Global Water Partnership

Integrated approaches to planning and implementation of adaptation: Water Resources

Implementation of the Water, Climate and Development Programme (WACDEP) in Africa

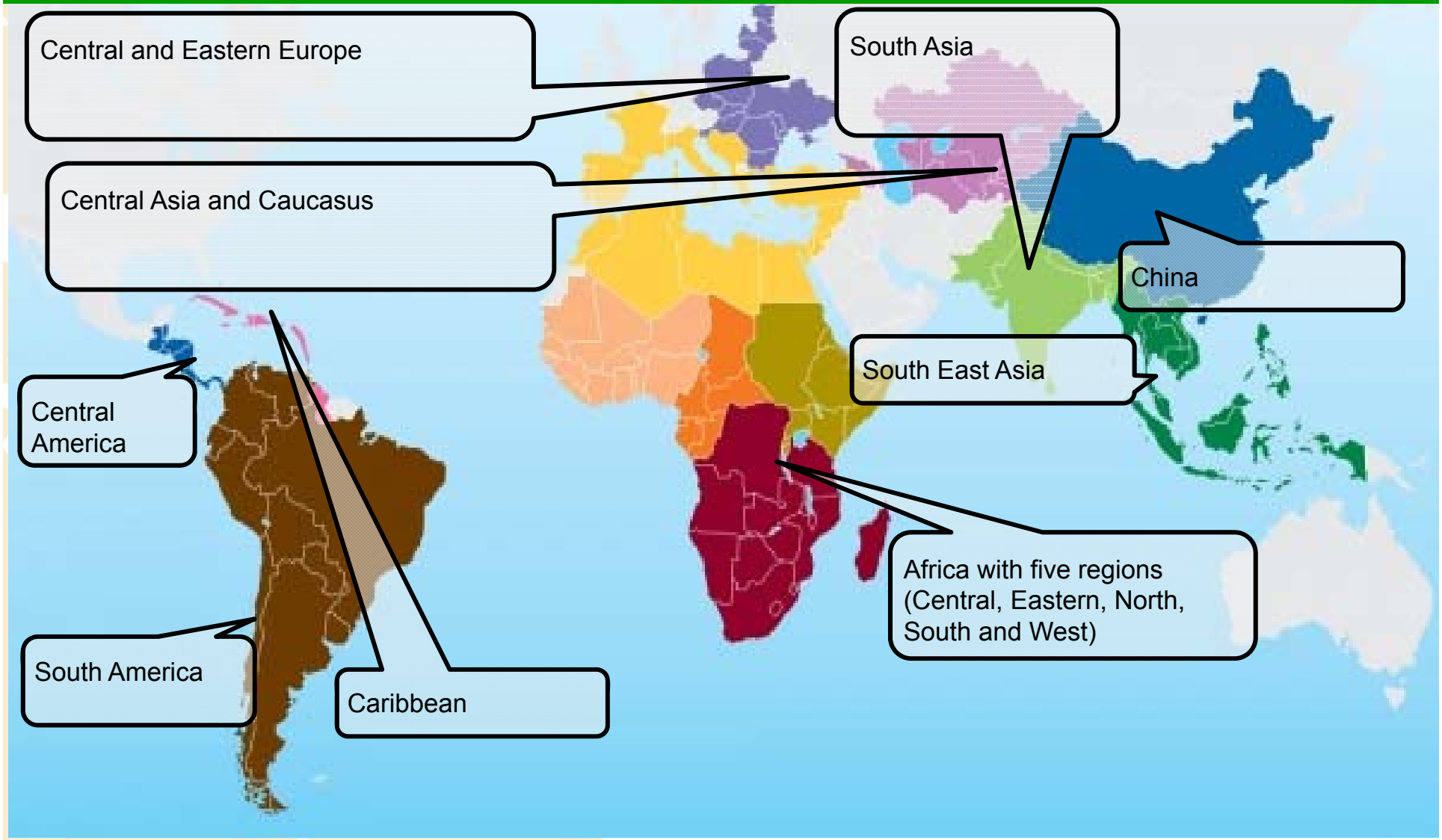
NAP Expo, Bonn, Germany
9 August 2014

Andrew Takawira
Senior Programme Officer
GWP Africa

www.gwp.org

BACKGROUND

Global WACDEP implementation



Framing water resources issues in WACDEP

- Water is the **primary medium through which climate change** influences the Earth ecosystems – livelihoods and well-beings of societies (UN-Water)
- Water **is the agent that delivers many of the impacts of climate change to society**, for example to the energy, agriculture, and transport sectors (IPCC WGII AR5)
- **Water resources and services are impacted by climate hazards** (floods, droughts etc.)
- Impacts extend beyond the **sphere of influence of the water sector** – requires cooperation

Framing water resources issues in WACDEP

- Water resources are already under pressure from non-climatic drivers and **climate change amplifies the problem**
- Key challenge in factoring climate change into water resources management lies in the **uncertainty**
- **Important to consider the regional and transboundary dimensions and link to national and local responses**
- Understanding **current interactions and water, climate and development futures** becomes critical in understanding risks to water resources and impacts to other sectors

WACDEP In Africa

WACDEP implements commitments in the 2008 Sharm el Sheik Declaration by the AU Heads of State on Water and Sanitation

And is central to the delivery of climate related objectives in the AMCOW Triennial WorkPlan

Goal of WACDEP

The goal of WACDEP is to promote water as a key part of sustainable regional and national development and contribute to climate change adaptation for economic growth and human security.

Overall objective of WACDEP

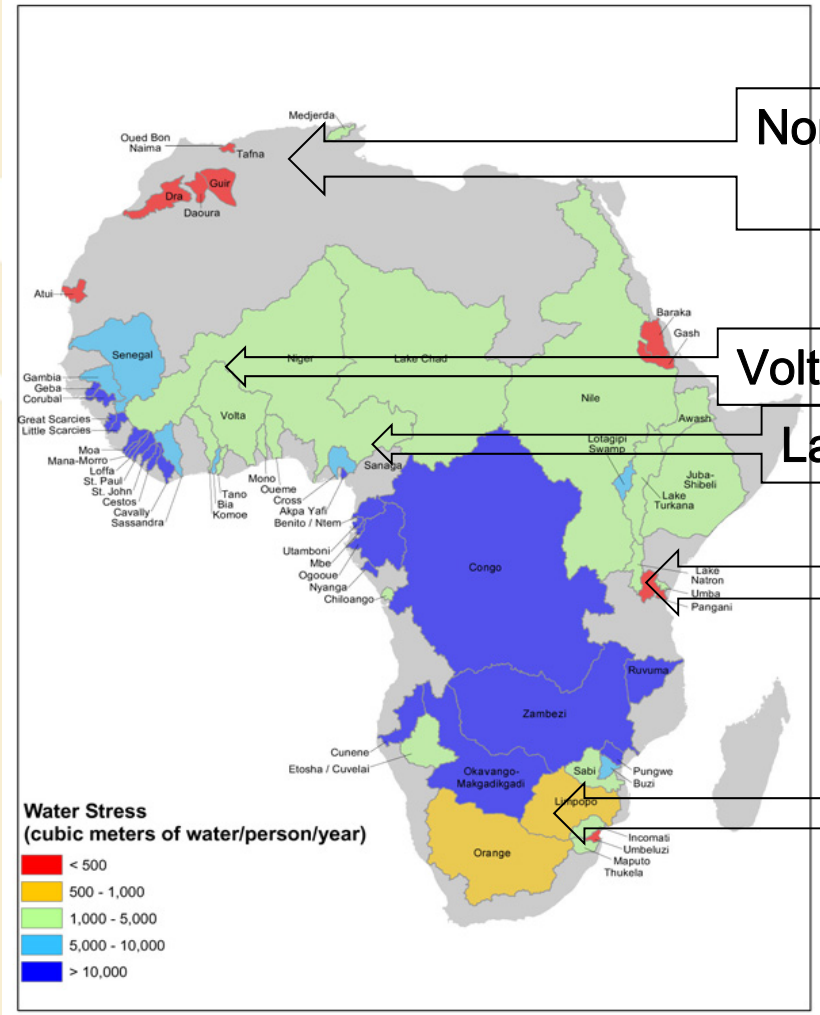
To support integration of water security and climate resilience in development planning and decision making processes

