drought management
  - Integrated Flood management



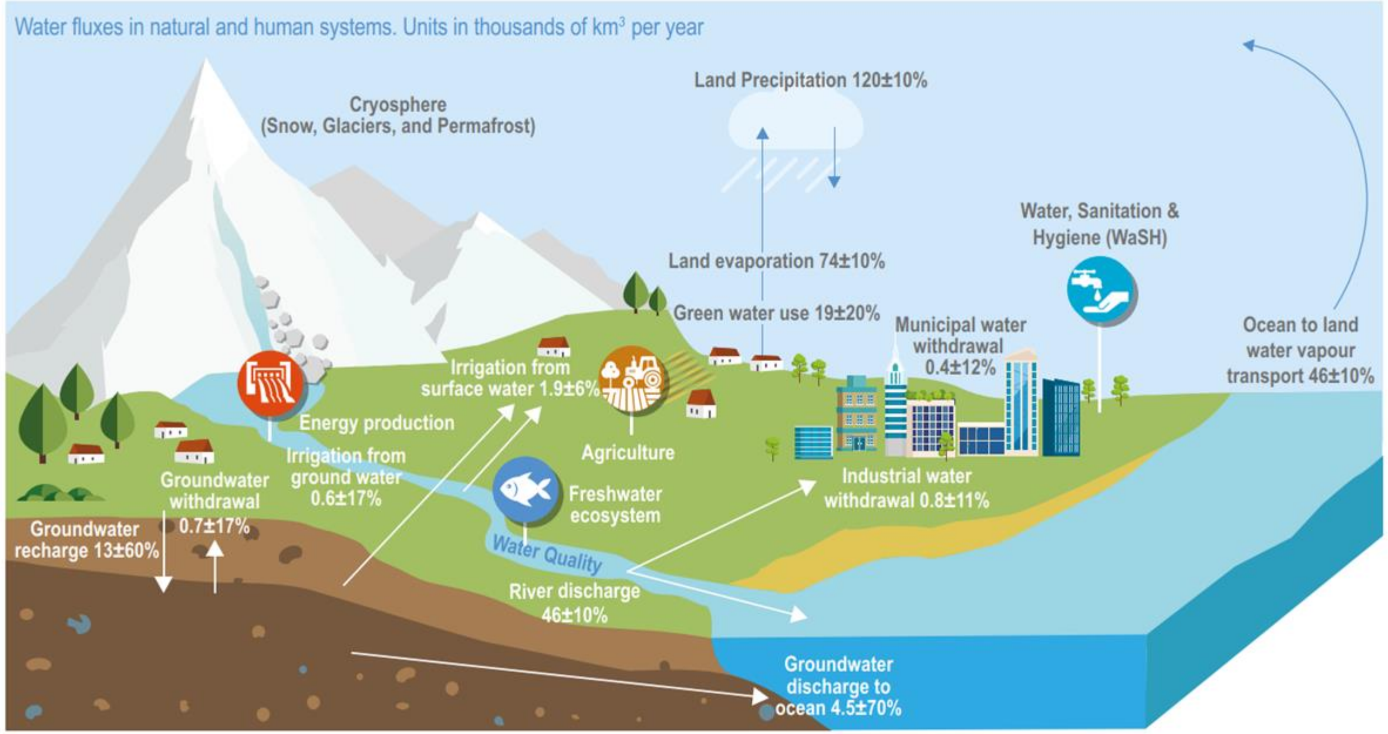


Figure 4.2 | The water cycle, including direct human interventions. Water fluxes on land precipitation, land evaporation, river discharge, groundwater recharge and groundwater discharge to the ocean from Douville et al. (2021). Human water withdrawals for various sectors are shown from Hanasaki et al. (2018), Sutanudjaja et al. (2018), Burek et al. (2020), Droppers et al. (2020) and Müller Schmied et al. (2021). Green water use (Abbott et al., 2019) refers to the use of soil moisture for agriculture and forestry. Irrigation water use (called blue water) is not included in green water use.

- The Water sector has strong links with other sectors such as Agriculture, Energy (hydropower), Environment, etc.
  - Irrigation projects, hydropower projects are covered by the other GCF sectors
- IWRM as a sub-sector project brings together water users from multiple sectors to co-invest for mutual benefits
  - And as such can include irrigation, hydropower, ecology, etc, as part of the water system

WATERSECURITY SECTORS THAT ALLOW FOR 'SAP'ABLE PROJECTS (SEE WATER SECURITY SAP GUIDE)

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- IWRM
- CR-WASH
- Integrated Drought management
- Integrated Flood management

The sustainable and effective management of competing water uses through integrated water resources management (IWRM). Climate change affects water management in multiple ways, ranging from changes in seasonal and annual

The provision of access to clean water for human consumption – through climate resilient water sanitation and hygiene (CR-WASH) policies and technologies. More intense or prolonged precipitation, more variable or declining

Dealing with hydrological extremes regarding droughts through integrated drought management (IDM). IDM is considered to be a key component of disaster risk reduction programmes, climate adaptation strategies and national

Dealing with hydrological extremes regarding floods through integrated flood management (IFM). An increase in flood magnitude and frequency is occurring in many regions due to the intensification of the global water cycle induced by global warming. IFM aims to "*maximize the productivity and efficient use of floodplains*

WATER SECURITY FOR CLIMATE RESILIENCE PARADIGM SHIFTING PATHWAYS

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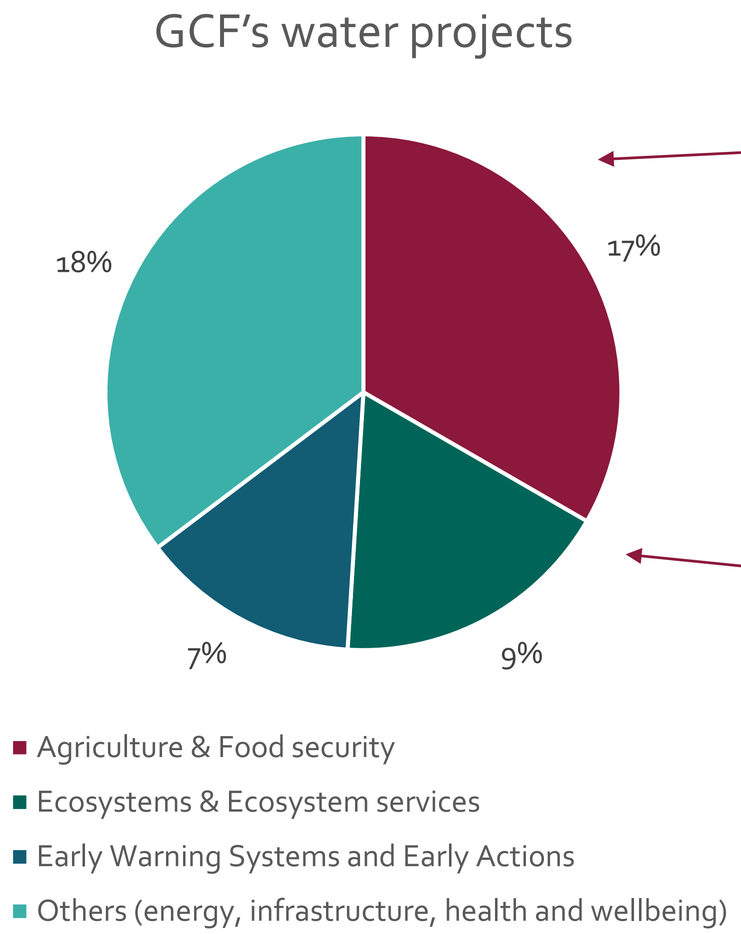
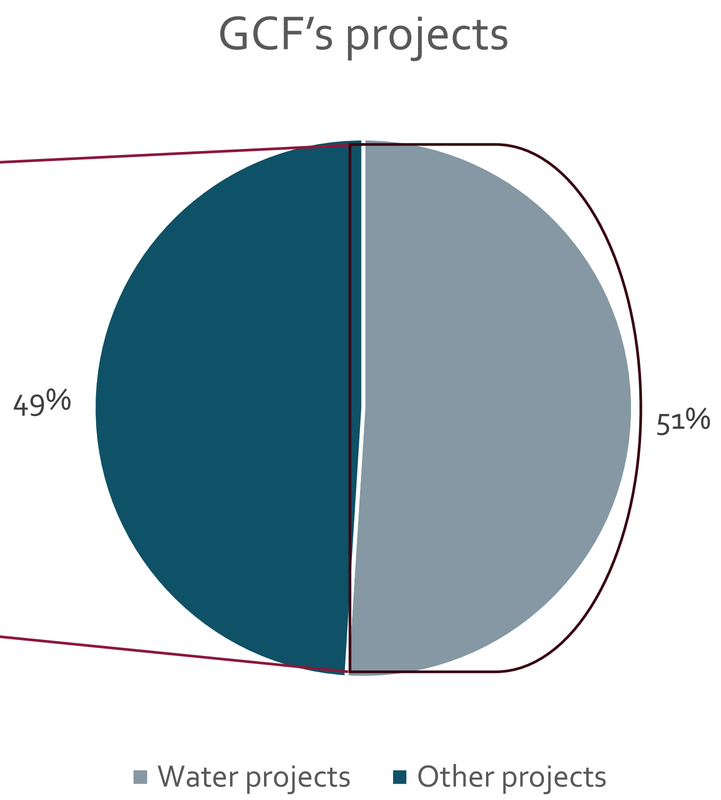
- An innovative approach to water security: **six detailed pathways**
- Need for global and regional lead advocacy
- Applicable on **needs-based** projects for countries using nexus and integrated approach
- **Systems thinking** approach considering NRS, SES and AIS links on project design
- **Context-based** unique connections between systems to be assessed

- Water conservation, efficiency and reuse
- Hydrological observation, forecasting & risk assessment
- Integrated Water Resources Management (IWRM) & SDGs
- Ecosystems-based approach
- Climate resilience and WASH
- Community knowledge

GCF'S COMPREHENSIVE APPROACH





GCF'S APPROACH TO PARADIGM SHIFT

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- Recognize country needs
- Define a succesfull project
  - Emphasis on scaling up (# beneficiaries)
  - Overcoming implementation barriers
  - Attracting private investment
  - Contributing to result areas
- Larger scale programs, aimed at building capacity, proven, low-regret replicable solutions (e.g. SAP guide)

> ➢ Quite indirect Climate rationale
> ➢ Less large scale (infrastructural) interventions

PROJECT SCENARIO

This is an example of a CR-WASH and drought management project that would be suitable for the SAP modality.

CONTEXT

Country A is considered one of the most vulnerable countries to climate change impacts, particularly to more frequent and extreme droughts. Consequently, climate change will potentially impact the country´s drinking water supply.

The rainfall data for the two most vulnerable districts from 1965-2016 reveals periods of extremely low rainfall and drought in 1965, 1970, 1977, 1983, 1992, 1998, 2001, 2007/08, 2012/13 and 2015/16. Scientists observe that severe droughts are occurring more frequently than previously estimated.

The main source of potable water is rainwater accessed from household and community rainwater harvesting systems. Whereas these systems provide adequate supply during times of sufficient rainfall, when the number of consecutive days with little or no rain exceeds a threshold, the harvesting and/or storage capacity is insufficient to meet even basic needs.

The inhabitants of the two most vulnerable districts are mostly subsistence farmers. The yields from their fields and gardens have been declining over the years, as the low and unreliable water availability negatively affects the yield of their crops. Open defecation is still widely practiced in the two districts, often close to the few surface water bodies, contaminating the little surface water available. This leads to frequent outbreaks of water-borne diseases.

The country's Ministry responsible for water resources aims to increase the resilience and reliability of water resources for drinking and hygiene purposes in the two most vulnerable districts of the country.

PROJECT ACTIVITIES

The project will implement the following activities:

- Rehabilitate existing rooftop rainwater harvesting systems for community buildings, to secure water for use during increasingly frequent periods of drought;
- Construct household rainwater harvesting facilities for the most vulnerable households;
- Support households to construct urine-diverting dry toilets, so as to prevent surface- and groundwater contamination;
- Train unemployed community members in operation and maintenance of rainwater harvesting systems;
- Develop and implement community-level drought contingency planning, factoring in impacts under various climate change scenarios; and
- Once the new water and sanitation facilities are in place and the drought contingency plan has been developed, organize field visits from less vulnerable communities which might have the potential to replicate these interventions using their own funds.

PARADIGM SHIFT

The project will improve water security for communities in the two most vulnerable districts of the country through enhancing and providing water storage and sanitation facilities that are resilient to present and future climate-induced droughts. Consequently, the project will improve the well-being and health of the communities. The paradigm shift of the project lies in the potential for collective learning, scale-up and replication, through the field visits from members of less vulnerable communities, who may be able to construct similar WASH facilities and develop drought contingency plans without financial support.

EXAMPLE PROJECTS

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EXAMPLE PRO

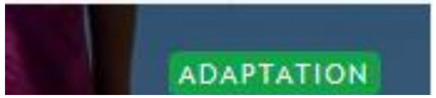
- **Background:** Benin faces significant vuln change, with noticeable increases in temp floods, affecting livelihoods and key secto
- **Challenge:** The country's low adaptive ca space, coupled with high poverty rates ar amplify the impact of climate challenges.
- **Goal:** Enhance the capability of local gov communities in Benin to implement clima and increase climate-compatible investm
- **Focus:** Empowering local stakeholders to adaptation in key climate-sensitive secto resilience to climate change impacts.
- **Project Category:**

Climate Resilience

Community Knov

Water conservation

Integrat



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EXAMPLE PROJECTS

- **Background:** Cambodia faces high vulnerability to climate change, experiencing frequent and severe climate hazards such as floods, landslides, cyclones, and extreme heat and wildfires. without effective interventions, climate change threatens significant economic repercussions and an increase in poverty across Cambodia
- **Challenge:** The climate vulnerability situation is compounded by financial and market barriers that hinder the mobilization of funds for climate projects, alongside non-financial barriers such as inadequate stakeholder capacity in both public and private sectors.
- **Goal:** Fortify the country's resilience against climate change and accelerate NDC's execution. Securing significant financing for climate projects and fostering private sector participation.
- **Focus:** Financing climate projects in priority sectors and draw private sector funding to bridge gaps. Also, strengthen stakeholders' capacity and foster policy dialogues.
- **Project Category:**

Climate Resilience

Community Knowledge

Private sector focus
Medium size
Grant & Loan
Beneficiaries: 1.3 million (Direct: 785,263; Indirect: 490,675)

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Climate rationale for different water subsectors

Ad Jeuken (Deltares)

GCF regional water sector training – Day 1

LEARNING OBJECTIVES

By the end of this session, you will be able to:

- Understand how climate variability, change and development are all part of the climate rationale.
- Understand how the different components of risk: hazard, exposure, vulnerability, can inform the climate rationale
- Understand how climate and water science and data can be used to support your climate rationale
- Identify and select adaptation action that reduces climate impacts, maximizes benefits and increases resilience
- Know how to gather best possible evidence to support the CR

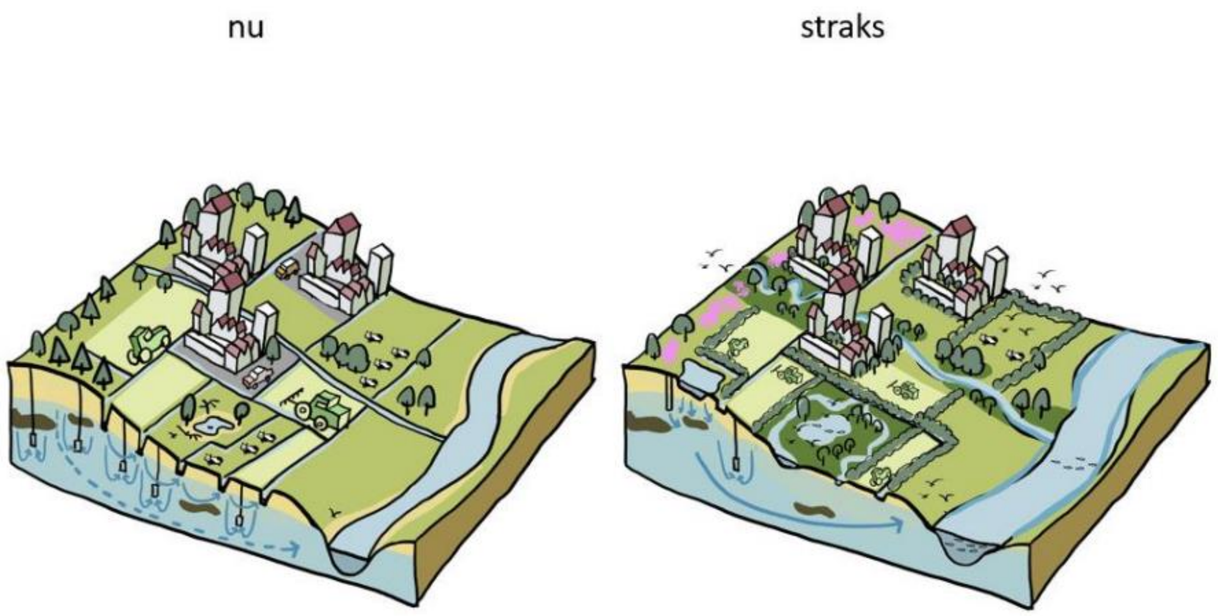
CONTENT

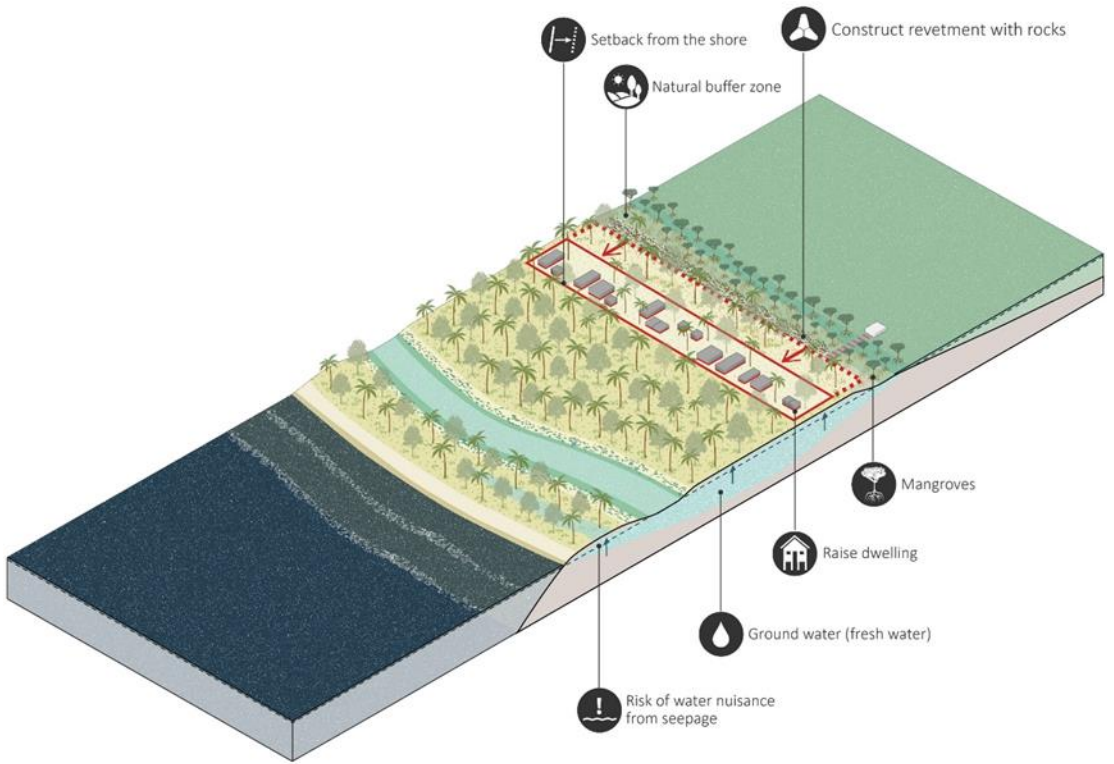
What are the key ingredients of the climate rationale?

What are key issues to overcome in the climate rationale?

How make an evidence-based climate rationale

Key Take aways





WHAT IS A CLIMATE RATIONALE ?

