# COMPASS-Navigating the 21st Century Water Challenges in Africa

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futureearth
research for global sustainability

# Water Future Objective:

Support the implementation of freshwater water related sustainable development through the integrating research, stimulating innovation, and building capacity .


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# Water Future Vision:

Water Future, through its partnerships with a large number of researchers and stakeholders, work together to harvest and synthesize authoritative sound and a scientific knowledge base to achieve the Sustainable Development priorities associated with water.

**KEY FACTS**

13 International Working Groups

202 Organisations

550 Core Researchers

5650 Network of Scientists, Policy Makers

**A Scientific, Policy Relevant, and Solution Oriented Global Water Research Initiative for Sustainable Development**

# Water Future Concept

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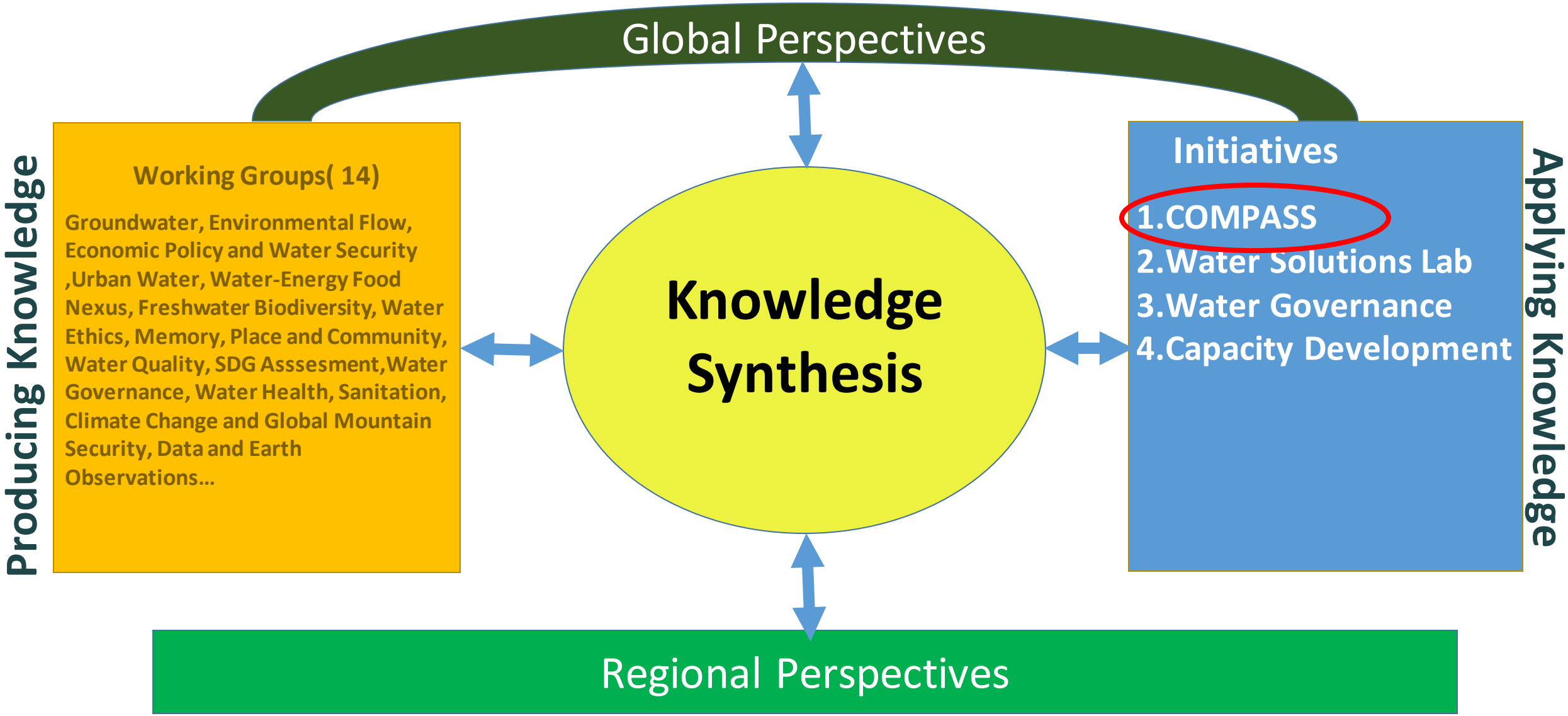
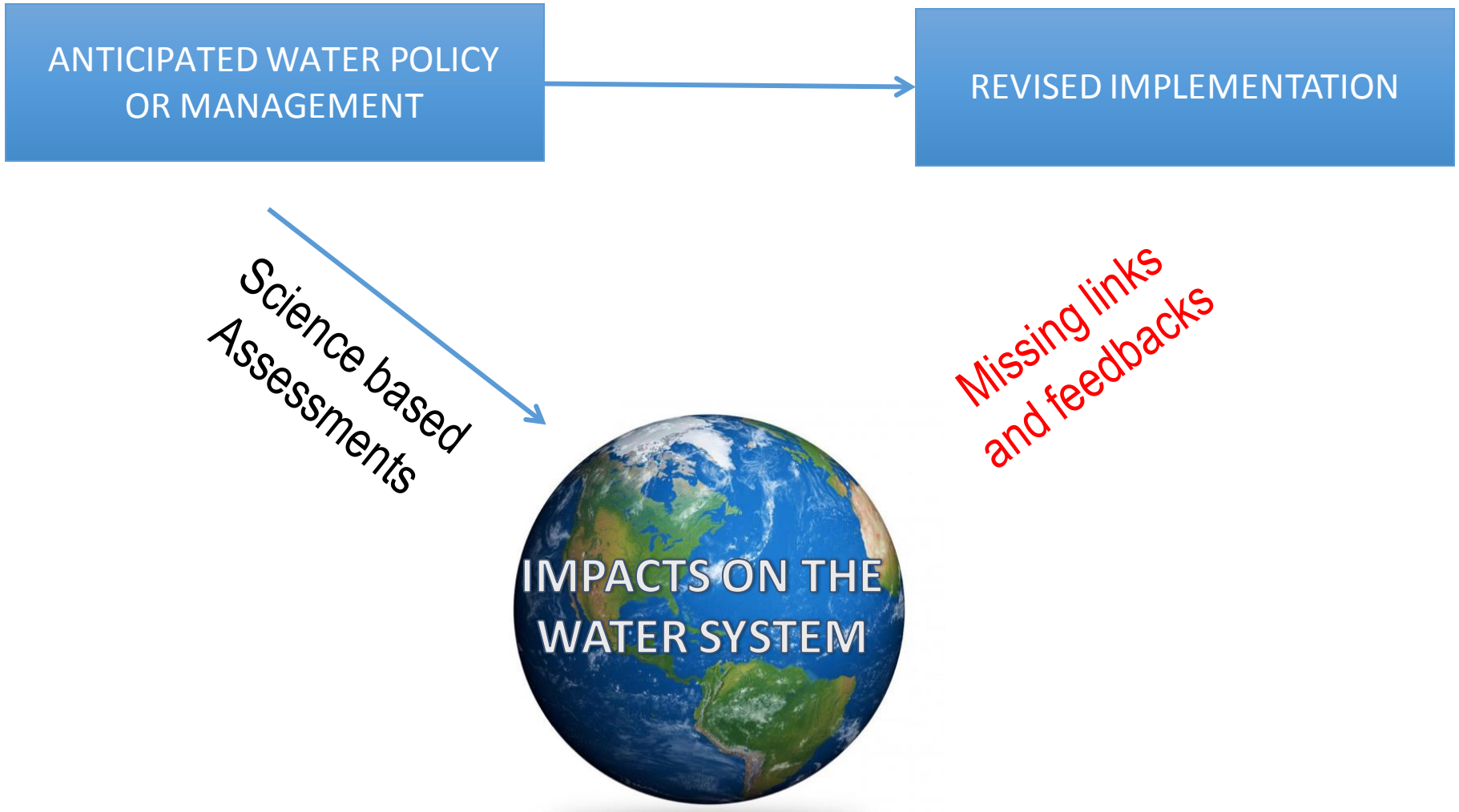


