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

INTERNATIONAL KICK-OFF WORKSHOP

11-12 NOVEMBER 2013
DRESDEN, GERMANY
Capacity Development for research and education

Teaching and training programmes addressing the nexus

Christian Bernhofer
Capacity Development for research and education

• Capacity development (CD) is generally a prerequisite for sustainable development
• Capacity development: individual level (education and training), organisational level (development of institutions) and enabling environment
• Nexus of Water, Soil & Waste typically not treated in teaching programmes, e.g. MSc of Environmental Engineering

→ need for teaching and training addressing the nexus
Definition of the Nexus for teaching & training

**Inner triangle** - Nexus of water, soil and waste

**Outer triangle** - Efficiency criteria: Energy, land use and food production

**Square** – societal and governmental framework (enabling environment)

Bernhofer & Leidel, 2013
ADVANCING A NEXUS APPROACH TO THE SUSTAINABLE MANAGEMENT OF WATER, SOIL AND WASTE

UNU-FLORES Structure

© flores.unu.edu
Nexus: research & teaching

• Research influences teaching by advancing the knowledge and by training and motivating the teachers, but primarily practical problems should trigger teaching topics of the nexus.

• Definition of teaching topics according to capacity needs and research questions related to the Nexus (applied research).

• Needs exist in all fields of the nexus: drinking water & waste water, soil conservation, waste recycling, ...

• Nexus specific needs relate to the links within the WSW triangle and their relations to efficiency criteria – land, energy and food production.

→ Nexus specific training & teaching ....
## Examples of “single” research and teaching topics

<table>
<thead>
<tr>
<th>Research directions</th>
<th>Research topics</th>
<th>Teaching topics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Water resources management</strong></td>
<td>Flood risk management</td>
<td>technical measures vs. natural retention increasing awareness, resilience and preparedness, decreasing vulnerability</td>
</tr>
<tr>
<td><strong>Soil and land use management</strong></td>
<td>Soil degradation</td>
<td>erosion; loss of soil carbon, nutrients and related soil fertility improper fertilizer management salinisation, soil compaction and sealing</td>
</tr>
<tr>
<td><strong>Waste management</strong></td>
<td>Recycle economy</td>
<td>waste composition &amp; reuse</td>
</tr>
<tr>
<td><strong>Systems and flux analysis/Global Change</strong></td>
<td>Carbon fluxes</td>
<td>C cycle: sinks &amp; sources, C sequestration &amp; GHG; erosion; organic amendments; quality &amp; function of soil organic matter</td>
</tr>
<tr>
<td><strong>Capacity Development and Governance</strong></td>
<td>Capacity issues</td>
<td>capacity assessments monitoring and evaluation of CD measures indicator development for CD</td>
</tr>
</tbody>
</table>
Nexus research and teaching topics

- Water
- Soil
- Waste

Sanitation, landfills, health
Conservation and management of food
Reuse and recycling, less contamination
Urbanization, sludge and sewage use

Water, Soil and Waste and example interdisciplinary research and teaching questions related to multiple components of the nexus

Bernhofer & Leidel, 2013
Analysing teaching programmes

- Dresden (TU Dresden: 4 DAAD funded international programmes, 3 relevant for the Nexus)
- Germany (DAAD - 39 Development-Related Postgraduate Courses, grouped into: 12 Engineering & Related Sciences, 7 Agricultural & Forest Sciences, 2 Environmental Sciences, 2 Development Co-operation, 2 Social Sciences & Education, ...)
- Europe (Erasmus Programmes): 33 participating countries, 138 joint Masters & Doctorates, relevant categories: Agriculture & Veterinary; Engineering, Manufacture & Construction; Health & Welfare; Science, Mathematics & Computing; Social Sciences, Business & Law
- Global – many nexus related studies (Environmental Engineering), but none we know dedicated to the Nexus!
Examples of integrated research & teaching

several international water related study courses in Germany

Master program Hydro Science and Engineering at the Technische Universität Dresden

