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UNU-FLORES

Institute for Integrated Management of Material Fluxes and of Resources

TECHNISCHE UNIVERSITÄT DRESDEN

ADVANCING A **NEXUS APPROACH** TO THE SUSTAINABLE MANAGEMENT OF **WATER, SOIL** AND **WASTE**

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OF **WATER, SOIL** AND **WASTE**

The Water-Energy-Food Nexus:

Enhancing Adaptive Capacity for Complex Global Challenges

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The Nexus

- Conceptually links multiple resource-use practices
- Serves paradigmatically to understand interrelations among such practices that were previously considered in isolation
- Resource recovery is at the core of operationalizing the nexus.

The Nexus in 2015

- Shift in global thinking towards sustainable futures
  - Human well-being
  - Resilient ecosystems
  - Co-exist within planetary boundaries
- This is imperative, a matter of survival
- Sustainable Development Goals (SDGs) in 2015 will supplant target-oriented Millennium Development Goals (MDGs)

The Nexus - A genealogy

- Early scientific references to the “nexus”
  - cell biology (complex electro-chemical-tissue interlinkages
  - economics (mutual wage-price-labor dependencies)
  - institutional literature (contracts among tiered firms)
- “Nexus” of resources
  - 1983 UNU Food-Energy Nexus Programme
    - Food, Energy, and Ecosystems Conference - Brasilia, 1984
    - Second International Symposium on the Food-Energy Nexus and Ecosystems - New Delhi, 1986
  - Mid-1980s Western United States water for electricity concerns (later dubbed a “nexus”)

The W-E nexus in agriculture

- Mid-to-late 1990s - early 2000s: India W-E-Agriculture "Nexus"
  - Green Revolution natural resource and socio-economic impacts became increasingly severe, no longer "externalities"
  - Sant and Dixit (1996) addressed energy supply for groundwater pumping
  - Padmanaban and Sarkar (2001) and Malik (2002) identified the groundwater-electricity nexus
  - Shah, Scott et al (2003, 2007) ag sector/ utility scale
  - WENEXA project (USAID)
  - applied to Jordan (Scott et al, 2003)
  - extended to Mexico (Scott & Shah, 2004; Scott et al 2004)

Water-Energy-Food Nexus

- 2006 Hyderabad workshop – IWMI, ICRISAT, Wageningen Univ., others
  - Hellegers et al (2008)
  - Siegfried et al (2008)
- WEF Nexus in climate adaptation (Lopez-Gunn 2009)
- Resource dependencies (Lazarus 2010)
- Climate-demographic coupled drivers (Scott 2011)
- WEF Nexus became further institutionalized
  - Bonn2011 (Hoff 2011)
  - Stockholm (multiple years, 2014)
- Dresden, UNU-FLORES, 2013 and beyond