# Problems-of-the-art

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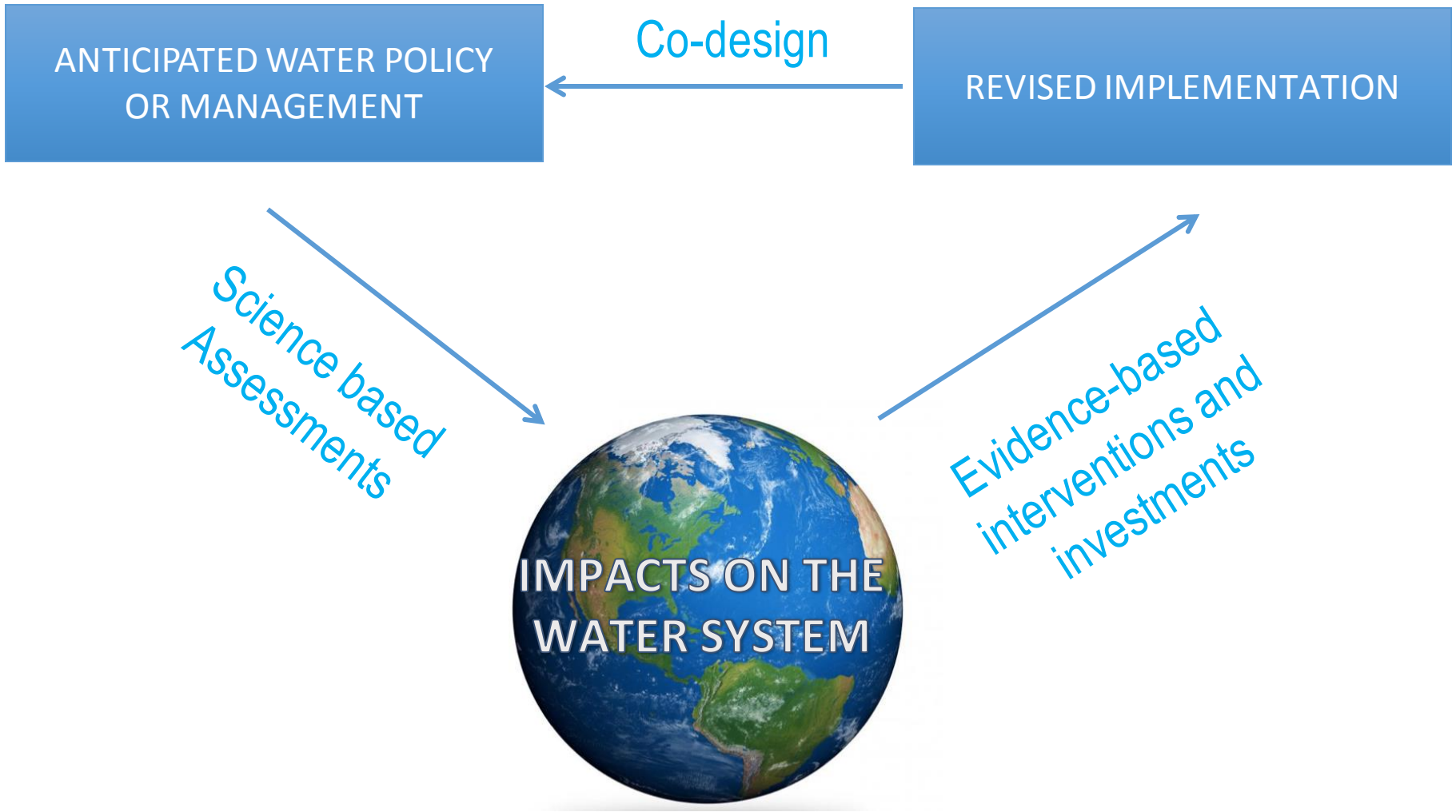
# Future-of-the-art

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# “Window of opportunity” towards comprehensive water assessments

- More data available now (because of Earth Observation data) for integrated modelling than before.
- Global Commitment-SDGs go beyond water and sanitation
- Increased capability –Methodologies already exist in undertaking such synthesis
- Audience for Global Assessment is not only the UN-but private and public sector as well.

What is missing ?

Scientific underpinning of connections between water, sanitation and other SDGs. A compendium of the state of the knowledge that identify key drivers, (emerging) trends, challenges and possible policy responses .

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COMPASS

01

Digital Tool Box

Detects, evaluates, existing, imminent, and emerging water resource challenges

COMPASS produces indicators and indices continuously updated monthly

02

Comprehensive Assessment of Water Resource Systems

Used for infrastructure planning, Identify Business Opportunities, Monitor SDGs

Indicators and Indices for Monthly Assessments

03

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COMPASS Product Suite

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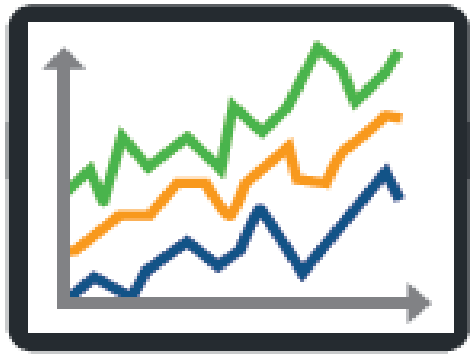
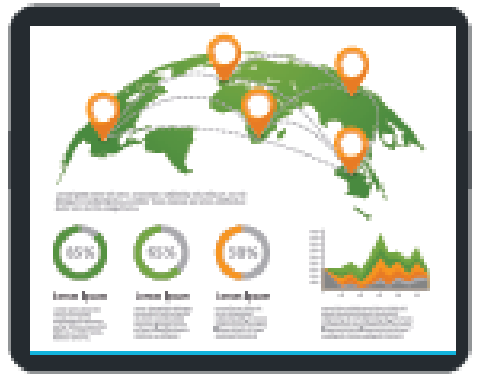


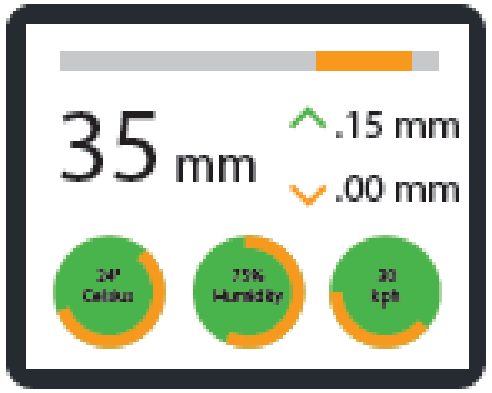
## Water State and Water Security Index

## Medium Term Water Trend

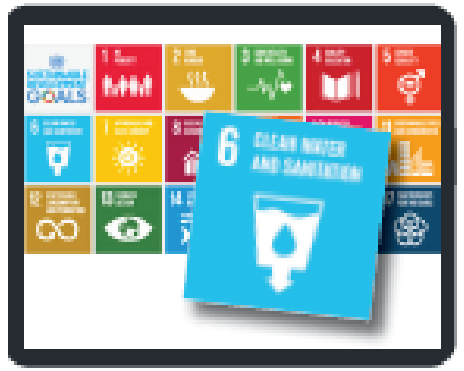


## Business Intelligence Report


## Annual State of Resource Report Cards




## Six Months Water Outlook




## SDG Report Cards

# One example: the Global Water Quality Challenge

- Wastewater production at least doubling by 2050 → Sewerage connections increasing
- But not wastewater treatment → More untreated wastewater to rivers and lakes; risk of "rebound effects"
- Intensifying agriculture → More nutrients, pesticides to rivers, lakes and groundwater


***Human Health:***

Health risk of contaminated rivers & lakes → contact with surface waters → washing, cleaning, drinking

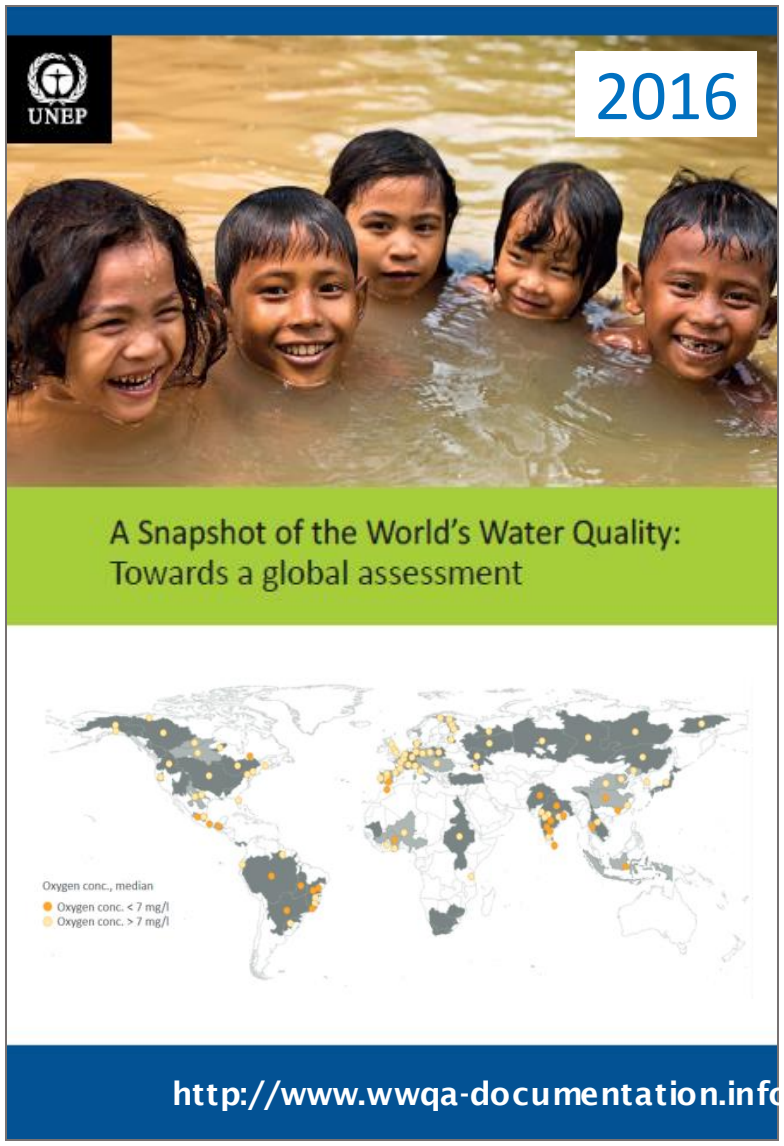
***Food Security:***

95% inland fishery production from developing world
200 million Africans consume fish regularly

