



International Water
Management Institute

Water Management for Climate Change Resilience: Priorities for Action

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Innovative water solutions for sustainable development

Food · Climate · Growth



Ignore water change at your peril...



Outline

- Motivations
- What is changing?
- Re-learning water management
- Action framework
- Adaptation and equality
- Conclusions

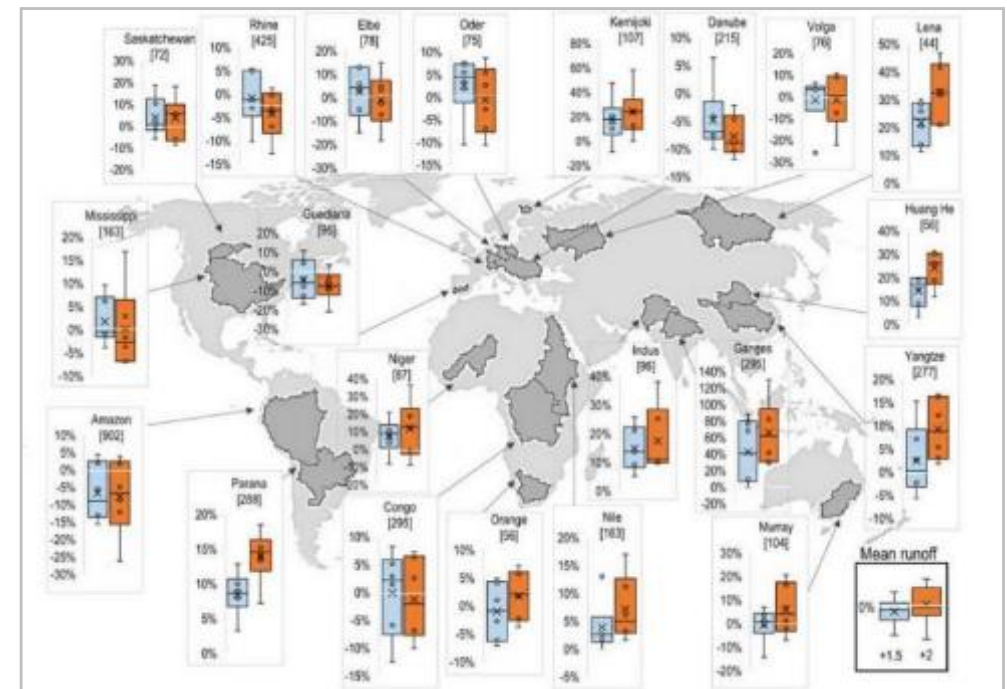
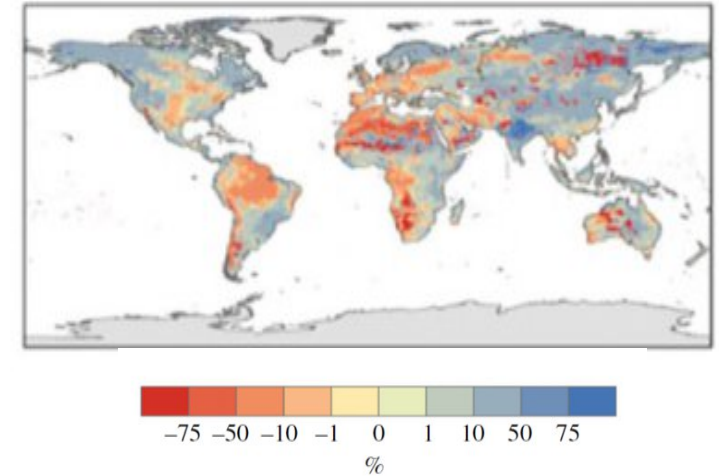


Water is the 'claws and teeth' of climate change...

- Water is complex
- CC is reconfiguring the water system
- Institutions & infrastructure must match the climate...
- ... and now must match new climates
- Menace... but with hope

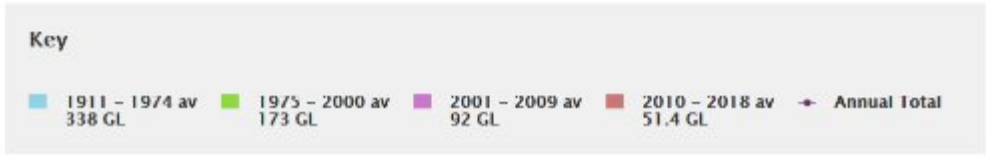
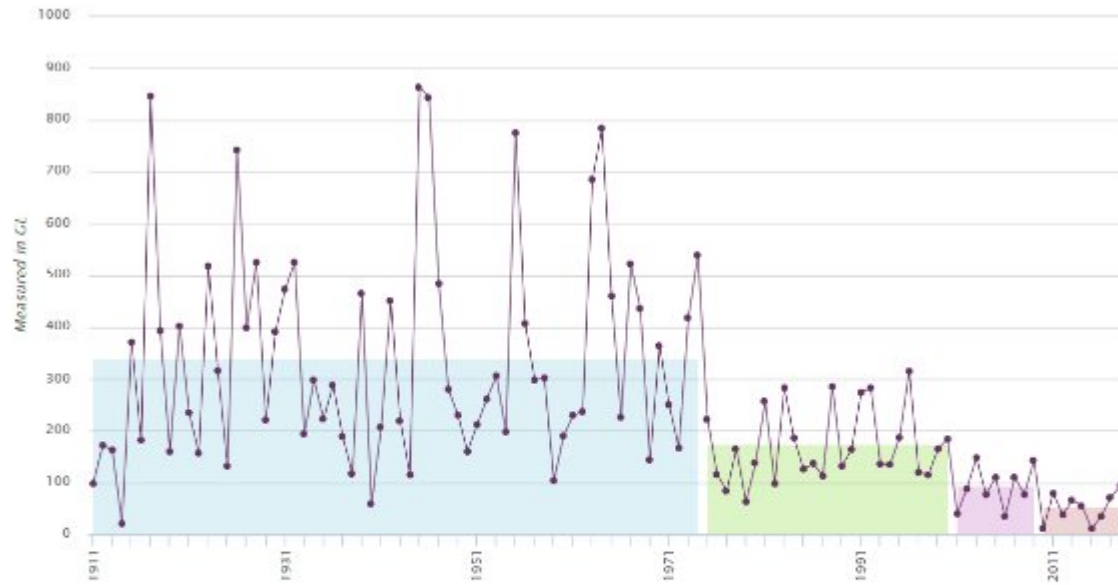
Climate Change is Water Change