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Adaptation

Climate change adaptation aims to improve resilience of communities and ecosystems to climate change

For adaptation activities, climate rationale is established by providing **an evidence-based analysis** to show that a proposed activity is likely to be an effective adaptive response to the risk or impact of a specific climate change hazard.

Mitigation

Climate change mitigation interventions seek to reduce the release of greenhouse gas emissions or to increase the capacity of carbon sinks

Proposals for mitigation activities should demonstrate that a projected level of GHG emissions reductions (or removals) will occur, and that these emission reductions would not have happened without the GCF-funded activity.

Building the climate rationale for adaptation activities

Provide an evidence-based analysis to show that a proposed activity is likely to be an effective adaptive response to the risk or impact of a specific climate change hazard.

1. **Identification:** Adaptation proposals should show how the activity addresses current or future projected climate change risk or current impact for target region, community group, and why it is likely to be an effective response (use of e.g. vulnerability assessments to demonstrate vulnerabilities of targeted communities.

2. **Response:** Proposals should explain how the activity will reduce the exposure and/or vulnerability (of people, systems, or ecosystems), justify the activity compared to others and thus lessen the climate change risk or impact considering barriers as well and how the project will overcome them. A methodological approach for the quantification of the number of beneficiaries expected to result from the activity should be included as well.

3. **Alignment:** Proposals should confirm alignment of the proposed activity with the host country's national plans and climate strategies (including their NAPs, NAPAs, long-term climate strategies, and adaptation communications including those submitted as components of NDCs, as applicable).

4. **Monitoring and evaluation:** Projects with a well-designed theory of change are more likely to result in successful outcomes that can be measured and evaluated.

IDENTIFICATION KEY ISSUES

- **What are key vulnerabilities of the target group and region?**
- **What is impact for a target group and region?**
- **What is the current risk?**
- **What is the future projected risk?**
- **What is an effective response?**

LET'S FIRST CHANGE THE ORDER A BIT!

- **Identification:** addresses current or future projected climate change risk or current impact for target region, community group, and why it is likely to be an effective response (use of e.g. vulnerability assessments to demonstrate vulnerabilities of targeted communities.

RESPONSE KEY ISSUES

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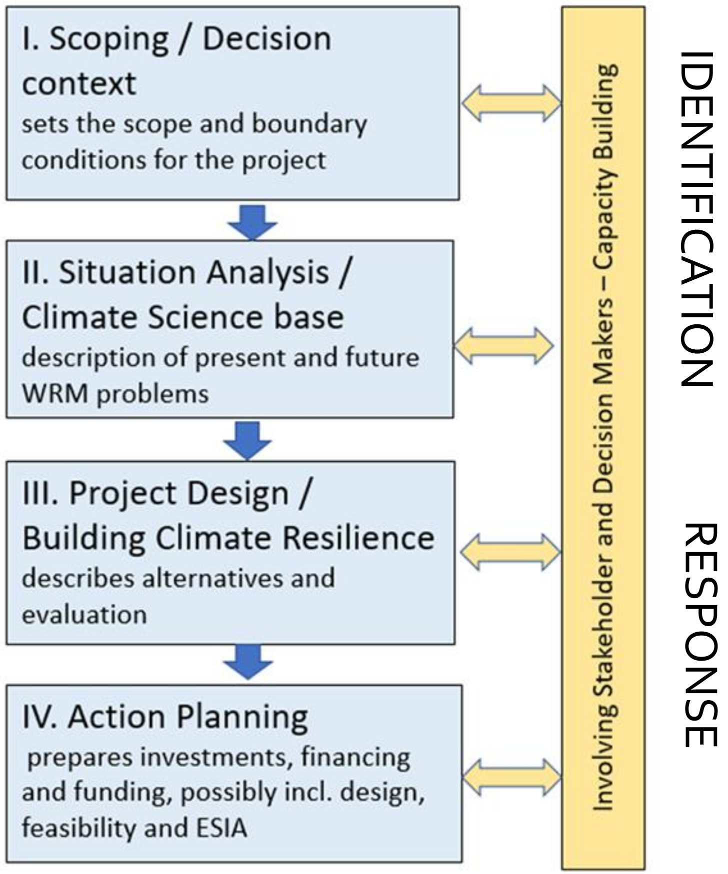
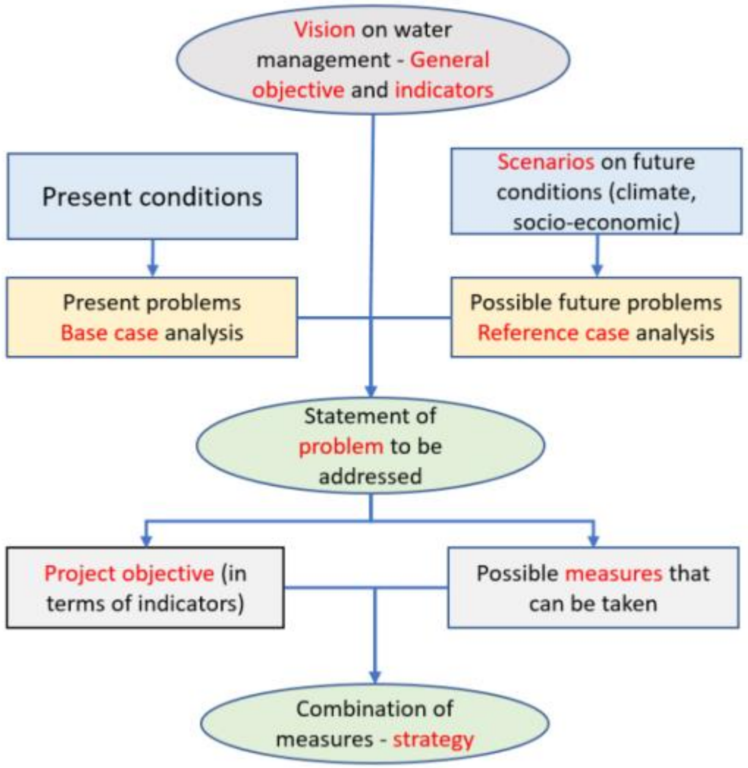
- **How is the proposed intervention/activity going to reduce exposure and vulnerability of people, (eco)-systems to CC?**
- **How to compare different alternatives and justify one over another? Based on:**
  - **Climate risk reduction**
  - **Tradeoffs and Benefits**
  - **Barriers for implementation**
- **How to overcome these barriers**
- **How many beneficiaries can be reached?**

Response: Proposals should explain how the activity will reduce the exposure and/or vulnerability (of people, systems, or ecosystems), justify the activity compared to others and thus lessen the climate change risk or impact considering barriers as well and how the project will overcome them. A methodological approach for the quantification of the number of beneficiaries expected to result from the activity should be included as well.

Analytical approach from the guideline – comparison of the situation with and without CC, and with and without measures





KEY topics this training

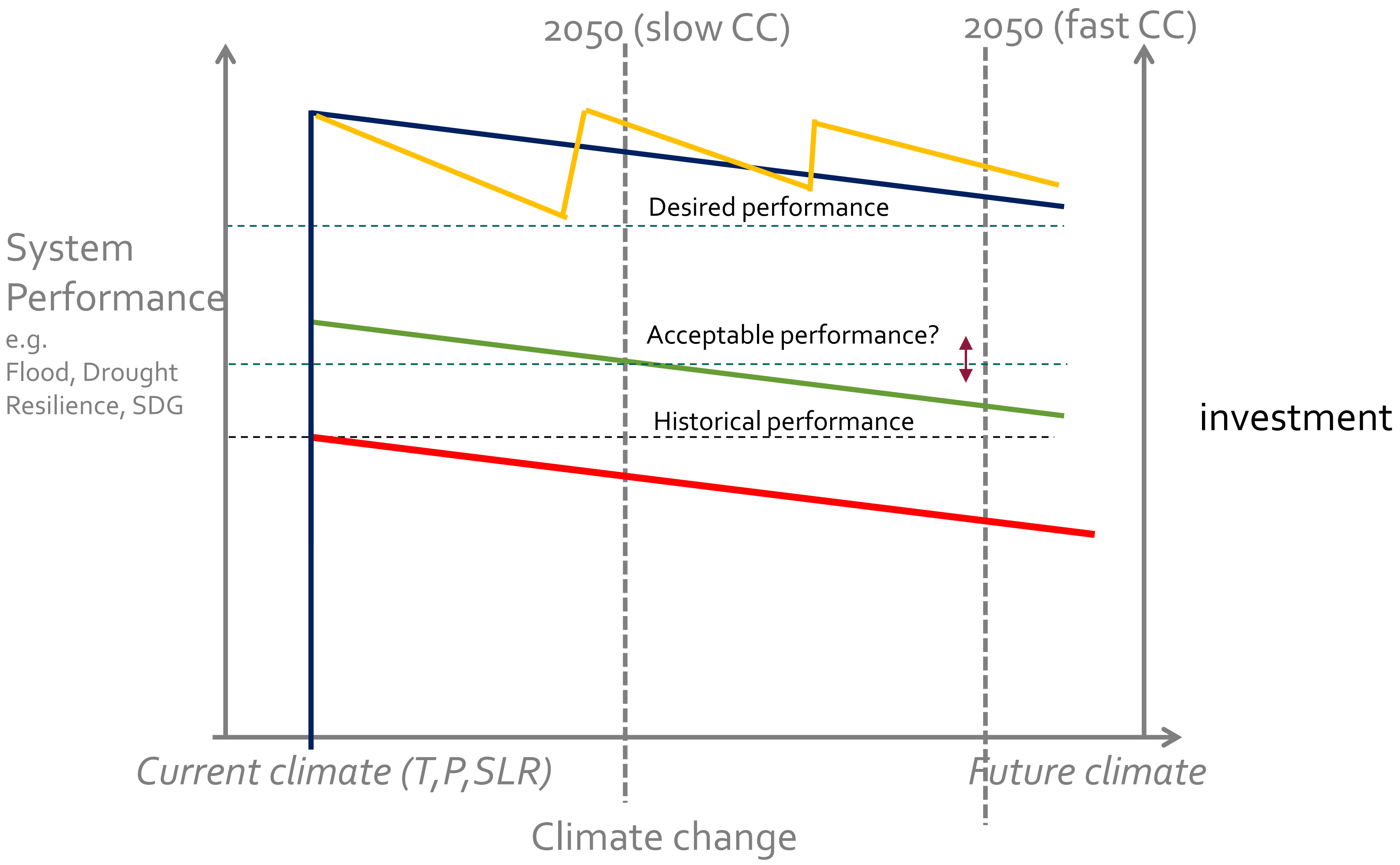
IDENTIFICATION

- Scoping using system and or risk analysis
- Address climate uncertainty in analysis and strategy building
- Choosing the relevant decision metrics that link climate with water management and policy objectives.
- How to use knowledge, data, models for the analysis

RESPONSE

- Choose measures that reduce main drivers of risk and lead to systemic improvements
- How to define low regret action
- How to compare alternative options

EFFECTIVE RESPONSES TO CC SIMPLY CANNOT BE CONSIDERED SEPARATELY FROM DEVELOPMENT



Desired performance is meeting SDG under climate **variability** + change

Note: **Historical performance** not necessarily = acceptable performance

Many factors among which **climate variability** affect performance

1. MAKE A GOOD START TO DEVELOP A CLIMATE RATIONALE

- Scoping using system- and risk analysis
- Define key uncertain drivers for risk and vulnerability, and choose the right climate variables, scenarios and events for identification of impacts
- Choosing the relevant decision metrics that link climate with water management and policy objectives.

TAKE A SYSTEMS AND A RISK PERSPECTIVE FOR YOUR ANALYSIS

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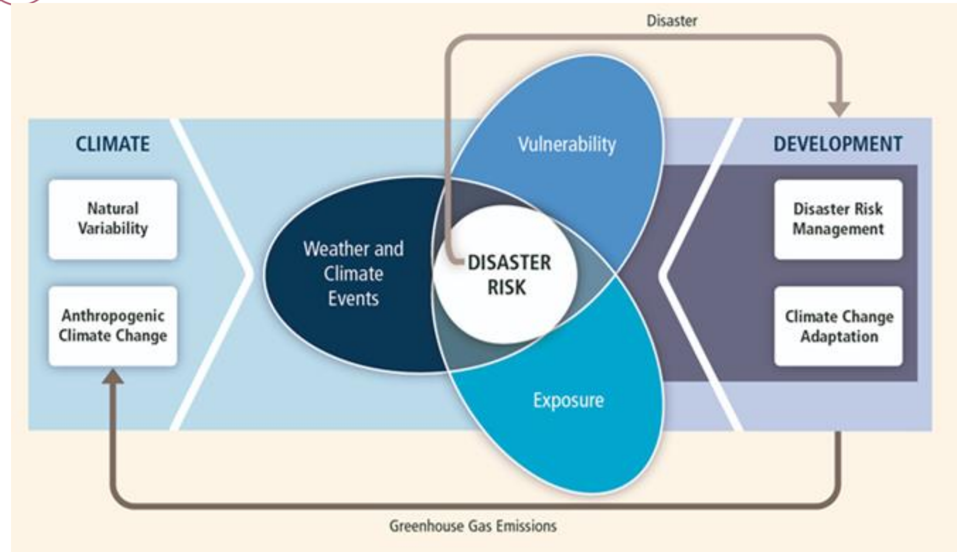
- **System analysis** will enable you to understand and weight complex relationships and interaction within systems – ultimately between CC and society.
  - ➢ Often associated with water resources management and Ecosystem based approached
- **Risk analysis** will enable you to understand root causes and assess impacts of various extreme events using a probalistic framework.
  - ➢ Often associated with disaster risk management, infrastructure design, safety regulations

❖ Both are often combined in analyses supporting proposal development and are key to identify where and how to adapt

- Water conservation, efficiency and reuse
- Hydrological observation, forecasting & risk assessment
- Integrated Water Resources Management (IWRM) & SDGs
- Ecosystems-based approach
- Climate resilience and WASH
- Community knowledge

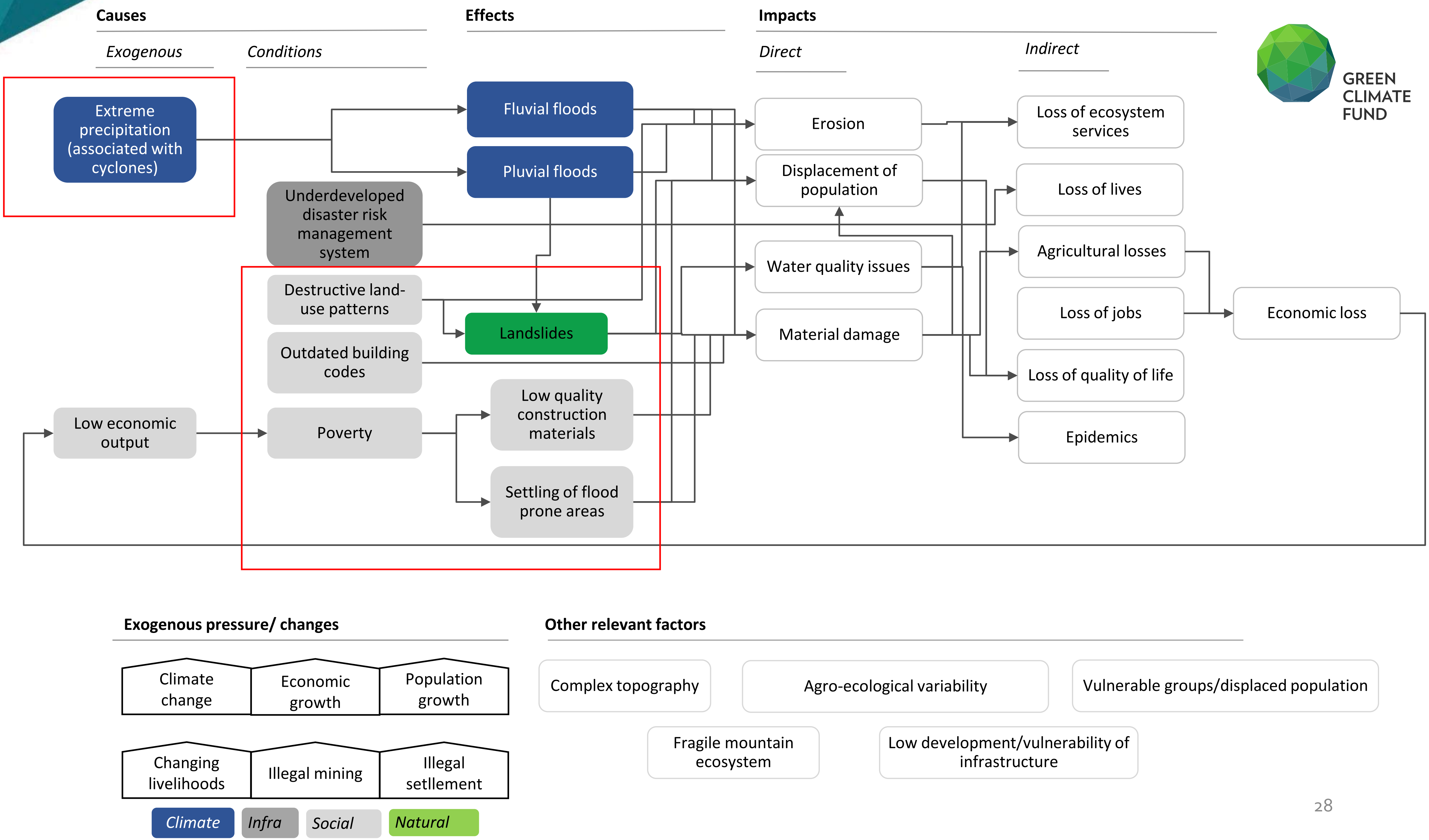


Risk = Probability x Exposure x Vulnerability
of climate
hazard

HOW TO DESCRIBE YOUR SYSTEM?

- Establish causal relationships (tables, chains, loops)
- Do this collaboratively
- Make use of local knowledge, experts and previous studies
- Some examples how this can be done…

GCF Subsector	Climate hazard	System state change	Impact	Potential Responses
Drought	Lack of groundwater recharge due to less rainfall	Lowering of groundwater table Lack of water storage for dry season	Declining yield, nature values, urban water shortages	Increase upstream natural storage and infiltration, MAR



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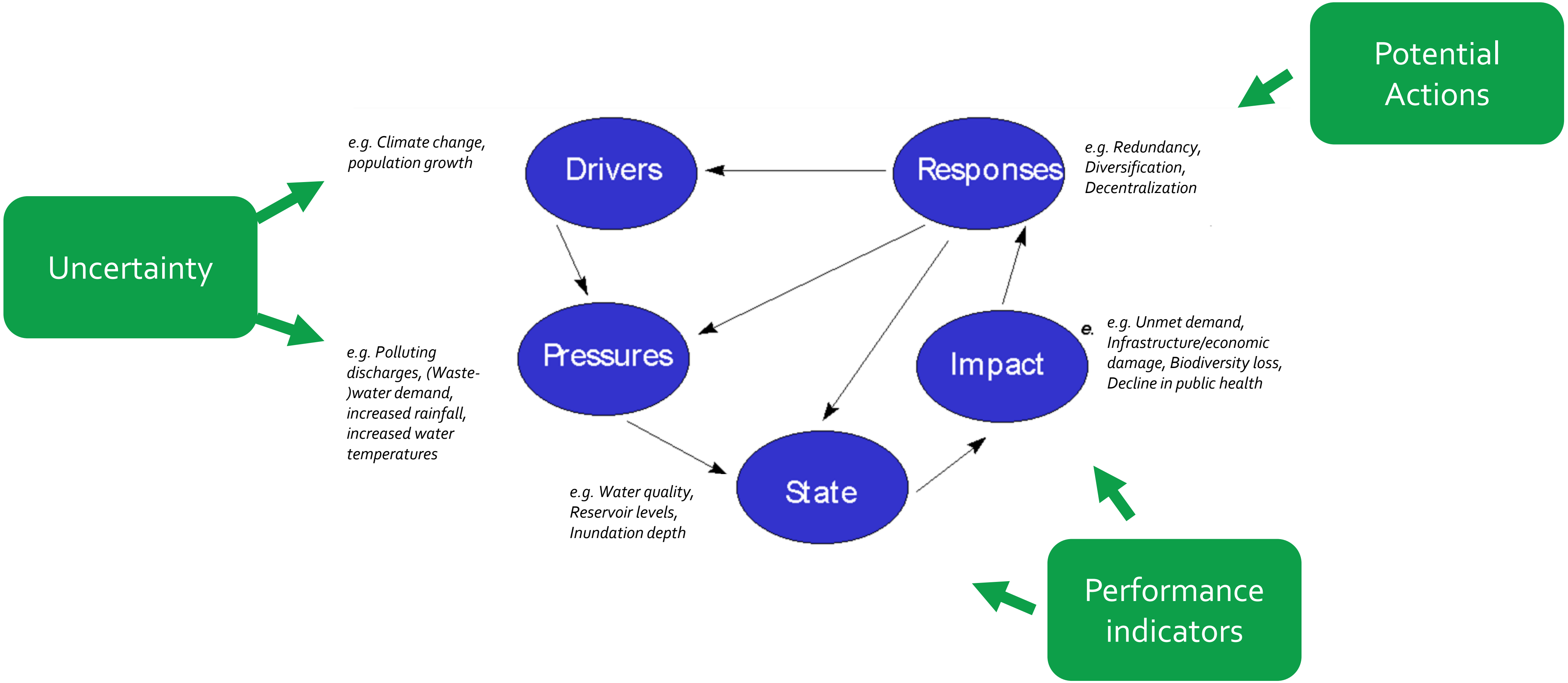
HOW TO DESCRIBE YOUR SYSTEM?