***Biodiversity:***

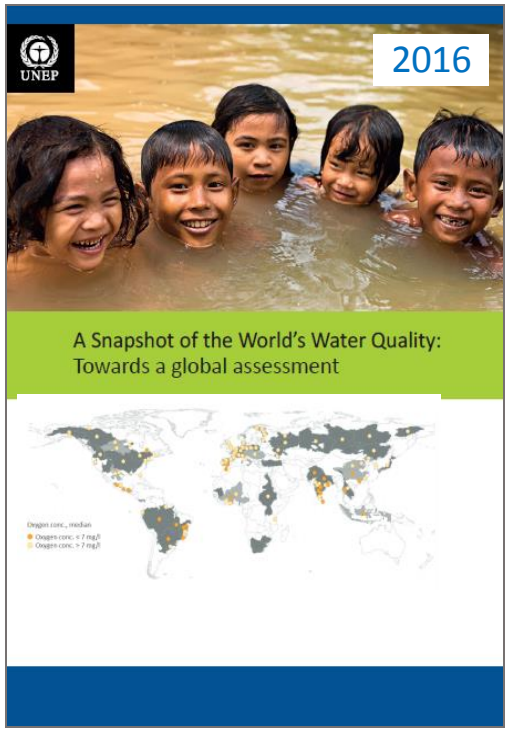
Ongoing species loss, over proportionally in freshwater species

# What do we know from the pre-study of the World´s Water Quality?




1. **Water pollution serious and getting worse in Latin America, Africa, and Asia**,
   - Severe pathogen pollution ≈ 1/3 all river km´s
   - Severe organic pollution ≈ 1/7 all river km´s
   - Severe & moderate salinity pollution ≈ 1/10 all river km´s
2. **The number of rural people at risk to health by coming into contact with polluted surface waters may range into the hundreds of millions on these continents.**
   - Among the most vulnerable groups are women and children.
3. **Majority of rivers in developing countries still in good condition** → Great opportunities for short-cutting further pollution and restoring the rivers that are polluted →
4. **Mix of management & technical options supported by good governance**

# What needs to be done ?




Full Assessment


**Important step, but …**

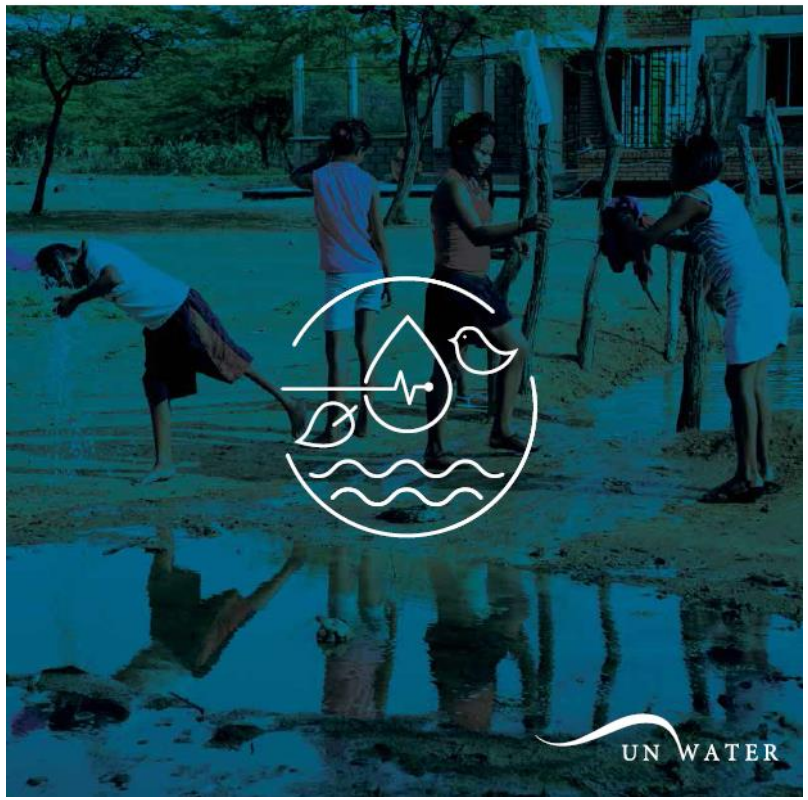
… covers limited number of issues,
no groundwater, estuaries…

… incomplete geographic coverage; data gaps, RS missing…

… very brief duration – no time for wider engagement

**Provides consistent preliminary results & methodological basis**

# The Roadmap towards a Global Water Quality Assessment




UN Resolution 2017

§ 1: Recalling…the ”Snapshot of the World’s Water Quality” and the Analytical Brief “Towards a Worldwide Assessment of Freshwater Quality”…,

United Nations Environment Programme

United Nations Environment Assembly of the
United Nations Environment Programme
Third session

§ 2c: Work with relevant international organisations, … and build upon the 2016 “Snapshot of the World’s Water Quality” and the Analytical Brief “Towards a Worldwide Assessment of Freshwater Quality”…,

stressing that sustainable solutions require integrated and intersectoral approaches from source-to-sea at all levels in order to reduce emissions and the transport of hazardous substances, and concerned that many water-related ecosystems face increased uncertainty and risks due to climate change and other factors,

*Recalling* General Assembly resolution 66/288 of 27 July 2012 entitled “The Future We Want”, which stresses the need to adopt measures to significantly reduce water pollution and improve

§2d: Cooperate with other relevant organizations, including through UN-Water, to **develop a World Water Quality Assessment for consideration at UNEA-5 (2021)**”…,

# Global Water Quality Assessment Approach

## Main theme?

Water quality in an interlinked context (Health, Food, Ecosystems) with Climate Change as background


## What?

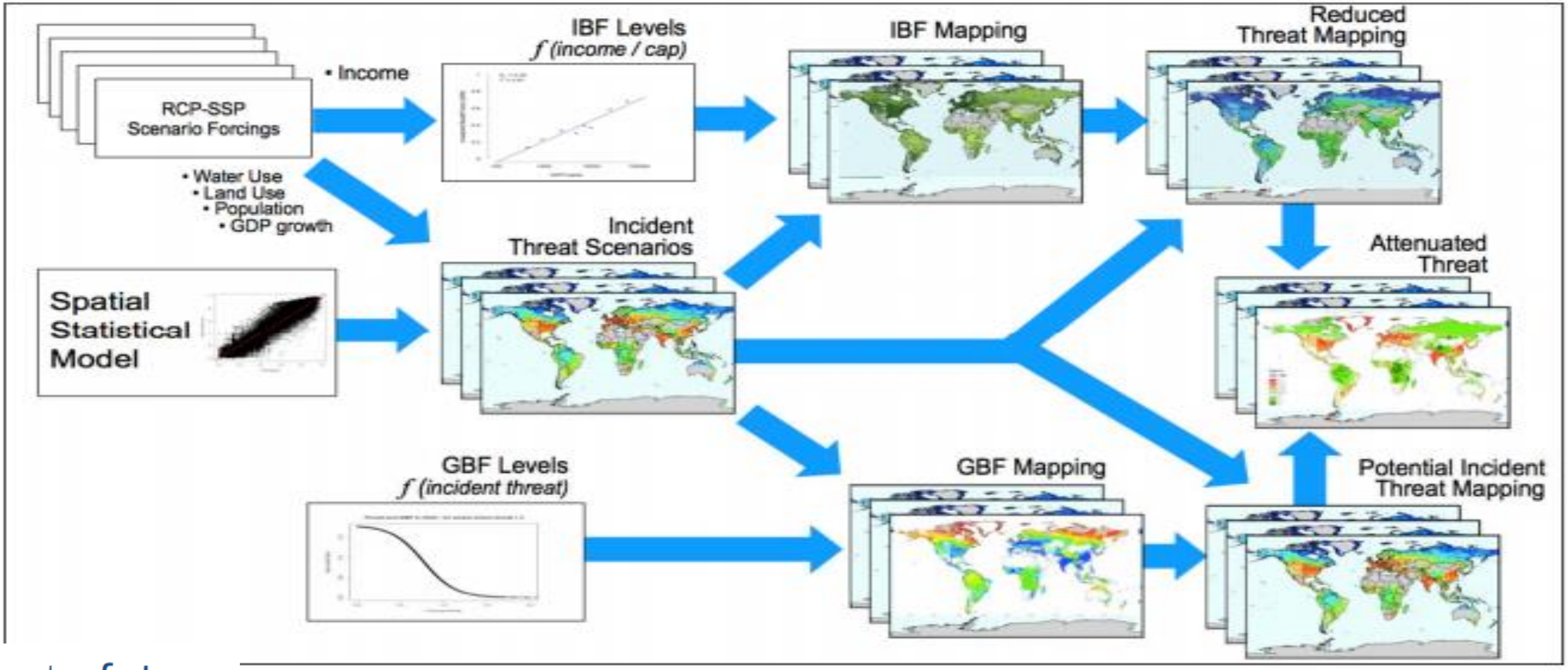
1. Assess the baseline – data and modeling driven; underlying causes, state of WQ, impacts
2. Anticipate trends – scenario analysis (retro-present-future)
3. Evaluate mitigation options – sources, polluters, measures, trade-offs
4. Support management and governance – provide fact based services for finding options

## Why?

Science based knowledge to act on water quality challenge regionally within the global context

Help achieve the SDGs, understand options, co-design the information services needed

# Data flows and modeling tools to estimate threats to river systems, impacts of investments in infrastructure (IBF), the extent of natural capital and its related water provisioning services (GBF)