- *Intensifying global water cycle*
 - new hydrologies
 - changes in rainfall and seasons
- *Changing water resources*
 - 0.5-3.1 bn living with scarcity by 2050
 - reduced river runoff in drier regions
 - changes in flow patterns
 - increased water pollution
- *Increasing water risks*
 - higher human exposure to flooding
 - increased frequency of drought
 - >2x exposure to water scarcity by 2050
 - more frequent & intense extreme events



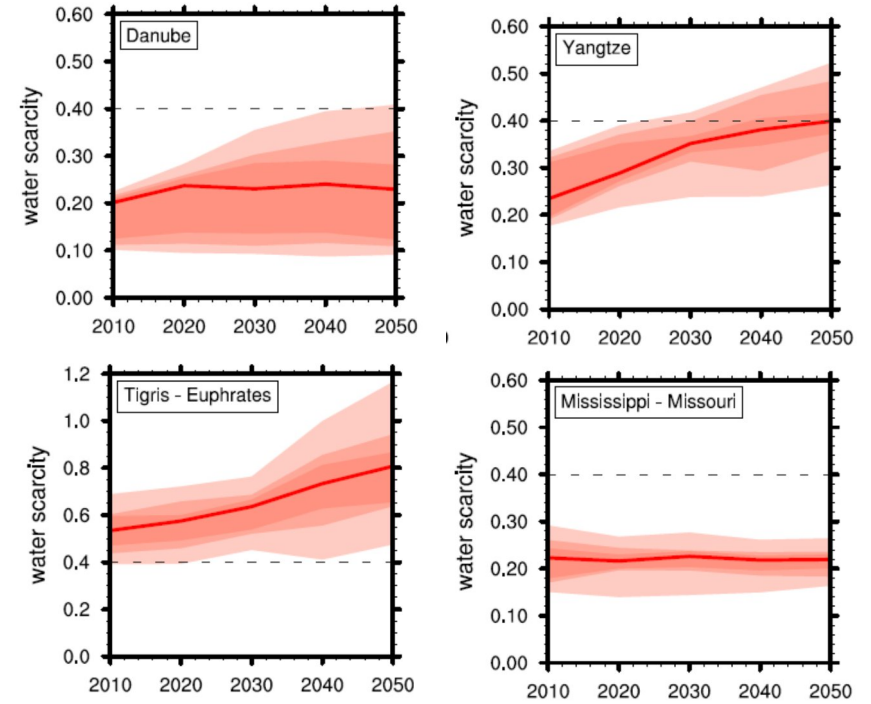
Modelled changes in runoff for mean flows (1.5 and 2°C)
Source: Betts et al. (2018)