WACDEP is being implemented from 2011 – 2016

AMCOW programme implemented by the Global Water Partnership and partners in Africa

How are we achieving our objective?

Piloting WACDEP in Africa – 5 Tranboundary Water Basins and 8 Countries



North West Sahara Aquifer (Tunisia)

Volta Basin (Burkina Faso and Ghana)

Lake Chad Basin (Cameroon)

Kagera Basin (Burundi and Rwanda)

Limpopo Basin (Mozambique and Zimbabwe)

WACDEP Work Packages

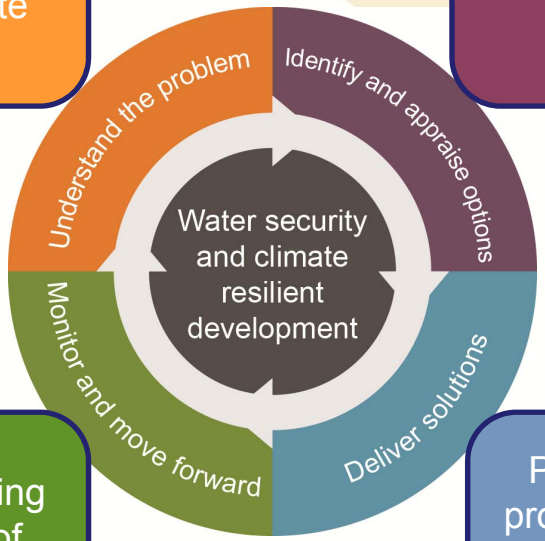
Outputs	Activities
Investments in Regional and National Development	**WP1: Regional and Transboundary Cooperation**
	WP 2: National Development and Sector Plans
	WP 3: Investment Planning
	WP 4: Project Preparation and Financing
Innovative solutions enhancing resilience	**WP 5: Local Projects building water security and climate resilience**
Knowledge and Capacity Development	**WP 6: Capacity Development**
	WP 7: Knowledge and Awareness
Partnership and Sustainability	**WP 8: Governance (M&E, fundraising, networking, partnerships)**

Framework for implementing WACDEP

Based around a generic decision making framework

Understand risks posed by current climate variability and future climate change

Identify options to improve climate resilience to current and future climate variability and change



Enhance monitoring and evaluation of water security and climate resilience

Prepare bankable projects and develop financing and implementation strategies

Understand the problem

The overall purpose of this phase of decision-making is to arrive at a common understanding on the priority existing and future climate risks and their potential impacts on development objectives.

Outcome: A strong, evidenced case for investment in climate resilient measures based on an understanding of the climate risks facing different stakeholders.

Sourcebook content: Tools, methods and approaches include:

1. Assessing existing climate risks
- 1.1 Engaging stakeholders in climate risk assessment
- 1.2 Rapid framing of climate impacts
- 1.3 Mapping the pathways between hazards, vulnerability and impacts
- 1.4 Prioritising impacts to assess levels of risk
- 1.5 Building the evidence base through technical studies

2. Assessing future climate risks
- 2.1 Understanding the role of climate change and development scenarios in the Caribbean
- 2.2 Determining the level of complexity for scenarios
- 2.3 Identifying data and information sources to develop scenarios
- 2.4 Building climate and development scenarios
- 2.5 Applying scenarios to assess future climate risk

3. Making a strong case for action
- 3.1 Identifying impact metrics to make a strong case
- 3.2 Using economic assessment of the impact of climate variability and change
- 3.3 Aligning the case for action with regional, national and sectoral policies and strategies
- 3.4 Identifying champions as a catalyst for action
- 3.5 Communicating the case for action

Identify and appraise options

The overall purpose of this phase of decision-making is to identify and appraise a coherent set of cost effective and feasible climate resilient adaptation options which address urgent and high priority risks.

Outcome: A strong, well-articulated and evidenced case for high priority options to build climate resilience.

Sourcebook content: Tools, methods and approaches include:

4. Understanding the principles of building resilience in water management
- 4.1 No and low regrets options are robust to climate change uncertainty
- 4.2 Enhancing resilience in water brings co-benefits to other sectors
- 4.3 Preparing for long term climate change requires a flexible pathway of actions

5. Using CCORAL to identify adaptation options
- 5.1 Introducing CCORAL
- 5.2 Applying CCORAL in the context of water management

6. Building on existing work to identify adaptation options
- 6.1 Reviewing past plans, policies and risk assessments to identify adaptation options
- 6.2 Building on the lessons from case studies and ongoing initiatives
- 6.3 Reviewing regional and international databases to identify opportunities for resilience

7. Prioritising adaptation options for implementation
- 7.1 Selecting appropriate prioritisation techniques
- 7.2 Multi criteria analysis (MCA)
- 7.3 Benefit cost analysis (BCA) and Cost Effectiveness Analysis (CEA)
- 7.4 Specialised decision making techniques

Monitor and move forward

The purpose of this phase of decision-making is to monitor and evaluate the impacts of investments in climate resilient development.

Outcome: Enhanced monitoring and evaluation frameworks which track the impact of investments in climate resilience, building on lessons learned.

Sourcebook content: Tools, methods and approaches include:

10. Benefiting from results based monitoring and evaluation
- 10.1 Results-based monitoring and evaluation
- 10.2 Incorporating climate change in existing monitoring and evaluation systems
- 10.3 Benchmarking and performance measurement

11. Learning lessons and communicating findings
- 11.1 Benefiting from learning reviews
- 11.2 Disseminating findings and regional learning

Deliver solutions

The purpose of this phase of decision-making is to secure finance for bankable projects that will enhance climate resilience.

Outcome: A suite of bankable projects, maximising leverage from climate financing sources for taking these forward.