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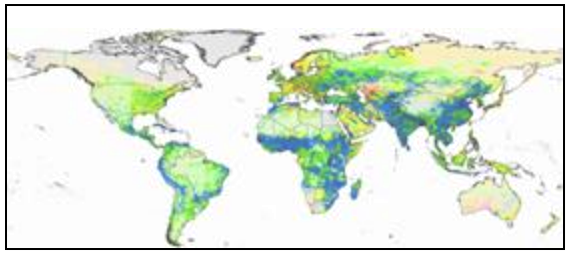
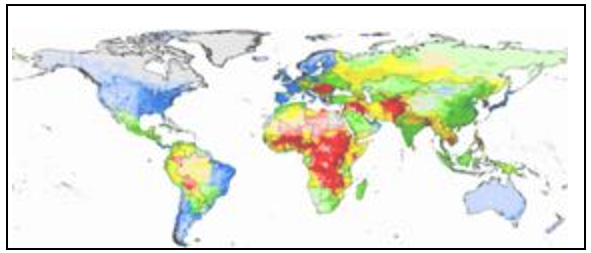
# Pin-point opportunities for impact investing / SDG support



Investment Opportunities
(Threats to rivers, climate variability)

−



Investment Challenges
(Fragile States, Multinational River Basins)

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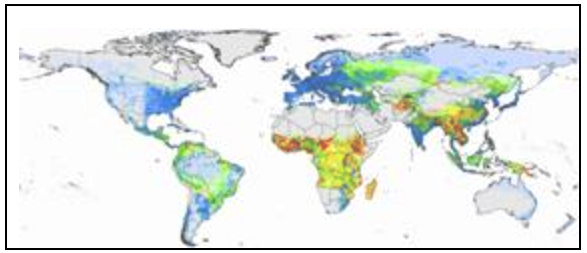
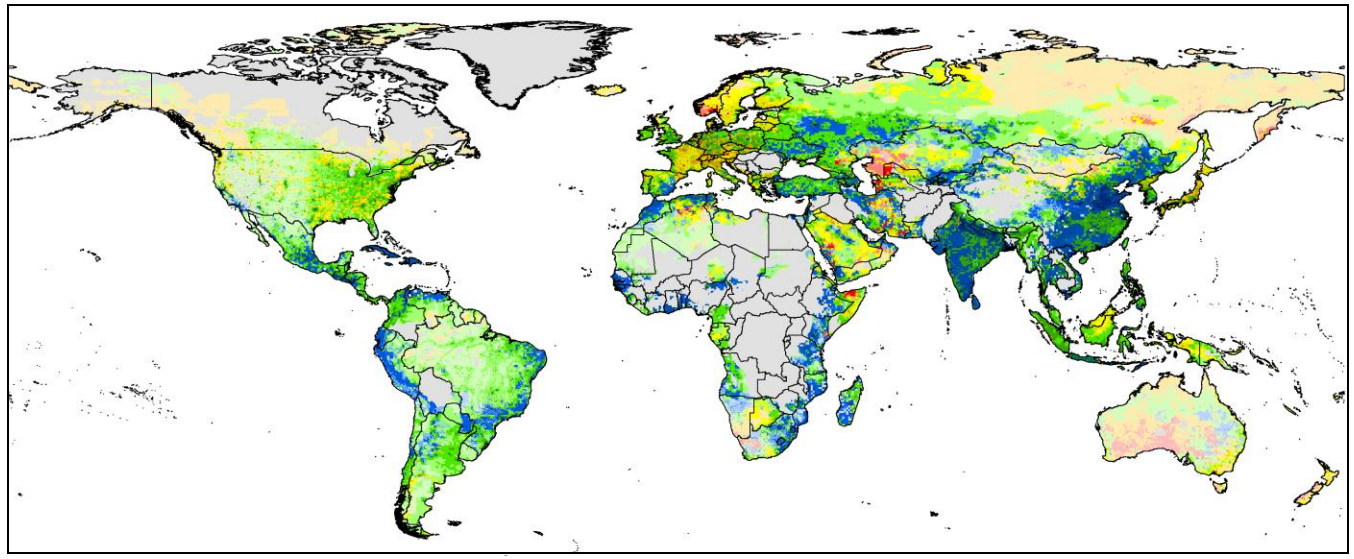


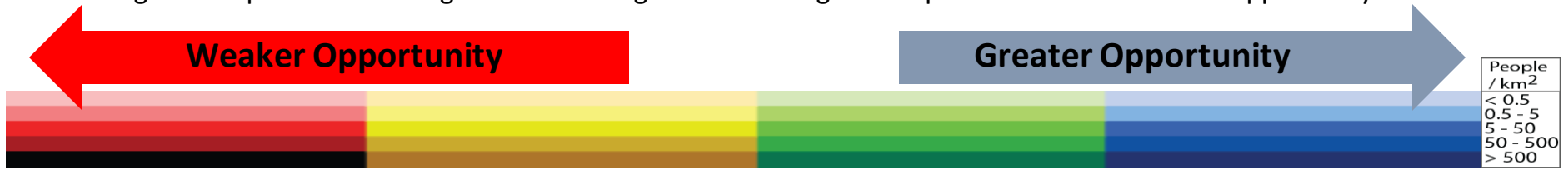
Negative Impacts of Investment
(Decreases to "Natural Capital")

=

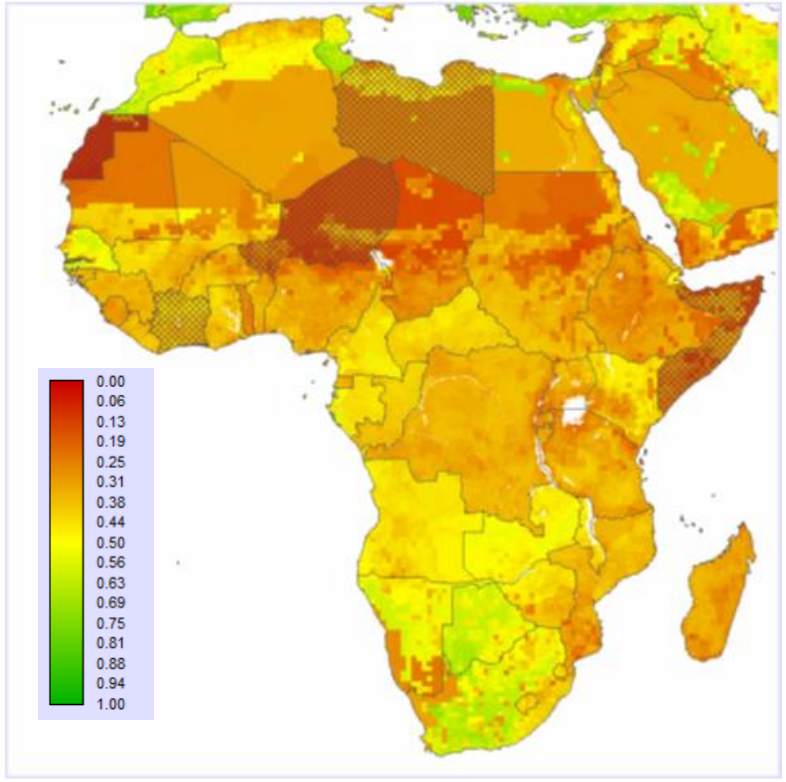


*Green et al., in prep.*

Greyed out zones represent areas with the lowest investment opportunities due to highest investment challenges and potential negative impacts. Remaining areas show regions with the greatest potential for investment opportunity.



# COMPASS capabilities to map water security in Africa




*COMPASS uses one of the most detailed spatial information allowing to go beyond country boundaries, by taking into account hydrology and other physical features from remotely sensed information and model outputs (map extracted from global data processing).*

*The **"Water Security Index"** is the result of the aggregation of GIS layers with different resolution by means of spatial multi-criteria analysis techniques.*

*Water security index, calculated using the aggregation of water availability, accessibility, safety and quality, and management indices. The value '0–1'(with the continuous coloured to green')represents 'low to high' security.*

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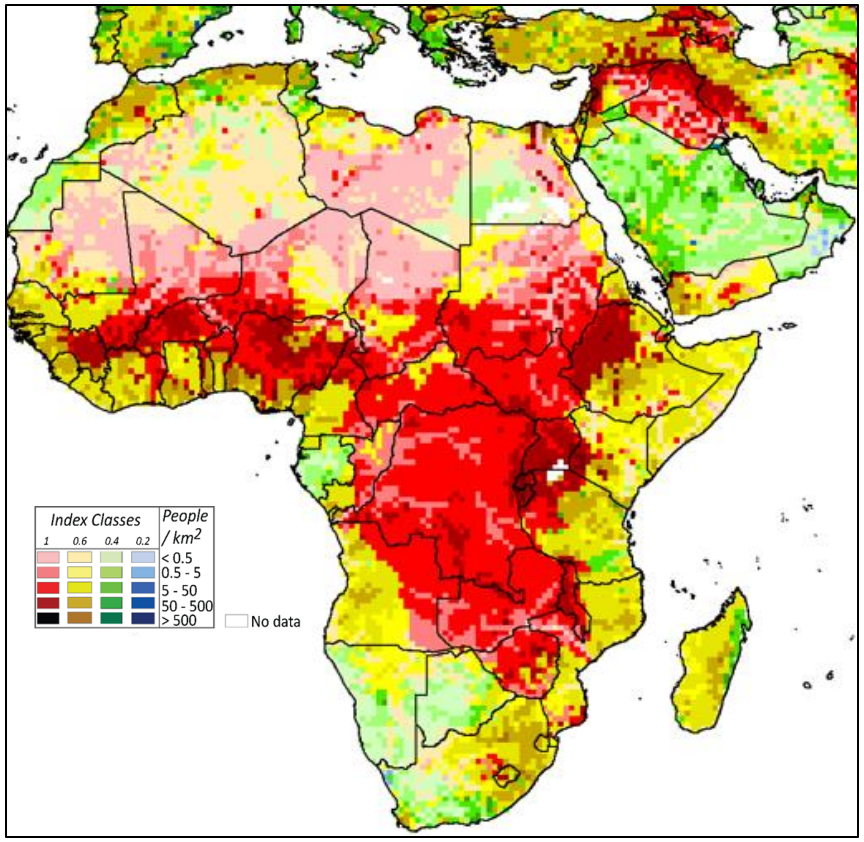
# Predict hotspots for poential water conflicts and involuntary population displacement in Africa




