Integrated Assessments of WEF nexus solutions

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Federal Ministry of Food and Agriculture

LAND BRANDENBURG Ministry for Science, Research and Culture

Megatrends and challenges to agriculture

Source: Ewert et al., ZALF, 2019

ZALF research domain

… | Natural | Managed | Urban | …

Forest | Pastures | Arable | Peri urban

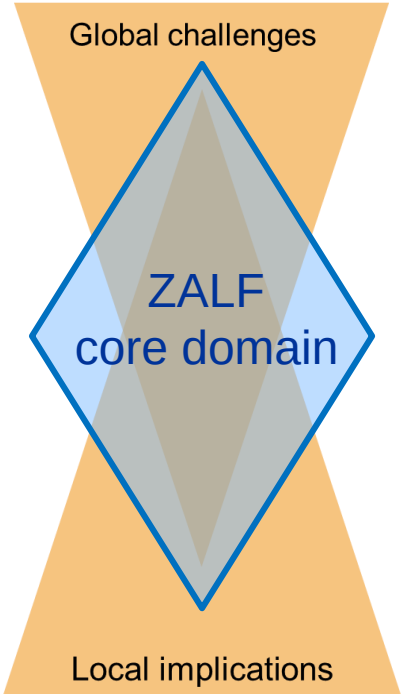
…

Region

Landscape

Field

…



Source: Ewert et al., ZALF, 2019

Mission

To develop solutions for economically, ecologically and socially sustainable agriculture - together with society

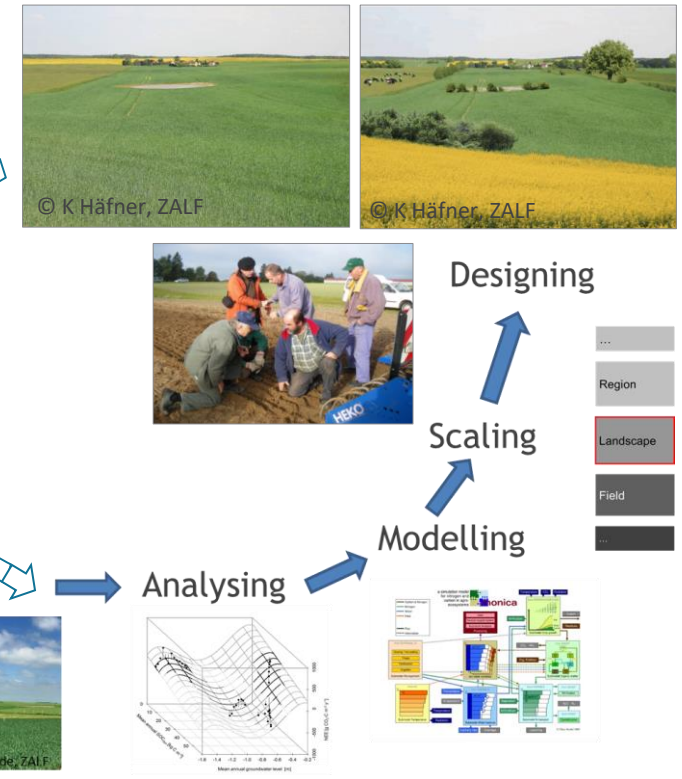
ZALF research approach

Integrated system approach

- Integration across disciplines (sub-systems) and scales
- Combination of thematic knowledge, data and models
- Combination of experimental and modeling research
- Research, application and social integration