Non-Stationarity and Uncertainty



Annual inflow to Perth Water Supply System, 1911-2018

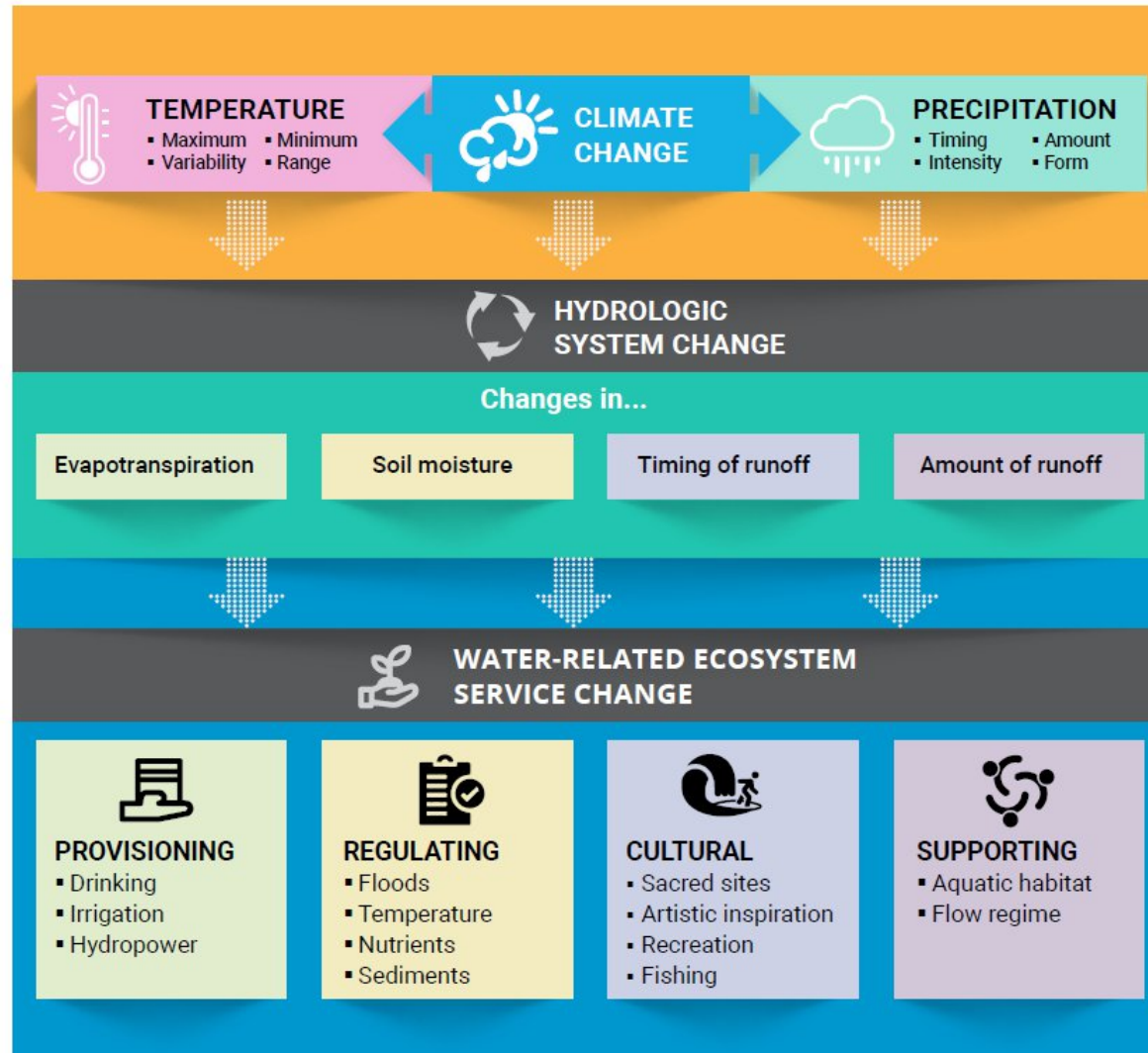
Source: watercorporation.com.au



Projected changes in water scarcity and uncertainty, 2010-2050

Source: Greve et al. (2018)

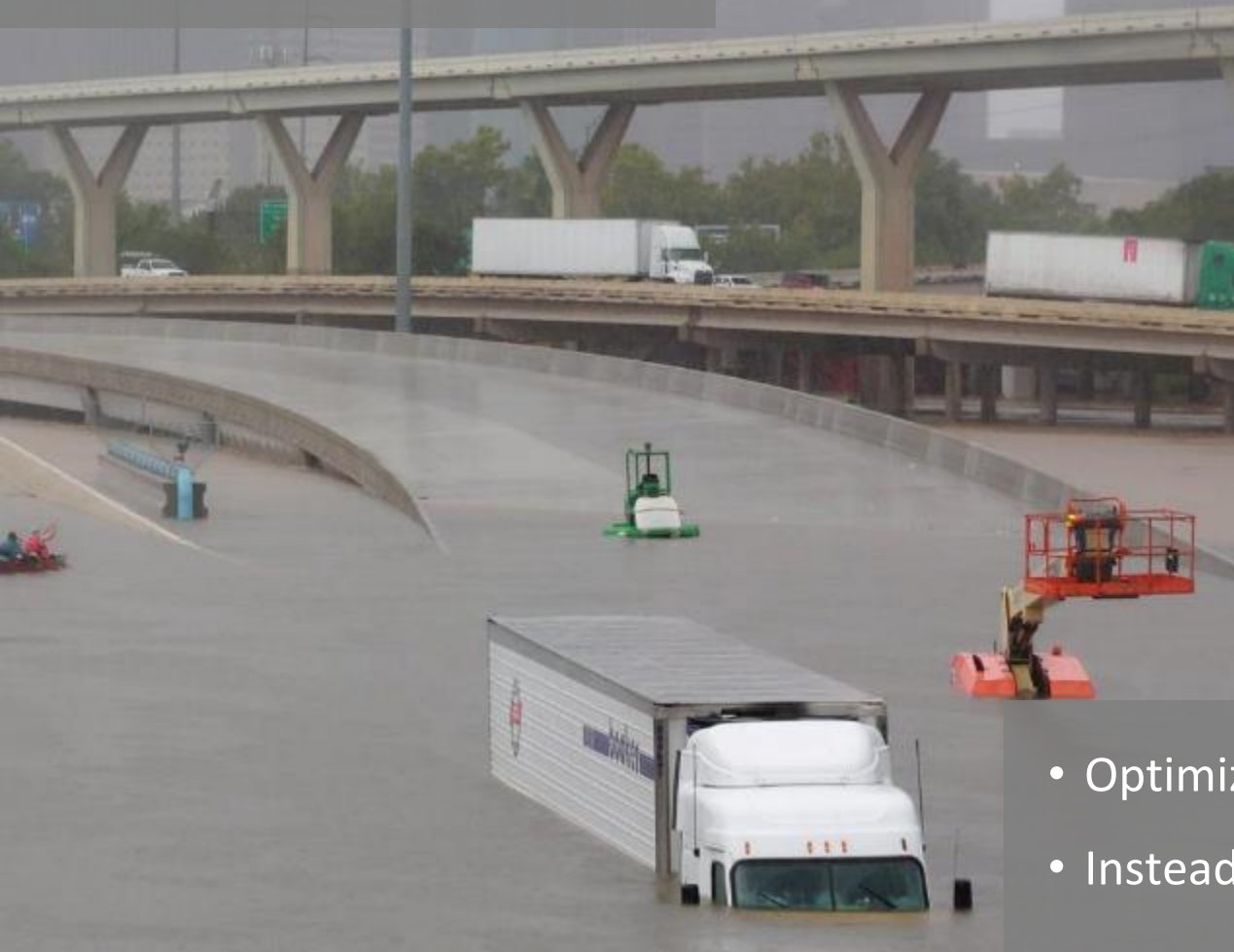
Cascading Effects of Climate Change on Water-related Ecosystem Services



Source: Chang and Bonnette, 2016

Re-learning Water Management

What is a 1-in-100 year flood?

