Bridging the gap across scales in scenario planning: Co-designing water-energy-land visions and pathways in transboundary basins

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Develop tools and capacities that can support the management of the water-energy-land nexus at global and regional scales

Partners: [IIASA] [GEF] [UNIDO]
Outputs and outcomes

• Two types of tools to address WEL nexus development challenges
  • Regional basin planning model (policy optimization IAM)
  • Policy exercise to develop stakeholder visions and pathways

• Stakeholder scenarios

• Enhanced capacities for nexus management and research
Participatory Scenario Development process
From Global to Basin scale

Global SCENARIOS
- e.g. IPCC scenarios (SSP narratives)

INTERNATIONAL FRAMEWORKS
- e.g. SDGs, Sendai, Paris Agreement

OTHER OPPORTUNITIES AND THREATS

EXTERNAL
Sphere of Uncertainty

Regional PATHWAYS
- plans, visions, strategies, knowledge and data, e.g. national development plans

INTERNAL
Sphere of Influence

Who is setting the direction and marketing decisions (organization, country, group of countries, river basin organization)?
Research design & progress

1. **CURRENT SITUATION**
   - Image of a world map with icons and a basemap.
   - Text: "is a basis for"

2. **STAKEHOLDER VISIONS**
   - Images of vision cards.
   - Text: "provide input for"
   - Subtext: "provide feedback and revisions suggestions"

3. **SCENARIOS**
   - Images of scenario cards.

4. **RESEARCH MODELS & ANALYSIS**
   - Images of research models.
   - Text: "provide feedback and corrections"

5. **Researchers**
6. **Stakeholders**

**DESIRED FUTURES**
Stakeholders

INDUS

ZAMBEZI
Stakeholder visions and pathways
Elements

Map

Cards

Indicators

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Card</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Runoff</td>
<td><img src="runoff.png" alt="Runoff" /></td>
<td>Water flow resulting from precipitation</td>
</tr>
<tr>
<td>Precipitation</td>
<td><img src="precipitation.png" alt="Precipitation" /></td>
<td>Rainfall activity</td>
</tr>
<tr>
<td>Evapo-Transpiration</td>
<td><img src="evapo-transpiration.png" alt="Evapo-Transpiration" /></td>
<td>Loss of water through evaporation and transpiration</td>
</tr>
<tr>
<td>Water Outflow (from the area)</td>
<td><img src="water-outflow.png" alt="Water Outflow" /></td>
<td>Flow of water from the area</td>
</tr>
<tr>
<td>Land Availability and Demand</td>
<td><img src="land-availability.png" alt="Land Availability and Demand" /></td>
<td>Availability of land for different purposes</td>
</tr>
<tr>
<td>Food Production and Demand</td>
<td><img src="food-production.png" alt="Food Production and Demand" /></td>
<td>Production of food and its demand</td>
</tr>
<tr>
<td>Energy Production and Demand</td>
<td><img src="energy-production.png" alt="Energy Production and Demand" /></td>
<td>Production of energy and its demand</td>
</tr>
<tr>
<td>Population</td>
<td><img src="population.png" alt="Population" /></td>
<td>Number of people in the area</td>
</tr>
</tbody>
</table>

ARABIAN SEA
Current Situation

STEP 1

Runoff

Outflow

INDUS RIVER BASIN
MAIN RIVERS
NATIONAL CAPITALS

ELEVATIONS IN METERS:
- 4000
- 2000
- 1000
- 500
- 200

Conflict

Waterlogging

Water Stress

Habitat Degradation
STEP 2

Business as Usual Pathway
Desired Future Pathway

STEP 3

2018

2050
Robustness of Pathways

STEP 4

INTERNAL (PATHWAYS, STRATEGIES)

Desired Future 1
Desired Future 2
Desired Future 3

provide reference for

Business as usual

EXTERNAL (SCENARIOS)

Past & present → Possible future

STEP 4

SSP3-5
Indus visions and pathways

Economy pathway  Society pathway  Environment pathway
## From pathways to basin scenarios