Sourcebook content: Tools, methods and approaches include:

8. Taking options forward for implementation
- 8.1 Preparing bankable investment projects and programmes
- 8.2 Integrating adaptation options into development planning processes
- 8.3 Mainstreaming climate resilience

9. Identifying sources of finance to implement adaptation options
- 9.1 'Traditional' financing sources
- 9.2 Appreciating the growing importance of climate finance
- 9.3 Seeking opportunities to fund climate change related actions
- 9.4 Pragmatic considerations to be aware of when seeking funding

Understand the problem – Phase 1

Aim: to arrive at a common understanding on the priority of existing and future climate risks to water resources and services and their potential impacts on development objectives

Investments in Regional and National Development

WP1: Regional and Transboundary Cooperation

WP 2: National Development and Sector Plans

Understand the problem

The
co
ar

O
cli
of

Sc
ar

1.

2. **Assessing future climate risks**
   - 2.1 Understanding the role of climate change and development scenarios in the Caribbean
   - 2.2 Determining the level of complexity for scenarios

Identify and appraise options

The overall purpose of this phase of decision-making is to identify and appraise a coherent set of cost effective and feasible climate resilient adaptation options which address urgent and high priority risks.

Outcome: A strong, well-articulated and evidenced case for high priority options to build climate resilience.

Sourcebook content: Tools, methods and approaches include:

4. **Understanding the principles of building resilience in water management**
   - 4.1 No and low regrets options are robust to climate change uncertainty
   - 4.2 Enhancing resilience in water brings co-benefits to other sectors
   - 4.3 Preparing for long term climate change requires a flexible pathway of actions

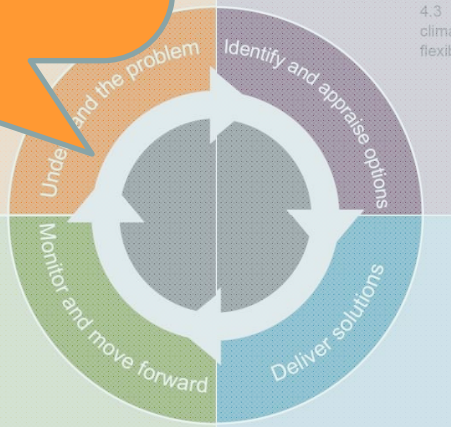
5. **Using CCORAL to identify adaptation options**
   - 5.1 Introducing CCORAL
   - 5.2 Applying CCORAL in the context of water management

6. **Building on existing work to identify adaptation options**
   - 6.1 Reviewing past plans, policies and risk assessments to identify adaptation options
   - 6.2 Building on the lessons from case studies and ongoing initiatives
   - 6.3 Reviewing regional and international databases to identify opportunities for resilience

7. **Prioritising adaptation options for implementation**
   - 7.1 Selecting appropriate prioritisation techniques
   - 7.2 Multi criteria analysis (MCA)
   - 7.3 Benefit cost analysis (BCA) and Cost Effectiveness Analysis (CEA)
   - 7.4 Specialised decision making techniques

Understand the problem

1. **Assessing existing climate risks**
2. **Assessing future risks**
3. **Making a strong case**



Monitor and move forward

The purpose of this phase of decision-making is to monitor and evaluate the impacts of investments in climate resilient development.

Outcome: Enhanced monitoring and evaluation frameworks which track the impact of investments in climate resilience, building on lessons learned.

Sourcebook content: Tools, methods and approaches include:

10. **Benefiting from results based monitoring and evaluation**
    - 10.1 Results-based monitoring and evaluation
    - 10.2 Incorporating climate change in existing monitoring and evaluation systems
    - 10.3 Benchmarking and performance measurement

11. **Learning lessons and communicating findings**
    - 11.1 Benefiting from learning reviews
    - 11.2 Disseminating findings and regional learning

Deliver solutions

The purpose of this phase of decision-making is to secure finance for bankable projects that will enhance climate resilience.

Outcome: A suite of bankable projects, maximising leverage from climate financing sources for taking these forward.

Sourcebook content: Tools, methods and approaches include:

8. **Taking options forward for implementation**
   - 8.1 Preparing bankable investment projects and programmes
   - 8.2 Integrating adaptation options into development planning processes
   - 8.3 Mainstreaming climate resilience

9. **Identifying sources of finance to implement adaptation options**
   - 9.1 'Traditional' financing sources
   - 9.2 Appreciating the growing importance of climate finance
   - 9.3 Seeking opportunities to fund climate change related actions
   - 9.4 Pragmatic considerations to be aware of when seeking funding

Examples of activities – Understand the Problem

Assessing existing and future climate risks –

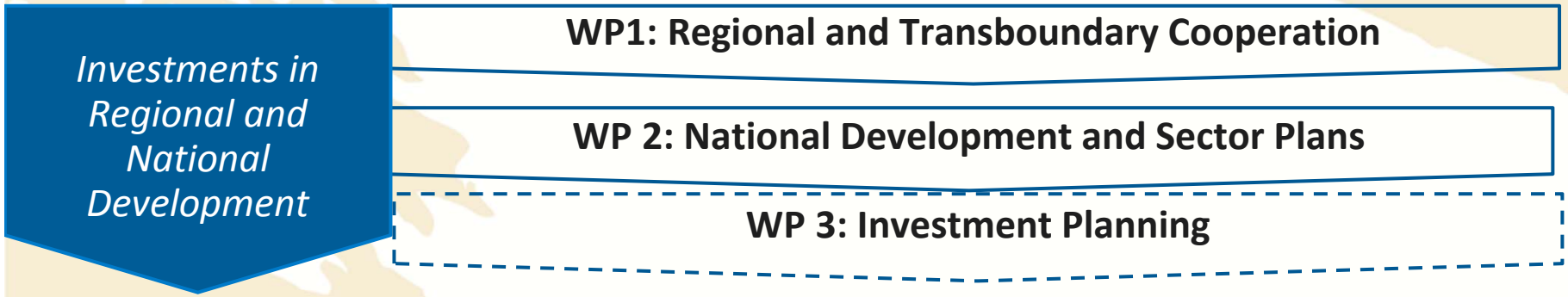
- Vulnerability Mapping in Tunisia to inform key strategies and plans on vulnerabilities (current and future) for the country's main water resources.
- Understanding key climate and non-climate scenario variables linked to the potential risks
- Development of scenarios with broader stakeholder consultation
- Working with experts to develop scenarios of water demand and climate change (climate specialists, hydrologists, water planners etc.)

Making a strong case for action

- Showing the cost of inaction (not investing in adaptation strategies) in the Limpopo Basin in Southern Africa (economic assessment of the impact of climate variability and change) aimed at building a case to engage development planners

Identify and appraise options – Phase 2

Aim: to identify and appraise a coherent set of cost effective and feasible climate resilient adaptation options which address identified risks



Identify options

4. **Principles of building resilience in water management**
5. **Building on existing work**
6. **Prioritising options**

Understand the problem

The overall purpose of this phase of decision-making is to arrive at a common understanding on the priority existing and future climate risks and their potential impacts on development objectives.