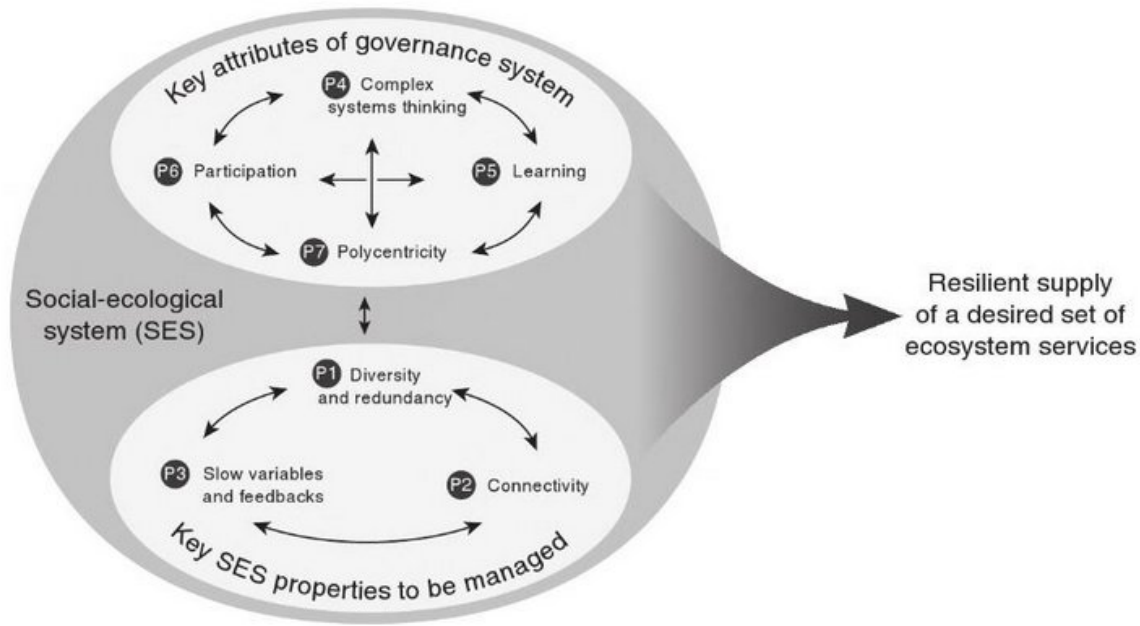


How reliable is energy supply?



- Optimized 'single-solution' plans no longer hold
- Instead, prepare for multiple possible futures

Climate Resilient Water Management



Climate Change Resilience

the ability to withstand or recover from impacts of climate change and, when recovery cannot be achieved, to reorganize to meet needs for development and well-being in new ways

Design for Robustness...

satisfactory performance over a wide range of future climate change scenarios

...and Flexibility

capacity to adjust, change course, and reorganize as conditions evolve and information about the future becomes clearer

Source: Biggs et al. (2015)

Making Resilience Practical

Biggs et al. Principles	Resilience in practice
P7. Promote polycentric governance	1. Governance & participation
P6. Broaden participation	
P4. Foster complex adaptive systems thinking	2. Information & learning
P5. Encourage learning	
P1. Maintain diversity	3. System diversity & connectivity
P2. Manage connectivity	
P3. Manage slow variables and feedback	4. Infrastructure, technologies & (water) management

Climate-Resilient Water Management: Action Framework



GOVERNANCE AND PARTICIPATION

- multi-level governance
- reform policies, laws & institutions
- right-based approaches
- inclusion & participation
- collaborative co-creation



INFORMATION AND LEARNING

- climate & water information
- training & skills development
- scientific and local knowledge
- disseminate data
- learning at all levels



SYSTEM DIVERSITY AND CONNECTIVITY

- ecological diversity & connectivity
- economic diversity
- multiple water storage options
- guard against maladaptive engineering



INFRASTRUCTURE, TECHNOLOGY AND MANAGEMENT

- response options assessment
- engineered & nature-based solutions
- systems-oriented, risk-informed decision analysis
- adaptive management

Nexus Thinking

Transforming systems by strengthening nexus thinking and integrated management for inclusive, sustainable development and climate resilience

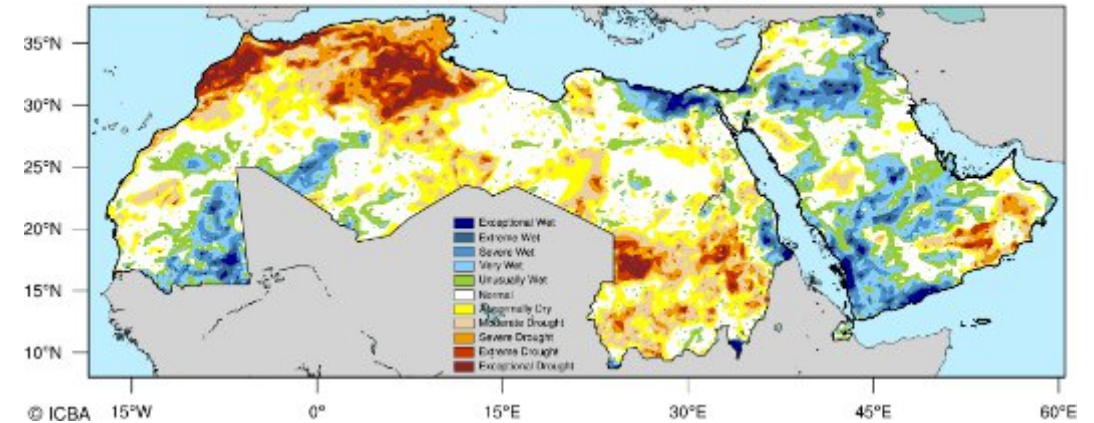


MENA Drought Project

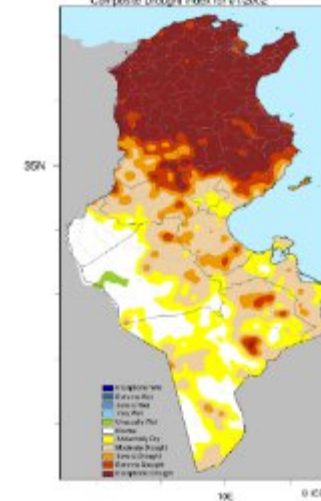
Empowering decision makers to prepare for and respond to drought:

- Multi-ministerial planning
- Local government coordination
- Farmers' organizing to deploy water and agricultural responses

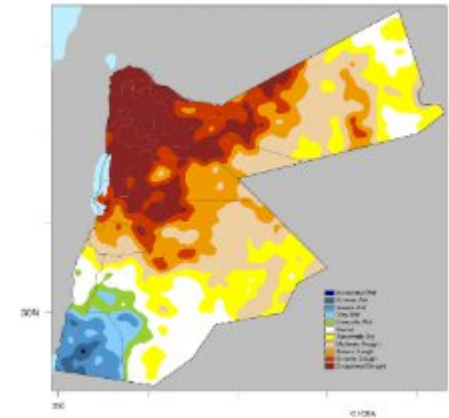
Composite Drought Index for January 2016