HOW TO DESCRIBE YOUR SYSTEM?

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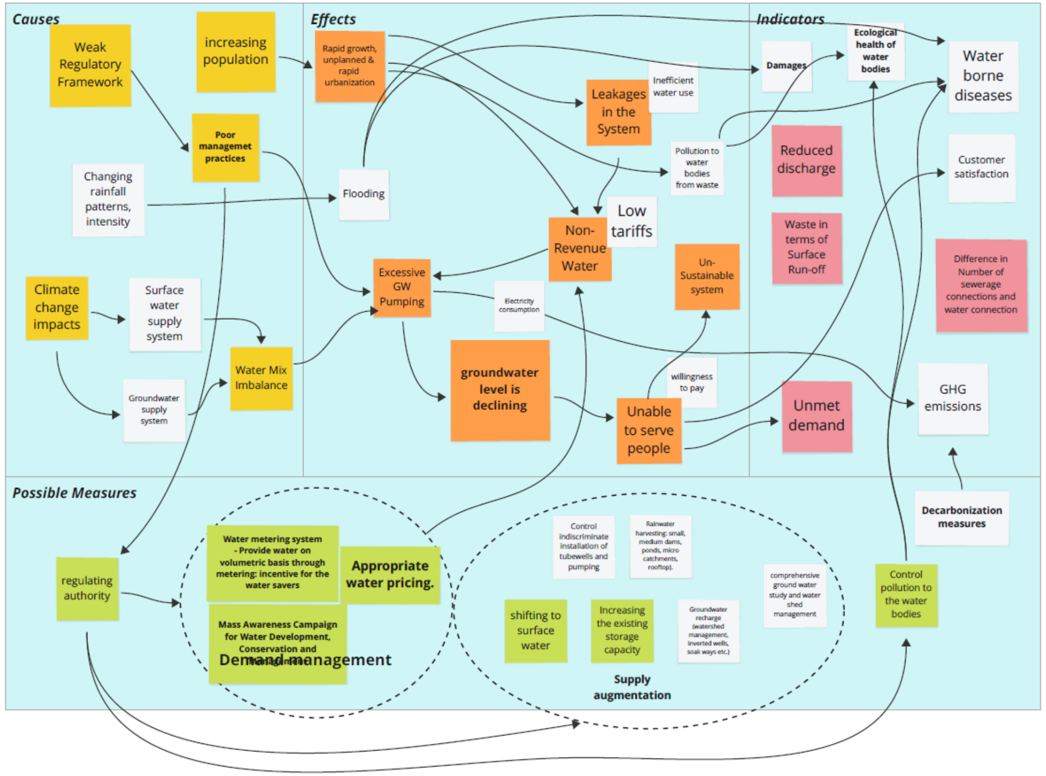

CHOOSING PERFORMANCE INDICATORS FOR IMPACT ASSESSMENT AND MONITORING

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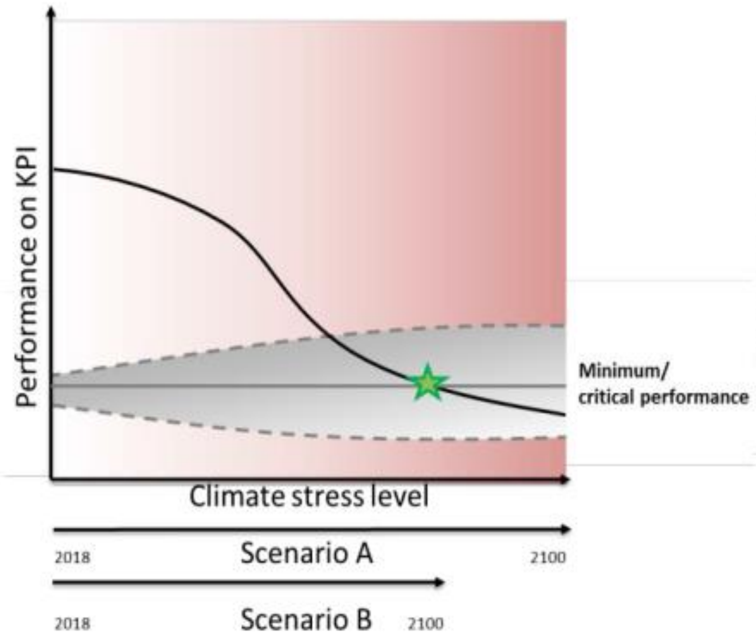
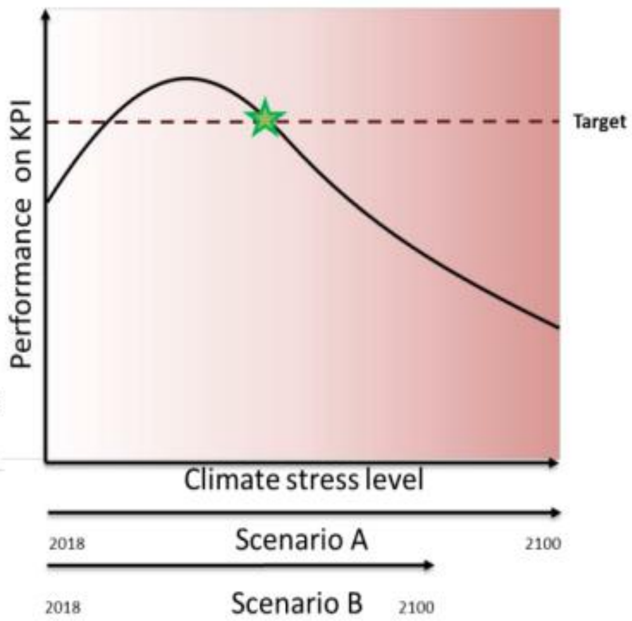
- Direct vs indirect impacts
- Measurable quantifiable vs qualifiable impacts
  - What can we measure/model? (e.g. System state? Direct impacts?)
  - What does this tell us about impacts we may not be able to measure? (e.g. indirect impacts)
- Choose a SMART, comprehensive and complete set e.g.
  - Water level, unmet demand, #people (of different vulnerability class) affected, direct damage, time of service interruption, *indirect damages*, *employment*, *GDP*
- Mainstream with national level KPI's and monitoring and or SDG

PERFORMANCE THRESHOLDS

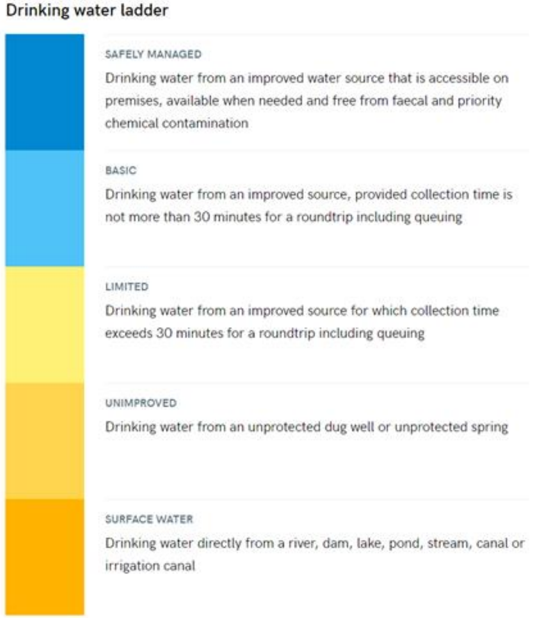
- At what level of impact is your livelihood/environment/sector severely affected, beyond its ability to recover?
- Which variables we can use to characterize the system performance (described by the system diagram) as a proxy to the full complexity of interactions.

How to define performance indicators and thresholds





EXAMPLE FOR WASH



Risk drivers

Climate change and sea level rise, leading to drought, floods and water quality hazards

Population growth, increase demand for WASH, increased hazard exposure and Rural to urban migration.

Economic growth increase demand for WASH, increased hazard exposure, development opportunities

Impacted systems and objectives

Sustainable ecosystems, Ecosystems based planning

Integrated flood risk management and IWRM

Sustainable water resources

Resilient WASH infrastucture

Equitable WASH services
KPIs1-4

Compounding factors

Ecosystem degradation,

Insufficient planning

Unplanned development

Land filling practices

Overexploitation of resources

Pollution

Ageing infrastructure

Insufficient operation and maintenance

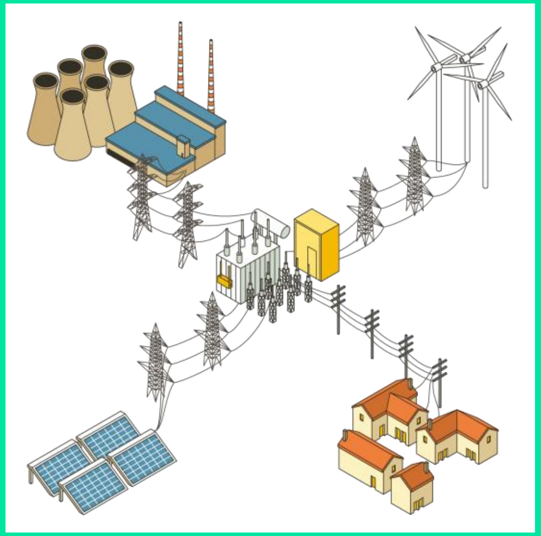
EXAMPLE DROUGHT RISK MANAGEMENT

Table 7: Example of objectives of drought risk management with associated metrics

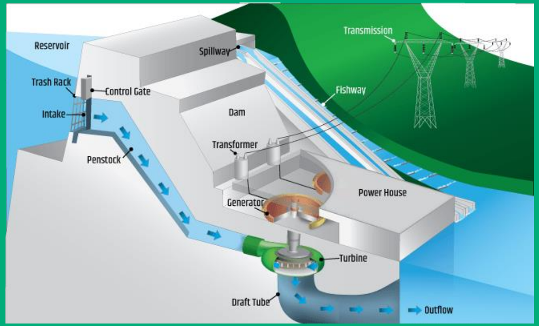
Objectives of drought risk management	Associated metrics
Improve local - regional food security	agricultural yield reduction, communities/people with access to food and water etc.
Improve the functioning of critical infrastructure under droughts, i.e., drinking water supply, energy supply	reliability of services, storage in reservoirs etc
Improve economic functioning under drought	direct damage to water-dependent economic production (e.g., production crops), economic damage to sectors, to export, to regional GDP, etc.
Improve emergency preparedness and response.	number of people affected, casualties but also the number of people reached by the early warning.

Resilience of what against what?

3. **Grid** can cope with and recover quickly from shocks in service delivery (e.g. blackouts)



2. **Facility** can cope with and recover quickly from shocks in service delivery (e.g. flooded facility, cyber attack)

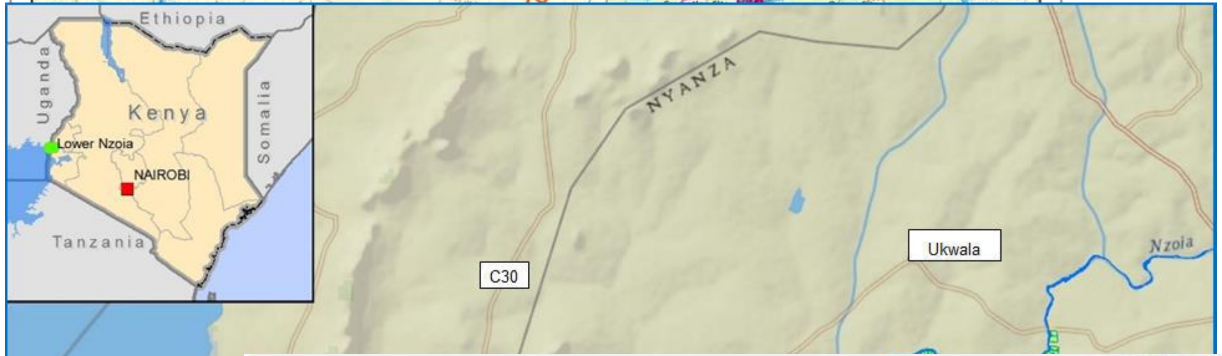


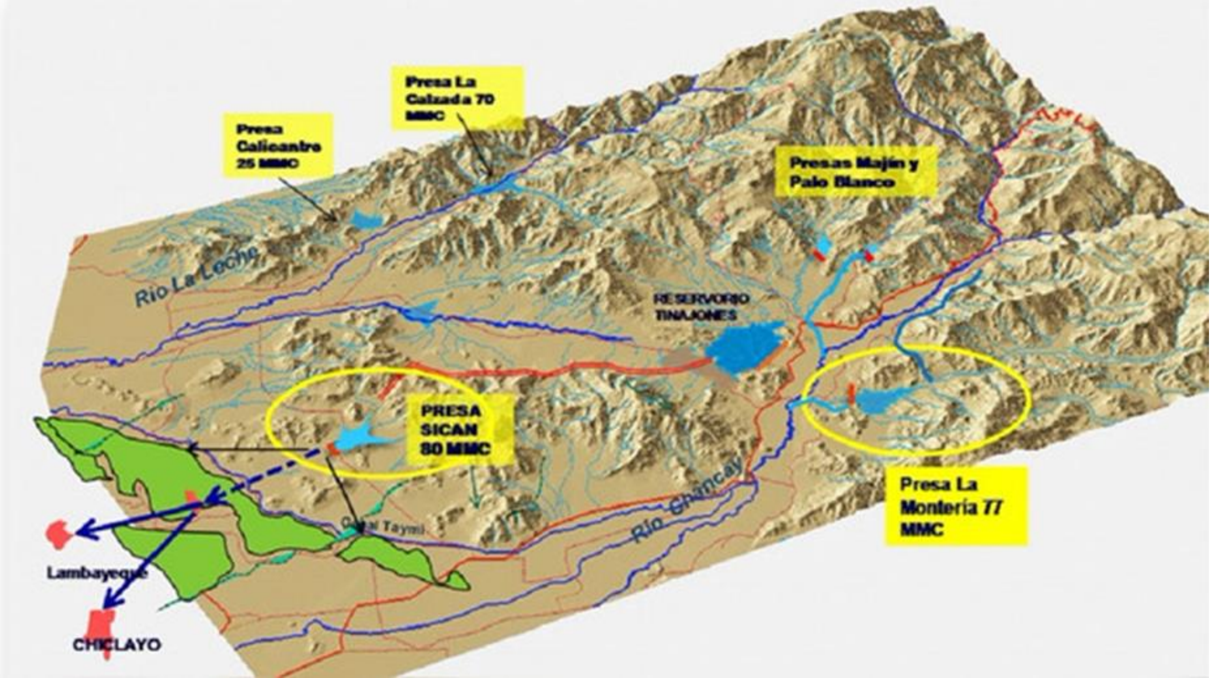
1. **Component** can cope with and recover quickly from shocks in service delivery (e.g. transformer failure, turbine failure)

System boundaries need to be defined clearly to <u>specify and prioritize</u> decision context and evaluate project performance, both in terms of level of complexity and project area

Deltares

Three projects with increasing complexity





The **Kabeli A Hydroelectric Project (KAHEP)** is a proposed peaking run-of-river hydropower project with an installed capacity of 37.6 MW.

The **Nzoia** irrigation and flood protection project

The **Chancay-Lambayeque** river basin management plan

Deltares

THE WORLD BANK FutureWater UNIVERSITY OF Cincinnati

Purpose of the 3 projects

- **Kabeli:** Hydropower production (NPV)

- **Nzoia:** providing irrigation services (Crop yield) and offering flood protection (Avoided damage) -> IRR

- **Chancay-Lambayeque**:
  - Irrigation water supply reliability (aggregated across all demand nodes)
  - Domestic water supply reliability (aggregated across three principal towns)
  - Flood protection (peak discharges over the threshold at the specified locations)

Deltares

Risk management options

- **Infrastructure level**
  - Expand levees
  - Set back levees
  - *Add dams for flood control (upstream)*
  - *Erosion prevention (upstream)*
  - *Sediment management (downstream)*
- **Sector level**
  - Shelters, early warning
  - Flood proofing, zoning
- **Community level**
  - Risk transfer, insurance
  - Investments that strengthen income