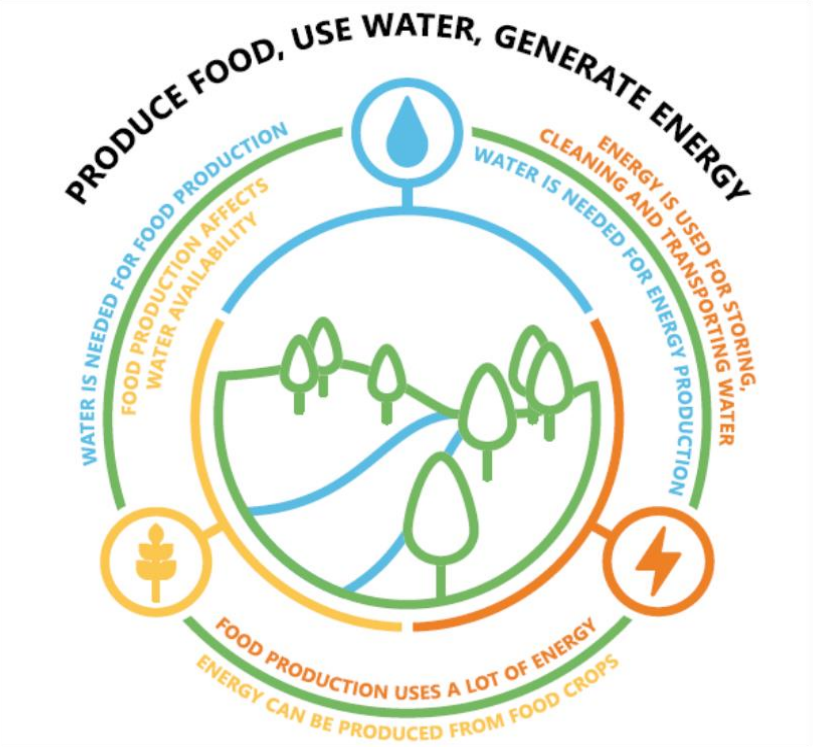
Research approach

- Classical basic research
- Program research
- Applied research
- Transdisciplinary research



FOOD-WATER-ENERGY-NEXUS

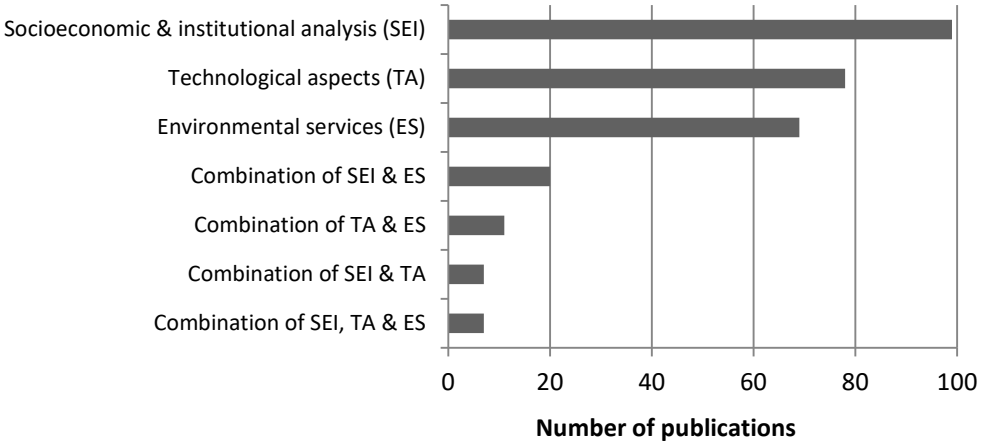
APPROACH & APPLICATION

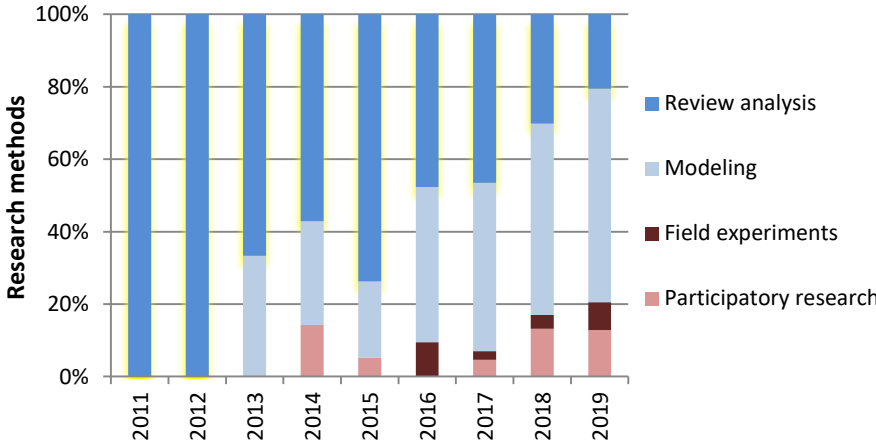


- Provide a systems-based perspective that explicitly recognizes water, energy, and food systems as both interconnected and interdependent
- Addresses also feedbacks between human and natural systems