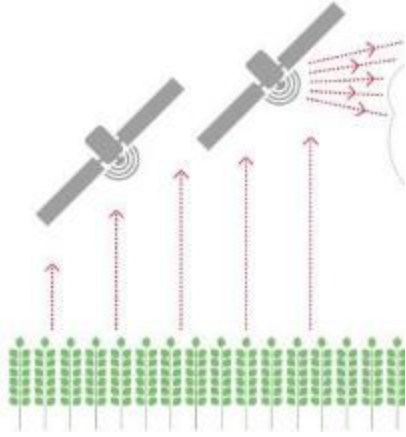
Composite Drought Index for 01/2012



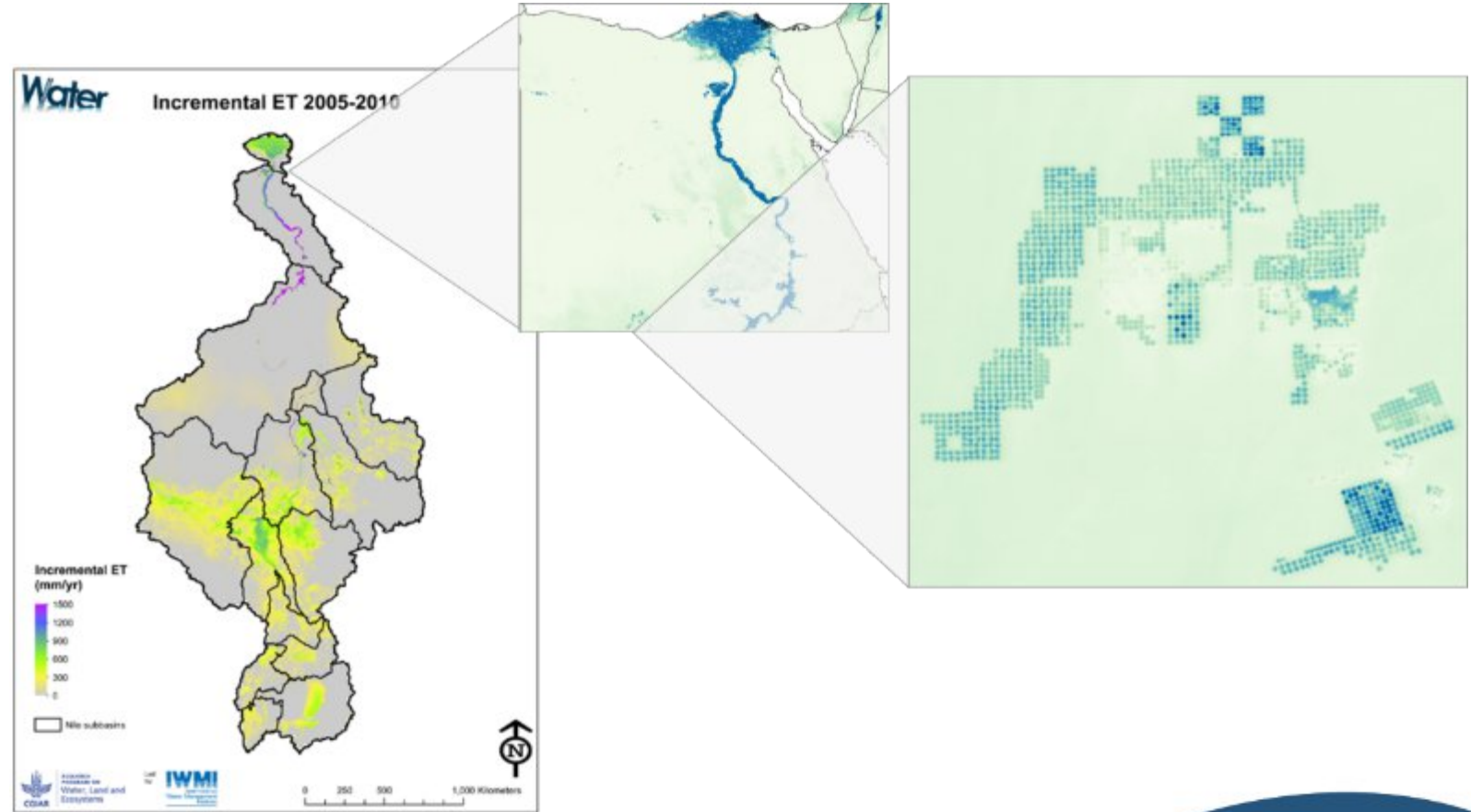
Composite Drought Index for 02/2014



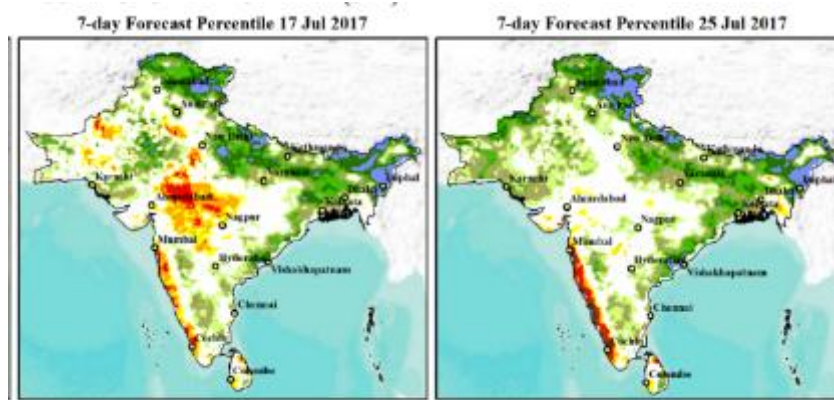
Water Accounting



- water balances
- hydrological baselines
- adaptation planning
- regular updating
- infrastructure design
- water productivity