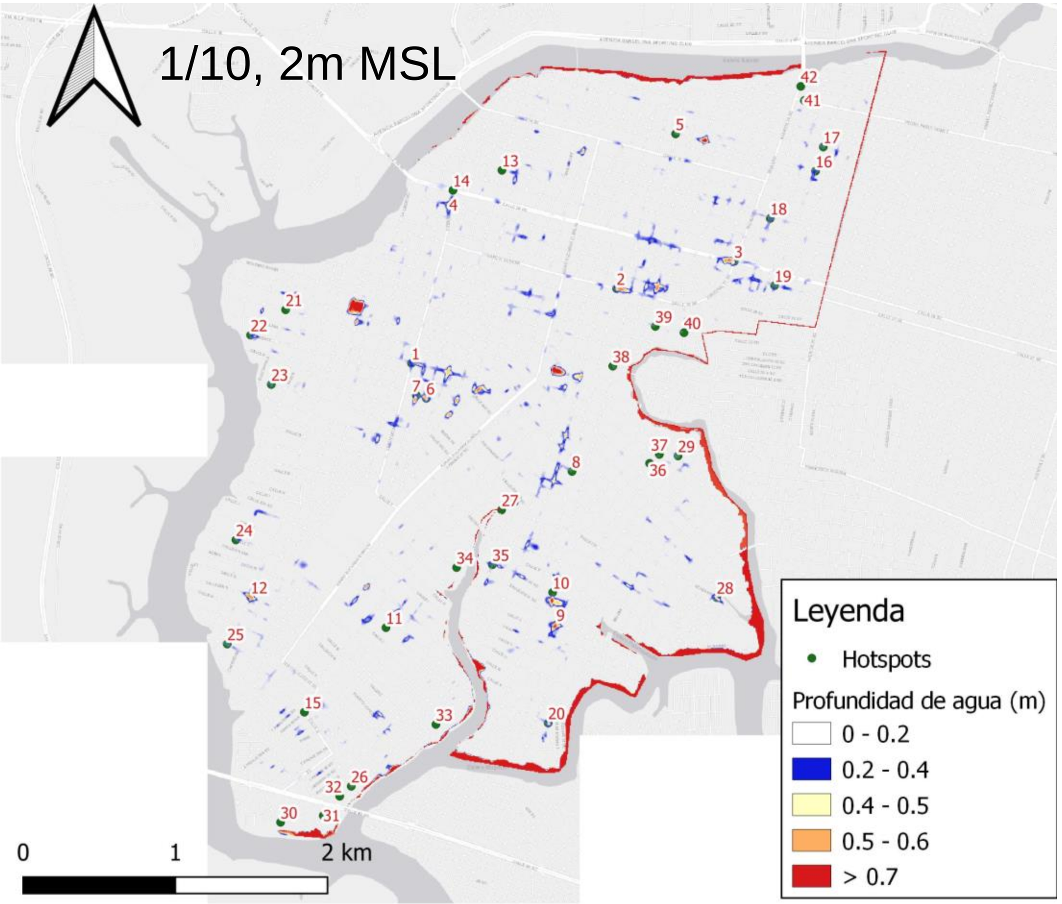
Flood protection → FRM

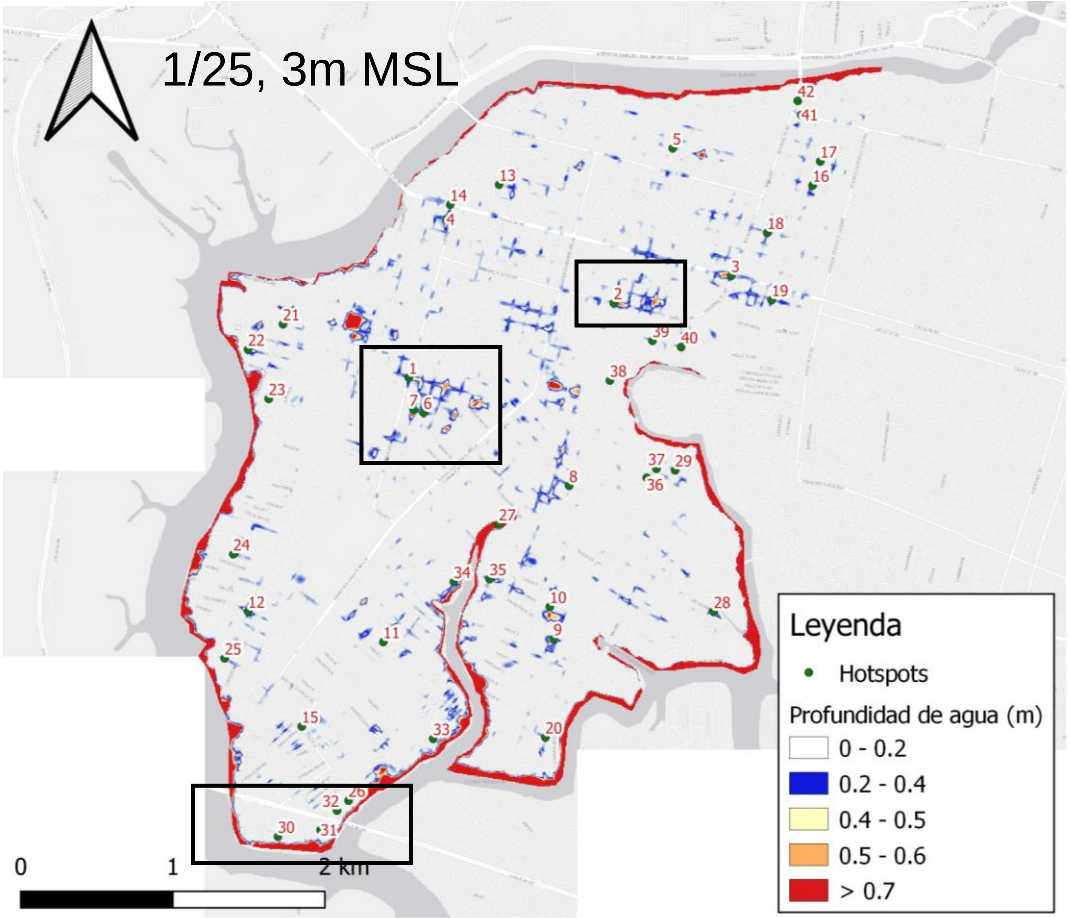
- **Infrastructure level**
  - Improve irrigation efficiency
  - Improve local storage capacity
  - *Add dams for storage (upstream)*
  - *Green Infrastructure (upstream)*
- **Sector level**
  - Change crop patterns
  - Rain water harvesting
  - Pricing, subsidies, insurance
- **Community level**
  - Risk transfer, insurance
  - Investments that strengthen income

Irrigation → Rural development

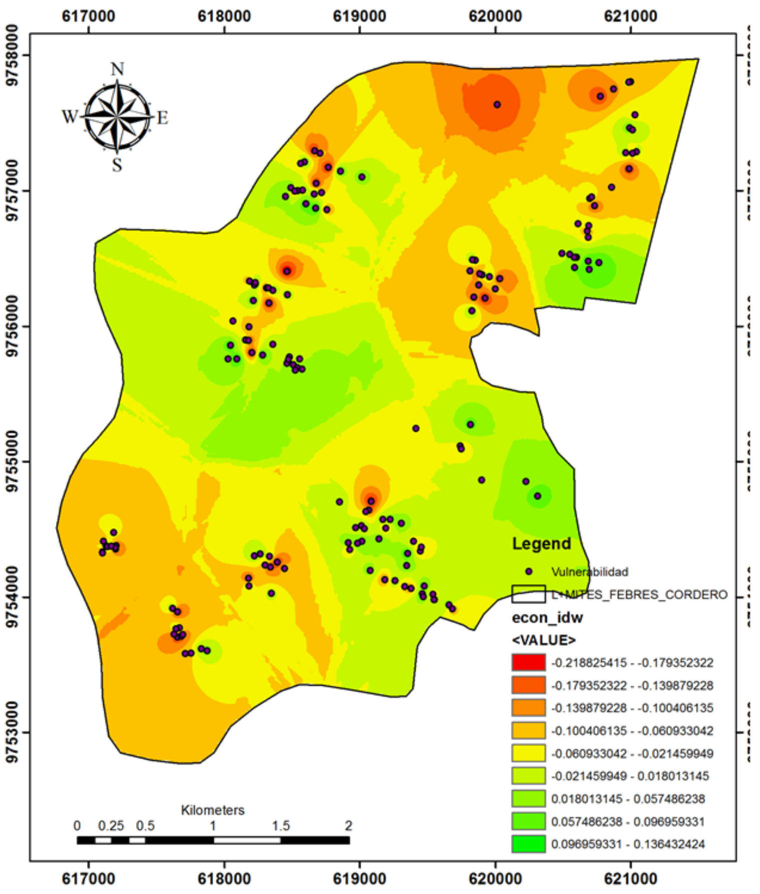
Deltares

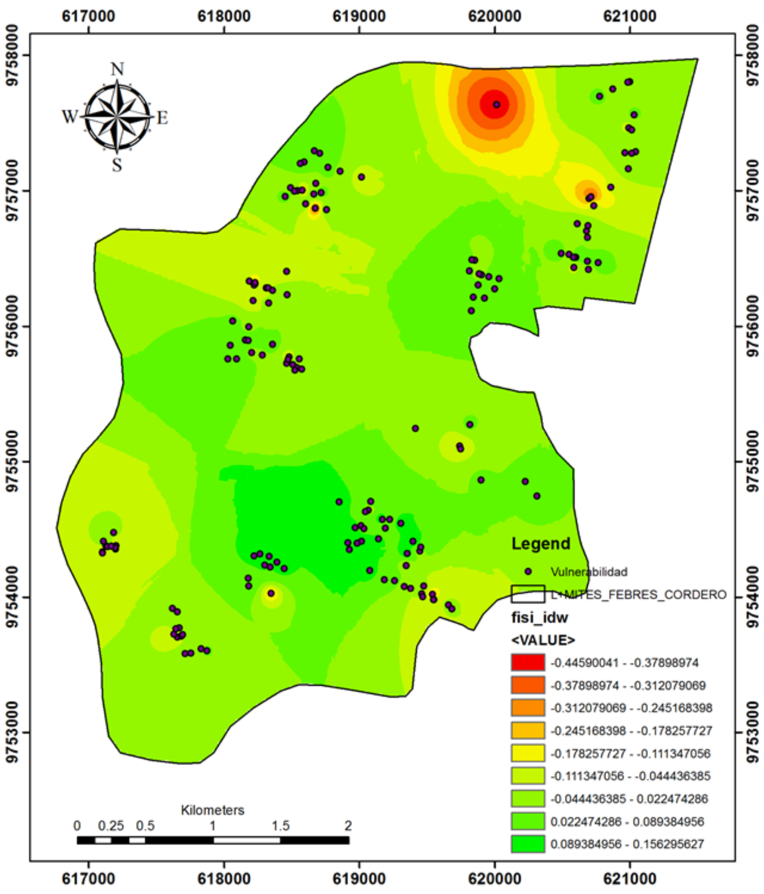
Example of a risk based approach:
Hot spot selection using design events and vulnerability – exposure to recurrent flooding

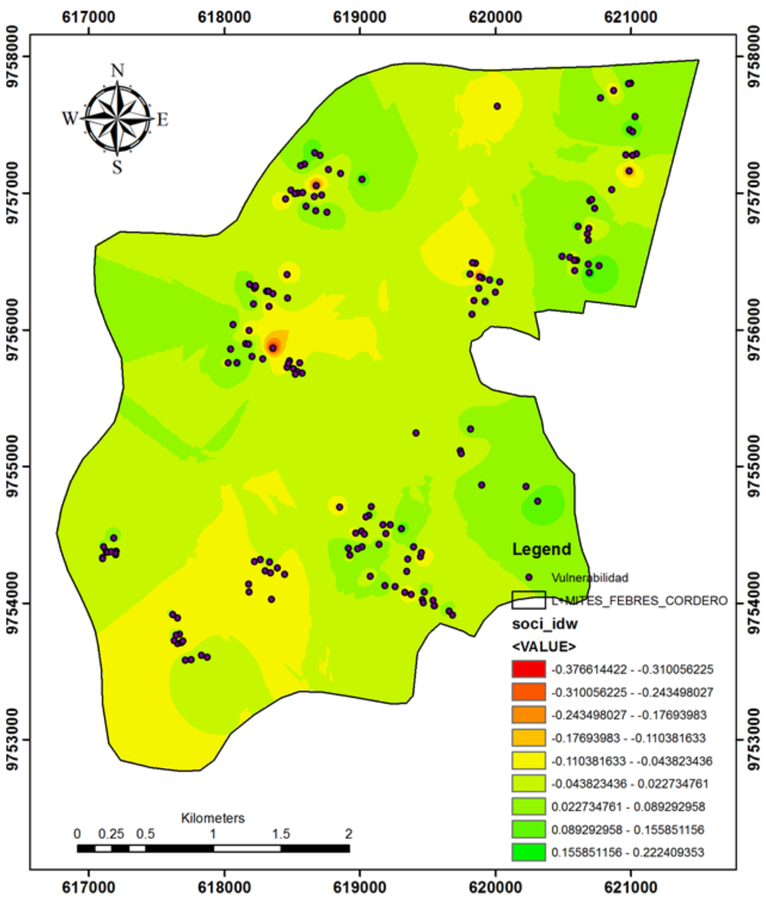




Physical, Economic and Social vulnerability based on questionaires







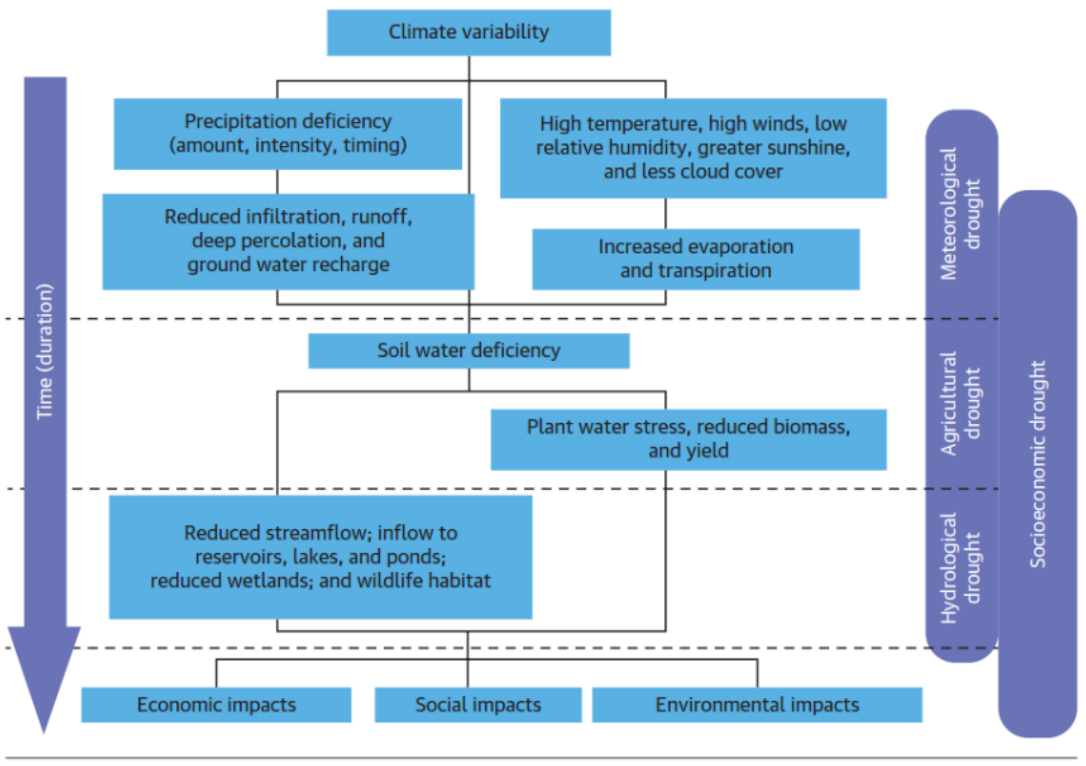
SVI layer credit to Selena Hinojos of George Washington University

Deltares

CHOOSING CLIMATE EVENTS THAT MATTER TO ASSESS CURRENT AND FUTURE IMPACT

- **Events matter** - Adaption response is not to a statistical change but to a experienced or anticipated (plausible) event
- What are climate events or **parameters of consequence**?
  - For the given context
  - Weather extremes instead of averages
    - 5-day precipitation total vs Average Annual precipitation
    - Peak water level vs Mean sea level
    - # Hot days > 30 deg.C vs Average monthly temperature
    - Consecutive dry days/months/years

Figure 5: Definition of meteorological, agricultural and hydrological droughts

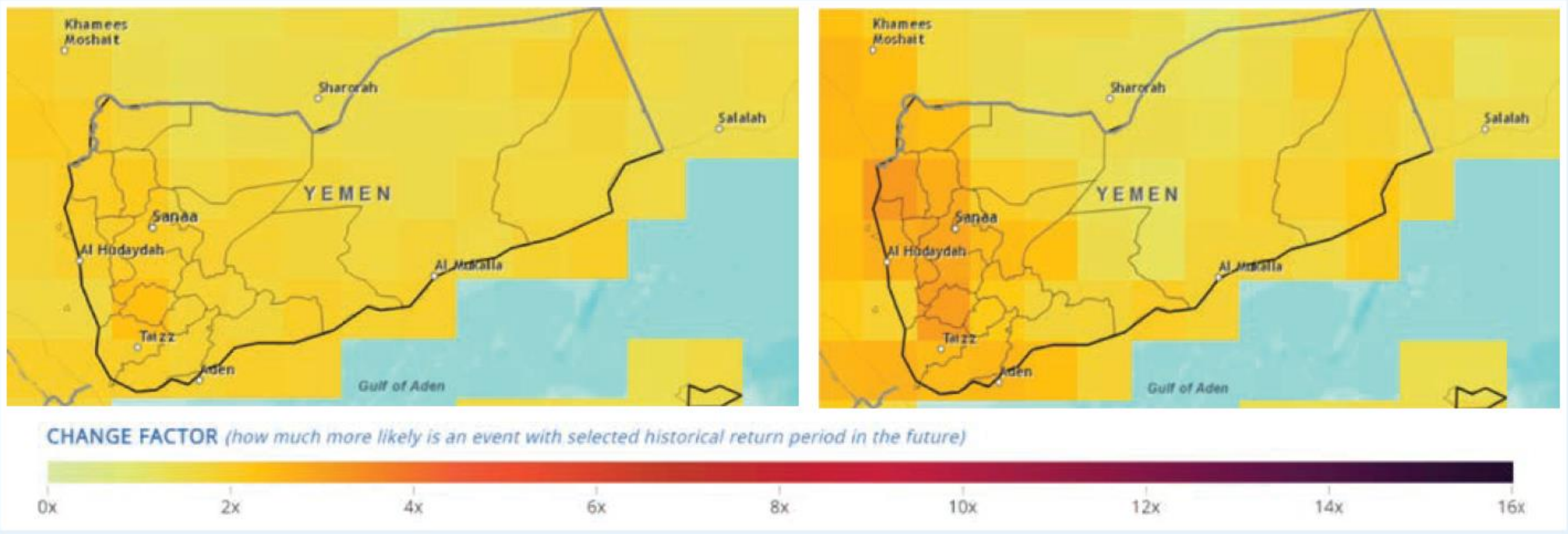


Source: WMO 2006.

ADAPTATION IS ABOUT DEALING WIT EXTREMES

FIGURE 7A. Change in Annual Exceedance Probability of Largest 5-Day Cumulative Precipitation, 10-Year Event (SSP3-7.0, 2035–2064, Center 2050)

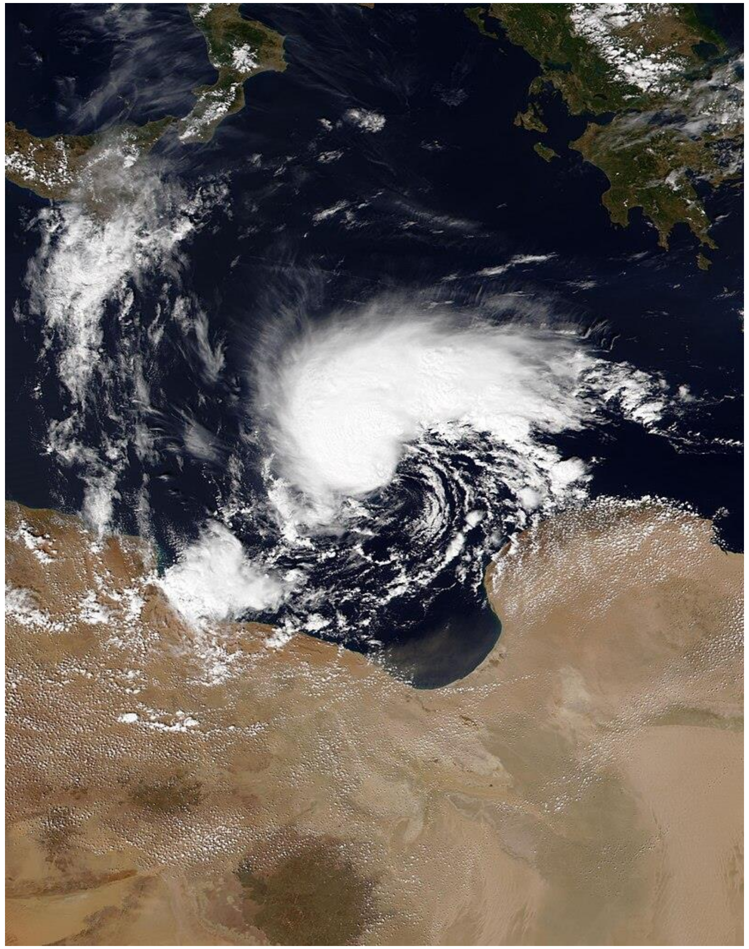
FIGURE 7B. Change in Annual Exceedance Probability of Largest 5-Day Cumulative Precipitation, 50-Year Event (SSP3-7.0, 2035–2064, Center 2050)



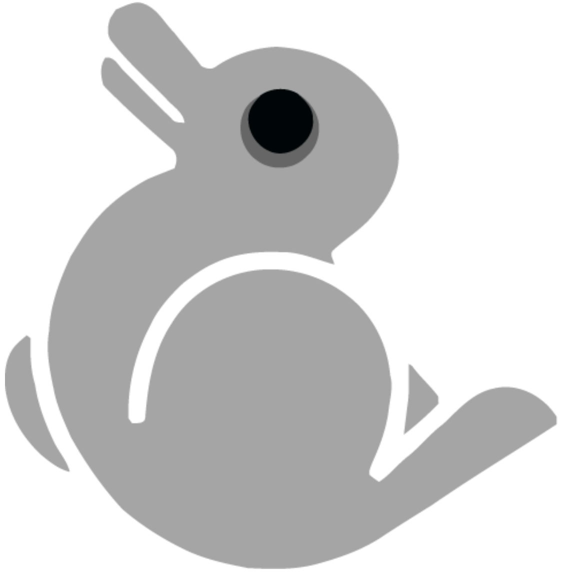
ADAPTATION IS ABOUT DEALING WITH (UNEXEPECTED) EXTREME EVENTS

- Storm Daniel is 50 times more likely due to climate change….
- can we say in hindsight
- What can we do in foresight?