<table>
<thead>
<tr>
<th>Sector(s)</th>
<th>Policy</th>
<th>Target (Economy)</th>
<th>Target (Society)</th>
<th>Target (Environment)</th>
<th>Model Represent.</th>
<th>Model Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>Access to water clean water</td>
<td>100% in 2050</td>
<td>100% in 2030</td>
<td>100% in 2030</td>
<td>people connected to pipes</td>
<td>infrastructure costs and urban water demand</td>
</tr>
<tr>
<td></td>
<td>Water storage and supply</td>
<td>Development of large</td>
<td>Strategic large</td>
<td>Strategic storage</td>
<td>Storage capacity</td>
<td>total storage capacity, min, max and actual level of reservoirs, storage</td>
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<tr>
<td></td>
<td></td>
<td>storage dams and</td>
<td>storage dams; develop</td>
<td>storage potential</td>
<td></td>
<td>investment costs</td>
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<tr>
<td></td>
<td></td>
<td>interbasin transfers</td>
<td>groundwater potential</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Conservaion of water-related ecosystems</td>
<td>Economic water uses</td>
<td>Securing environmental</td>
<td>Securing environmental</td>
<td>Allocation prioritization, Restrict land use changes</td>
<td>Volumetric flow by sector (km^3), Share of wetlands protected (%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>attended first</td>
<td>flows + conservation of</td>
<td>flows + conservation</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>sensitive wetlands</td>
<td>sensitive wetlands</td>
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<tr>
<td></td>
<td>Ensuring water quality</td>
<td>At least primary</td>
<td>At least primary</td>
<td>Secondary wastewater</td>
<td>wastewater tratament and water pollutants</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>treatment of industrial</td>
<td>treatment of industrial and urban water</td>
<td>treatment and water</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>and urban water</td>
<td>urban water</td>
<td>recycling,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Flood and drought management</td>
<td>Multipurpose-dam</td>
<td>Multipurpose-dam</td>
<td>Multi-purpose</td>
<td>Maximum river flows</td>
<td>Activity of river, canals and level of reservoir</td>
</tr>
<tr>
<td></td>
<td></td>
<td>management; Joint</td>
<td>management +Transboundary</td>
<td>management and NBS</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>surface and groundwater</td>
<td>cooperation strategy</td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>management</td>
<td></td>
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</tbody>
</table>
Pros/cons of the tool/approach

1. Well received by stakeholders (great buy-in)
2. Very flexible, can be adapted to explore a wide range of different challenges and pathways
3. It allows to generate sets of regional scenarios that are coherent with global storylines. Inter-comparability
4. Combined with IAMs, suitable for policy issue identification and measure development
5. Time and resource consuming
6. Not everything can be modelled (manage expectations)
IIASA Young Scientists Summer Program (YSSP)

Each year: 50 international students working under the supervision of IIASA staff

• 1 June - 31 August, in Laxenburg, Austria

• Open to advanced PhD. students whose research interests correspond to IIASA’s research

• Goal: publishable journal article

• Funding available from IIASA’s National Member Organizations

• On-line application (Oct – Jan) www.iiasa.ac.at/yssp
VIDEO
Thanks

Barbara Willaarts
willaart@iiasa.ac.at
Stakeholder Process-ROADMAP

Build partnerships with regional partners: national and basin organizations

Meeting 1: Warming Up
Identify priority needs from stakeholders

Meeting 2: Scenario and Capacity Development Workshop

Meeting 3: Presentation of results and Capacity Development Workshop

Beyond 2019

Identify opportunities for continuing the collaboration
Current Situation

STEP 1

STEP 2
Business as Usual Pathway

STEP 3
Desired Future Pathways

STEP 4
Robustness of Pathways
Basin Nexus challenges
Preliminary results

• Process-wise the approach has been very well received by stakeholders
• There is not one but various possible desirable futures and pathways. Yet to quantify if these imply big differences...
• Basins have different perceptions about how global scenarios might influence their regional pathways
• The stakeholder visions encompass many dimensions that cannot be modelled (expectation management)
Take home messages

• Mixed bottom up and top down approaches ensure buy-in from stakeholders and coherence regional scenarios with global storylines

• Thinking outside of the box is challenging for stakeholders but
### Key nexus challenges