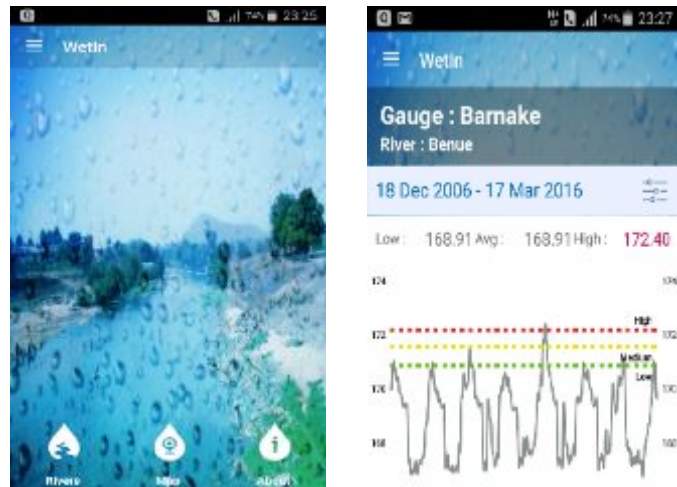
Drought Early Warning Systems



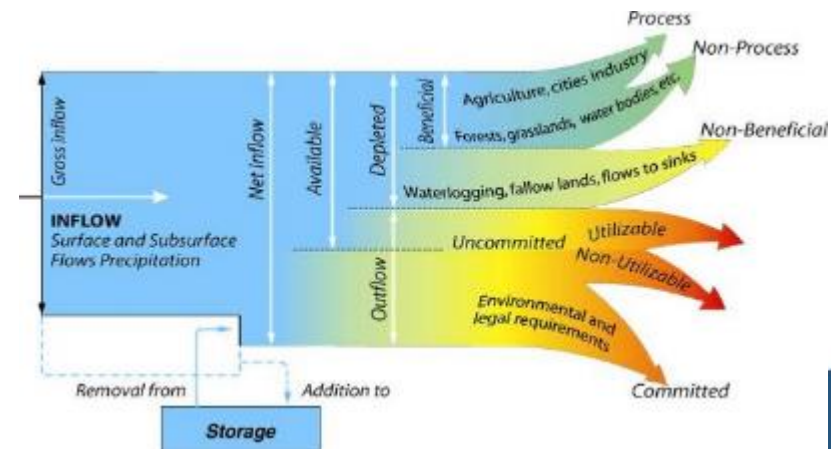
Flood Monitoring & Forecasting



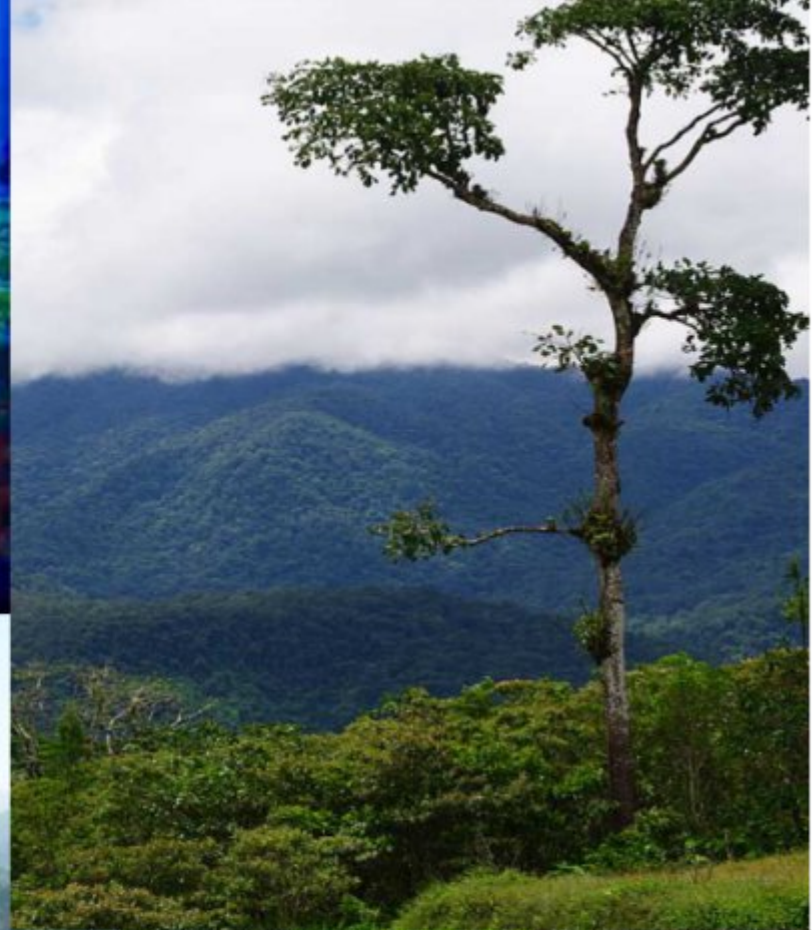
Mobile App Flood Early Warning



Water Accounting+



- redundancy & 'fail-safes'
- switching water storage
- agricultural value chains
- offsetting vulnerability across multiple sectors
- flexibility is responding to unexpected events
- systemic assessments

