Session:

Water–energy nexus  Reza Ardakanian
How do we optimise services? UNU-FLORES

For more information:  www.hydropower.org/congress
Hydropower’s role in the water-energy nexus - Relevance for SDGs -

Water and Energy:
What role does hydropower play?
20 May 2015

Reza Ardakanian
Director, UNU-FLORES
The Nexus Approach

Resources perspective:

- Water
  - Also for food and energy
- Soil
  - Food and biomass production
- Waste
  - Source of organic material and nutrients
  - Energy production

➢ Energy implicitly included

Source: UN Water 2013
The Water-Energy Nexus

- Energy production requires water
- Providing water requires energy

- Multi-purpose reservoirs as showcase of nexus (not only WE)

- Importance of case studies for showing nexus in practice
Case study Mozambique

• Low HDI: rank 178 of 187 (2014)
• MDG on hunger: met
• but still >25% of population undernourished
• Many (mostly transboundary) rivers
• Major importance of reservoirs for
  – Energy
  – Irrigation
  – Water supply
  – Flood control
Hydro in Mozambique

- Hydropower generates > 90% of electricity (mostly Cahora Bassa)
- ~2GW installed capacity, mostly for export
- Potential for up to 18 GW
- Low grid development
- Low access to grid (2012: 24% average, 50% in Maputo)
Challenges and Opportunities in Mozambique

Trend towards multi-purpose usage, potential conflicts increasingly recognized (mainly irrigation vs hydro, amplified by climate change)

Importance of Hydro/reservoirs for SDGs
- Food Security (#2)
- Water Security (#6)
- Energy Security (#7)
- Combat climate change (#13)
Lessons and generalization

Main lessons comply with outcomes of **DNC 2015**: 

- Focus on food-node of nexus 
- Emphasis on human dimension: livelihoods, stakeholder involvement, governance

Need for 

- New Hydro/multi-use reservoirs
- Adapted management schemes
- Tools for integrated management 
- Grid development within and across borders

... and on soil within nexus

.... Strong emphasis! => Nexus Observatory

.... More research: Impact assessment, Transferability of schemes 

.... Integrated models => Nexus Tools Platform

.... Diversification (food, energy) and regional integration
Further focus on SDGs

Side event:

Water storage and hydropower as drivers for sustainable development

Adopting a nexus approach and considering other water uses and users is essential to maximize the benefits of water storage infrastructure and hydropower while considering environmental, social and economic implications

Convenors

• UNU-FLORES
• IHA
• UNDP
Thank you

For further Information please contact us:

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flores.unu.edu
• >350 participants from 65 countries
• Platform to discuss relevance of nexus approach for SDGs: biennial event
• http://www.dresden-nexus-conference.org/
Lessons and generalization

• Focus on food-node of nexus
• Focus on livelihoods, stakeholder involvement, governance

Need for

➢ New Hydro/multi-use reservoirs
➢ Adapted management schemes
➢ Tools for integrated management
➢ Grid development within and across borders

Outcome of DNC/FLORES actions
⇒ ... and on soil within nexus
⇒ Strengthen nexus governance
   (Nexus Observatory)

⇒ More research (Impact assessment, transferability)
⇒ Integrated models,
   (Nexus Tools Platform)
⇒ Diversification and regional integration
The wider perspective: Relevance for SDGs

The 17 proposed Sustainable Development Goals

1. End poverty in all its forms everywhere
2. End hunger, achieve **food security** and improved nutrition, and promote sustainable agriculture
3. Ensure healthy lives and promote wellbeing for all at all ages
4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
5. Achieve gender equality and empower all women and girls
6. Ensure availability and **sustainable management of water** and sanitation for all
7. Ensure access to affordable, reliable, sustainable and modern **energy** for all
8. Promote sustained, inclusive and sustainable economic growth, full and productive employment, and decent work for all
9. Build resilient infrastructure, promote inclusive and sustainable industrialisation, and foster innovation
10. Reduce inequality within and among countries
11. Make cities and human settlements inclusive, safe, resilient and sustainable
12. Ensure sustainable consumption and production patterns
13. Take urgent action to combat climate change and its impacts (taking note of agreements made by the UNFCCC forum)
14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development
15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification and halt and reverse land degradation, and halt biodiversity loss
16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
17. Strengthen the means of implementation and revitalise the global partnership for sustainable development
Major issues of DNC

Focusing on global challenges (climate, urbanization, population growth), DNC aimed at identifying

- Best management practices for maintaining and enhancing environmental resources by adopting the nexus approach to the sustainable management of water, soil and waste
- Capacity development needs, which are required for the implementation of a nexus approach and instrumental to achieving the sustainable development goals (SDGs)
- Priorities for research, education and policy advice
Major outcomes of DNC