Heavy rainfall caused catastrophic flooding in Derna, northeastern Libya, on September 11, 2023. AFP/Getty Images

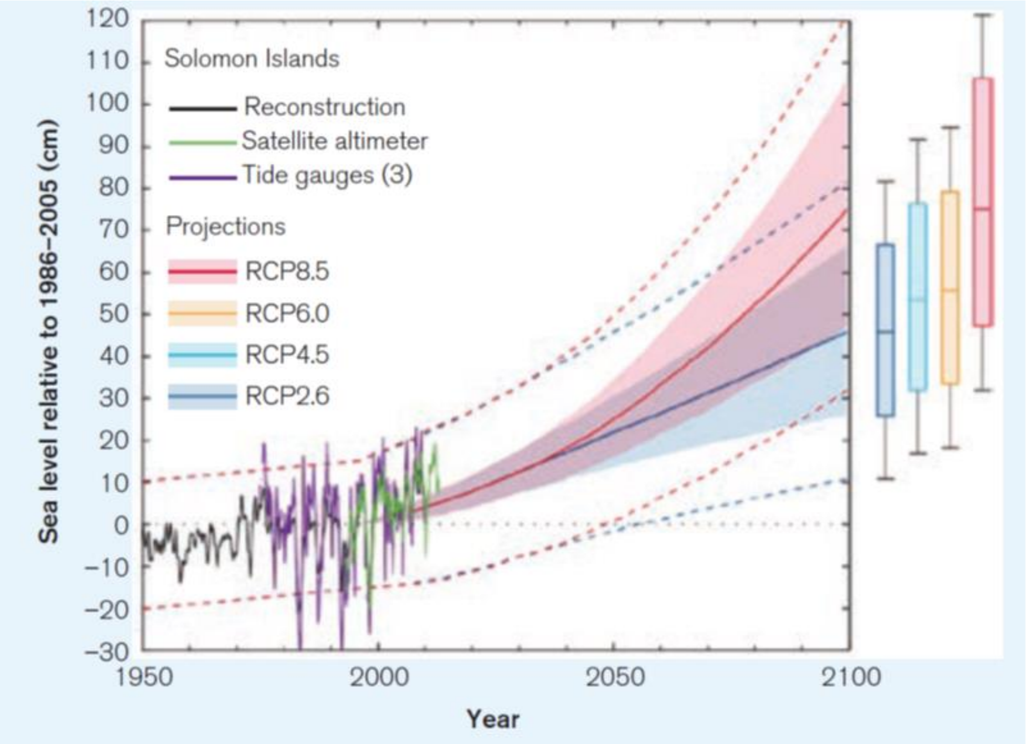


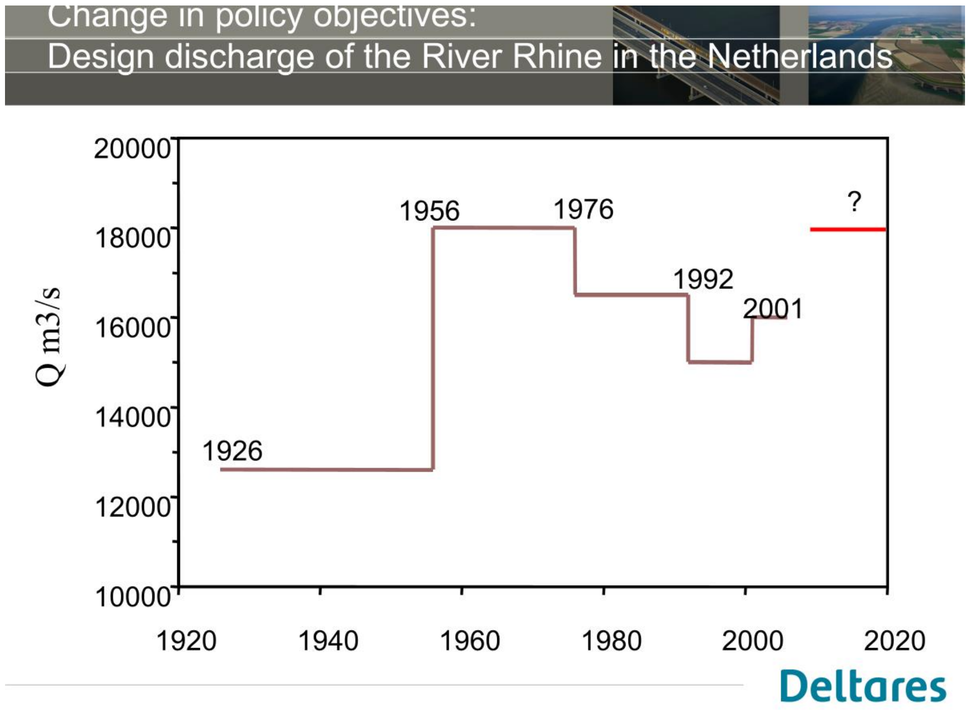
TYPES OF UNCERTAINTY

Unpredictability	Incomplete knowledge	Ambiguity
		
Cannot know	*Do not know (yet)*	*Knowing differently*

Types of uncertainty

- **Variability and Trends** - Climate change signal often difficult to detect locally
- Uncertainty in **demographics and economy**
- Uncertainty in **Policy objectives**





DECISION MAKING UNDER UNCERTAINTY

It's about:

- **informed decision making**
  → acknowledging uncertainties and building strategies to accommodate these
- Have the right discussion on what determines climate vulnerability
- bottom-up identification of **performance limits** (what plausible conditions lead to failure?)
- **minimizing regret**, maximizing **resilience** and **robustness**, while introducing **flexibility**

DISCUSSION EXERCISE

- Establish the causal relationships linking your country's/region's climate problems to its direct and indirect impacts
- Identify (measurable) indicators by which to measure these impacts. Select the 3 most important ones
- Are there any clear performance limits, critical thresholds that should not be surpassed?
- Summarise your climate problem(s) in the form of a simple narrative (to be shared with the group)

GCF Subsector	Climate hazard	System state change	Impact	Potential Responses
Drought	Lack of groundwater recharge due to less rainfall	Lowering of groundwater table Lack of water storage for dry season	Declining yield, nature values, urban water shortages	Increase upstream natural storage and infiltration, MAR

KEY TAKEAWAYS

- Improved system understanding helps to scope:
  - Which problems to prioritise and root causes to address
  - Which (prioritised) options you have available to address these problems. Which measures will have the greatest influence on system risks?
  - How you will measure the success
  - Potential knowledge and data needs to support the assessment of risks and options
  - Stakeholder input in the assessment – who to involve, when, and how

- **Do not** commence assessments without such understanding
  - To avoid wasted effort, resources, maladaptation, etc.

2. INJECTING CLIMATE SCIENCE INTO ANALYSIS

GREEN CLIMATE FUND

- Undertake quantitative assessments of **climate risks**, **effects**, **impacts** as well as potential **options** to manage these can be based on:
  - **Modelling**
  - **Data** on current and future hazards, exposures and vulnerabilities
    - Historic climate data
    - Historic hazard data
    - Local risk perceptions
    - Likelihood/plausibility of future climate impacts (via projections)
  - **Modelling** and **data** support potential options to manage risks, effects and impacts

CLIMATE SCIENCE BASE IS DIFFERENT PER GCF SUBSECTOR

GREEN CLIMATE FUND

IWRM: Climate Science base depends on project focus

- In case of balancing supply and demand: probabilities of low water availability (rainfall, river flow, etc.)
- Impacts and vulnerabilities

ICZM:

- (Multi-hazard) Risk assessment very important
- Impacts and vulnerabilities

WASH: Climate Science base depends on the project component (water supply network, sanitation, etc.)

- Analysis of historic WASH impacts with probabilities
- Prediction on how climate change will influence probabilities (and with that the extremes of the hazard)
- Analysis of exposure (what component of WASH will be impacted) and vulnerability (sensitivity and adaptive capacity)

Drought:

- Information on historical analysis of drought hazard and impact
- Extend with predictions on how climate change might influence the probabilities involved.

Flood management:

- Analysis of historic floods with probabilities
- Prediction on how climate change will influence probabilities (and with that the extremes of the hazard)
- Analysis of exposure (flood extend) and vulnerability (who will be impacted)

Sea level rise:

- Predictions of SLR to be taken from IPCC related sources
- Often to be combined with predictions on soil subsidence (mostly as result of groundwater withdrawal)
- Analysis of exposure (flood extend), vulnerability (who will be impacted) and displacement (coastal erosion)

ANALYSIS OF WATER RELATED HAZARDS

GREEN CLIMATE FUND

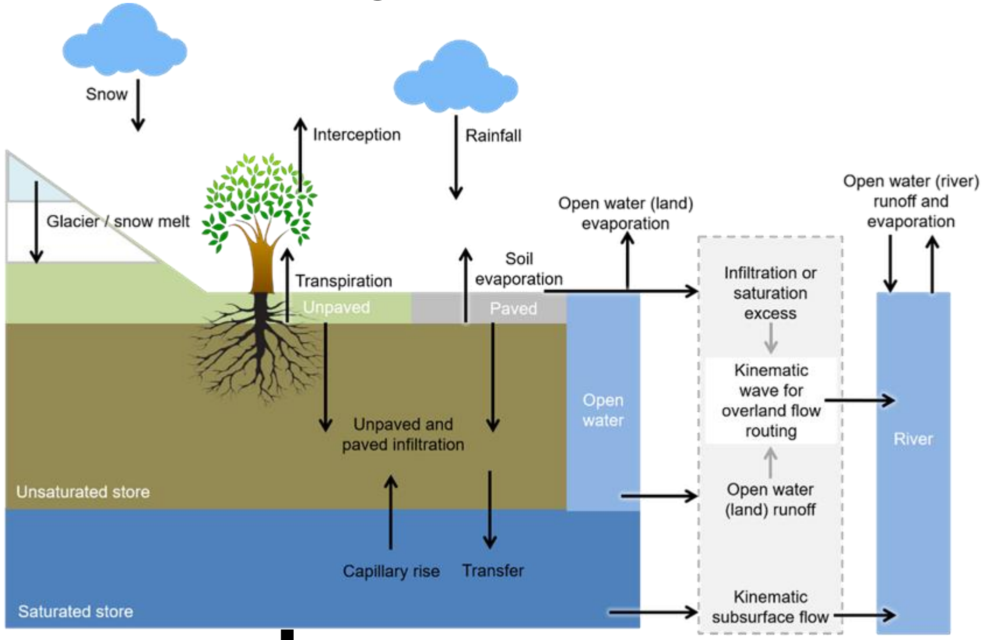
Historical climate

ERA5-data

Projected climate conditions

NASA-NEX-GDDP

Simulate hydrology response using wflow



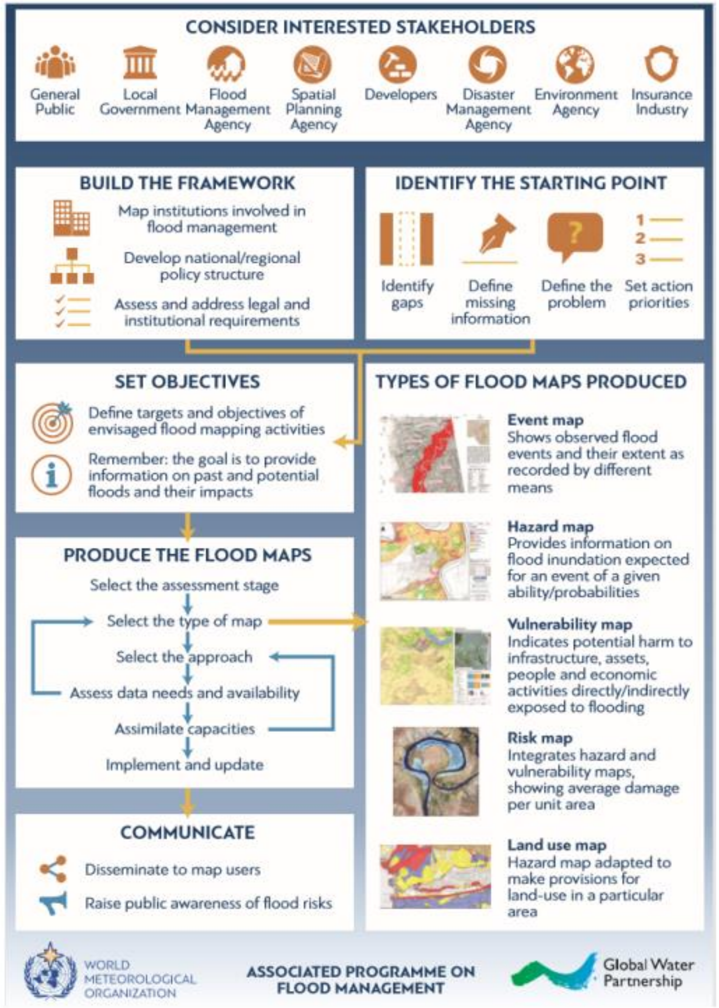
Issue	Proxy variable	Specific metric/statistic
Droughts/ water shortages	Daily stream flow at subcatchment level Daily groundwater recharge at gewog level	Changes in the duration, frequency, and severity of drought events. Drought threshold set to Q10 of daily 7MA of flow/recharge.
Extreme precipitation/ flooding	Daily precipitation at gewog level Daily stream flow at subcatchment level	Changes in the frequency of extreme rainfall and flow events (at 10 and 30 years return intervals)
Landslides	Proxy variables: Daily precipitation at gewog level	Changes in the 7-day accumulated precipitation amounts during the Monsoon season (JJASO)
GLOF	Daily temperatures	Change of area with permafrost
Hydropower	Proxy variables: Daily river flow at hydropower plant locations	Changes in annual, as well as dry and wet season means.

Hazard metrics

Calculate relative changes in risk under a changing climate

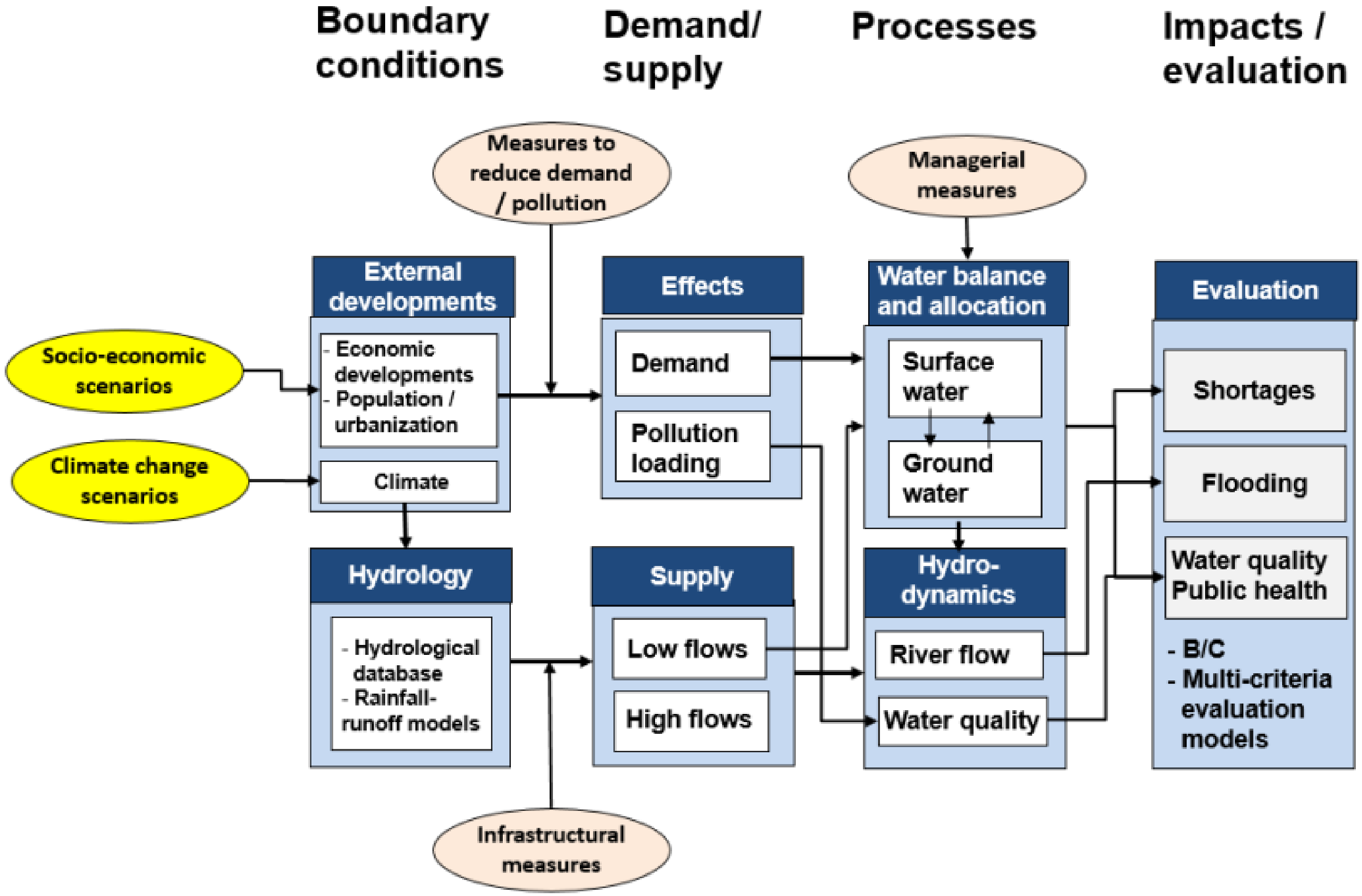
MODELLING FROM CLIMATE TO IMPACT

GREEN CLIMATE FUND



Source: Associate Programme on Flood Management

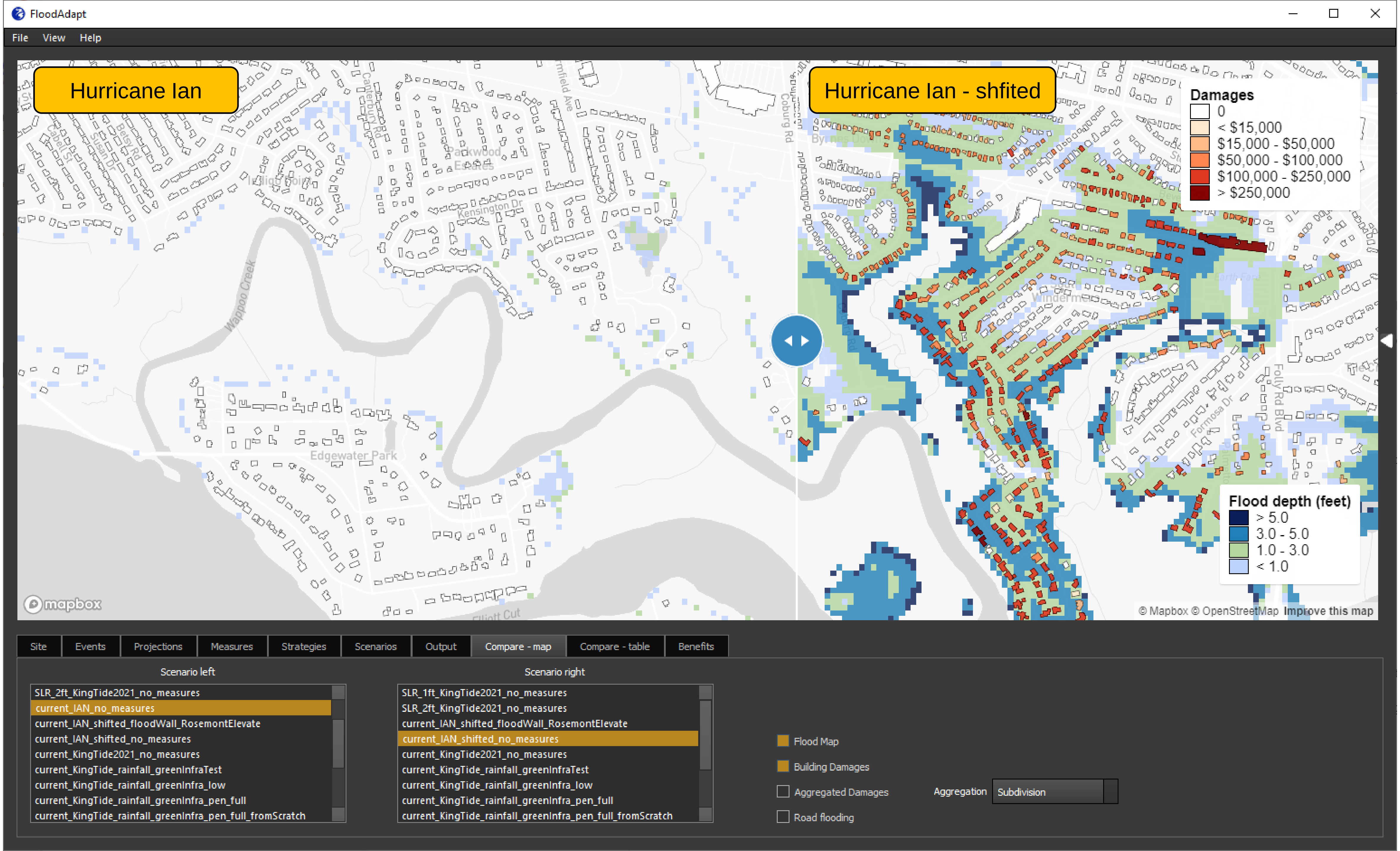
Figure 16: Illustrative integrated modelling approach for water resource projects



STEPS TO ASSESS CLIMATE RISKS

GREEN CLIMATE FUND

Understand historic weather-hazard vulnerability relation	Under what conditions did the system fail?
Select events that matter, synthesize analogues	How could these conditions also have looked like?
Perform stress test and map risks	Under what conditions will the system fail?
Use climate projections to assess plausibility of future risks	How likely is this to happen under CC?