Outcome: A strong, evidenced case for investment in climate resilient measures based on an understanding of the climate risks facing different stakeholders.

Sourcebook content: Tools, methods and approaches include:

1. **Assessing existing climate risks**
   - 1.1 Engaging stakeholders in climate risk assessment
   - 1.2 Rapid framing of climate impacts
   - 1.3 Mapping the pathways between hazards, vulnerability and impacts
   - 1.4 Prioritising impacts to assess levels of risk
   - 1.5 Building the evidence base through technical studies
2. **Assessing future climate risks**
   - 2.1 Understanding the role of climate change and development scenarios in the Caribbean
   - 2.2 Determining the level of complexity for scenarios
   - 2.3 Identifying data and information sources to develop scenarios
   - 2.4 Building climate and development scenarios
   - 2.5 Applying scenarios to assess future climate risk
3. **Making a strong case for action**
   - 3.1 Identifying impact metrics to make a strong case
   - 3.2 Using economic assessment of the impact of climate variability and change
   - 3.3 Aligning the case for action with regional, national and sectoral policies and strategies
   - 3.4 Identifying champions as a catalyst for action
   - 3.5 Communicating the case for action

Identify and appraise options

The overal… appraise a… adaptation…

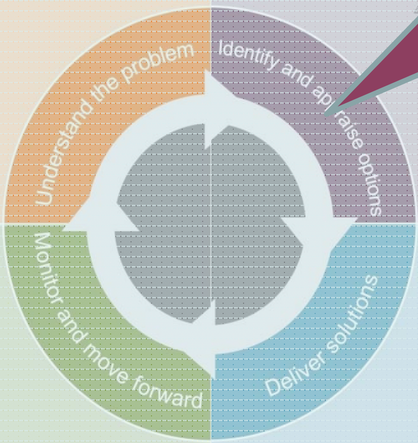
Outcome: A… case for high…

Sourceboo… and approac…

4. **Unders… resilien…**
   - 4.1 No… to cl…
   - 4.2 Enhanc… co-benefits to othe…

…to identify opportunities for resilience

7. **Prioritising adaptation options for implementation**
   - 7.1 Selecting appropriate prioritisation techniques
   - 7.2 Multi criteria analysis (MCA)
   - 7.3 Benefit cost analysis (BCA) and Cost Effectiveness Analysis (CEA)
   - 7.4 Specialised decision making techniques



Monitor and move forward

The purpose of this phase of decision-making is to monitor and evaluate the impacts of investments in climate resilient development.

Outcome: Enhanced monitoring and evaluation frameworks which track the impact of investments in climate resilience, building on lessons learned.

Sourcebook content: Tools, methods and approaches include:

10. **Benefiting from results based monitoring and evaluation**
    - 10.1 Results-based monitoring and evaluation
    - 10.2 Incorporating climate change in existing monitoring and evaluation systems
    - 10.3 Benchmarking and performance measurement
11. **Learning lessons and communicating findings**
    - 11.1 Benefiting from learning reviews
    - 11.2 Disseminating findings and regional learning

Deliver solutions

The purpose of this phase of decision-making is to secure finance for bankable projects that will enhance climate resilience.

Outcome: A suite of bankable projects, maximising leverage from climate financing sources for taking these forward.

Sourcebook content: Tools, methods and approaches include:

8. **Taking options forward for implementation**
   - 8.1 Preparing bankable investment projects and programmes
   - 8.2 Integrating adaptation options into development planning processes
   - 8.3 Mainstreaming climate resilience
9. **Identifying sources of finance to implement adaptation options**
   - 9.1 'Traditional' financing sources
   - 9.2 Appreciating the growing importance of climate finance
   - 9.3 Seeking opportunities to fund climate change related actions
   - 9.4 Pragmatic considerations to be aware of when seeking funding

Examples of activities – Identifying and appraise options

Building on existing work to identify adaptation options –

- In Ghana supporting the development of a tool for screening projects to ensure they enhance water security and climate resilience working with the National Planning and Development Commission
- Tool to be used by District Assemblies (DAs) and Basin Water Authorities in their prioritisation of water related projects in local development plans – to ensure robustness
- Testing of guidelines in the White Volta Basin working with DAs

Prioritising adaptation options for implementation –

Working with UNDP GEF to implement training on Economics of Climate Change Adaptation in order to prioritise adaptation options for implementation – planners from government institutions supported in WACDEP have been identified to be part of this training.

Deliver solutions – Phase 3

Aim: to integrating adaptation options into development plans and securing finance for well prepared projects which will enhance climate resilience

Investments in Regional and National Development

WP 3: Investment Planning

WP 4: Project Preparation and Financing

Innovative solutions enhancing resilience

WP 5: Local Projects building water security and climate resilience

Understand the problem

The overall purpose of this phase of decision-making is to arrive at a common understanding on the priority existing and future climate risks and their potential impacts on development objectives.

Outcome: A strong, evidenced case for investment in climate resilient measures based on an understanding of the climate risks facing different stakeholders.

Sourcebook content: Tools, methods and approaches include:

1. **Assessing existing climate risks**
   - 1.1 Engaging stakeholders in climate risk assessment
   - 1.2 Rapid framing of climate impacts
   - 1.3 Mapping the pathways between hazards, vulnerability and impacts
   - 1.4 Prioritising impacts to assess levels of risk
   - 1.5 Building the evidence base through technical studies
2. **Assessing future climate risks**
   - 2.1 Understanding the role of climate change and development scenarios in the Caribbean
   - 2.2 Determining the level of complexity for scenarios
   - 2.3 Identifying data and information sources to develop scenarios
   - 2.4 Building climate and development scenarios
   - 2.5 Applying scenarios to assess future climate risk
3. **Making a strong case for action**
   - 3.1 Identifying impact metrics to make a strong case
   - 3.2 Using economic assessment of the impact of climate variability and change
   - 3.3 Aligning the case for action with regional, national and sectoral policies and strategies
   - 3.4 Identifying champions as a catalyst for action
   - 3.5 Communicating the case for action

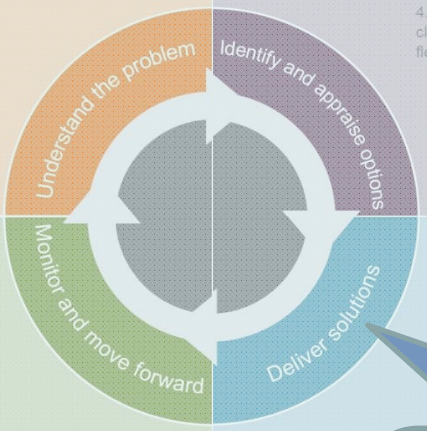
Identify and appraise options

The overall purpose of this phase of decision-making is to identify and appraise a coherent set of cost effective and feasible climate resilient adaptation options which address urgent and high priority risks.

Outcome: A strong, well-articulated and evidenced case for high priority options to build climate resilience.