- Emphasizing the energy-food nexus
- Focus on the importance of soil within the nexus
- Stressing the human dimension (lifelyhoods, stakeholder involvement, governance)
- Need for integrated modeling tools and monitoring strategies

Nexus approach is essential for addressing global challenges and achieving SDGs
### Sustainability Assessment of energy technologies

- **Multi-criteria Analysis of energy technologies**
- **Sustainability indicators**
  - Economic (1)
  - Technological (3)
  - Environmental (2)
  - Socio-political (4)
- **Weighting of indicators based on expert judgement (n=62)**

#### Fig. 2: Sustainability ranking of the electricity generation technologies.

<table>
<thead>
<tr>
<th>Technology</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydro (large)</td>
<td>0.881</td>
</tr>
<tr>
<td>Hydro (small)</td>
<td>0.697</td>
</tr>
<tr>
<td>Wind (onshore)</td>
<td>0.684</td>
</tr>
<tr>
<td>Solar PV</td>
<td>0.671</td>
</tr>
<tr>
<td>Wind (offshore)</td>
<td>0.661</td>
</tr>
<tr>
<td>Nuclear</td>
<td>0.657</td>
</tr>
<tr>
<td>Natural gas</td>
<td>0.635</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>0.630</td>
</tr>
<tr>
<td>Geothermal</td>
<td>0.624</td>
</tr>
<tr>
<td>Biomass</td>
<td>0.539</td>
</tr>
<tr>
<td>CHP</td>
<td>0.538</td>
</tr>
<tr>
<td>Piston engine</td>
<td>0.516</td>
</tr>
<tr>
<td>Coal</td>
<td>0.453</td>
</tr>
</tbody>
</table>

Maxim 2014
Nexus Tools Platform

https://data.flores.unu.edu/projects/ntp/

- Interactive comparison of nexus modeling tools
Nexus Observatory

- Cross-fertilisation of good practice policy guidance through Ph.D. level research and commissioned studies
- Piloting of innovative approaches for planning and management of environmental resources through collaboration with relevant departments and ministries
- Capacity development through joint delivery of online courses offered as part of the Blended Learning Platform of the Nexus Observatory
- Dissemination of insights/policy advocacy through organisation of Nexus Observatory workshops and biennial Dresden Nexus Conference
- Contribute towards development of a unified monitoring framework through co-operation agreements with UN agencies, Member States and knowledge institutes worldwide
Multi-purpose Reservoirs: Showcase of Nexus

- Energy
- Agriculture
- Domestic/industry
- Ecosystems
- Flood/Drought management
- Further uses...(SHARE)

➢ Economic processes and boundary conditions
➢ Governance

Source: napocor.gov.ph
Items to be addressed for the W-E Nexus

- Improved (coupled) models for integrated management
- Technical upgrading and retrofitting of reservoirs to increase management options, e.g.
  - Bi-directional connections between reservoirs (pumped storage)
  - Pre-reservoirs (nutrient and sedimentation control, storage capacity)
  - Variable withdrawal depths (water quality, mitigate flood effects)
- Co-generation of electricity and desalinated sea-water from Solar Energy (pilot plants operational)

Equally important:

- Capacity development
- Governance
FLORES perspective

- Systems and Flux Analysis Considering Global Change Assessment
- Water
- Soil
- Waste
- Capacity Development and Governance
## Challenges and ways ahead

- **Missing link(s)/aspects**
  - Ecosystems within Nexus, Latitudinal gradient in climate effects, RE within Nexus (Mozambique)

- **Appropriate tools**

- **Management options**
  - Transferability of adapted management strategies, Impact assessment

- **Governance**
  - Policy Briefs, Nexus Observatory: Data and knowledge classification, - consolidation, - translation, - transfer
(yet) another Nexus perspective

Energy

Hydropower  Bioenergy

Water quantity and water quality

Food production

Irrigation intensity
Crop composition
Fertilizer application

Drinking water supply

Ecosystem (services)

Discharges and water levels
Eutrophication and pollution
SHARE concept

The multipurpose water uses of hydropower reservoirs

flores.unu.edu
SHARE concept

Hydropower reservoir services

Renewable energy sources and other power services (storage, controllable, non-variable, flexibility, capacity, enabler of other renewables, etc.)

Local livelihoods (improved: health services, education, sanitation, community services, housing, livelihoods, nutrition & food supply; barrier to saline water intrusion)

Water quantity management (flood control, drought mitigation, ground water stabilisation, water supply)

Economic growth (navigation, irrigation, recreational activities: tourism & leisure, aquaculture, domestic and industrial water supply management, improved Infrastructures, energy intensive industries)

Ecosystem services (guaranteed downstream flows for both environment and humans - water quality management; reduction of atmospheric emissions; creation of wetlands)