FloodAdapt
File
View
Help
Hurricane Ian
Hurricane Ian - shfited
Damages
0
< $15,000
$15,000 - $50,000
$50,000 - $100,000
$100,000 - $250,000
> $250,000
Flood depth (feet)
> 5.0
3.0 - 5.0
1.0 - 3.0
< 1.0
Parkwood Estates
Kensington Dr
Wappoo Creek
Edgewater Park
Elliott Cut
Coburg Rd
Windermere
Formosa Dr
Folly Rd Blvd
mapbox
© Mapbox © OpenStreetMap Improve this map
Site
Events
Projections
Measures
Strategies
Scenarios
Output
Compare - map
Compare - table
Benefits
Scenario left
SLR_2ft_KingTide2021_no_measures
current_IAN_no_measures
current_IAN_shifted_floodWall_RosemontElevate
current_IAN_shifted_no_measures
current_KingTide2021_no_measures
current_KingTide_rainfall_greenInfraTest
current_KingTide_rainfall_greenInfra_low
current_KingTide_rainfall_greenInfra_pen_full
current_KingTide_rainfall_greenInfra_pen_full_fromScratch
Scenario right
SLR_1ft_KingTide2021_no_measures
SLR_2ft_KingTide2021_no_measures
current_IAN_shifted_floodWall_RosemontElevate
current_IAN_shifted_no_measures
current_KingTide2021_no_measures
current_KingTide_rainfall_greenInfraTest
current_KingTide_rainfall_greenInfra_low
current_KingTide_rainfall_greenInfra_pen_full
current_KingTide_rainfall_greenInfra_pen_full_fromScratch
Flood Map
Building Damages
Aggregated Damages
Aggregation
Subdivision
Road flooding

USE OF CLIMATE PROJECTIONS

- The only tool we have with some foresight capabilities
- Highly uncertain when it comes to precipitation extremes
- Some common practices to reduce this uncertainty is to use dynamic or statistical downscaling (increase resolution/reliability locally).
- Often dedicated limited ensembles are chosen that represents country's regional climate
- Best to use for deriving relative changes
- Main purpose is to **inform plausible changes** in impact and to derive **robust design** requirements for infrastructure and plans.

USING CLIMATE PROJECTIONS

GREEN CLIMATE FUND

- Recognise there is uncertainty that needs to be dealt with
  - Therefore, assess a range of future projections
    - Minimum 2 scenarios, and 4 GCMs; for SLR – include accelerated scenario
  - Which RCP scenarios are the most logical to use?
    - RCP 8.5 – Is it still logical to consider this when planning? Or for stress-testing only? RCP4.5 & 6.0 – Do these cover entire range of most plausible outcomes?
    - RCP 2.6 – Ideal scenario?
    - Climate sensitivity until 2050 higher than RCP ranges
- Use additional scientific knowledge (e.g. temperature scaling of rain intensity)
  - Water holding capacity of the atmosphere increases ~7-14% per deg.C.
- Is it plausible? - always expert judgment needed

POTENTIAL SOURCES OF DATA

- **Local** data sources – weather, water and hazard records, historic flood levels
- **Regional and national** data sources – national hydromet data, data on water use, groundwater tables. WRM, FRM plans, Studies, scientific papers, SDG reporting
- **Global** data sources – Climate reanalyses, satellite observations, climate models, climate data portals, global modeled data
- What if there is no data available?
  - Harness local knowledge: surveys,
  - interviews, storytelling, anecdotal evidence
  - Journal articles
- *Above can be seen as a decision tree on which data to use when*

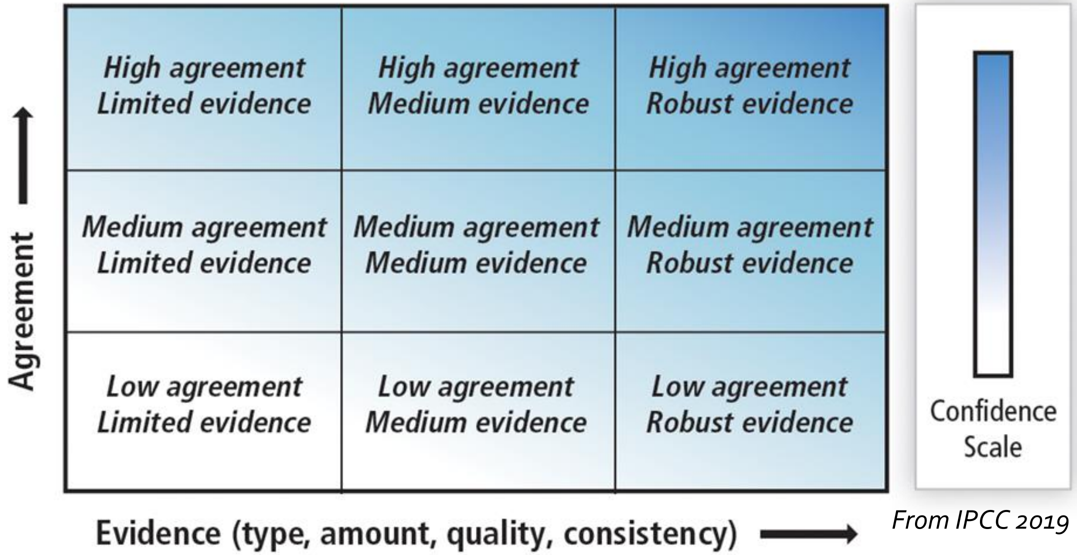
HOW TO PROVIDE EVIDENCE TO INCREASE CONFIDENCE AND REDUCE UNCERTAINTY

GREEN CLIMATE FUND

- combine multiple sources of information, at least:
  - Vulnerability data, historic hazard record
  - Historic weather (trend)
  - Future climate projection (ensembles)

And see to what extend there is agreement

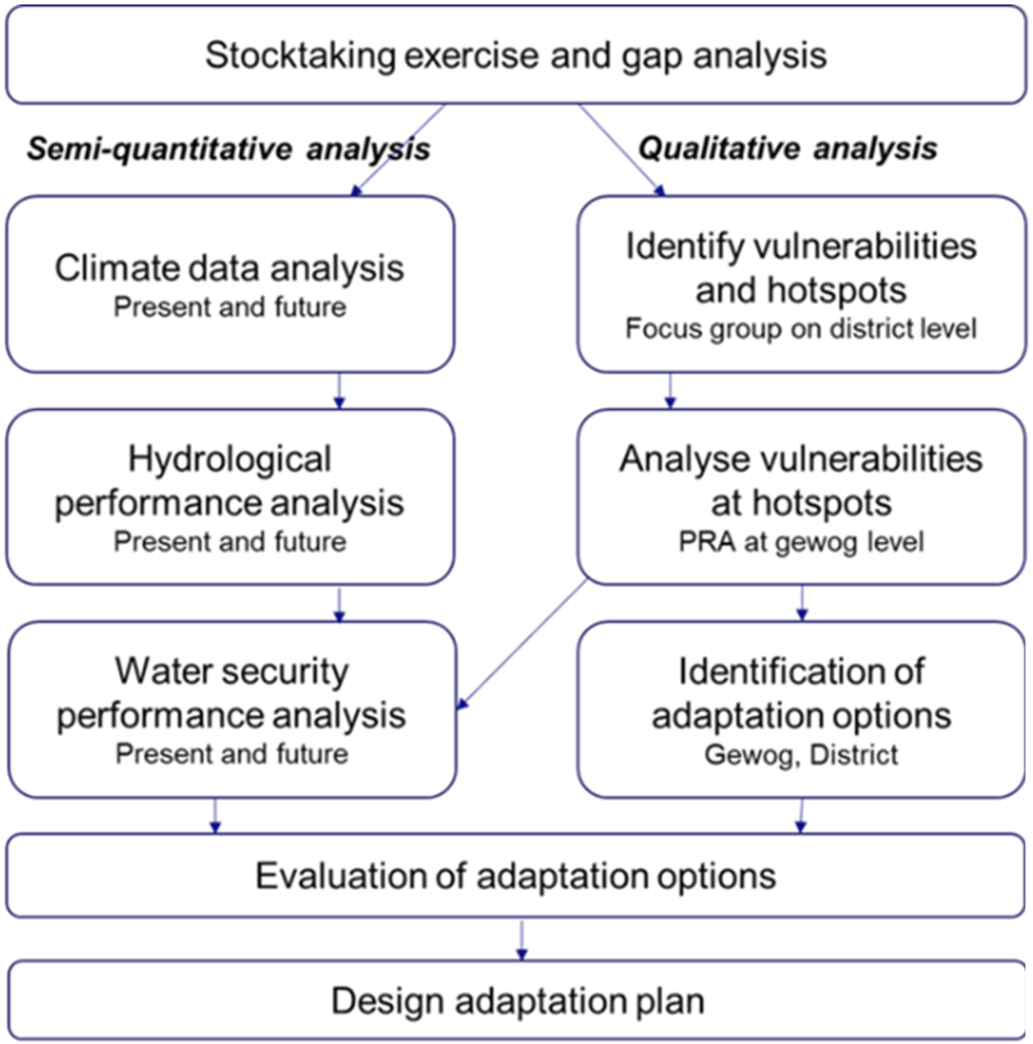
- Maximize quality and consistency by:
  - Include hydrological modeling
  - Extended historical weather analysis (in case of droughts)
  - Use regional climate projections, larger ensembles



From IPCC 2019

EXAMPLE BHUTAN WATER NAP

GREEN CLIMATE FUND



List of questions used for th
discussions to identify drink

Which are the areas in the Ge
water issues? (Please specify

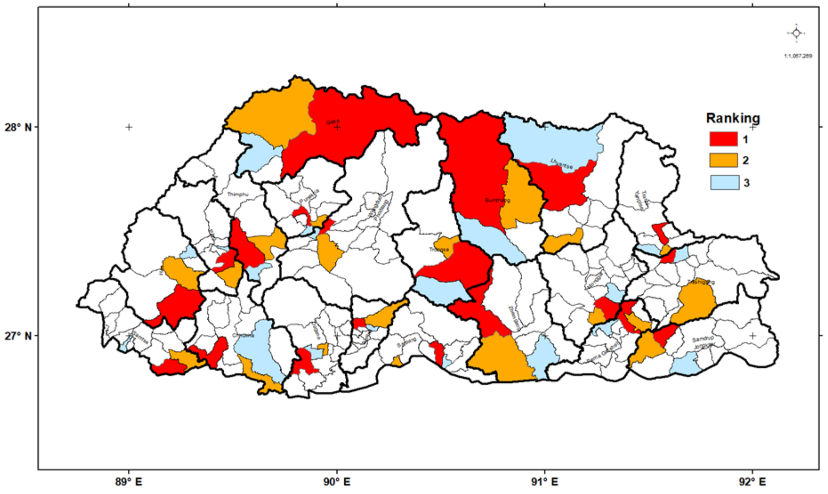
What are the main issues relat
in those areas?

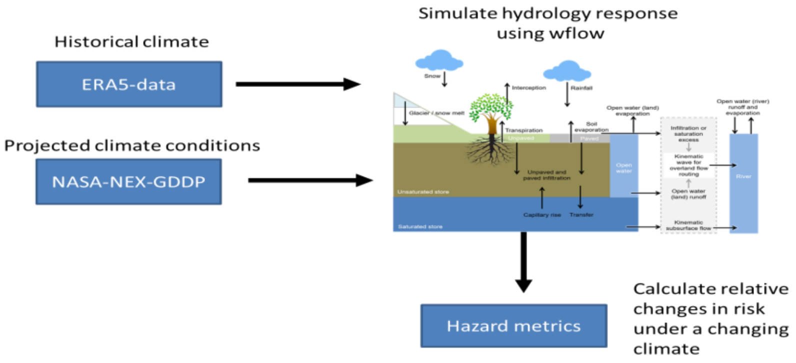
What are the main causes of t

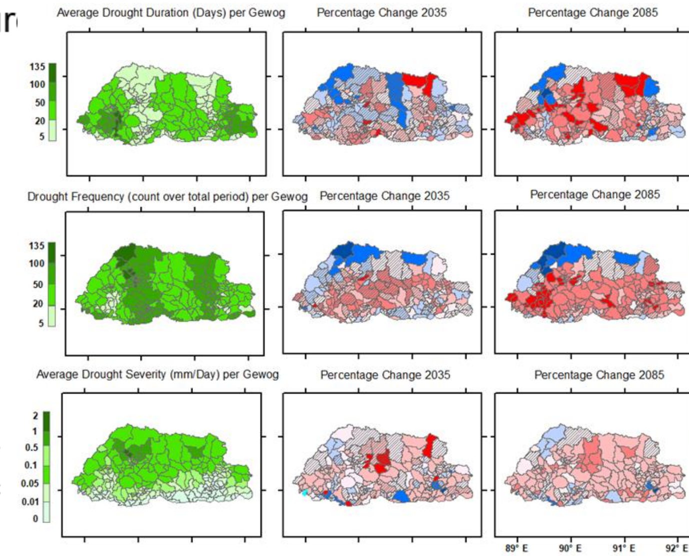
When did these problems start

How did the community respor
far?

What are some on-going activities and measur
the Gewog to resolve those issues?