Source: ZALF Jahresbericht 2018

WEF nexus research – state of the art





- Mainly disciplinary focus
- Few examples of full integration between socio-economic, technological and environmental aspects

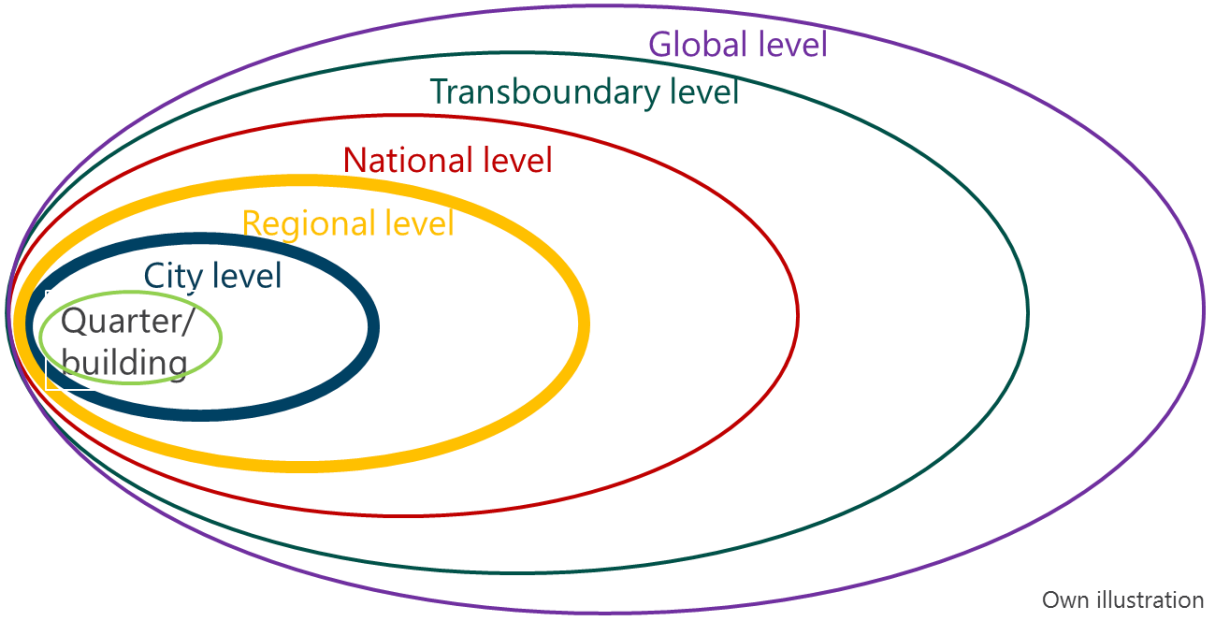
- Mainly conceptual research (reviews)
- Experimental and modelling research picking up recently

Source: Hamidov & Helming (2020). Sustainability considerations in water-energy-food nexus research in irrigated agriculture. Sustainability 12:6274.

FOOD-WATER-ENERGY-NEXUS

APPROACH & APPLICATION

Macro-level Nexus Research
e.g. assessing and guiding for ressource management



Own illustration based on Dai 2018

Micro-level Nexus Research
e.g. resource flows in specific (economic sectors)