- *The figure illustrates population dependent on water source areas under contrasting conflict potentials. The conflict potential index is composite of indicators including River Threats, Fragile States, Climate Shock, and Transboundary Complexity.*
- *The index class reflects the vulnerability of people living under different conflict levels: low (blue), low-moderate (green), moderate (yellow), and high (red).*

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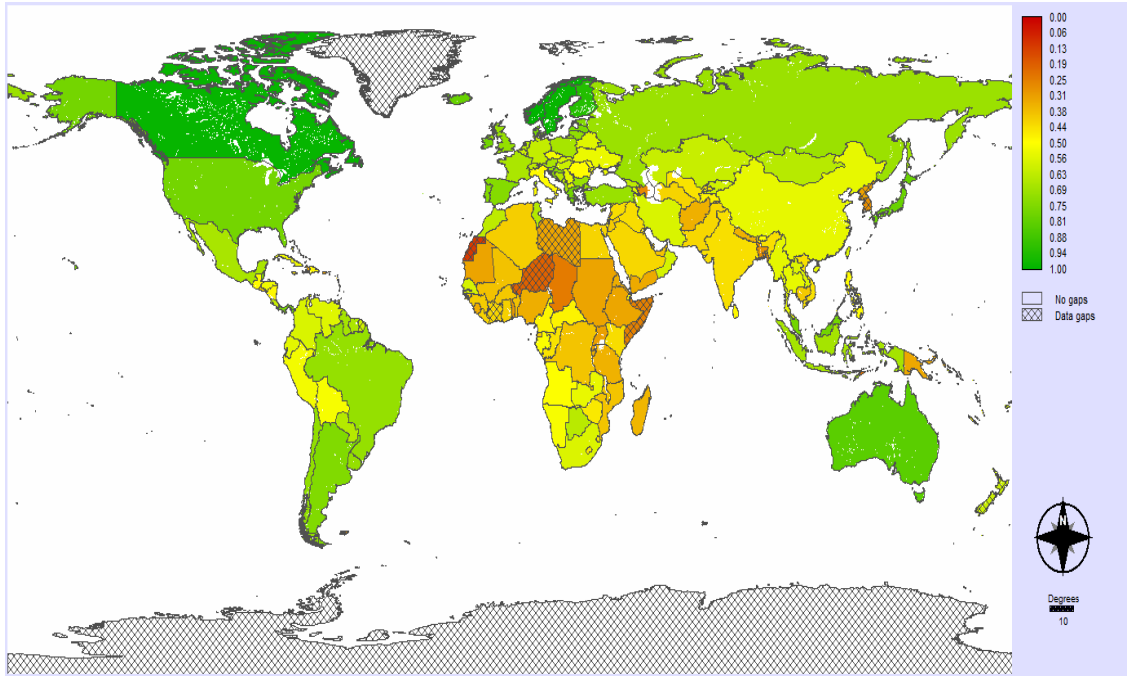
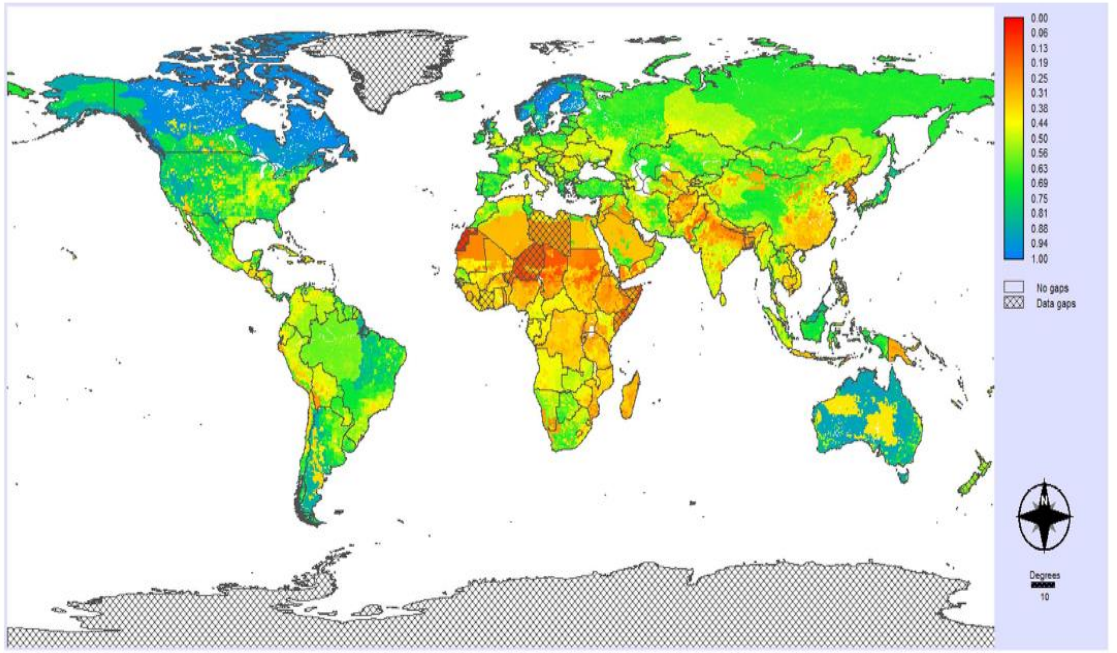
# High-resolution “Water Security Index” for policy support: from country level to pixel based global maps




*Aggregated global water security index, calculated using the aggregation of water availability, accessibility, safety and quality, and management indices. The values represent low (0, blue) to high (1, red) security. The shaded areas identify countries with data gaps.*

Country averages hide knowledge of spatial distribution of phenomena needed for policy makers’ decisions

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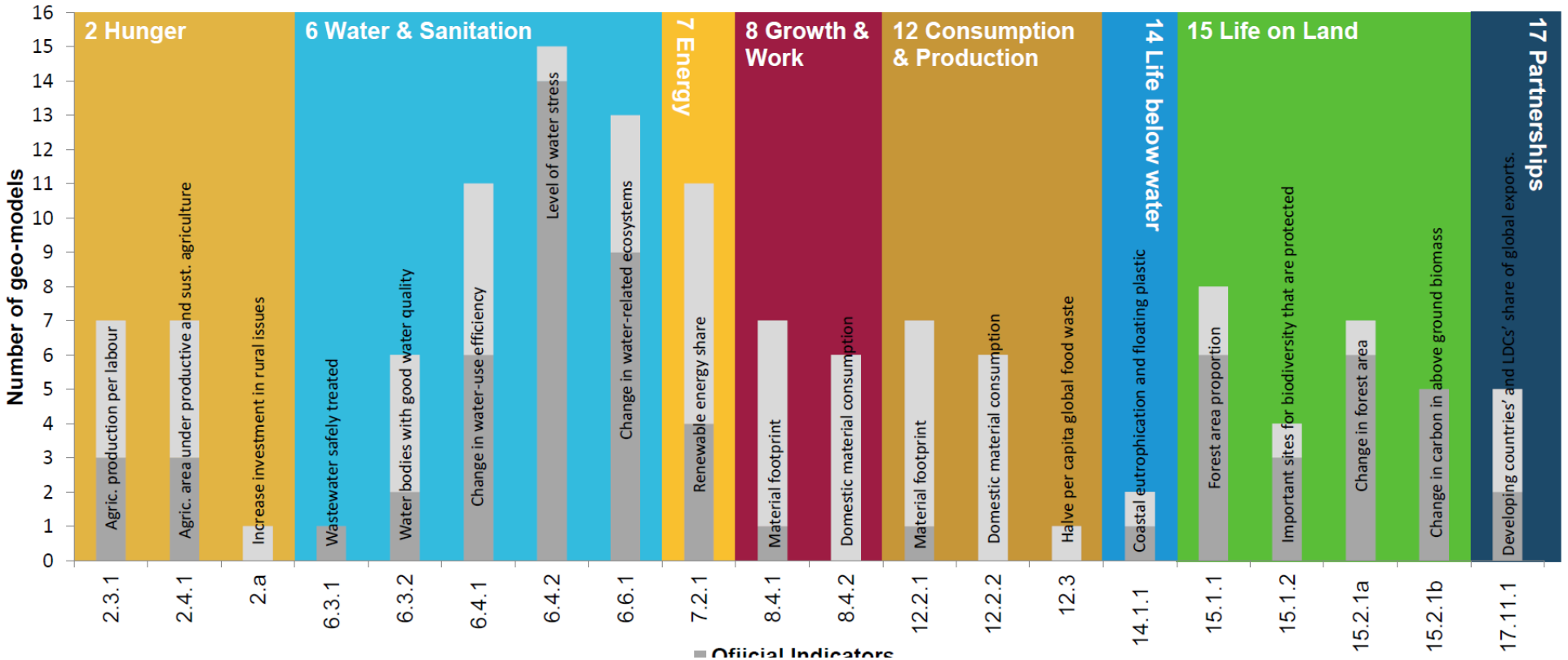
# Operational geo-models address more than 20 indicators out of 8 different SDGs