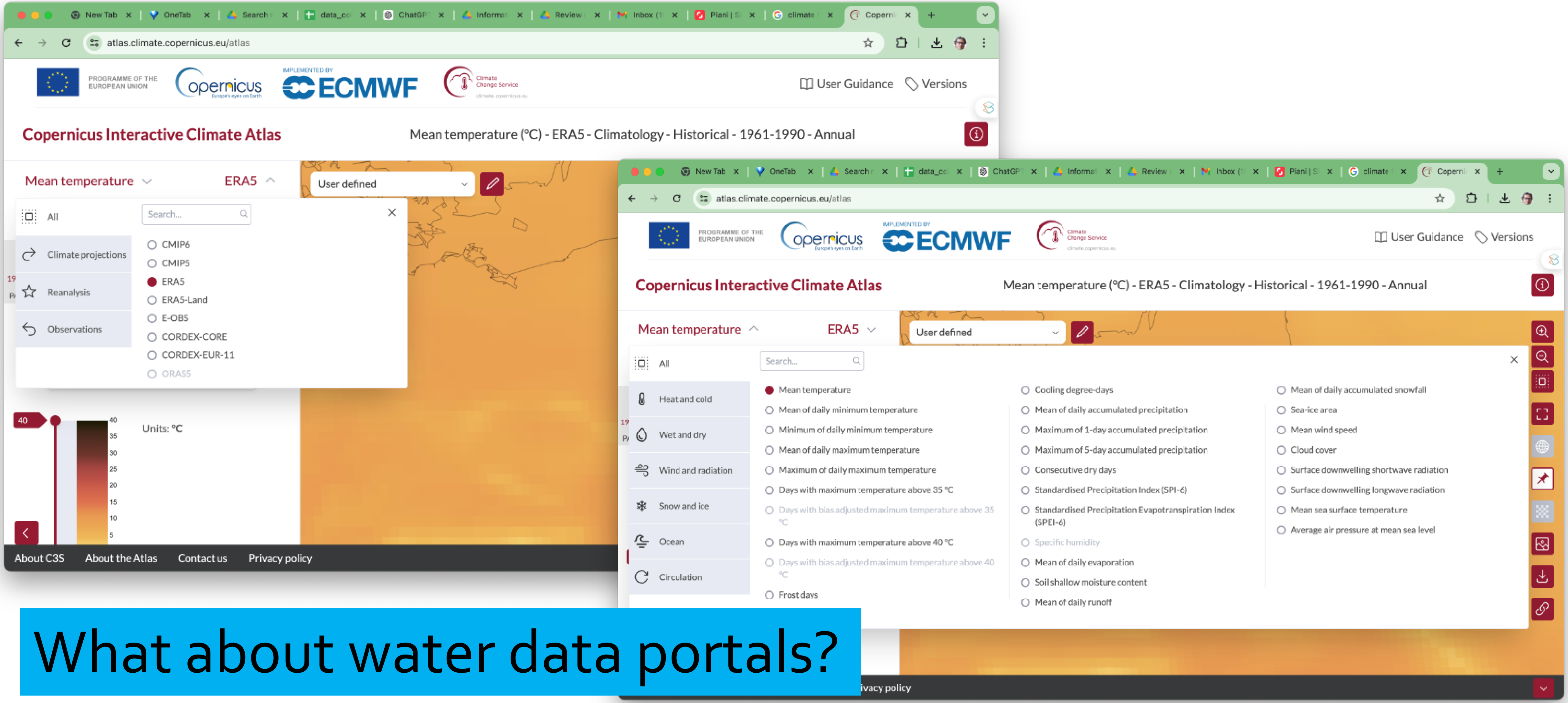






SEVERAL CLIMATE DATA PORTALS EXIST

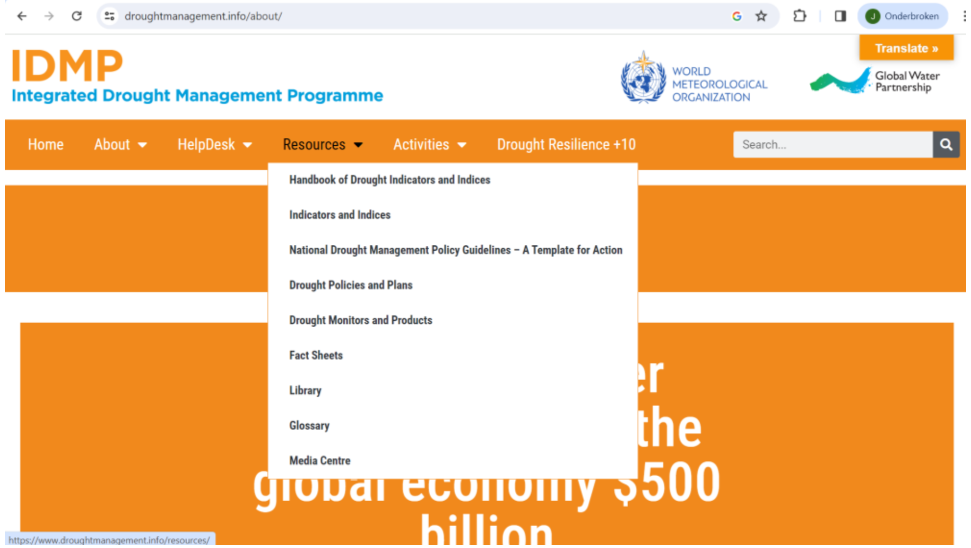
GREEN CLIMATE FUND

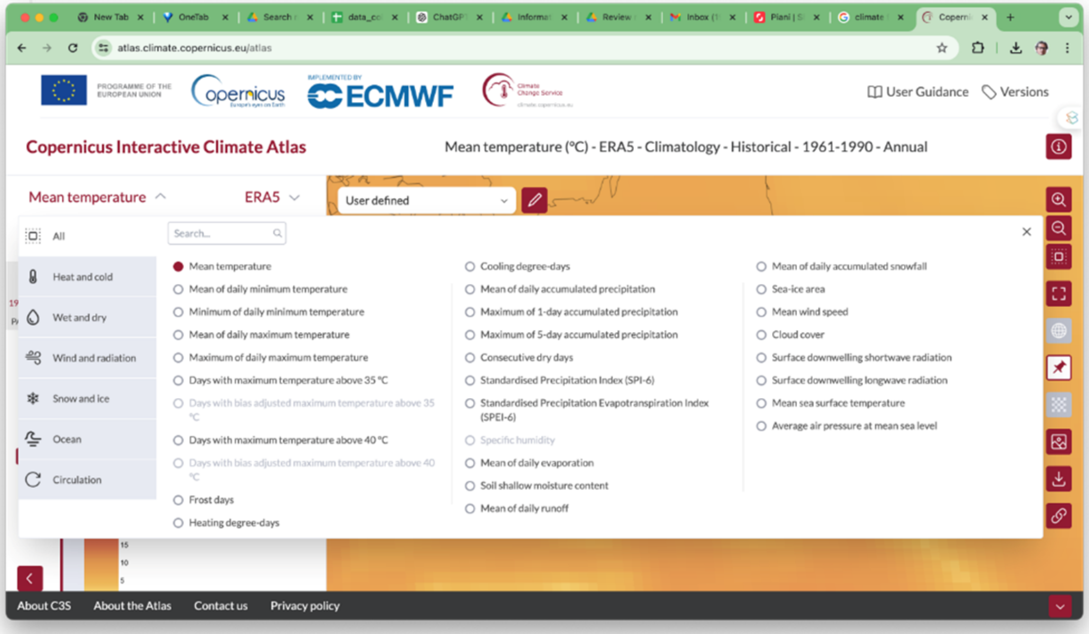


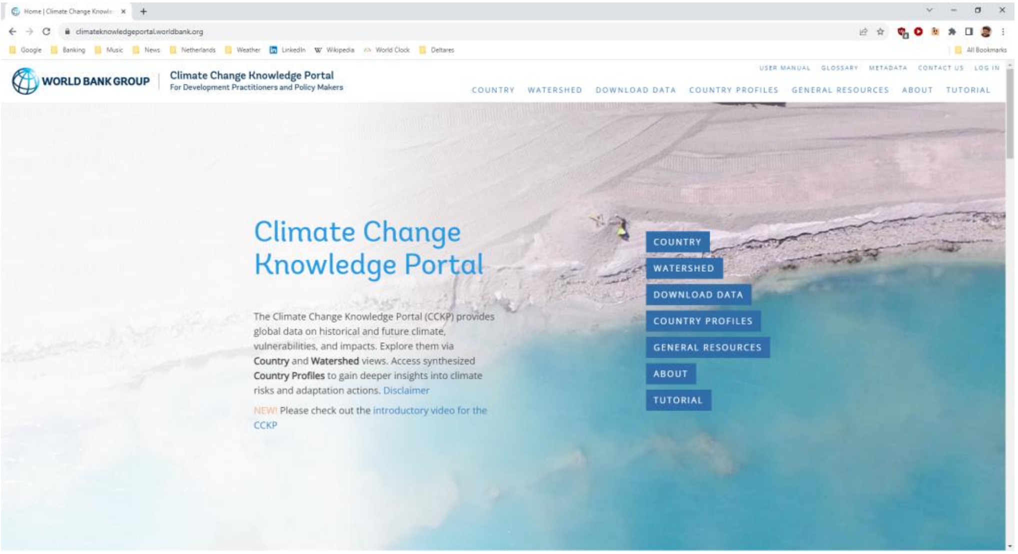
What about water data portals?

POTENTIAL SOURCES OF DATA

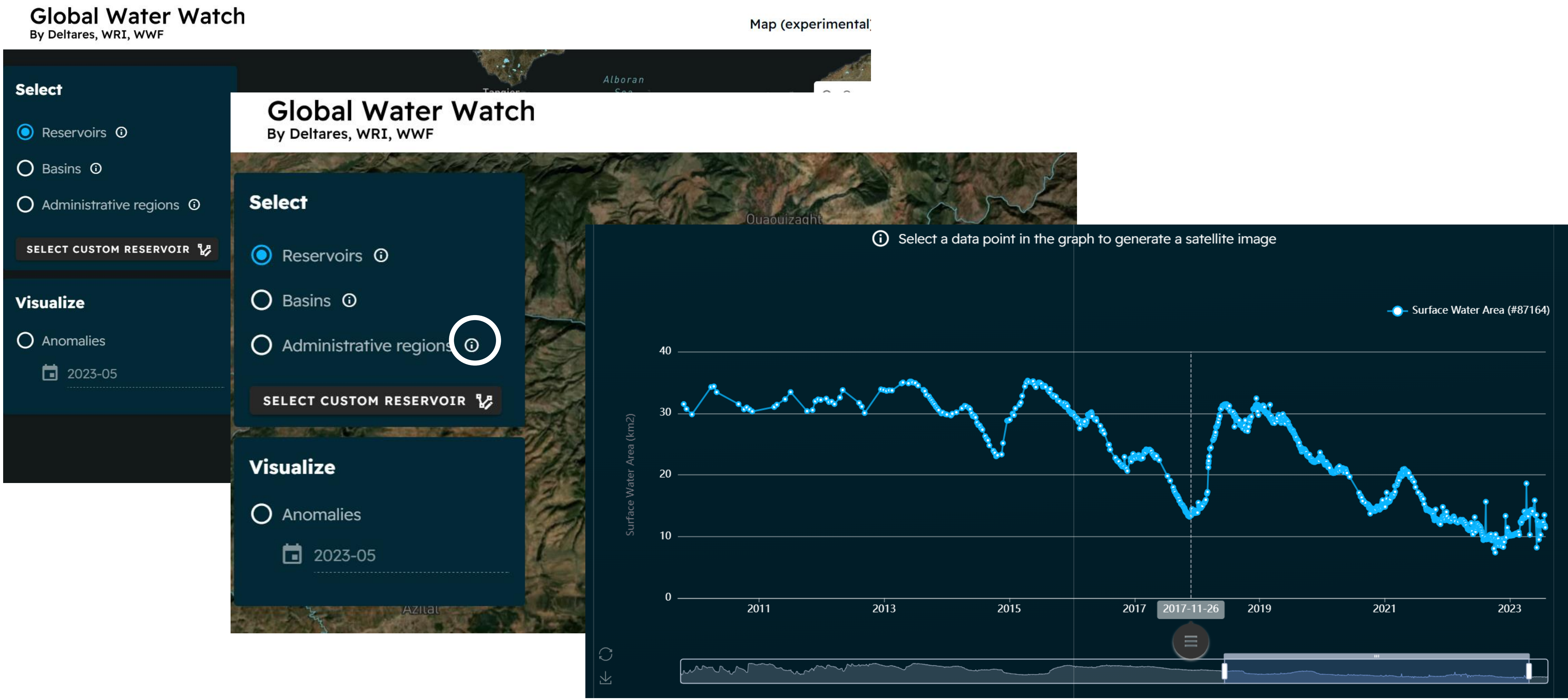
- Example data portals



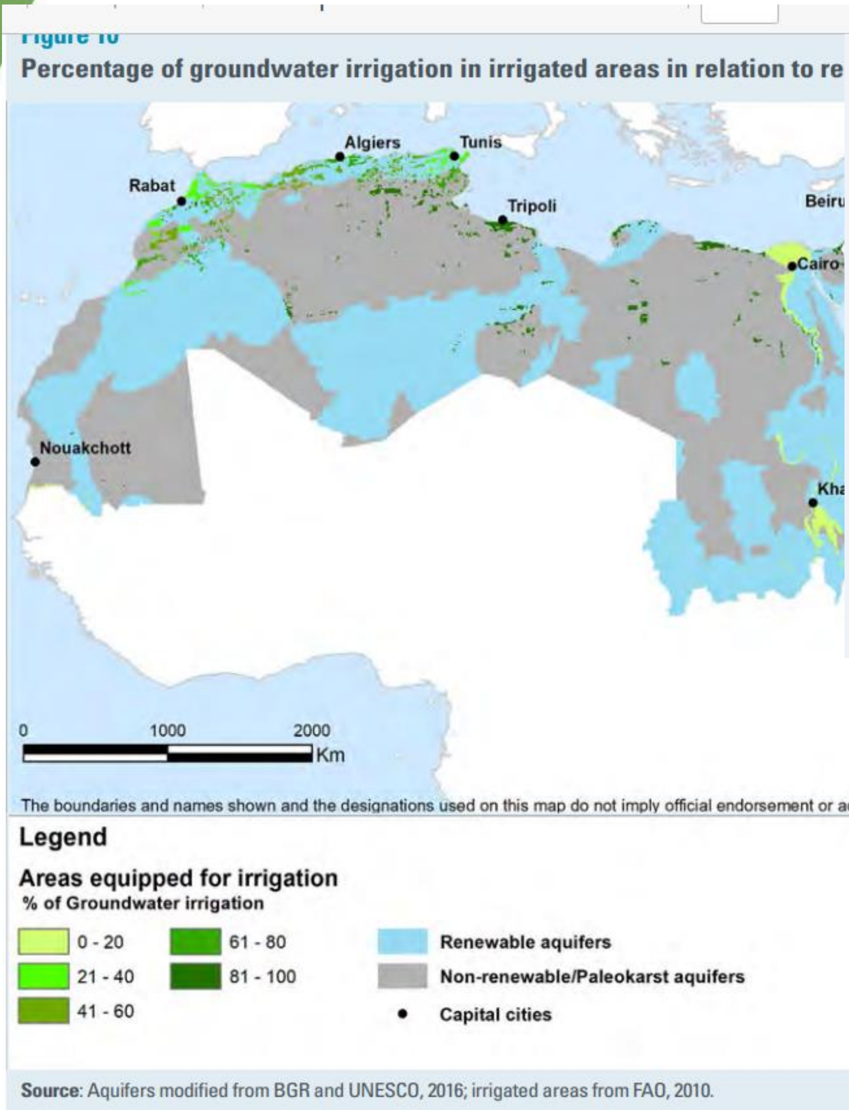




GLOBAL DATA REPOSITORY TO LEARN FROM THE PAST



USE REGIONAL RESOURCES FROM UNESCWA



Guidelines for accessing CORDEX regional climate projections

March 2022

The present technical note serves as an explanatory reference to access regional climate modelling (RCM) outputs developed as part of the Coordinated Regional Climate Downscaling Experiment (CORDEX), conducted within the framework of the Regional Initiative for the Assessment of Climate Change Impacts on Water Resources and Socio-Economic Vulnerability in the Arab Region (RICCAR). The intention is to inform users where to access raw RCM outputs (non-bias-corrected) and other climate data projections not evaluated as part of RICCAR within the Arab domain.

Details regarding CORDEX modelling activities can be obtained in the RICCAR technical note "Regional Climate Modelling and Regional Hydrological Modelling Applications in the Arab Region".

IN ADDITION

- Climate risk and options assessments reliant on knowledge, data and (typically) modelling
- Assessment methodology should be fit-for-purpose.
  - Do not over-invest in risk assessments at the expense of options assessments
  - Would the additional RA investment change the decision to intervene?

	Outputs	Input into GCF processes	Duration
Level I: National level Assessment	• A **rapid assessment of climate change risks** for water security at **national** level.	**Basic and national level climate narrative** for project concepts for **Readiness Funds**	4 months
Level II: Sub-national Level	• Climate Risk Assessment to develop a **National Adaptation Plan for Water Resources** • Identification of **hotspots for climate change adaptation**	**Climate narrative** and detailed analysis for **Project Preparation Grant** for identified hotspots	6 months to 1 year
Level III: Local/project Level	• A climate risk assessment and **adaptation pathway** to address the **climate change impact on the water security for a local hotspot or priority area.**	**In-depth climate narrative** and stakeholder engagement for **Full Project Proposal** development	1 to 1.5 year

Example UNESCO CRIDA

Key takeaways

- Defining the climate **hazard, exposure, and vulnerability** of a project domain involves gathering and synthesizing a diverse range of information, which will be unique for each proposal.
- **Historical information** and data provide an essential baseline and serve as strong basis for identification of **impacts that matter**.
- The IPCC stresses the value of developing any climate analysis by using multiple lines of evidence (to increase **confidence**).
- Demonstrating the *identification* and *response* principles should make use of project-specific **local information** and observational data where it is available and of sufficient quality
- Match **level of analysis** with the information need

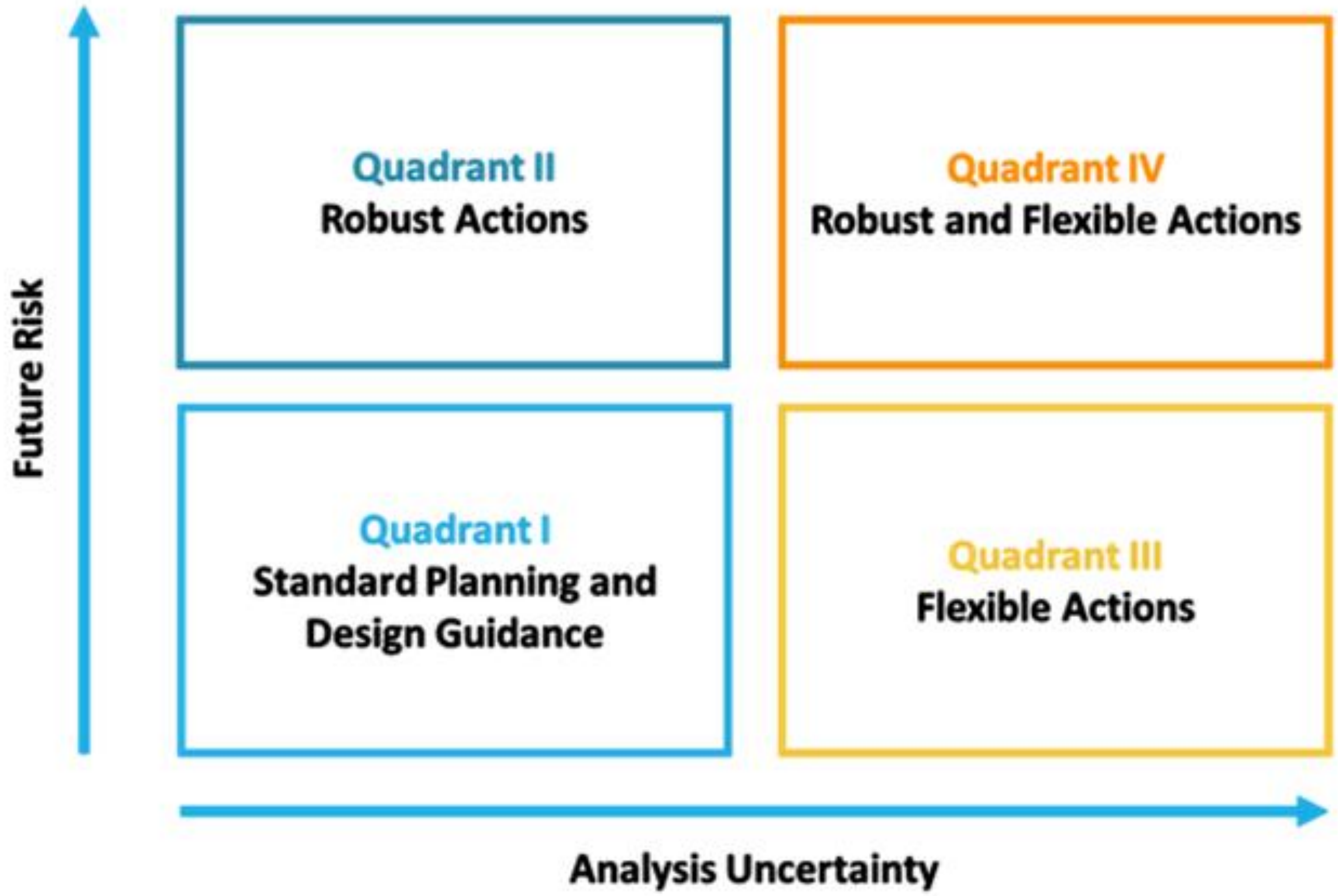
EXERCISE / DISCUSSION

- Identify climate science data needs to undertake risk assessment for your case
- Identify potential sources for this data (also non-computational, e.g. interviews, stories)
- Discuss how you could build your climate rationale from this

3. SELECTING ACTIONS TO MANAGE RISKS

- Prioritise those actions which deliver the greatest risk reduction benefits, while minimizing potential for future regret
- Consider sequencing of actions in time as conditions change
  - What to do immediately, what to do next, what to leave as options for the future?
- Evaluate different action sequences (pathways) against their delivery of co-benefits/trade-offs

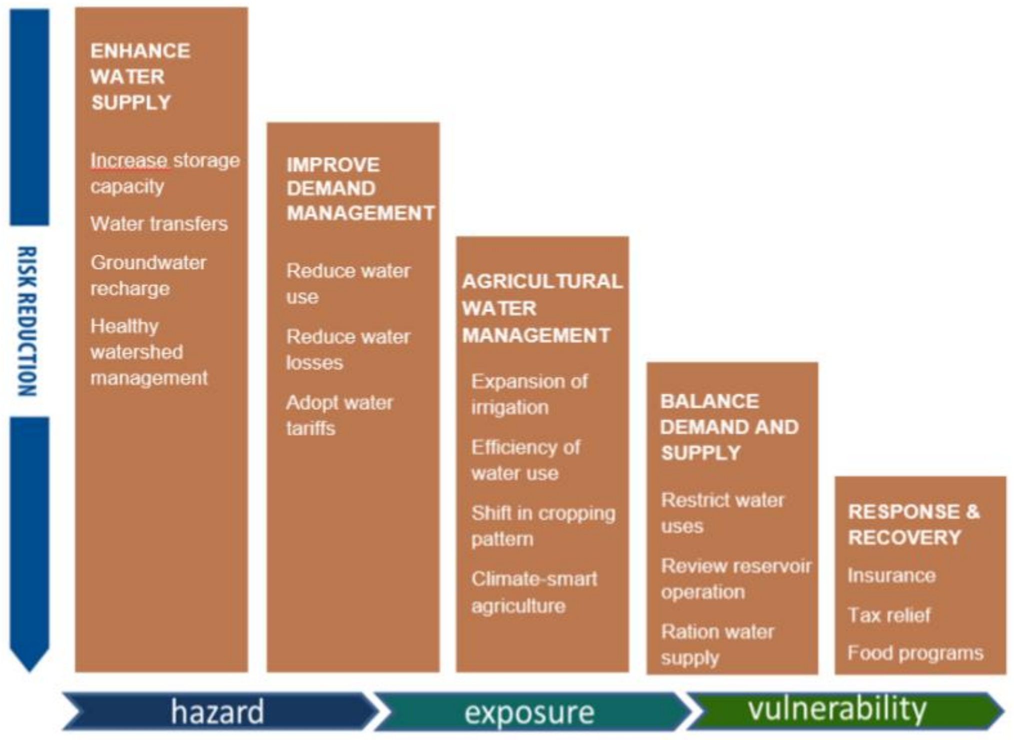
WITH OR WITHOUT 'GOOD' CRA DECISIONS HAVE TO BE MADE



Adapted from: CRIDA, Mendoza et al. (2018)