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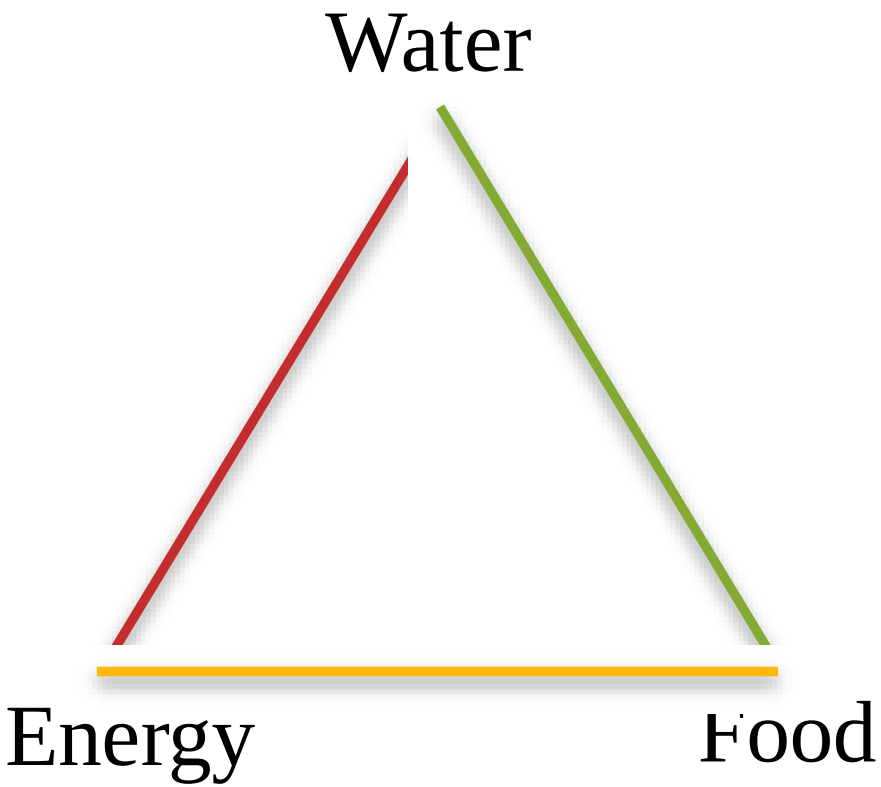
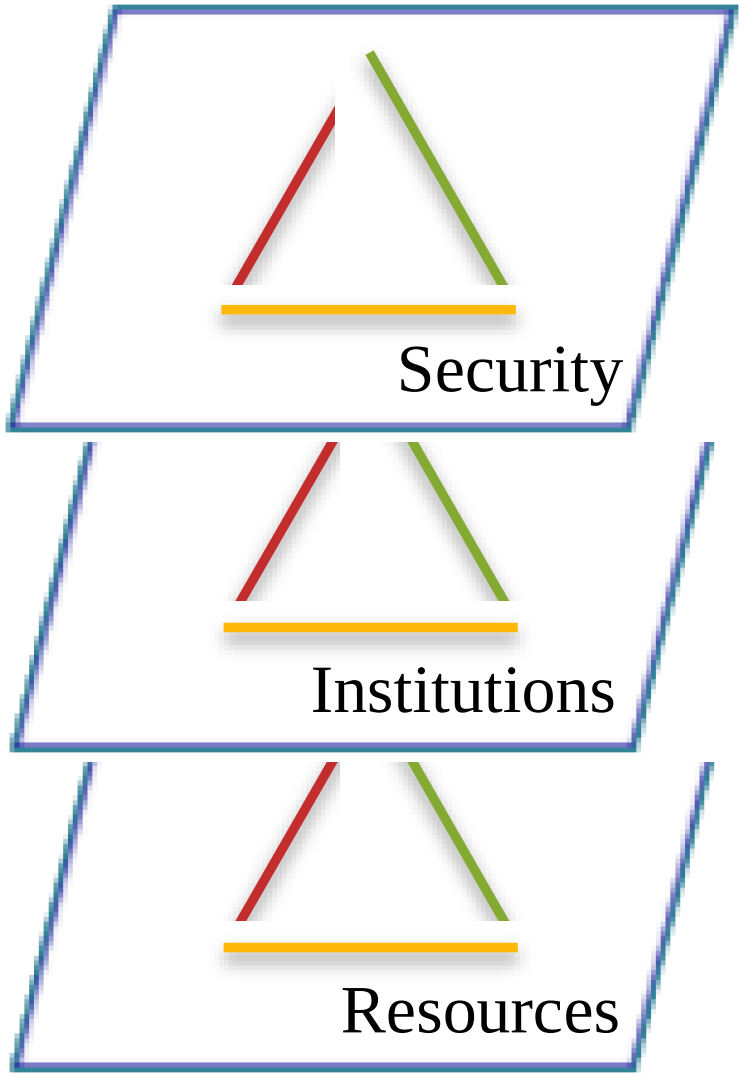
Water, energy, food: multi-scale interactions