Sourcebook content: Tools, methods and approaches include:

4. **Understanding the principles of building resilience in water management**
   - 4.1 No and low regrets options are robust to climate change uncertainty
   - 4.2 Enhancing resilience in water brings co-benefits to other sectors
   - 4.3 Preparing for long term climate change requires a flexible pathway of actions
5. **Using CCORAL to identify adaptation options**
   - 5.1 Introducing CCORAL
   - 5.2 Applying CCORAL in the context of water management
6. **Building on existing work to identify adaptation options**
   - 6.1 Reviewing past plans, policies and risk assessments to identify adaptation options
   - 6.2 Building on the lessons from case studies and ongoing initiatives
   - 6.3 Reviewing regional and international databases to identify opportunities for resilience
7. **Prioritising adaptation options for implementation**
   - 7.1 Selecting appropriate prioritisation techniques
   - 7.2 Multi criteria analysis (MCA)
   - 7.3 Benefit cost analysis (BCA) and Cost Effectiveness Analysis (CEA)
   - 7.4 Specialised decision making techniques



Monitor and move forward

The purpose of this phase of decision-making is to monitor and evaluate the impacts of investments in climate resilient development.

Outcome: Enhanced monitoring and evaluation frameworks which track the impact of investments in climate resilience, building on lessons learned.

Sourcebook content: Tools, methods and approaches include:

10. **Benefiting from results based monitoring and evaluation**
    - 10.1 Results-based monitoring and evaluation
    - 10.2 Incorporating climate change in existing monitoring and evaluation systems
    - 10.3 Benchmarking and performance measurement
11. **Learning lessons and communicating findings**
    - 11.1 Benefiting from learning reviews
    - 11.2 Disseminating findings and regional learning

Deliver solutions

The purpose of this phase of decision-making is to secure finance for bankable projects that will enhance climate resilience.

Outcome: A suite of bankable projects, maximising leverage [illegible] financing sources for taking these forward.

S[illegible] Tools, methods and approaches include:

8. **Taking opt[illegible]**
   - 8.1 Prepar[illegible]
   - 8.2 Integra[illegible]
   - 8.3 Mainst[illegible]
9. **Identifying[illegible]**
   - 9.1 'Traditi[illegible]
   - 9.2 Appre[illegible]
   - 9.3 Seekin[illegible]
   - 9.4 Pragm[illegible]

Deliver solutions

8. Taking options forward for implementation

9. Identifying sources of finance to implement adaptation options

Examples of activities – Deliver solutions

Taking forward options for implementation

- In Burkina Faso WACDEP supported SP/CONEDD in strengthening water issues in the NAP as a cross-cutting issue through stakeholder engagement and expert consultation
- In Rwanda and Burundi in the Bugasera Catchment (Kagera Basin) local projects promoting transboundary cooperation are being implemented
  - focused on hotspots identified in the Kagera Vulnerablity Assessment
  - Community level vulnerability assessments conducted in selected communities – looking at the impacts of hazards on water resources thus livelihoods and assets
  - aimed at enhancing community resilience to climate risks by protecting the catchment area around Lake Cyhoha in both countries – creating buffer zones and introducing alternative energy sources

Preparing projects and identifying sources of finance to implement adaptation options

- Working with the Infrastructure Consortium for Africa and the Africa Water Facility to support institutions in better preparing projects **to leverage funding for water security and climate resilience projects** targeting climate finance, water financing, public funds, private funders etc.

Enabling Actions – Capacity Development

Knowledge and Capacity Development

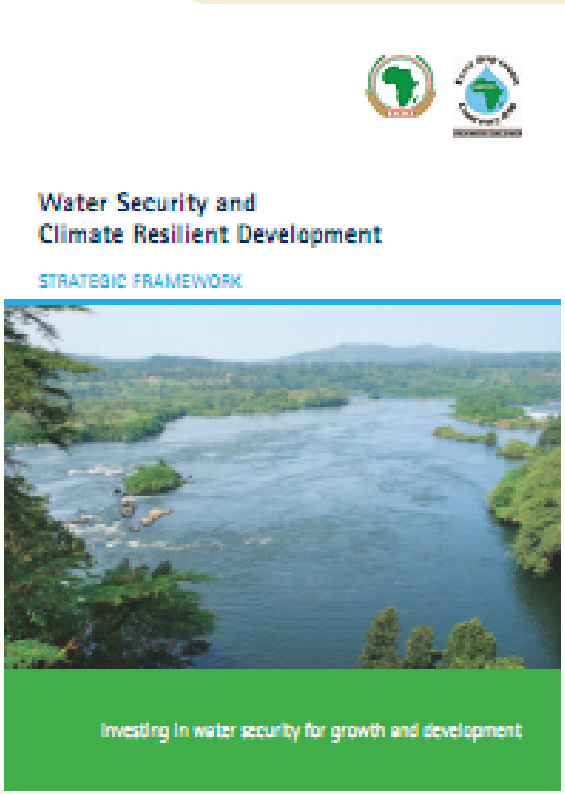
WP 6: Capacity Development

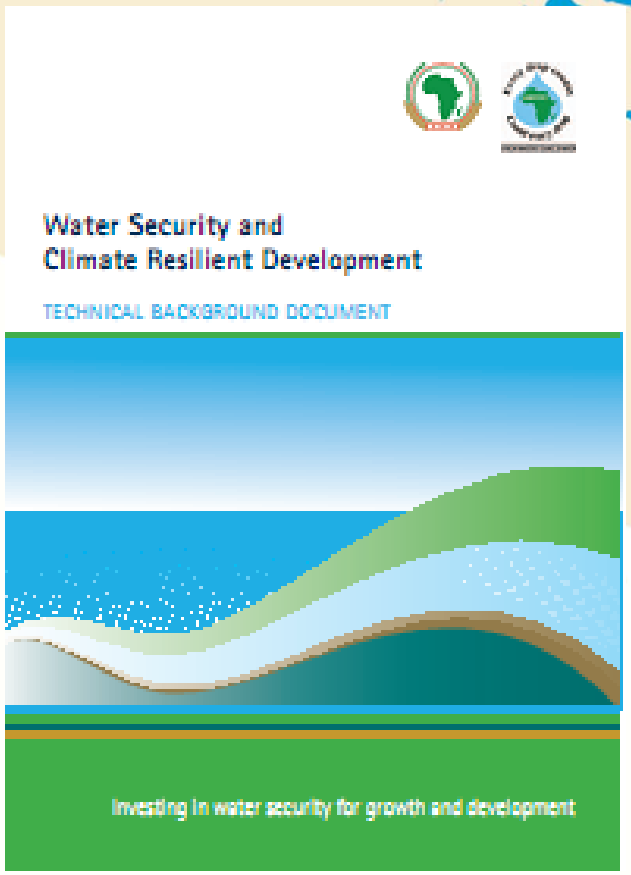
- 5 workshops over a period of 1 year on the Phases of the Strategic Framework (module developed for each Phase)
- Training 96 planners in the 8 pilot countries with support from CDKN (3-4 institutions per country)
- Participants are planners from water related sectors – identified through a Capacity Needs Assessment carried out in each country
- Training linked to on-going processes in the participants home institution and other WPs in WACDEP
- Mentoring and coaching in between the 5 workshops in home institutions
- Senior decision makers (from institutions where the planners are coming from) also involved in parts of the training
- Trainers are local experts trained at the Pan African level working with UNDP GEF