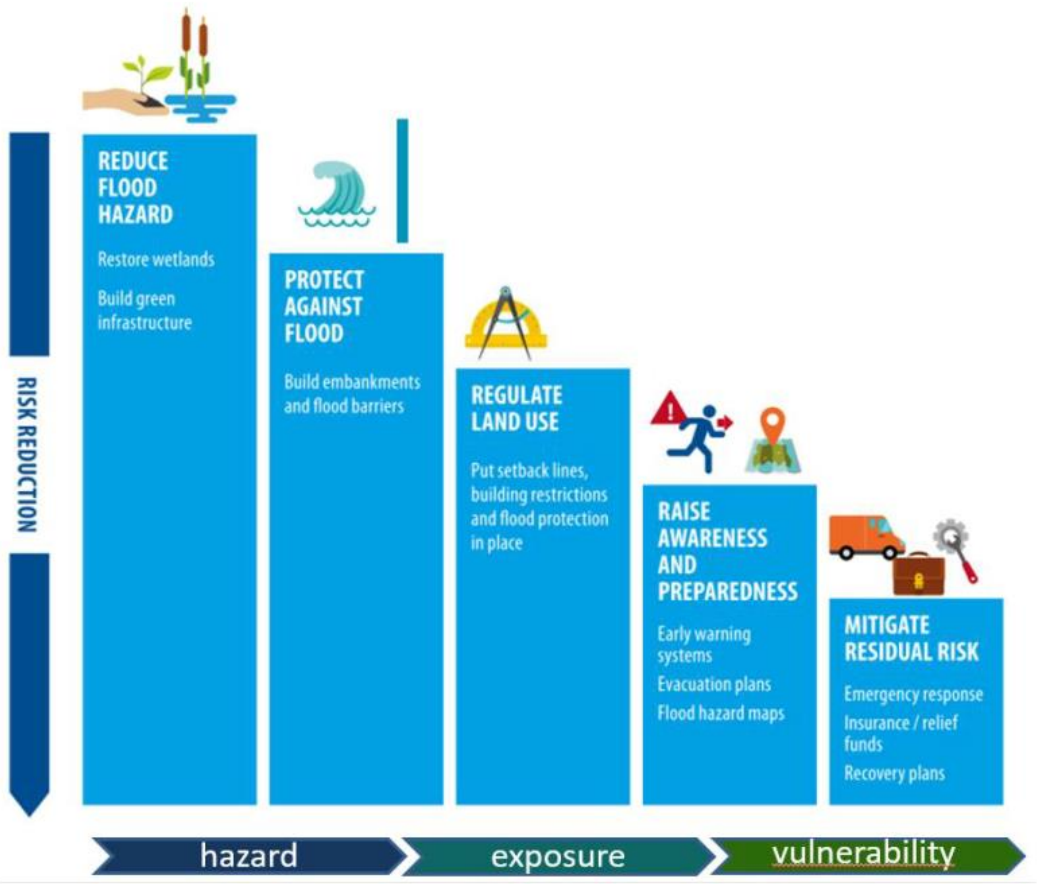
IDENTIFY DIFFERENT COURSES OF ACTION TO REDUCE IMPACTS

Figure 7: Risk cascade with overview of measures for risk reduction in drought management



Source: adapted from Beek, E.v, Nolte, A.J., Maat, J.t, Fanesca - Sanchez, M., Asselman, N. Gehrels, H. (2022). Strategic Water System Planning, A framework for Achieving Sustainable, Resilient and Adaptive Management. Deltares.

Figure 9: Risk cascade with overview of measures for risk reduction



Source: UN-ECE; UN-DRR, 2018[41]

ASSESSING OPTIONS EFFECTIVENESS AND OTHER CRITERIA

- Options should “align” with NAP
- Options assessment of effectiveness links back to the risk assessment
  - Quantify impacts using similar methods to risk assessment (where possible)
  - Consider robustness of options against (subset of) scenarios
- Other assessment criteria (low regret)

- **effective risk reduction** under current and future (climate) conditions
- Avoid **undesirable path dependencies**
- lead to **systematic improvement in resilience (**e.g restore demand-supply balance, increase biodiversity and equity)
- result in **few negative tradeoffs**
- deliver **ample co-benefits** with respect to other development goals, and
- deliver benefits that outweigh the costs.

LOW REGRET SAP-ABLE PROJECTS

GREEN CLIMATE FUND

SUBSECTOR	SAMPLE SAP-ABLE ACTIVITY	NOTES
Climate resilient water supply, sanitation and hygiene (CR-WASH)	Construction or rehabilitation of rainwater harvesting and storage systems	Ponds, cisterns and tanks are often household or small community features built to capture rainwater or surface runoff
	Communal handpumps	These are ordinarily for domestic use. Thus, assessment of groundwater quality and quantity vs. demand is required.
	Boreholes with solar pumps	Include activities to prevent over-abstraction of water
	Water use efficiency in households, public and commercial buildings: no- or low-flush toilets, low-flow showerheads	Could be combined with introduction or revision of water tariffs, to incentivize water users to avoid wastage
	Decentralised water treatment (non-traditional water purification options applied at household or community level)	Climate change impacts on water quality would need to be demonstrated
	Climate-proofing water supply and sanitation infrastructure	Depending on the specific activity and its scale, ESS* screening should be undertaken to determine the ESS risk category
	Aquifer recharge (groundwater banking or aquifer storage and recovery)	Risks depend on scale and location. It is recommended to undertake a water balance assessment to demonstrate sustainability of the water source and avoid maladaptation.
Integrated water resources management (IWRM)	Water policy review, IWRM planning or incorporation of climate change adaptation into existing IWRM plans	This could be measured by survey of the beneficiaries.
	Water resources monitoring and information systems	A rating scale could be established, against which to measure the extent of application.
	Hydrological zoning considering climate change impacts	Zoning ensures that agriculture, urban development and other land-use activities take place in the most suitable locations, based on local hydrology.

** ESS = environmental and social safeguards*

	NOTES
	These activities pose potentially adverse environmental and/or social risks. Thus, they do not fall under ESS* Category C and are therefore not eligible for SAP.
locks and levees that protect areas at risk of	
ojected climate change impacts	

Example: recommended direction for adaptation in a NAP project

Improve

Improve system’s resilience

Add

Add robustness where needed

Start

Start with enabling and low-regret action

Start

Start with smaller scale proven adaptation

But this is quite context specific – would look different for the Netherlands

Prioritization of adaptation where to invest first?

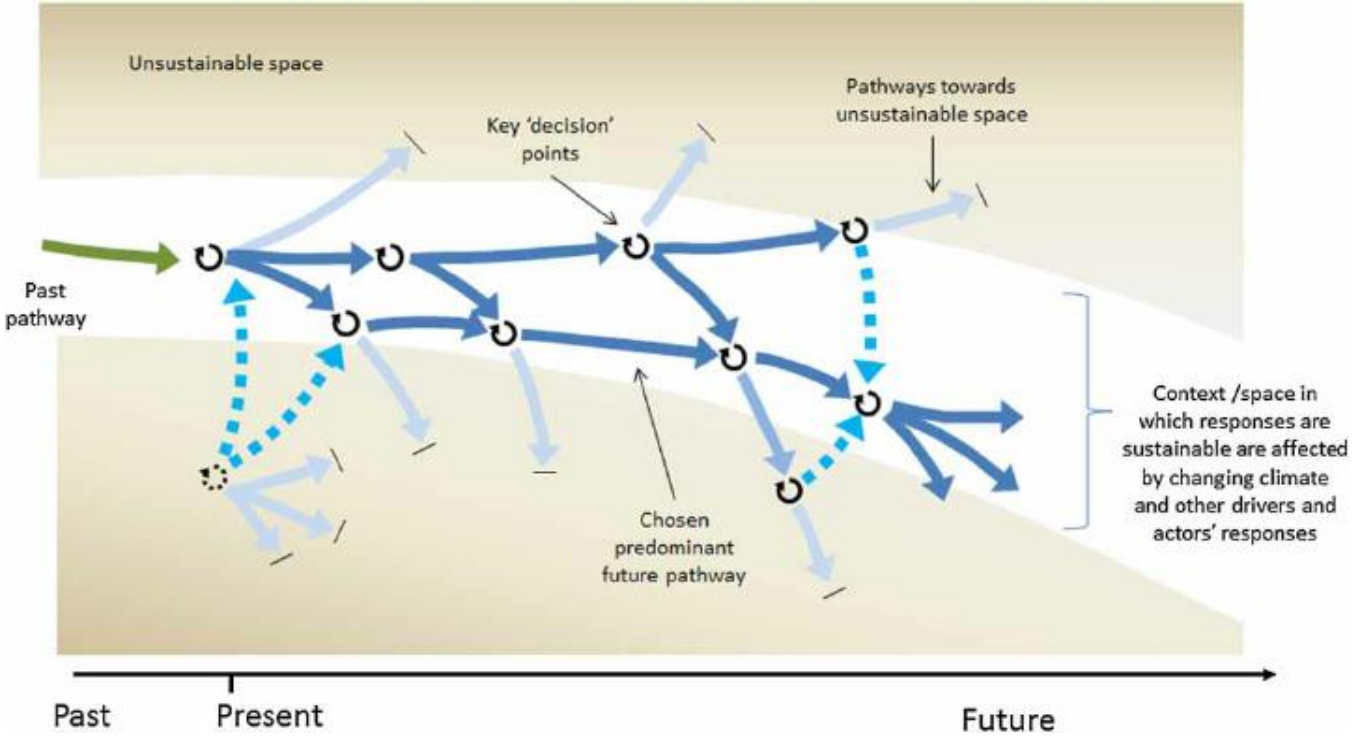
If there is an increase in **exposure** and water demand to be expected this means that investments are needed in these areas anyway and that these investments should be done in a climate resilient manner and preferably **add robustness** to the system

There should be **vulnerabilities** reported under the current climate, the more serious the issues reported the higher the priority to implement measures.

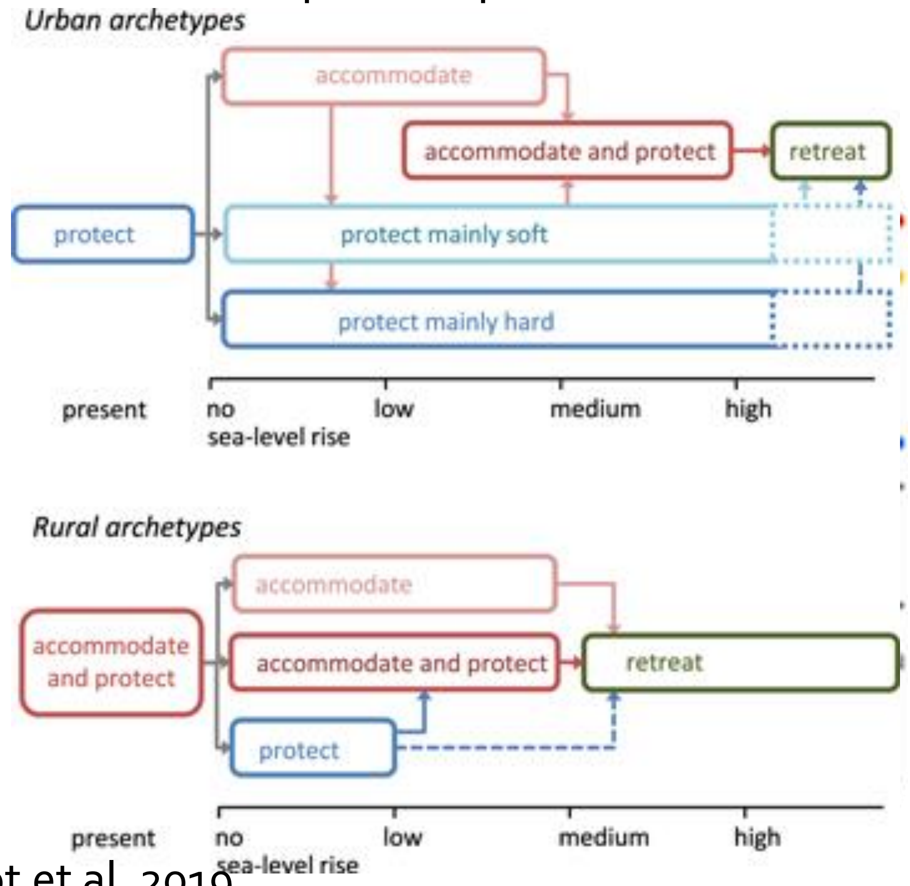
If in addition to this the **climate change impacts** are expected to be large in the future, an area should receive extra attention

ADAPTATION AS PATHWAYS

- How to sequence actions in such a way as to remain in the sustainable (white) space?
- Need for **flexibility** (keeping future options open)

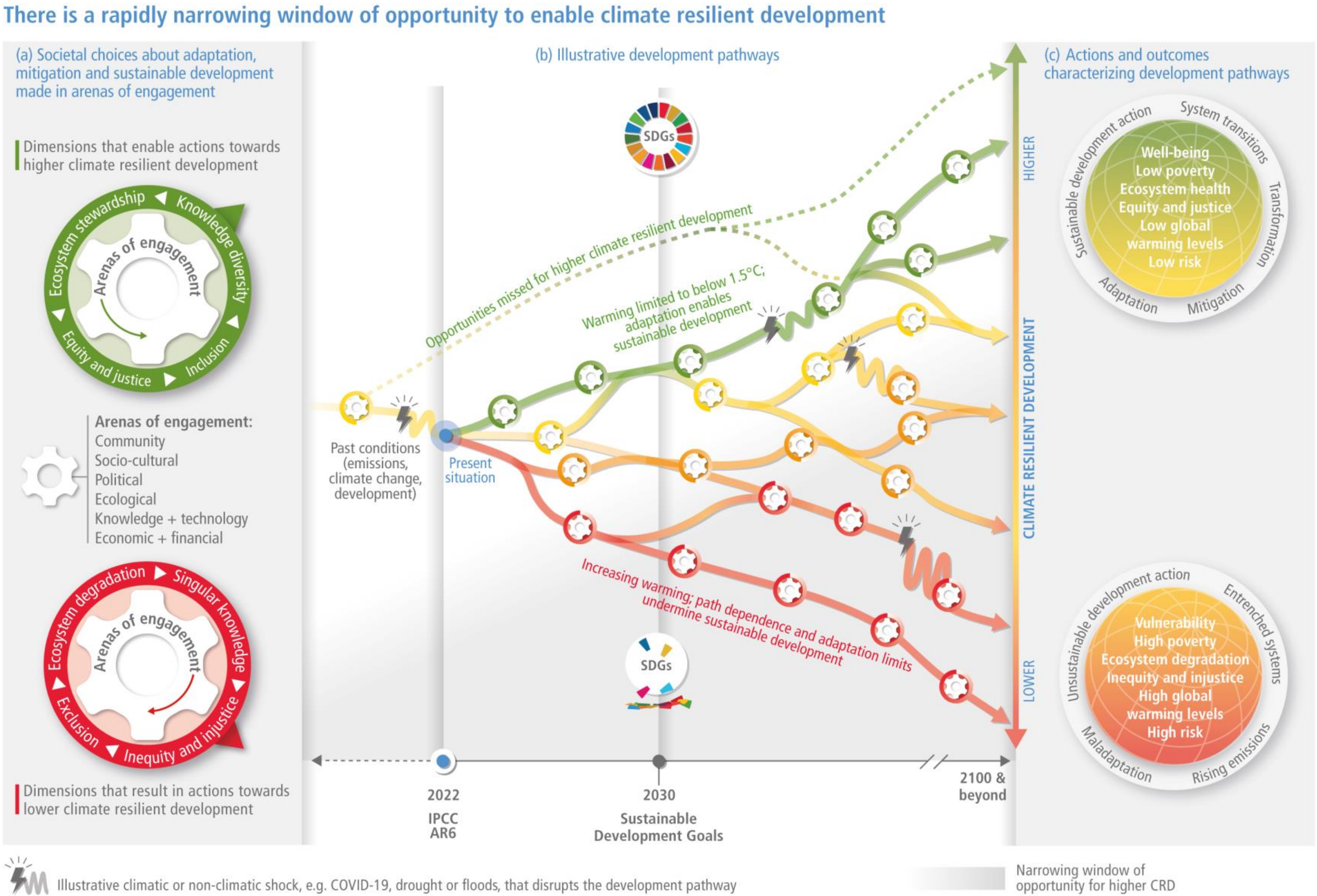


Source: *Wise et al. 2014*



Source Haasnoot et al. 2019

CLIMATE RESILIENT DEVELOPMENT PATHWAYS



- How to avoid long-term **maladaptive** 'solutions' to short-term needs?
- Looking for **robust** strategies that can successfully manage risks in all possible future scenarios.

IPCC (2022)

MINIMIZING FUTURE 'REGRET'

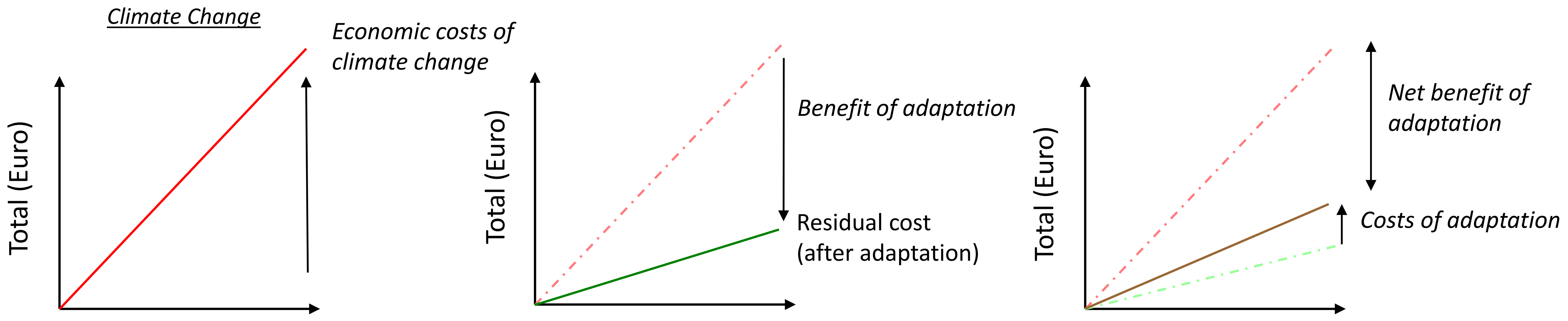
EVALUATING ACTIONS

- Need to balance performance of actions/pathways across a range of decision-making criteria:
  - Cost-effectiveness
  - Co-benefits/trade-offs
  - Flexibility for future subsequent adaptation
  - Implementability
- Different methods:

Criteria	Scorecard	MCA	CE	CBA
Phase of the policy process	Inventory	Inventory Policy evaluation	Inventory Policy evaluation Financing decision	Policy evaluation Financing decision.
Data availability	Low-Medium	Low-Medium	Medium	High
Time availability	Low	Low-Medium	Low-Medium	Medium-High
Capacity	Low	Low-Medium	Low-Medium	High
Number of (co-)benefits	Low-High	Low-High	Low	Low-High

Proposals need to show costs and benefits of reducing economic impacts of CC through adaptation, noting there is a trade off with residual costs

- Net benefits of adaptation = **avoided damages** of CC + **co-benefits** – costs (CAPEX+OPEX)



From: P. Watkiss HE ACCREU

KEY TAKEAWAYS

- Assembling action in the form of pathways helps to minimize risk of future regret and avoid maladaptation
- Evaluation methods should match the level of data available and number of criteria to be evaluated
- **Low-regret action** has many meanings, e.g. robust outcomes under climate uncertainty; tested and proven technologies; minimal tradeoffs and maximal (societal) benefits; limited barriers to implementation.
- Any CBA at the basis of a GCF water project should include some sensitivity analysis with respect to uncertain climate outcomes.

SOME USEFUL RESOURCES

- Atlas.climate.copernicus.eu/atlas (climate data)
- Climate services for urban planning – Triple-A Toolkit - Reachout (reachout-cities.eu)
- Guidelines for accessing CORDEX regional climate projections - United Nations Economic and Social Commission for Western Asia (unescwa.org)
- Climate Risk Informed Decision Analysis (CRIDA) | UNESCO
- SAP Technical Guidelines: Water security | Green Climate Fund