<table>
<thead>
<tr>
<th>Basin</th>
<th>Water-Energy</th>
<th>Water-Land</th>
<th>Energy-Land</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZAMBEZI</td>
<td>- Hydropower potential under Climate Change</td>
<td>- Irrigation development to address productivity gaps</td>
<td>- Charcoal energy in rural households as the main driver of forest degradation, land erosion and dam sedimentation</td>
</tr>
<tr>
<td></td>
<td>- Balancing hydropower production &amp; other water users</td>
<td>- Impacts of irrigation developments for other water uses</td>
<td></td>
</tr>
<tr>
<td>INDUS</td>
<td>- Hydropower development upstream will affect downstream &amp; Climate Change</td>
<td>- Inefficient irrigation systems and its impact on soil salinization</td>
<td>- Biomass energy in rural households causing soil degradation and air pollution</td>
</tr>
<tr>
<td></td>
<td>- Energy subsidies &amp; groundwater mining</td>
<td>- Priority allocation to irrigation causing economic water scarcity</td>
<td></td>
</tr>
</tbody>
</table>
In 1973, the global economy was shocked by a major oil crisis. Shell wasn’t.
Scenarios enabled Shell to successfully adapt to unexpected changes.
2018 Basin outcomes

- Cross-sectoral and transboundary knowledge exchange
- Nexus approach mainstreaming the policy agenda (e.g. Zambezi Nexus dialogues)
- ZAMCOM interested in using the Scenario development tool for ZSDP
- LUMS and TERI researchers taking ownership on Indus modeling tool
- UNIDO and WB interested in applying the tools in other geographical contexts
## Scenario comparison

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Energy-land-climate</th>
<th>Water</th>
<th>SDGs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>2.0°C</td>
<td>BAU</td>
<td></td>
</tr>
<tr>
<td>1.5°C</td>
<td>1.5°C</td>
<td>BAU</td>
<td></td>
</tr>
<tr>
<td>SDG6</td>
<td>2.0°C</td>
<td>SDG6</td>
<td></td>
</tr>
<tr>
<td>SDG6 + 1.5°C</td>
<td>1.5°C</td>
<td>SDG6</td>
<td></td>
</tr>
</tbody>
</table>

### Water Sector Development Scenario

**Baseline**
- Water infrastructure access
  1. Piped water and treatment access proceeds according to the baseline SSP2 socioeconomic projections

**SDG6**
- Water demand
  1. Baseline SSP2 per capita water withdrawals and return flows
  2. SDG 6.1 By 2030 Urban domestic withdrawals exceed 100 liters per day and rural domestic withdrawals exceed 50 liters per day

**SDG6 + 1.5°C**
- Water allocation
  1. No change to allocation schemes

**Water technology development**
- Water infrastructure access
  1. Expansion of advanced recycling and desalination in water stressed regions at historical rates
  2. Phase out of freshwater once-through systems
  3. Energy intensive water supply technologies

### Water infrastructure access

**Baseline**
- SDG 6.1 By 2030 100% municipal withdrawals from piped water infrastructure
- SDG 6.2 By 2030 100% municipal return flows collected
- SDG 6.3/6.6 By 2030 50% of return flows treated

**SDG6**
- SDG 6.1 By 2030 Urban domestic withdrawals exceed 100 liters per day and rural domestic withdrawals exceed 50 liters per day
- SDG 6.4/6.6 Baseline SSP2 per capita withdrawals and return flows 10% end-use efficiency improvement due to behavior change
- SDG 6.6 By 2030 urban domestic withdrawals exceed 100 liters per day and rural domestic withdrawals exceed 50 liters per day

**SDG6 + 1.5°C**
- SDG 6.4/6.6 Up to 30% of irrigation withdrawals can be efficiently reallocated to other sectors.
- SDG 6.4/6.6 By 2030 30% less withdrawals from rivers and aquifers relative to 2010
- SDG 6.4/6.6 By 2030 minimum 5% reduction in energy sector water consumption relative to BAU

### Baseline SSP2 per capita water withdrawals and return flows

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2. SDG 6.1 By 2030 Urban domestic withdrawals exceed 100 liters per day and rural domestic withdrawals exceed 50 liters per day

### Water allocation

**Baseline**
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**Parkinson, S., et al., Environmental Research Letters, 2019**
VIDEO