International Postgraduate Studies in Water Technologies (IPSWaT)

International Water Research Alliance Saxony (IWAS)

Center for Advanced Water Research (CAWR)
EM- FRM: Global Change, Hydroinformatics and Planning (FLOODRisk) focuses on integrated flood risk management

- reducing human and socio-economic losses caused by flooding
- taking into account the social, economic and ecological benefits from floods
- designed to cover a wide range of topics
  - UNESCO-IHE Institute for Water Education (the Netherlands)
  - Technische Universität Dresden (Germany)
  - Technical University of Catalonia (Spain)
  - University of Ljubljana (Slovenia)
### Related master courses at TU Dresden

<table>
<thead>
<tr>
<th>Master of Science Study course</th>
<th>Number of mandatory modules and elective modules (credits)</th>
<th>Dedicated mandatory and elective modules for interdisciplinary competence (credits)</th>
<th>Specification (“T” or “I” type) and characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water management</td>
<td>9 (65) and 36 (25)</td>
<td>2 (15) and &gt;5 (25)</td>
<td>“I” with good portion of interdisciplinary modules (e.g., IWRM)</td>
</tr>
<tr>
<td>Hydrology</td>
<td>11 (70) and 34 (20)</td>
<td>0 (0) and &gt;5 (20)</td>
<td>“I” with some interdisciplinary elective modules</td>
</tr>
<tr>
<td>Waste management (and contaminated site treatment)</td>
<td>10 (70) and 26 (20)</td>
<td>2 (13) and 5 (20)</td>
<td>“I” with good portion of interdisciplinary modules</td>
</tr>
<tr>
<td>Hydrobiology</td>
<td>6 (65) and 36 (25)</td>
<td>1 (10) and &gt;5 (25)</td>
<td>“I” with some interdisciplinary modules</td>
</tr>
<tr>
<td>Hydro Science and Engineering</td>
<td>7 (40) and 15 (50)</td>
<td>2 (15) and &gt;5 (50)</td>
<td>“T” with choice of disciplinary competence</td>
</tr>
<tr>
<td>Tropical Forestry</td>
<td>16 (85) and 1 (5)</td>
<td>3 (15) and 0(0)</td>
<td>“I” with good portion of interdisciplinary modules</td>
</tr>
<tr>
<td>Vocational Education</td>
<td>9 (74) and 5 (16)</td>
<td>4 (36) and 3 (16)</td>
<td>“T” with emphasis on CD competence</td>
</tr>
<tr>
<td>Master of Science Study course</td>
<td>Number of mandatory modules and elective modules (credits)</td>
<td>Dedicated mandatory and elective modules for interdisciplinary competence (credits)</td>
<td>Specification (“T” or “I” type) and characteristics</td>
</tr>
<tr>
<td>-------------------------------------------------------</td>
<td>-----------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>Water management</td>
<td>9 (65) and 36 (25)</td>
<td>2 (15) and &gt;5 (25)</td>
<td>“I” with good portion of interdisciplinary modules (e.g., IWRM)</td>
</tr>
<tr>
<td>Hydrology</td>
<td>11 (70) and 34 (20)</td>
<td>0 (0) and &gt;5 (20)</td>
<td>“I” with some interdisciplinary elective modules</td>
</tr>
<tr>
<td>Waste management (and contaminated site treatment)</td>
<td>10 (70) and 26 (20)</td>
<td>2 (13) and 5 (20)</td>
<td>“I” with good portion of interdisciplinary modules</td>
</tr>
<tr>
<td>Hydrobiology</td>
<td>6 (65) and 36 (25)</td>
<td>1 (10) and &gt;5 (25)</td>
<td>“I” with some interdisciplinary modules</td>
</tr>
<tr>
<td>Hydro Science and Engineering</td>
<td>7 (40) and 15 (50)</td>
<td>2 (15) and &gt;5 (50)</td>
<td>“T” with choice of disciplinary competence</td>
</tr>
<tr>
<td>Tropical Forestry</td>
<td>16 (85) and 1 (5)</td>
<td>3 (15) and 0(0)</td>
<td>“I” with good portion of interdisciplinary modules</td>
</tr>
<tr>
<td>Vocational Education</td>
<td>9 (74) and 5 (16)</td>
<td>4 (36) and 3 (16)</td>
<td>“T” with emphasis on CD competence</td>
</tr>
<tr>
<td>General skills and competencies</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------------------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Statistics, Ecology, Climate change, Geodesy, IWRM, International Water Issues, Study project, ...</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Specific skills and competencies</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Water:</strong> Hydrology &amp; Watershed Mt. Hydraulics &amp; Hydrodynamics Hydrochemistry &amp; Water Quality Urban Water Flood Risk Mt. Aquatic ecology Ground water Drinking water</td>
</tr>
<tr>
<td><strong>Soil &amp; land use:</strong> Soils Soil water</td>
</tr>
<tr>
<td><strong>Waste:</strong> Circular Economy Biotechnology</td>
</tr>
</tbody>
</table>
### BSc in water, soil or waste