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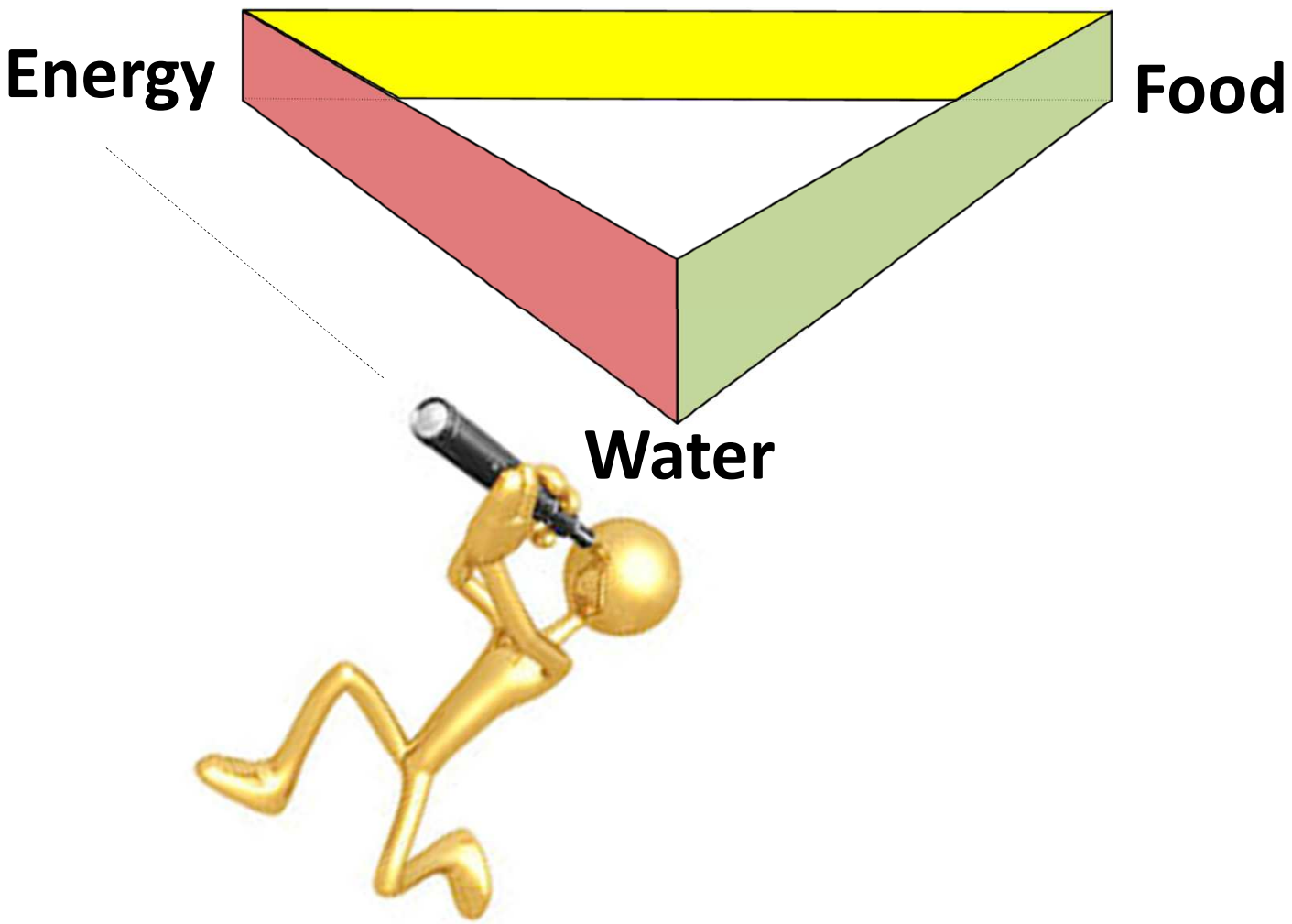
The Opticon:
W-E-F mutual perspectives vary



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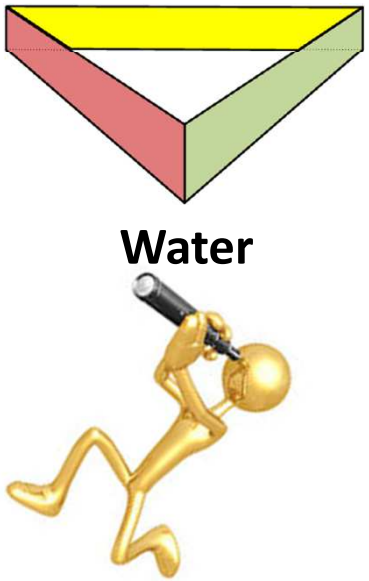
The water perspective on energy and food challenges