Enabling Actions

Knowledge and Capacity Development

WP 7: Knowledge and Awareness





Enabling Actions

Knowledge and Capacity Development

WP 7: Knowledge and Awareness

- Working with UNICEF to develop a Framework for aimed at **building resilience in the WASH sector**
- Contributing to the work on the development of a **water supplement for the NAP technical guidelines**
- Development of **guidelines on flood and drought management** through the GWP/WMO Help Desks on floods and droughts
- GWP ToolBox – **www.gwptoolbox.org**
- Working with the Africa Network of Basin Organisations – to develop tools, methods and approaches for considering the **regional and transboundary dimensions of climate change on water resources**

Monitor and move forward– Phase 4

Aim: monitor and evaluate the impacts of investments in water security and climate resilience building on lessons learnt development planning and fundable projects developed for financing

Partnership and Sustainability

WP 8: Governance (M&E, fundraising, networking, partnerships)

Box 11.2 – The Global Water Partnership (GWP) IWRMToolBox, disseminating good practice

The IWRM ToolBox comprises an organized collection of case studies, reference documents, reader lists, external web sites and other supporting materials in water resources management, which have been submitted by various contributors and are peer reviewed including from the Caribbean.

The IWRM ToolBox is intended to be an information exchange platform where experiences are shared to help develop the body of knowledge which can enable all those engaged in water issues to work together to build water security and sustainable water for all. GWP has developed the ToolBox as a free access source of knowledge.

1.4 Prioritising impacts to assess levels of risk
1.5 Building the evidence base through technical studies

2. **Assessing future climate risks**
   2.1 Understanding the role of climate change and development scenarios in the Caribbean
   2.2 Determining the level of complexity for scenarios

Monitor and move forward

The purpose of this phase of decision-making is to monitor and evaluate the impacts of investments in climate resilient development.

Outcome: Enhanced monitoring and evaluation frameworks which track the impa… of investments in climate resilience, building on lessons learned.

Sourcebook content: Tools, methods and approaches incl…

10

11

10. Results based monitoring and evaluation
11. Learning lessons and dissemination

…nd appraise options

…l purpose of this phase of decision-making is to identify and … coherent set of cost effective and feasible climate resilient … options which address urgent and high priority risks.

… strong, well-articulated and evidenced … priority options to build climate resilience.

…k content: Tools, methods …hes include:

…tanding the principles of building …ce in water management

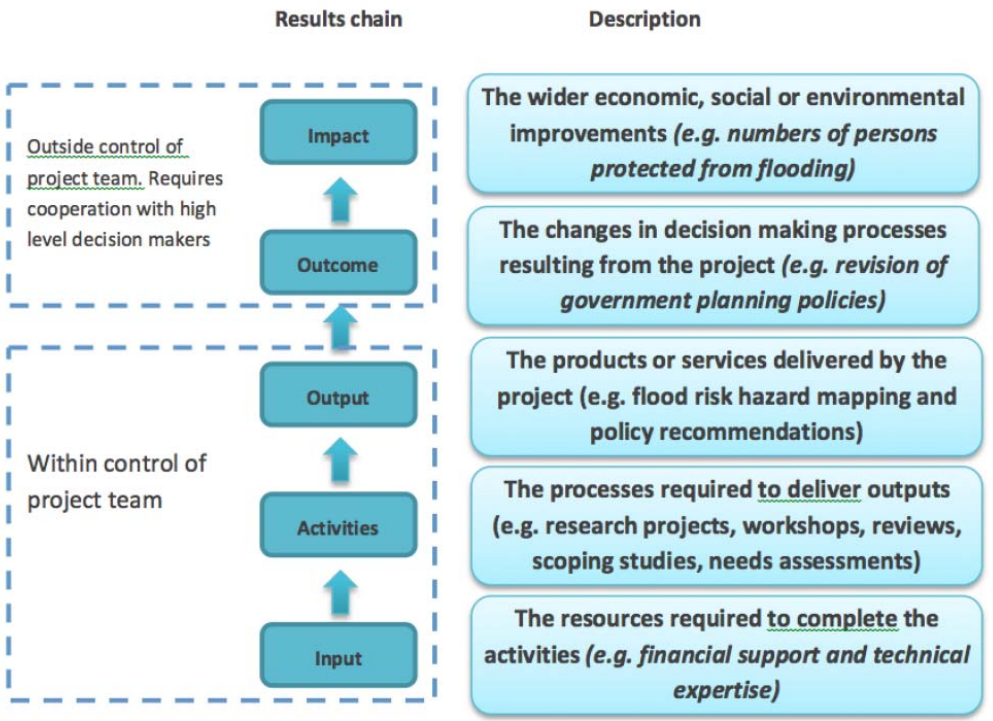
…and low regrets options are robust …limate change uncertainty …ancing resilience in water brings …benefits to other sectors

4.3 Preparing for long term

5. **Using CCORAL to identify adaptation options**
   5.1 Introducing CCORAL
   5.2 Applying CCORAL in the context of water management

6. **Building on existing work to identify adaptation options**
   6.1 Reviewing past plans, policies and risk assessments to identify adaptation options
   6.2 Building on the lessons from case studies and ongoing initiatives
   6.3 Reviewing regional and international databases to identify opportunities for resilience

Figure 10.1 - Conceptual results framework (adapted from UNDP, 2011)



www.gwp.org

Global Water Partnership

What are we learning so far in the implementation of WACDEP?

Key lessons so far

- Uncertainty in understanding the interaction of water , climate and development futures – a focus on no/low regret options addresses the link between resilience to current and future climate risks
- Preparing for long term climate change requires consideration for flexible pathways
- In managing risks: risk preference is an important component in decision making and more understanding is needed in this area
- Partnerships are important at all levels in order to effectively deliver and support countries and institutions in adaptation planning and implementation – NAP GSP
- Important to work at all scales (transboundary, national and local) and link - noting that development is at local level