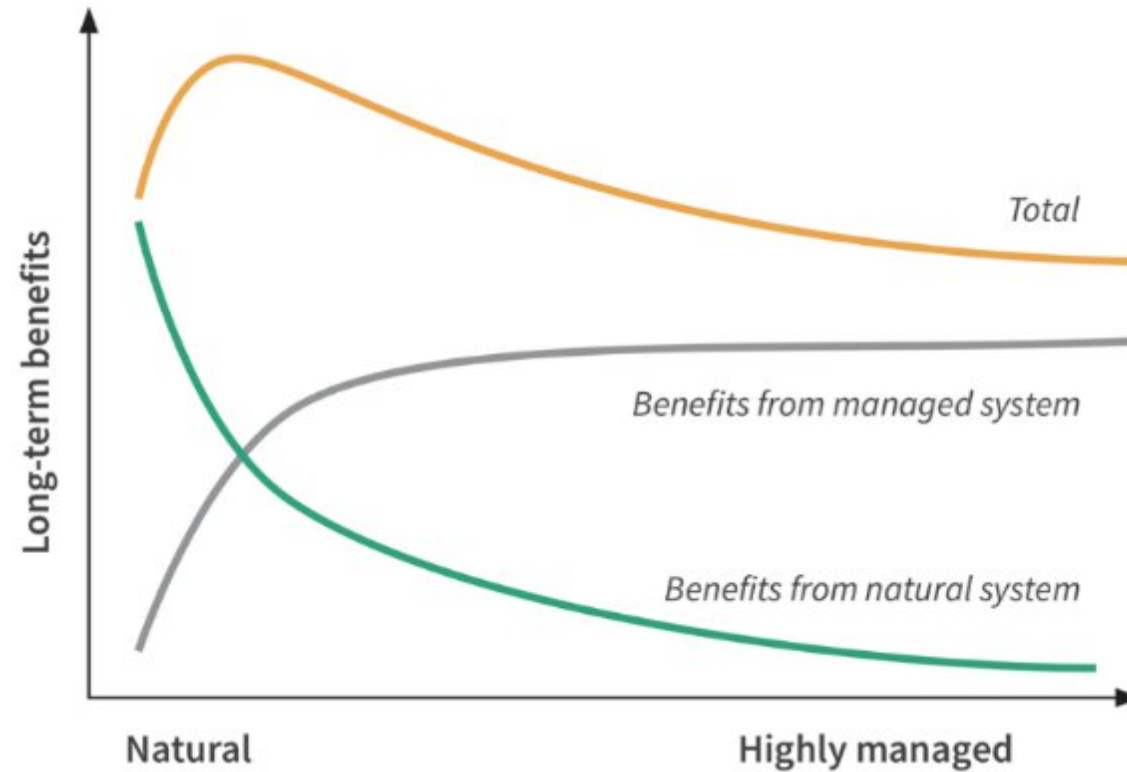


Infrastructure and Technology Options

Action Track	Options	Enhancing Robustness	Enhancing Flexibility
Water supply	<ul style="list-style-type: none"> • dams and reservoirs, aquifer recharge • water recycling • wetland restoration... 	<ul style="list-style-type: none"> • increase safety margins • modular designs 	<ul style="list-style-type: none"> • periodic reset of baselines • water agreements for proportional allocation
Food security	<ul style="list-style-type: none"> • irrigation • enhance water productivity • drought/flood tolerant varieties 	<ul style="list-style-type: none"> • multiple water supply options • scalable designs 	<ul style="list-style-type: none"> • staged water allocations • mixed built and natural infrastructure
Cities	<ul style="list-style-type: none"> • demand management • water recycling, desalination • flood protection... 	<ul style="list-style-type: none"> • M&E to enhance operational management 	<ul style="list-style-type: none"> • contingency planning • dynamic policy pathways
Rural livelihoods	<ul style="list-style-type: none"> • less water-intensive production • rainwater harvesting • flood/drought insurance... 	<ul style="list-style-type: none"> • fallback options 	<ul style="list-style-type: none"> • adaptive institutions

Combining Green and Grey Infrastructure

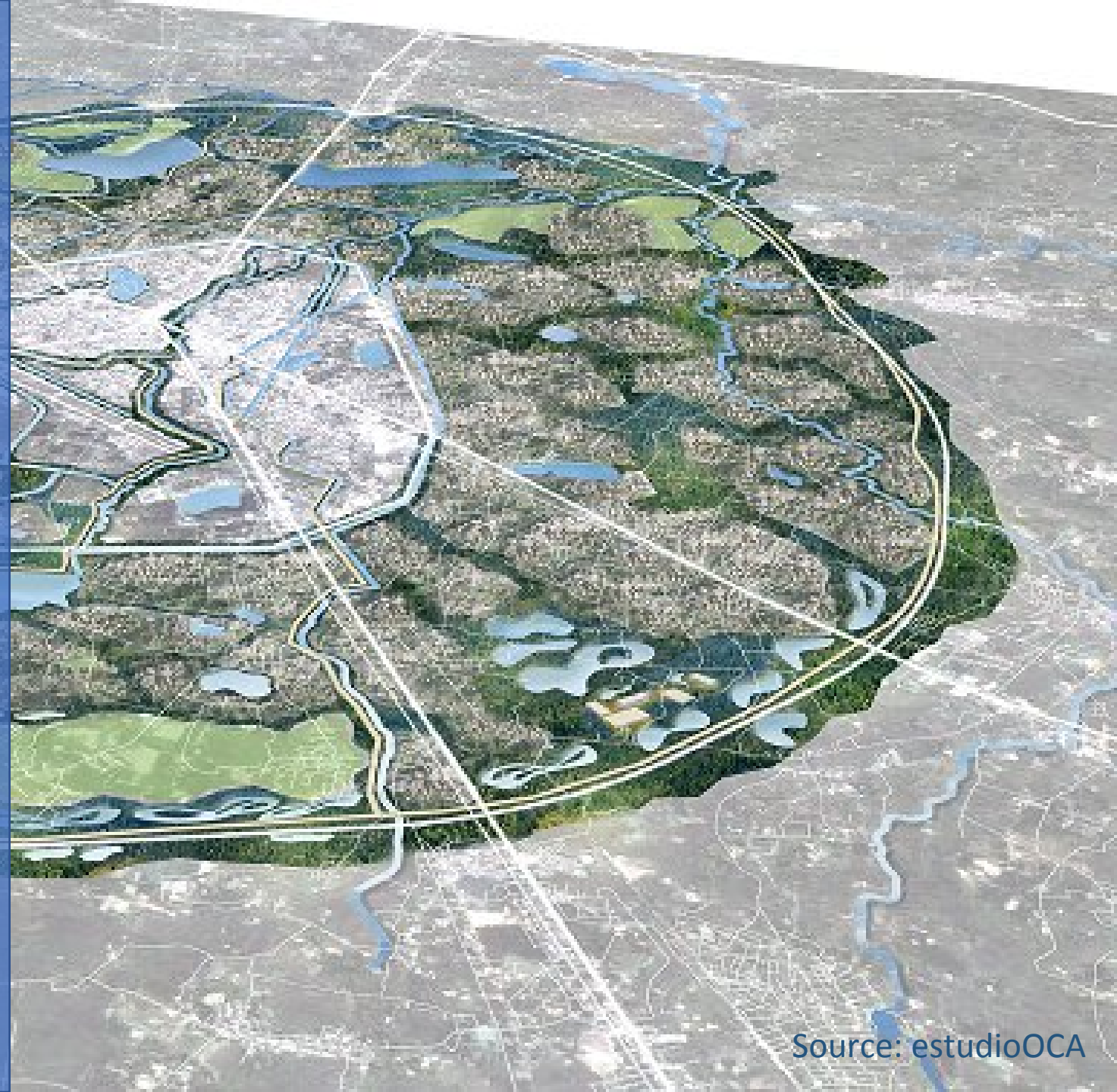
The goal is to find the most appropriate blend of NBS (green) and traditional engineered (grey) infrastructure to maximize benefits and system efficiency whilst minimizing costs and trade-offs