**„Geo-models“:** hydrology, vegetation, land use, land surface, agent-based models, integrated assessment models.

Number of geo-models that can simulate the *official* indicators

Number of geo-models that can simulate *alternative* SDG indicators

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# Projections of the level of water stress (SDG indicator 6.4.2)

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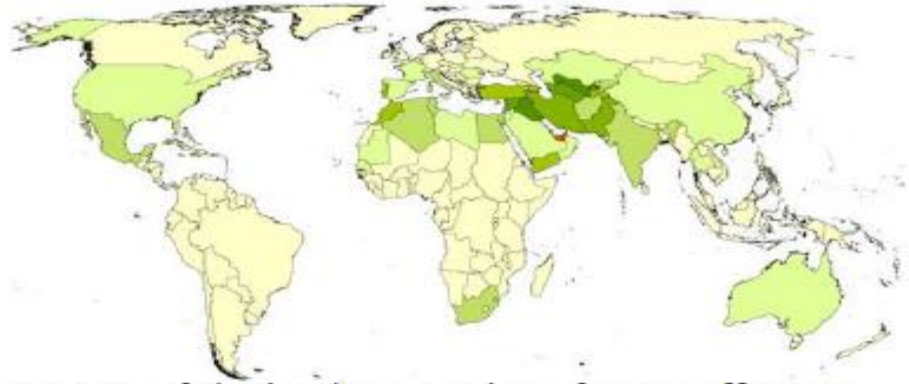
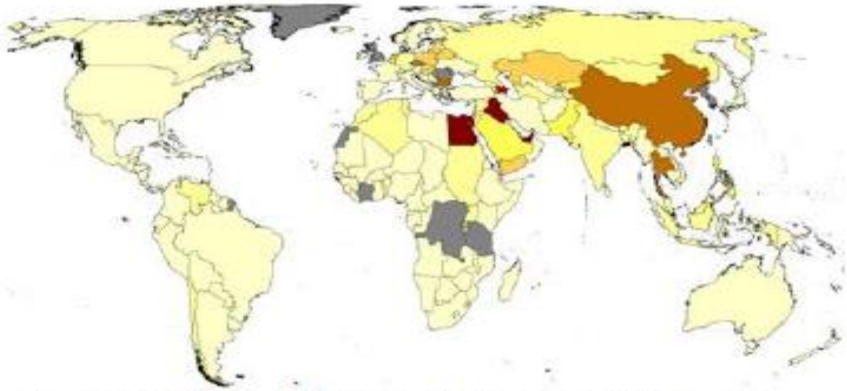
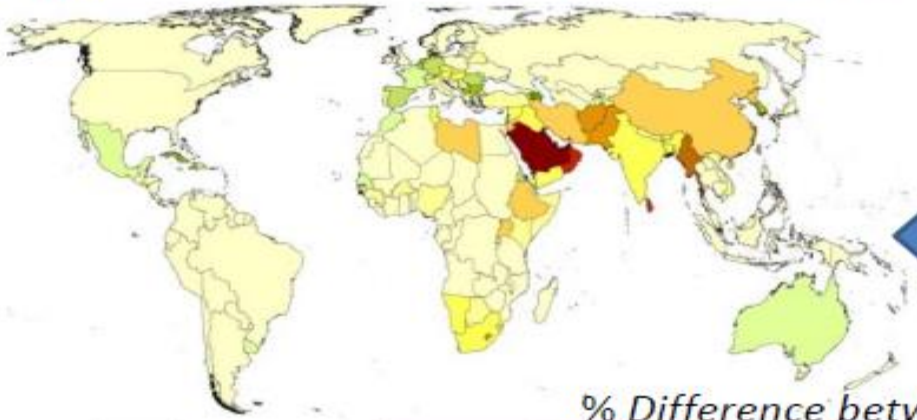


*Impacts of the implementation of **more efficient irrigation systems** as simulated by the model LPJmL*



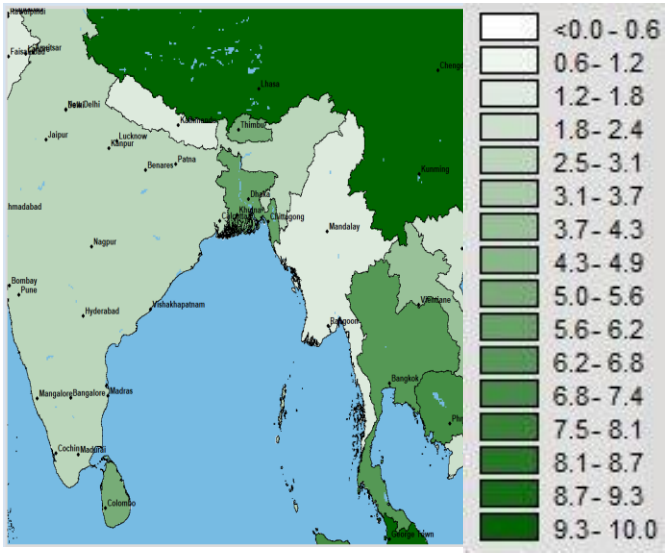
*Impact of **GDP change** at the country level according to SSP2 as simulated by the model DBH*



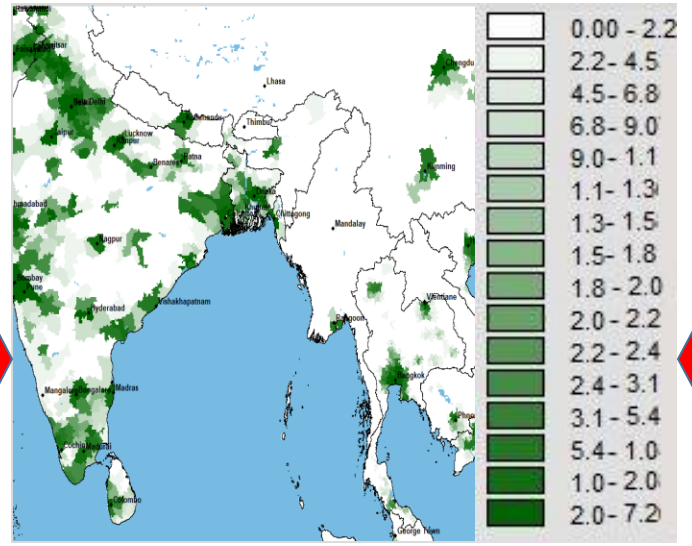
*Impact of **combined changes** in food demand (population), trade patterns, yield improvement and a transition to vegan diets, as simulated by the model MAgPIE.*

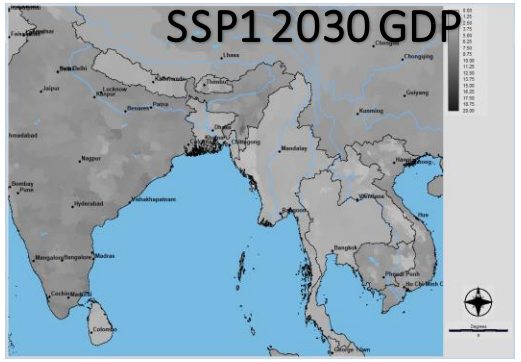
# High-resolution analysis of SDG indicator 6.4. "Water Use Efficiency" (WUE) for policy support