Energy challenges from **water** perspective:

- Water footprint of multiple energy portfolios
- Energy generation degrades water quality
- Dry cooled thermo-generation potential/limits
- Low water footprint solar PV and wind



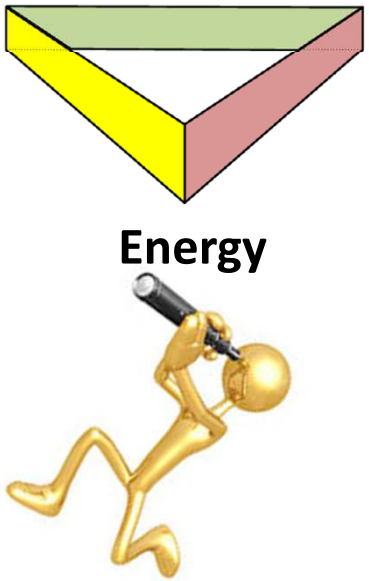
Food challenges from **water** perspective:

- Production shifts poleward, higher elevation
- Climate change raises irrigation demand
- More groundwater pumped w/variable climate
- Diminishing institutional influence of irrigation

The energy perspective on food and water challenges

Food challenges from **energy** perspective:

- Local food chains minimize transport energy
- Energy intensity of farm operations
- Climate change increases food cooling needs
- Extended crop seasons, night-time operation



Water challenges from **energy** perspective:

- Climate change raises water needs of energy
- Ensure water allocation to energy generation
- Rising demand for carbon-free hydropower
- Energy intensity of desalination, water reuse

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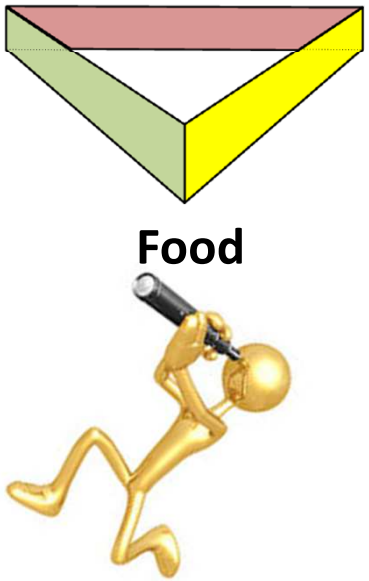
The food perspective on water and energy challenges

Water challenges from **food** perspective:

- High water footprint of agriculture
- Ensure water allocation to irrigation
- Supplemental irrigation of rainfed land
- Water, land degradation (e.g., salinization)
- Wastewater use for food production



Energy challenges from **food** perspective:

- Biofuel must not compete w/ food production
- Energy intensification of agriculture
- Energy intensification of food transport
- Mitigate hydropower-farming tradeoffs

Session III - key question 1

1. <u>Which are the research topics to be addressed?</u>
   - How are mutual WEF interlinkages expressed in resource, institutional and security terms?
   - Which interdisciplinary approaches can pose challenges and solutions drawn from the Tri-Opticon figures above?

Session III - key question 3

3. Is the Nexus concept "mature" and developed enough to be covered in study programmes

- Certainly, see genealogy above; requires:
  - Policy, institutions expertise
  - Natural resource use, environmental science
  - Engineering

Session III - key question 4

4. Is there a need for specific nexus education programmes or should the concept be addressed in the framework of existing programmes on water/soil/waste management?

- Must resist tendency to focus solely on resource level (i.e., move beyond resource management and engineering)
- Geographical and temporal scales
- Sustainability science, complex systems

Conclusions

- WEF nexus expressed in multiple domains
  - Resources
  - Institutions
  - Security
- WEF mutual perspectives offer multiple solutions
- Resource recovery key

Thank you

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http://aquasec.org/wrpg/publications/#nexus