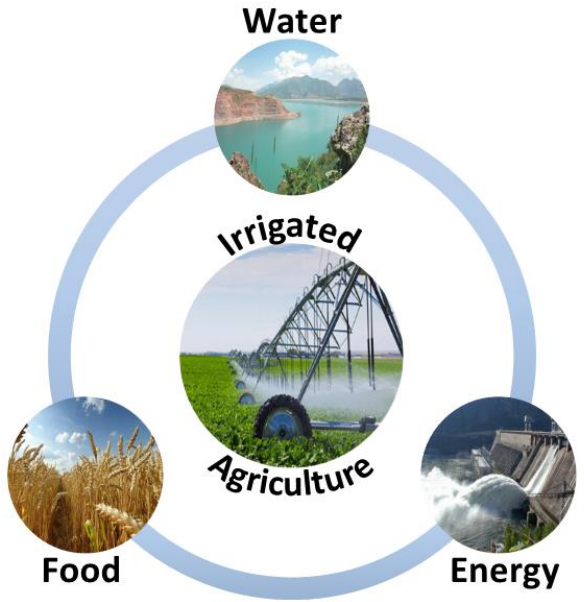
- WEF nexus concepts at different scales

2 Research examples:
Integrated assessment of WEF nexus solutions

Example 1

- Modelling conflicting land demands in Germany

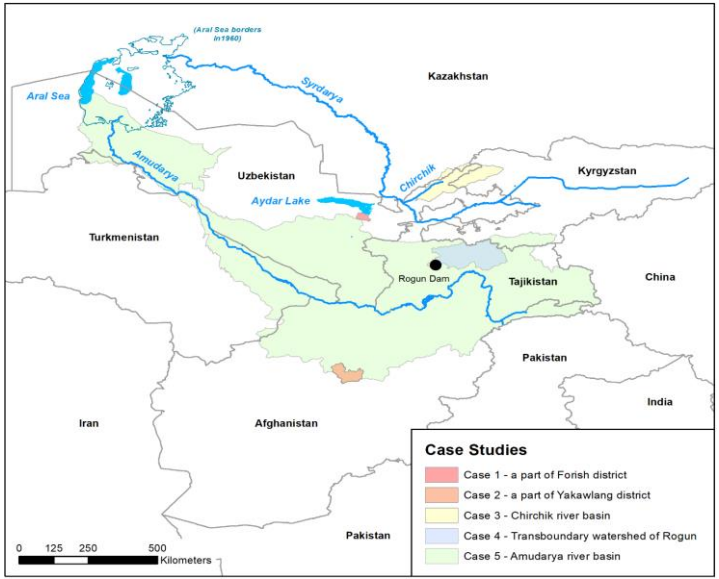
Example 2



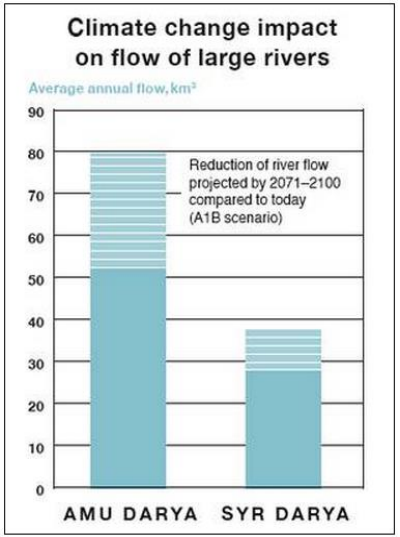
- WEF nexus in irrigated agriculture in Central Asia

Research example 2:
Irrigated agriculture in Central Asia

- Irrigated agriculture remains an important sector in the economy of Central Asia (CA) → 90% of the total water is used for irrigation
- Population growth along with emerging climate change has resulted in rising demand for **water**, **energy**, and **food**
- Soil salinity is a key threat for sustainable agriculture: over 50% of the irrigated lands are salinized and is a threat for declining crop production
- Construction of hydropower plants for energy purposes in upstream countries have reduced water availability for downstream countries
- ZALF conducted Participatory Impact Assessment WEF nexus cases at different scales



Location of the five WEF nexus study areas in Central Asia



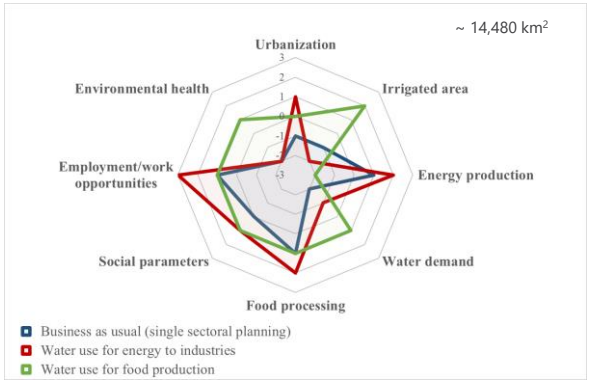
Source: http://www.waterunites-ca.org

Source: Hamidov et al. (2016)