Source: Acreman, 2011

Udon Thani, Thailand

- Flood and drought under CC + urbanization
- Bottom-up vulnerability assessments
- Shared vision dialogues
- Regional economic vision
- NI strategy:
 - pumps and gates
 - linear parks for stormwater routing
 - wetlands + restoration for storage
 - risk informed decision making
- Leadership



Colombo Wetlands

- aligning community wetland practices and monitoring with government policies.
- promoting community best practices of wetland management to safeguard biodiversity and ecosystem services



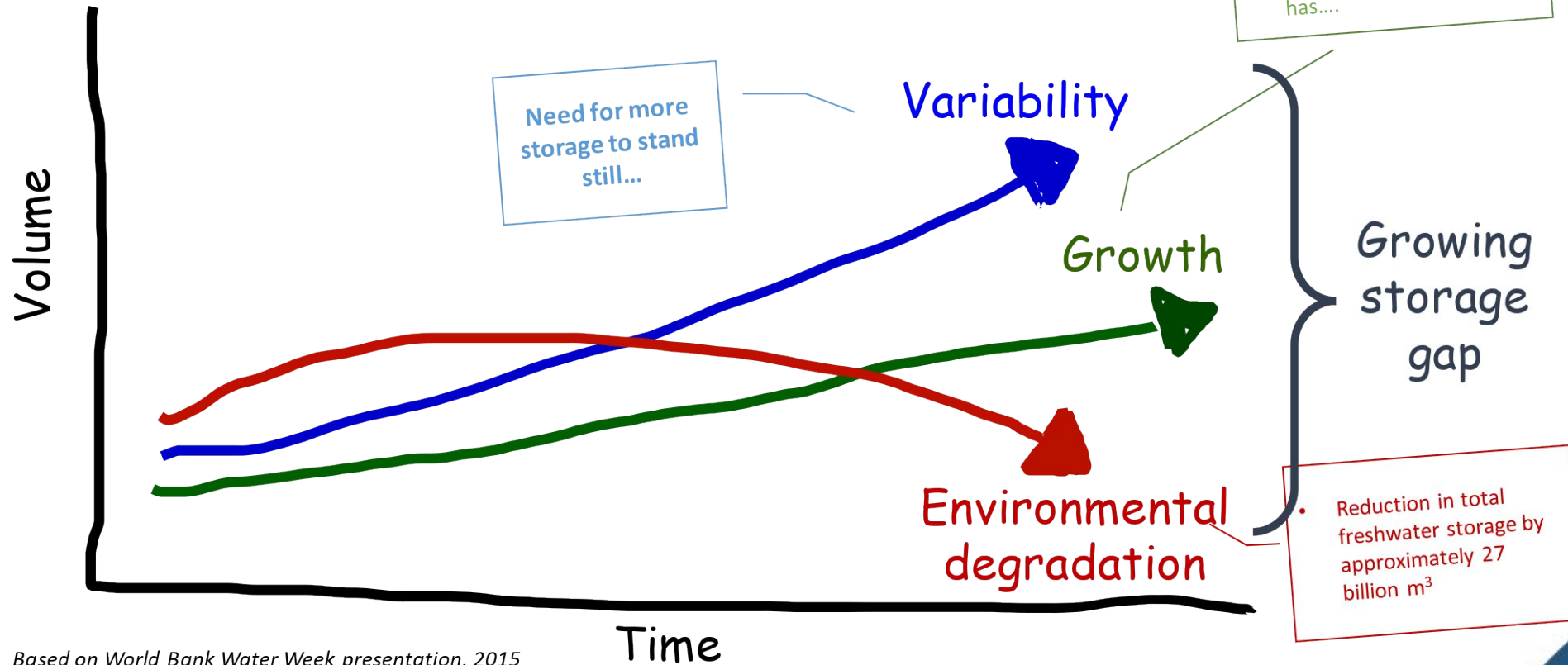
Schools Program



Participatory Video

Increasing water storage

loss of storage decreases the capability of a river basin or region to cope with increased hydroclimatic variability



Water, Adaptation and Equality

- Risk of making inequalities worse
- Inclusion of those most vulnerable to climate change
- Incorporate equality and inclusion in the Action Framework:
 - balancing scientific and local knowledge
 - integrating local practices through local participation
 - applying right's-based approaches



Conclusions

- Matching institutions and infrastructure to dynamically changing climates is radical change
 - single optimal solutions being replaced by resilient solutions
 - changes needed in policy, regulation, planning
 - decision making needs new methods and new data
- Build resilience by coordinating across 4 action domains
 - governance and participation; information and learning; system diversity and connectivity; infrastructure, technology and management
- Embed robustness and flexibility
- Ensure inclusion of those most vulnerable to climate change
- Financing water, financing climate...
- Living resiliently: we can prepare



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Thank you.

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Innovative water solutions for sustainable development

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