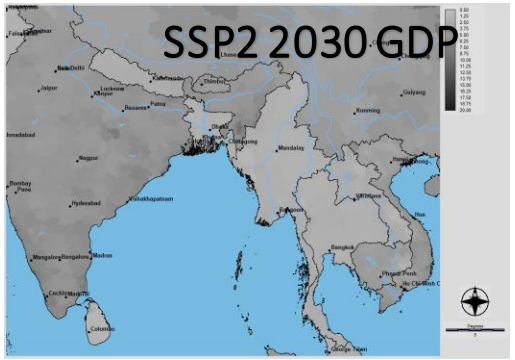
Average WUE/ country **US$/m³**

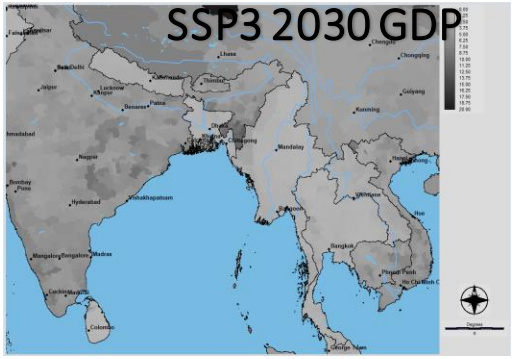



Spatially distributed WUE **US$/m³**



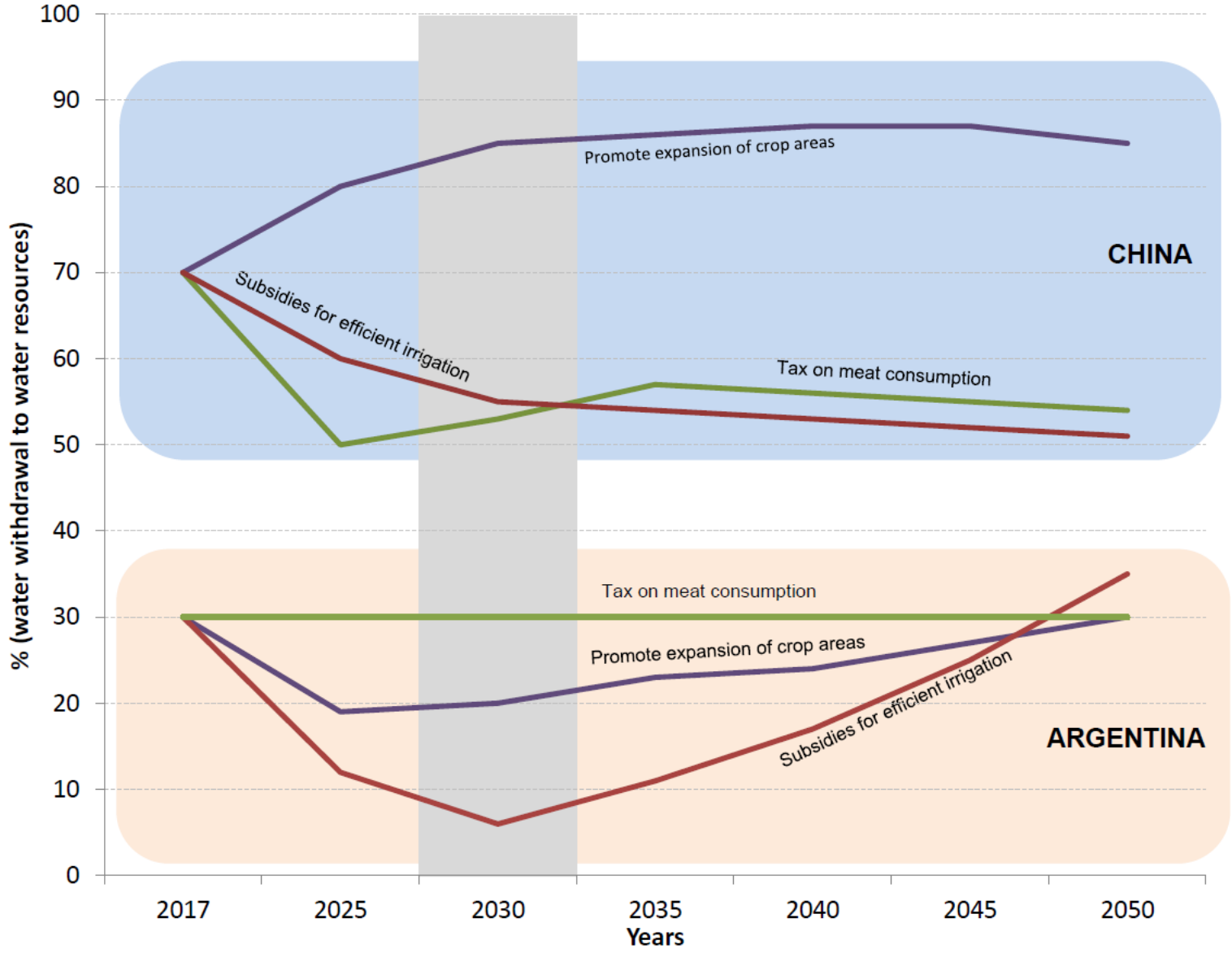




*Spatially distributed scenarios of economic development in 2030 allow to determine required increments in WUE to meet the targets*

Based on a downscaling procedure of freely available online datasets (i.e. allocation of water use and GDP based on existing spatially accurate information)

# Vision: Country projections to reach SDG targets




***Political measures and their effect on reaching target 6.4 in 2030 and beyond***

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# Trade-offs and synergies between targets

- **Quantitative approach to estimate potential trade-offs** between targets of SDG 2 (hunger), 6 (water) and 7 (energy)
- **Based on a business-as-usual development and accounting for:**
  - competition for natural resources,
  - synergies in infrastructure needs and
  - consequences (benefits and risks) for regulating and provisioning ecosystem services.
- **Flexible approach:**
  - Can be performed for regions, countries or ecosystems,
  - Can be adapted to other scenarios,
  - Can be applied for analyses of targets from other SDGs.

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# Trade-offs and synergies matrix between SDG targets

| | 6,1 | 6,2 | 6,3 | 6,4 | 6,5 | 6,6 | 6.a | 6.b | 2,1 | 2,2 | 2,3 | 2,4 | 2,5 | 2.a | 2.b | 2.c | 7,1 | 7,2 | 7,3 | 7.a | 7.b |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6,1 | | 1 | 2 | 2 | 3 | 1 | 1 | 2 | 0 | 0 | 0 | 1 | 3 | 3 | -1 | 1 | 2 | 2 | 2 | 3 | 2 |
| 6,2 | 1 | | 2 | 2 | 3 | 1 | 1 | 3 | 0 | 1 | 1 | 1 | 3 | 3 | -1 | 1 | 2 | 2 | 2 | 3 | 2 |
| 6,3 | 2 | 2 | | 2 | 3 | 2 | 1 | 3 | 2 | 2 | 2 | 2 | 3 | 3 | 0 | 1 | 2 | 3 | 2 | 3 | 2 |
| 6,4 | 2 | 2 | 2 | | 3 | 2 | 1 | 3 | 2 | 2 | 2 | 2 | 3 | 3 | 0 | 1 | 2 | 3 | 2 | 3 | 2 |
| 6,5 | 3 | 3 | 3 | 3 | | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 0 | 1 | 3 | 3 | 2 | 3 | 3 |
| 6,6 | 1 | 1 | 2 | 2 | 2 | | 2 | 1 | -1 | -1 | -1 | 0 | 2 | 2 | -1 | 1 | 2 | 1 | 2 | 2 | 1 |
| 6.a | 1 | 1 | 1 | 1 | 2 | 2 | | 2 | 0 | 0 | 0 | 1 | 2 | 2 | -1 | 1 | 1 | 2 | 2 | 2 | 1 |
| 6.b | 2 | 3 | 3 | 3 | 3 | 1 | 2 | | 1 | 2 | 2 | 2 | 3 | -1 | 3 | 1 | 3 | 2 | 2 | 3 | 3 |
| 2,1 | 0 | 0 | 2 | 2 | 3 | -1 | 0 | 1 | | -1 | -1 | 0 | 3 | 1 | -1 | -1 | 1 | 1 | 1 | 3 | -1 |
| 2,2 | 0 | 1 | 2 | 2 | 3 | -1 | 0 | 2 | -1 | | -1 | 0 | 3 | 1 | -1 | -1 | 1 | 1 | 1 | 3 | -1 |
| 2,3 | 0 | 1 | 2 | 2 | 3 | -1 | 0 | 2 | -1 | -1 | | 0 | 3 | 1 | -1 | -1 | 1 | 1 | 1 | 3 | -1 |
| 2,4 | 1 | 1 | 2 | 2 | 3 | 0 | 1 | 2 | 0 | 0 | 0 | | 3 | 3 | 0 | 1 | 2 | 2 | 2 | 3 | 1 |
| 2,5 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | | 3 | 0 | 1 | 3 | 3 | 2 | 3 | 3 |
| 2.a | 3 | 3 | 3 | 3 | 3 | 2 | 2 | -1 | 1 | 1 | 1 | 3 | 3 | | -1 | 0 | 3 | 3 | 2 | 3 | 2 |
| 2.b | -1 | -1 | 0 | 0 | 0 | -1 | -1 | 3 | -1 | -1 | -1 | 0 | 0 | -1 | | -1 | -1 | -1 | -1 | 0 | -1 |
| 2.c | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | -1 | -1 | -1 | 1 | 1 | 0 | -1 | | 1 | 1 | 1 | 1 | 0 |
| 7,1 | 2 | 2 | 2 | 2 | 3 | 2 | 1 | 3 | 1 | 1 | 1 | 2 | 3 | 3 | -1 | 1 | | 3 | 2 | 3 | 2 |
| 7,2 | 2 | 2 | 3 | 3 | 3 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | 3 | 3 | -1 | 1 | 3 | | 2 | 3 | 3 |
| 7,3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | -1 | 1 | 2 | 2 | | 2 | 2 |
| 7.a | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 0 | 1 | 3 | 3 | 2 | | 3 |
| 7.b | 2 | 2 | 2 | 2 | 3 | 1 | 1 | 3 | -1 | -1 | -1 | 1 | 3 | 2 | -1 | 0 | 2 | 3 | 2 | 3 | |

| | |
|---|---|
| 4 = indivisible | (-4) = cancelling |
| 3 = supporting | (-3) = restricting |
| 2 = reinforcing | (-2) = counteracting |
| 1 = enabling | (-1) = constraining |
| 0 = consistent | |

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# Trade-offs and synergies matrix between SDG targets

| | 6,1 | 6,2 | 6,3 | 6,4 | 6,5 | 6,6 | 6.a | 6.b | 2,1 | 2,2 | 2,3 | 2,4 | 2,5 | 2.a | 2.b | 2.c | 7,1 | 7,2 | 7,3 | 7.a | 7.b |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6,1 | | | | | | | | | | | | | | | | | | | | | |
| 6,2 | | | | | | | | | | | | | | | | | | | | | |
| 6,3 | | | | | | | | | | | | | | | | | | | | | |
| 6,4 | | | | | | | | | | | | | | | | | | | | | |
| 6,5 | | | | | | | | | | | | | | | | | | | | | |
| 6,6 | | | | | | | | | | | | | | | | | | | | | |
| 6.a | | | | | | | | | | | | | | | | | | | | | |
| 6.b | | | | | | | | | | | | | | | | | | | | | |
| 2,1 | | | | | | | | | | | | | | | | | | | | | |
| 2,2 | | | | | | | | | | | | | | | | | | | | | |
| 2,3 | | | | | | | | | | | | | | | | | | | | | |
| 2,4 | | | | | | | | | | | | | | | | | | | | | |
| 2,5 | | | | | | | | | | | | | | | | | | | | | |
| 2.a | | | | | | | | | | | | | | | | | | | | | |
| 2.b | | | | | | | | | | | | | | | | | | | | | |
| 2.c | | | | | | | | | | | | | | | | | | | | | |
| 7,1 | | | | | | | | | | | | | | | | | | | | | |
| 7,2 | | | | | | | | | | | | | | | | | | | | | |
| 7,3 | | | | | | | | | | | | | | | | | | | | | |
| 7.a | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 0 | 1 | 3 | 3 | 2 | | 3 |
| 7.b | 2 | 2 | 2 | 2 | 3 | 1 | 1 | 3 | -1 | -1 | -1 | 1 | 3 | 2 | -1 | 0 | 2 | 3 | 2 | 3 | |