Key lessons so far

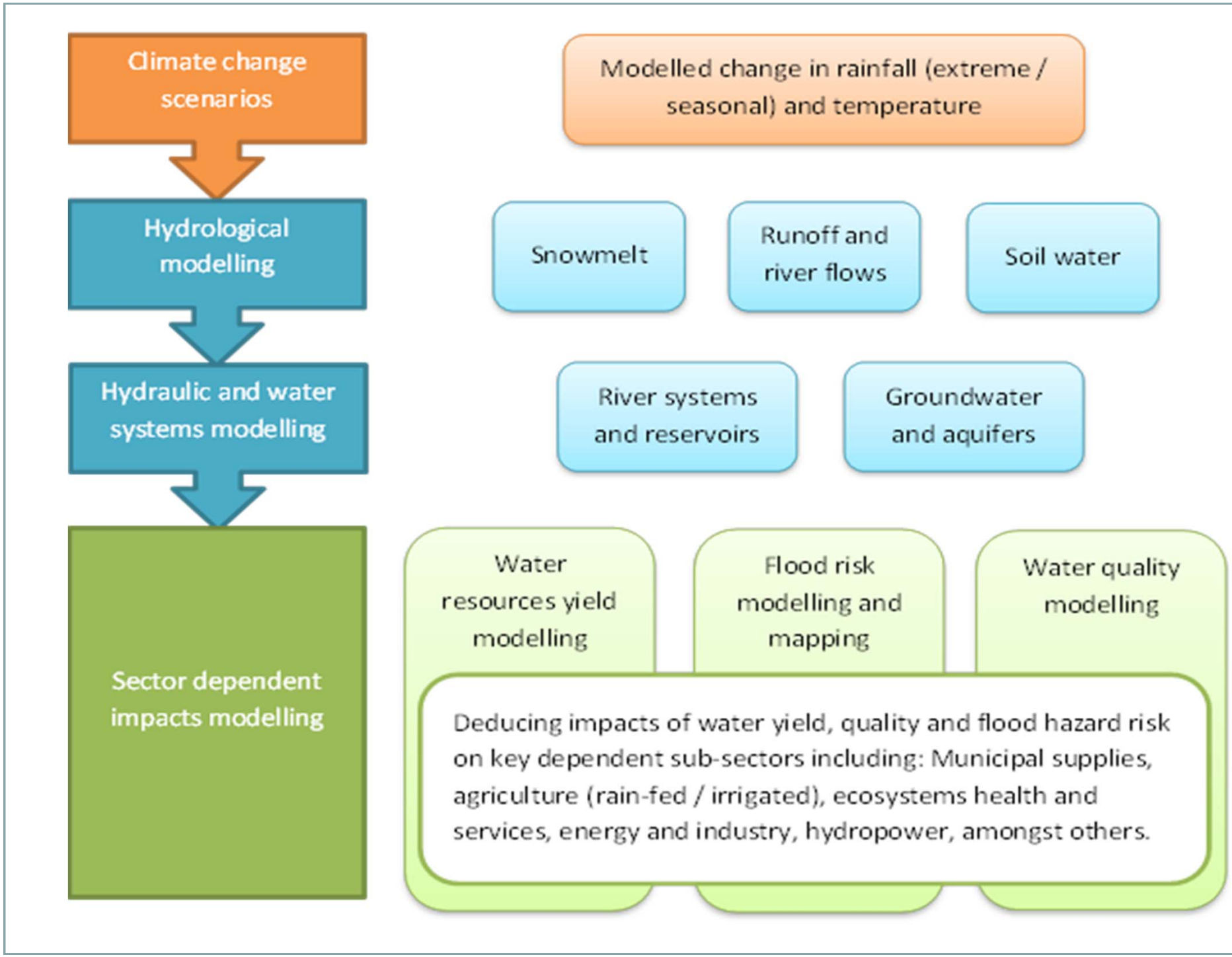
- Information is important in building the evidence base a lot of work is being done in improving availability but more resources are needed to improve water and climate data in Africa
- Planning and implementing adaptation within existing institutions and development processes leads to early action and putting adaptation into practice
- Broad stakeholder involvement is critical in order to consider the complex interdependencies between water and water related sectors
- It is important to learn from past and on-going adaptation actions. Managing risks to water resources builds on the foundations of IWRM and adaptive water management approaches
- Capacity development (targeted at institutions) takes time and is a necessary investment in order to ensure climate adaptation is integrated into development processes at different levels and sectors

