IIASA’s Water Futures and Solutions Initiative
Opportunities for African Lake and River Basin Organisations

AMCOW, RECs and L/RBOs Workshop

Simon Langan, Director
Robert Burtscher, Stakeholder Engagement and Liaison

Dar es Salaam, 26-27 July 2017
Potential population exposed to severe water scarcity

**Africa**

<table>
<thead>
<tr>
<th>Year</th>
<th>Water scarce pop. - Sustainability</th>
<th>Middle of the Road</th>
<th>Regional Rivalry</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>11% of total population or 105 - 108 m people</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2050</td>
<td>12% or 220 - 280 m people</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Change:**
- 2010: 11% of total population or 105 - 108 m people
- 2050: 12% or 220 - 280 m people
Water scarcity
Imbalance between supply and demand
Changes in cultivated land – Africa

- Cultivate land will increase by 20-50% till 2050
- Irrigated land will increase by 25-40% till 2050
- African cropland expansion is likely to come with significant deforestation (20-54 m hectares by 2050)
Water Futures and Solutions (WFaS) Initiative
Towards Innovative Solutions through Integrative Water Futures Analysis
Water Demand

Available Water Resources

- Surface Water
- Ground Water
- Re-use
- Desalination

Today

Solutions

- Regulation
- Storage (built, natural)
- Waste water treatment
- Climate change mitigation
- Land management

Scenarios

- Population, Economy, CC, Environment etc.

2050

Water Demand

- Domestic
- Agriculture
- Industry / Energy
- Eco-systems

Solutions

- Use efficiency
- Allocation policy
- Drought resistant seeds
- Tariff policy
- Renewable energy
- Climate change adaptation
Water Futures: Scenarios & Quantitative Assumptions

**SSP1**: The world is moving toward sustainability

**SSP characteristics**
- Improved resource use efficiency
- More stringent environmental regulations
- Rapid technological change is directed toward environmentally friendly processes
- Management of global commons improves.

**Implications for Manufacturing Water Use:**
- Manufacturing industries with efficient water use and low environmental impacts are favored.
- Enhanced treatment, reuse of water, and water-saving technologies;
- Widespread application of water-saving technologies in industry.

---

**Table 3**: Qualitative technological changes on water use intensities in the domestic and industry sectors according to HE-regions.

<table>
<thead>
<tr>
<th>Socio-economic capacity</th>
<th>HE-1</th>
<th>HE-2</th>
<th>HE-3</th>
<th>HE-4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor</td>
<td>L</td>
<td>M</td>
<td>H</td>
<td>M</td>
</tr>
<tr>
<td>Rich</td>
<td>M</td>
<td>L</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>High</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>M</td>
</tr>
<tr>
<td>Low</td>
<td>L</td>
<td>M</td>
<td>H</td>
<td>M</td>
</tr>
<tr>
<td>Hydro-climatic complexity</td>
<td>Low</td>
<td>Low</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>HE-1</td>
<td>L</td>
<td>M</td>
<td>H</td>
<td>M</td>
</tr>
<tr>
<td>HE-2</td>
<td>M</td>
<td>L</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>HE-3</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>M</td>
</tr>
<tr>
<td>HE-4</td>
<td>M</td>
<td>L</td>
<td>M</td>
<td>M</td>
</tr>
</tbody>
</table>

**Table 4**: Applied annual efficiency change rates as derived for different classes.

<table>
<thead>
<tr>
<th>Class</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.2%</td>
<td>1.1%</td>
<td>1%</td>
<td>0.6%</td>
<td>0.3%</td>
</tr>
</tbody>
</table>

Highest    | Lowest
Why to engage stakeholders and experts?
Analysis, projections and solutions towards Water Security in 2050

Global
Regional
East Africa, Southern Africa, Africa
Transboundary
Lake Victoria, Nile, Zambezi
National
Uganda, ...

Nested Approach: four tiers (case Africa)

Analysis, projections and solutions towards Water Security in 2050
Socio-economic change - Population

Lake Victoria basin
From 46 Mio. people in 2010 to 87 – 120 Mio. people in 2050 (+ 90% - 260% depending on scenario)

LVBC Strategy 2016 - 2021:
From 44.9 m people in 2015 to 59.5 m people in 2025
Change in built-up area in EAC
Socio-economic change - GDP

Middle of the Road scenario:
From 1,275 US$/year/cap in 2010 to 6,900 US$/year/cap in 2050 (+550%!)

EAC Vision 2050:
From 1,014 US$/year/cap in 2014 to 10,000 US$/year/cap in 2050
• Cultivate land will increase by 30-60% till 2050 for Uganda
• Cultivate land will increase by 20-40% till 2050 for EAC
Change cultivated land area in EAC
Change in irrigated land

Target based on different strategy documents:

Uganda Vision 2040 / National WR Strategy:
• more than 10 fold (>600,000 ha wetland und upland irrigation combined)

AMCOW Pan-African M&E System:
• Increase the size of irrigated areas by 100% from 2000 to 2025.
• Increase water productivity from irrigation and rainfed agriculture by 60% from 2000 to 2025

- Irrigated land will increase by 300-430% till 2050 for Uganda
- Irrigated land will increase by 60-200% till 2050 for EAC
Change irrigated land area in EAC
Water security and pathways to SOLUTIONS

• Water security depends on inter-relation of water resources availability (biophysical supply), societal and environmental water demand, and the potential to put dynamic response options in place.

• Water security results from a combination of both
  i) hydro-climatic challenges
  ii) socio-economic coping capacity
Hydro-Economic Classification defines a risk-based approach towards water security.

- **Hydro-climatic complexity (X-axes)**
  - Degree & type of water-related challenges

- **Economic-Institutional Capacity (Y-axes)**
  - Decreasing vulnerability → Coping capacity & Adaptation potential
  - Increasing vulnerability → Degree & type of water-related challenges

Partial vulnerability is present at both the low and high ends of both axes, indicating a risk-based approach to water security.
We present six strategies, or water-stress wedges, that collectively lead to a reduction in the population affected by water stress by 2050, despite an increasing population.

- Water productivity – crop per drop
- Irrigation efficiency – decrease losses
- Water use intensity – industry and domestic
- Population
- Reservoir storage
- Desalination

Solutions to water stress: Wedge approach

Each solution = 2% reduction

Wada et al. (2014), Nature Geoscience
Improvement in water productivity at 0.5% per year (20% by 2050)

Efficiency increase by 1% per year (40% by 2050)

Limit population growth by 0.5 billion (8.5 billion by 2050)
Additional 600 km$^3$ reservoir storage (by 2050) US$ 10 billion??

50 times increase in desalination capacity (by 2050) US$ 20 billion??
What for do we model hydrological processes and relating them to socio-economic developments and the environment?

- Building evidence base for solid policy, sustainable water management and investment decisions.
- Understanding synergies and trade-offs between sectors (users) and riparian countries.
- “water proofing” future development pathways and future solution options
Why to engage?

- Linking science with practitioners: Modelling based on robust but ambitious scenarios
- Co-create: thinking through possible development and solutions pathways and
- Co-design the models
- Benefit from robust water scenarios to support your decision making for SDG fit water resources planning in your water basin
- Deepening / strengthening capacities through partnerships

Contact: wfas.info@iiasa.ac.at

http://www.iiasa.ac.at/web/home/research/researchPrograms/water/waterhome.html