- More synergies than trade-offs (165 vs. 26)
- Good design (median = +2 & no strong trade-offs)
- 59 "supporting" interactions vs. only "constraining" trade-offs (-1)
- SDG 6 (water)
  - 124 synergies vs. 8 trade-offs
  - has the most supportive and reinforcing influence
- SDG 2 (end hunger)
  - 26 trade-offs vs. 106 synergies
- Targets 7.a (cooperation for clean energy), 2.5 (genetic diversity) and 6.5 (IWRM) -> highest averages of interactions (~+2.6)

| | |
|---|---|
| 4 = indivisible | (-4) = cancelling |
| 3 = supporting | (-3) = restricting |
| 2 = reinforcing | (-2) = counteracting |
| 1 = enabling | (-1) = constraining |
| 0 = consistent | |

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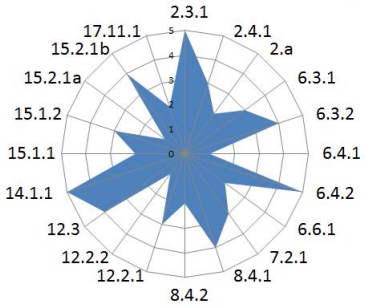
# COMPASS Vision: High resolution SDG Report Cards

## Argentina's SDG Report Card - Spring 2018

### Water Resources


### Data availability

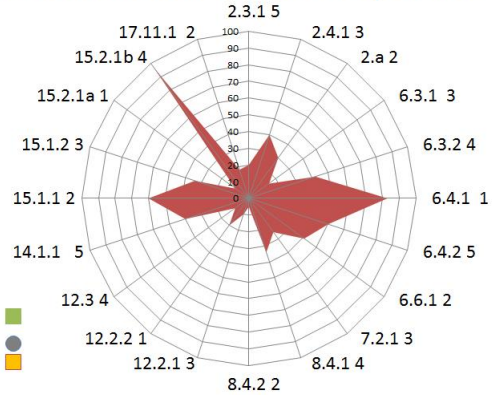



### Trade-off Alarm

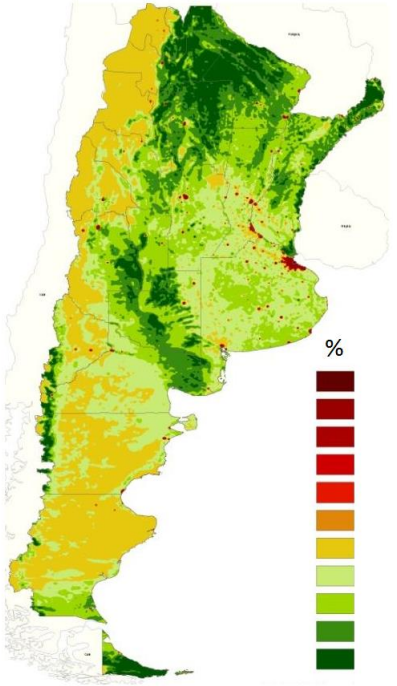
| | 6,1 | 6,2 | 6,3 | 6,4 | 6,5 | 6,6 | 6.a | 6.b | 2,1 | 2,2 | 2,3 | 2,4 | 2,5 | 2.a |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6,1 | | 1 | 2 | 2 | 3 | 1 | 1 | 2 | 0 | 0 | 0 | 1 | 3 | 3 |
| 6,2 | | | 2 | 2 | 3 | 1 | 1 | 3 | 0 | 1 | 1 | 1 | 3 | 3 |
| 6,3 | | | | 2 | 3 | 2 | 1 | 3 | 2 | 2 | 2 | 2 | 3 | 3 |
| 6,4 | | | | | 3 | 2 | 1 | 3 | 2 | 2 | 2 | 2 | 3 | 3 |
| 6,5 | | | | | | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 6,6 | | | | | | | 2 | 1 | -1 | -3 | -1 | 0 | 2 | 2 |
| 6.a | | | | | | | | 2 | 0 | 0 | 0 | 1 | 2 | 2 |
| 6.b | | | | | | | | | 1 | 2 | 2 | 2 | 3 | -1 |
| 2,1 | | | | | | | | | | -1 | -2 | 0 | 3 | 1 |
| 2,2 | | | | | | | | | | | -1 | 0 | 3 | 1 |
| 2,3 | | | | | | | | | | | | 0 | 3 | 1 |
| 2,4 | | | | | | | | | | | | | 3 | 3 |
| 2,5 | | | | | | | | | | | | | | 3 |
| 2.a | | | | | | | | | | | | | | |

4 = indivisible | (-4) = cancelling
3 = supporting | (-3) = restricting
2 = reinforcing | (-2) = counteracting
1 = enabling | (-1) = constraining
0 = consistent

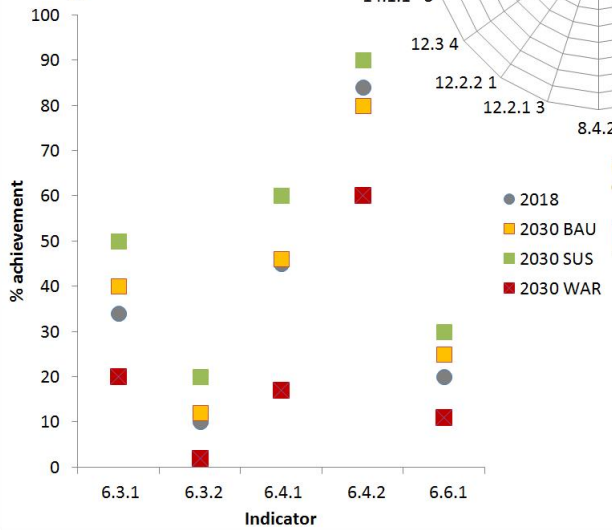
### Corroboration of data reported




### SDG 6.6.1 Implementation




### Projections 2030




### SDG 6.3.2 Alarm: Lago Potrerillos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# Value Added by COMPASS

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## Improved Fidelity of Global Resource Inventories

Better manage water resources (quantity and quality) at global, regional, and national scales.

## Early Identification

Pinpoint emerging hotspots to enable governments, businesses, and individuals to act before emergency situations develop.

## Water Intelligence

Create a water intelligence data repository to identify emerging business opportunities.

## Monitor Progress

Support national governments and international bodies in tracking SDG progress and implementation.

## State of the Art for Timeliness

Use advanced science, observations, models, and technologies that form the basis of strategic, advisory, and consultative services.

## Technology Support

Improve the technical capacity of developing countries to manage their strategic water resources.

## Identify New Opportunities

Lead dialogue on emerging research, exposing the importance of water science to the highest levels of government to inform critical decision-making.

# Unique Features of COMPASS

## A Co-Design & Co-Production Process

A partnership of researchers, policymakers, and the business community ensures ongoing improvement and relevance of COMPASS.

## Transparency & Traceability

All information resources and methodologies used to create the COMPASS products will be in the public domain.

## Harmonized Data

COMPASS identifies, assembles, and makes best use of existing Earth observation, socioeconomic, and big data resources.

## Timeliness

COMPASS is constantly updated, over multiple time frames: monthly for contemporary conditions and six-month forecasts and annually through to the 2030 SDG time horizon.

## Authoritative, Standardized, & Modernized

COMPASS fills an important niche in the current water assessment process by moving from ad hoc and inconsistent water assessments, to a systematic standardized and near-real-time water intelligence product suite.

## Policy Relevance

COMPASS provides knowledge support to SDG policy implementation and customized water resource planning and decision-maker needs.

## Business Relevance

COMPASS identifies, over both space and time, inherent water-related risks and opportunities for private-sector investment in sustainable water resource development.

## Tangible Information Products

COMPASS provides expert-produced, customized, online data compendia, traditional publications, and presentation materials for unrestricted reuse by information consumers.

# Phase-1: Process Design (October 2018-Sep 2019)

- ***Phase one will deliver prototype analyses based on a first track evaluation of technical capabilities, state-of-the-art knowledge, present technologies and data availability***
  ***– Projects with World Bank in Latin American Countries.***

- **Extensive stakeholder dialogue and regional consultation to understand policy and management needs**
  ***- Africa, India, Latin America, Europe.***

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# Phase-2: Implementation of the process (Sep 2019 onwards)

- ***Develop fully operational COMPASS products, coordinate the scientific assessment, review and synthesis with all relevant stakeholders and leaders from the science, policy, and applications communities.***
- ***This phase will include production of regional COMPASS Products, tailored to the analysis of the interlinkages between water resources and societal dynamics, economic growth and development.***

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