Research example 2: key results
Irrigated agriculture in Central Asia

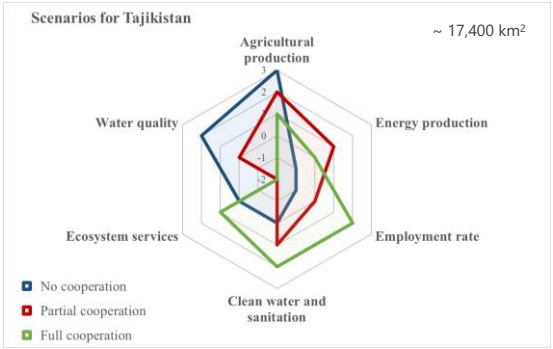
Tashkent area (~ 780 km^2)

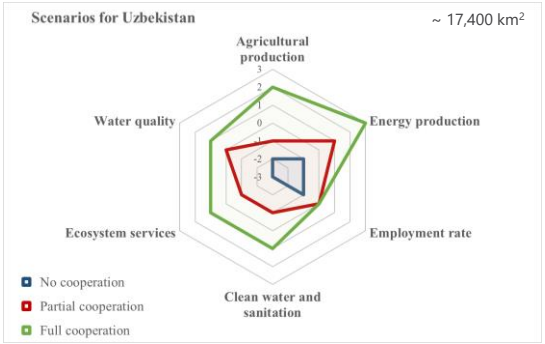
Water is the limiting factor for economic development. Industrialization potential may increase hydro-energy demand that may create trade-offs with irrigation and thus food security



Transboundary dam construction (~ 17400 km^2)

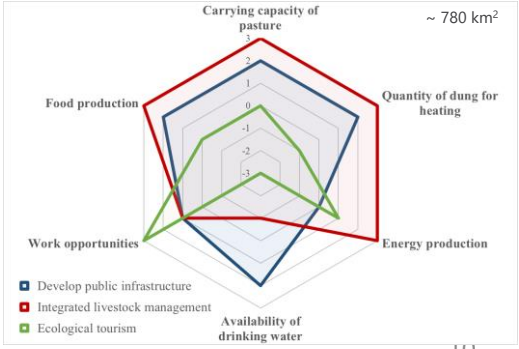
Cooperative transboundary WEF nexus governance can reduce trade-offs





Rural area Uzbekistan (~ 780 km^2)

Prolonged overgrazing and use of shrubs and manure for energy led to land degradation. Water storage capacity of the soils deteriorated. New income sources need to be developed



Source: Hamidov et al (in review). Making the water–energy–food nexus research operational for sustainable development. Regional Environmental Change

Research example 2:
Irrigated agriculture in Central Asia

- Cases ranged from international transboundary watersheds (Amudarya) to very local village scales, with a diversity of actors and sectorial focal issues
- Importance of systems' boundary definition in conducting impact assessment was crucial: spatial scales, governance levels, stakeholders, different complexity of impact assessment
- Water governance was critical for large-scale WEF nexus management, while land and soil management were decisive for minimizing tradeoffs at local levels
- Technological innovations (e.g. drip irrigation) can have unintended consequences in practice → typical rebound effects, if WEF nexus is not considered and governed.





Source: Hamidov et al (in review). Making the water–energy–food nexus research operational for sustainable development. Regional Environmental Change

Conclusions

- WEF nexus is still mainly a conceptual framework but can be used for integrated assessments
- The implementation of the WEF nexus is important to address relevant SDGs
- The Implementation can be done at different scales (transboundary water governance down to regional land/water management)
- It always requires integrated governance and cooperation of decision makers from different sectors
- Technical innovations are important but need to be accompagnied with governance innovations in order to avoid rebound effects and trade-offs between SDG targets
- Integrated assessments (scenario modelling, indicator assessments) can support the cooperation of decision makers across scales

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