**MSc Nexus water, soil and waste**

#### General skills and competencies (mandatory)
- Statistics, Ecology, Global Change, IRM, International Law, Study project, Nexus Lab, Economy, governance

#### Add. specific skills and competencies

**Water:**
- Hydrology & Watershed Mt.
- Hydraulics & Hydrodynamics
- Hydrochemistry & Water Quality
- Urban Water
- Flood Risk Mt.
- Aquatic ecology
- Ground water
- Drinking water

**Soil & land use:**
- Soils
- Soil Water
- Soil Conservation
- Land Use Mt.
- Agro and Forestry Systems
- ....

**Waste:**
- Circular Economy
- Biotechnology
- Waste Mt.
- Waste Thermodynamics
- Waste & Pollution
- ....
Nexus specific teaching styles and suggestions

• Teaching styles (general):
  * receptive (lectures)*
  * directive (training and tutorials) with practical exercises, etc.*
  * guided discovery (workshops, seminars, role plays)*
  * exploratory (self directed studies, e.g. study projects)*

• **Blended learning** combines teaching styles (also with e-learning)

• Suggestions for **Nexus specific teaching**:
  * Nexus team work* (groups of 2 to 5)*
  * Nexus field & lab class* (addressing jointly, e.g., a Nexus problem in urban waste management with field & lab work)*
  * Nexus theatre* (special actors’ WS with MSc and PhD students)*
  * Nexus study tour* (guided tour along a Nexus line)
• Support IWRM implementation
• Improve IWRM-research and education
• E-learning module that complements classical learning options
• Vocational training

• Currently 40+ interlinked lectures and case studies
PhD Programmes & Lifelong learning

• PhD Programmes (Nexus Academy): research driven and require appropriate funding → challenge (disciplinary structure of reviewing systems of typical donors)
• Lifelong learning: summer schools, e-learning modules and other distance learning tools, exchange programmes, on the job training taking advantage of existing programmes (UNEP)
How to proceed?

- Integrating the Nexus in existing programmes: *Participating* in existing interdisciplinary modules of existing programmes (e.g., study project in HSE) *Enriching* of existing interdisciplinary modules *Creating* new modules to offer Nexus “specialisation” *Offering* short courses to existing programmes (UNEP-CIPSEM)
- Creating Nexus specific new programmes: Nexus Master, Nexus PhD (Academy)
- Link these programmes to Nexus specific research
- Structure of UNU-FLORES and co-operation with TU Dresden are ideal to promote this Nexus specific teaching and training!
• For more details please see:
  Bernhofer & Leidel: **Capacity Development for research and education- Teaching and training programmes addressing the nexus.** UNU-FLORES Whitebook (Draft 2013)

Thank you for your attention!