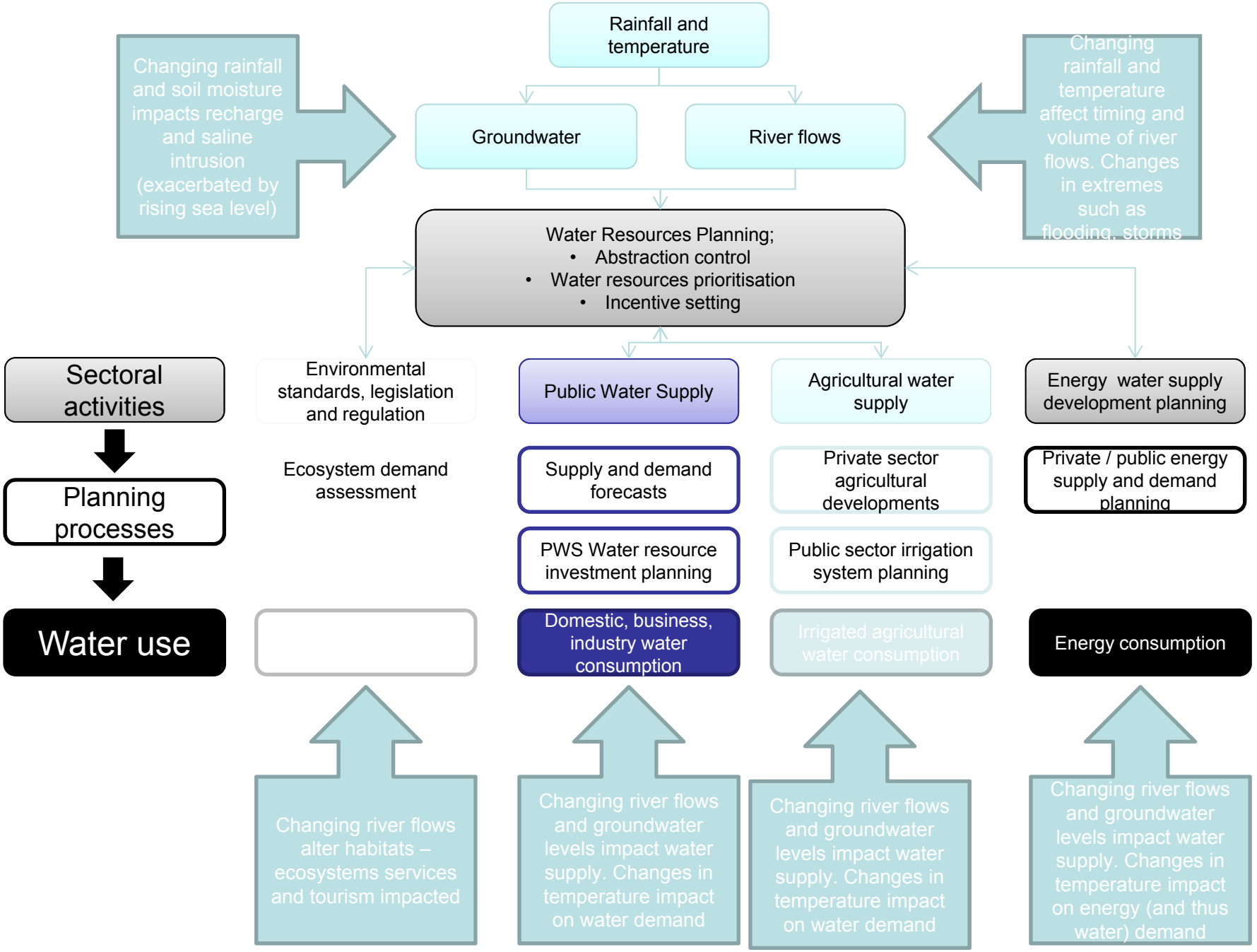
GWP Water and Climate Programme

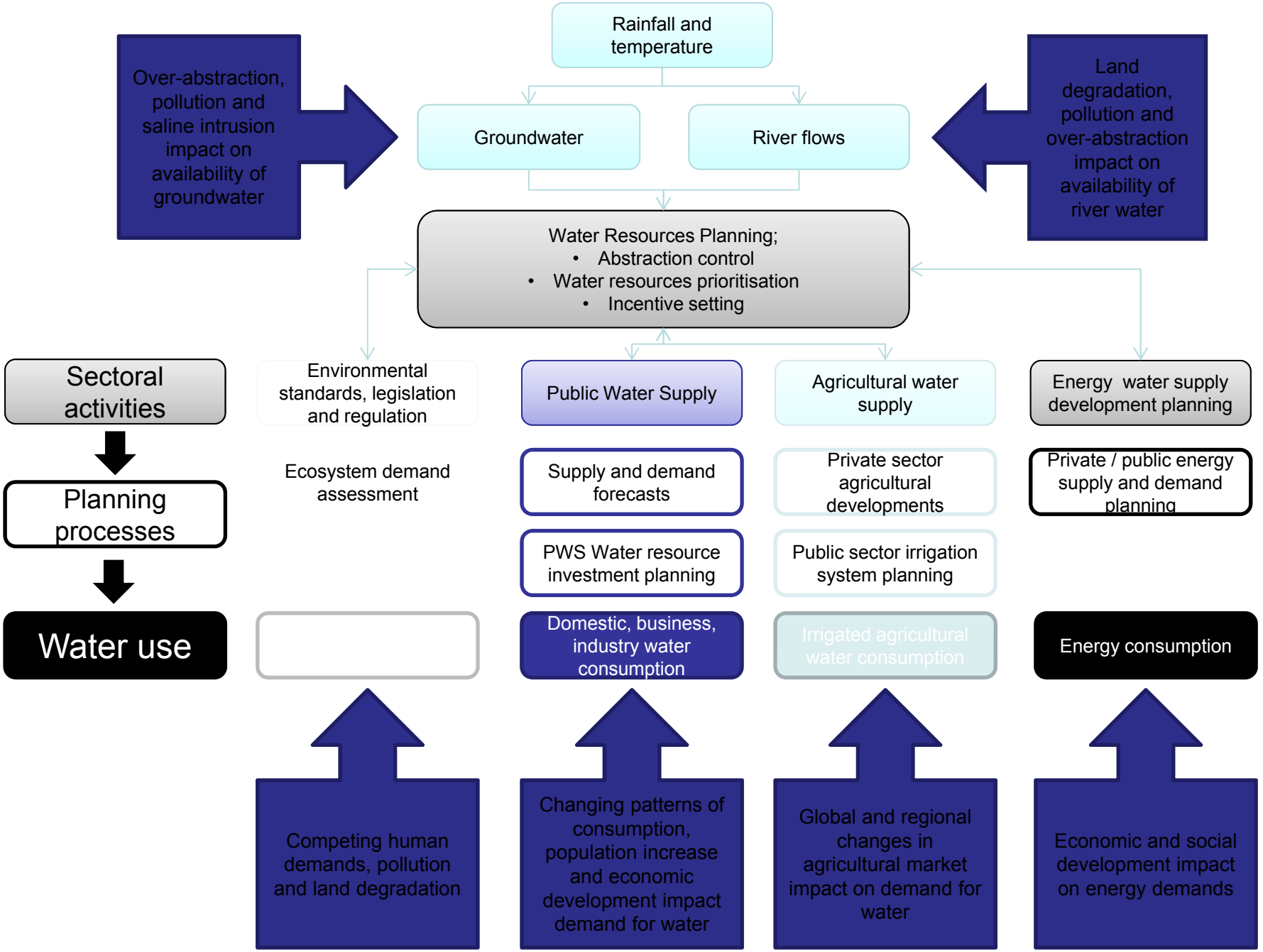
- WMO/GWP Associated Programme on Flood Management www.apfm.info
- WMO/GWP Integrated Drought Management Programme www.droughtmanagement.info
- Strengthening Institutions in Transboundary Water (SITWA) www.gwp.org
- Enabling Delta Life www.gwp.org

Thank you

For more information please visit
www.gwp.org/wacdep
www.amcow-online.org


Climate change scenarios
Modelled change in rainfall (extreme / seasonal) and temperature
Hydrological modelling
Snowmelt
Runoff and river flows
Soil water
Hydraulic and water systems modelling
River systems and reservoirs
Groundwater and aquifers
Sector dependent impacts modelling
Water resources yield modelling
Flood risk modelling and mapping
Water quality modelling
Deducing impacts of water yield, quality and flood hazard risk on key dependent sub-sectors including: Municipal supplies, agriculture (rain-fed / irrigated), ecosystems health and services, energy and industry, hydropower, amongst others.


Rainfall and temperature
Changing rainfall and soil moisture impacts recharge and saline intrusion (exacerbated by rising sea level)
Changing rainfall and temperature affect timing and volume of river flows. Changes in extremes such as flooding, storms
Groundwater
River flows
Water Resources Planning;
• Abstraction control
• Water resources prioritisation
• Incentive setting
Sectoral activities
Planning processes
Water use
Environmental standards, legislation and regulation
Ecosystem demand assessment
Public Water Supply
Supply and demand forecasts
PWS Water resource investment planning
Domestic, business, industry water consumption
Agricultural water supply
Private sector agricultural developments
Public sector irrigation system planning
Irrigated agricultural water consumption
Energy water supply development planning
Private / public energy supply and demand planning
Energy consumption
Changing river flows alter habitats – ecosystems services and tourism impacted
Changing river flows and groundwater levels impact water supply. Changes in temperature impact on water demand
Changing river flows and groundwater levels impact water supply. Changes in temperature impact on water demand
Changing river flows and groundwater levels impact water supply. Changes in temperature impact on energy (and thus water) demand


Rainfall and temperature
Over-abstraction, pollution and saline intrusion impact on availability of groundwater
Groundwater
River flows
Land degradation, pollution and over-abstraction impact on availability of river water
Water Resources Planning;
• Abstraction control
• Water resources prioritisation
• Incentive setting
Sectoral activities
Planning processes
Water use
Environmental standards, legislation and regulation
Ecosystem demand assessment
Public Water Supply
Supply and demand forecasts
PWS Water resource investment planning
Domestic, business, industry water consumption
Agricultural water supply
Private sector agricultural developments
Public sector irrigation system planning
Irrigated agricultural water consumption
Energy water supply development planning
Private / public energy supply and demand planning
Energy consumption
Competing human demands, pollution and land degradation
Changing patterns of consumption, population increase and economic development impact demand for water
Global and regional changes in agricultural market impact on demand for water
Economic and social development impact on energy demands