

The Water - (Land-) Energy – Ecosystem Nexus in the Blue Nile / Ethiopia

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Nexus Background Paper

www.water-energy-food.org/documents/understanding_the_nexus.pdf



SEI, KTH,
FAO, IAEA, UNDESA...



Bonn2011 Conference
The Water, Energy and
Food Security Nexus
Solutions for the Green Economy
16 – 18 November 2011

Understanding the Nexus

Background paper for the Bonn2011 Nexus Conference

What is „the nexus“ ?

an integrated approach promoting “systemic thinking”
e.g. externalities, tradeoffs, synergies

Why do we need it ?

increasing demand for natural resources,
for food, energy and other human securities,
threatens environmental sustainability , ecosystem services
-> need for sustainable intensification
-> need for coherent policies across scales
-> to be supported by multi-scale, cross-sectoral analyses

How to implement it?

mostly through case studies:

Burkina Faso (food-biofuel) , Mauritius (sugarcane for biofuel),
MENA (climate adaptation – mitigation), California, Blue Nile

Tool box for nexus tradeoff analysis, integrated scenarios, policy and investment support

WEAP / LEAP (AEZ)

- simulating long-term resource allocations,
- integrated network-based demand and supply analysis,
- transparent, flexible, user-friendly, low initial data requirements,
- similar user interfaces and terminologies,
- widely used in ministries, authorities, bureaus, NGOs, universities etc:
100s of users worldwide.
- for free to non-profit developing country institutions
- frequent trainings in Sweden, but also in various regions
(plus online tutorials and handbooks)

to be developed jointly with stakeholders and scientists

Linking Water and Energy Issues

Groundwater depletion
Water quality
Unmet ecological flows
Costs

Insufficient water for hydro and cooling, even with increased groundwater pumping.

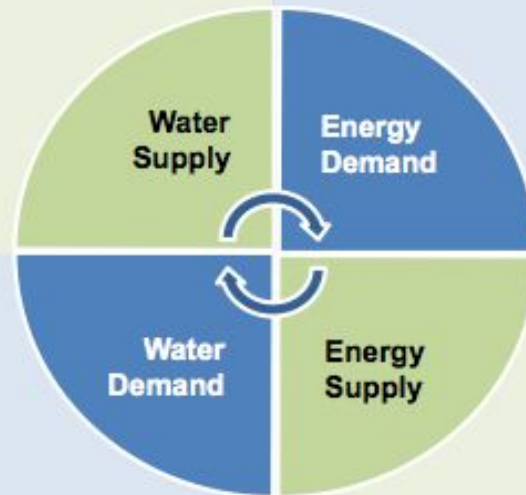
Still insufficient water--further enhance supply with desalination.



Water requirements for hydropower & thermal cooling
Water conservation

Limited hydropower & cooling water, increased energy requirements for pumping.

Increased energy requirements for desalination.



Hydropower energy & cooling water requirements
Reduced water demands

Electricity demand
Energy efficiency



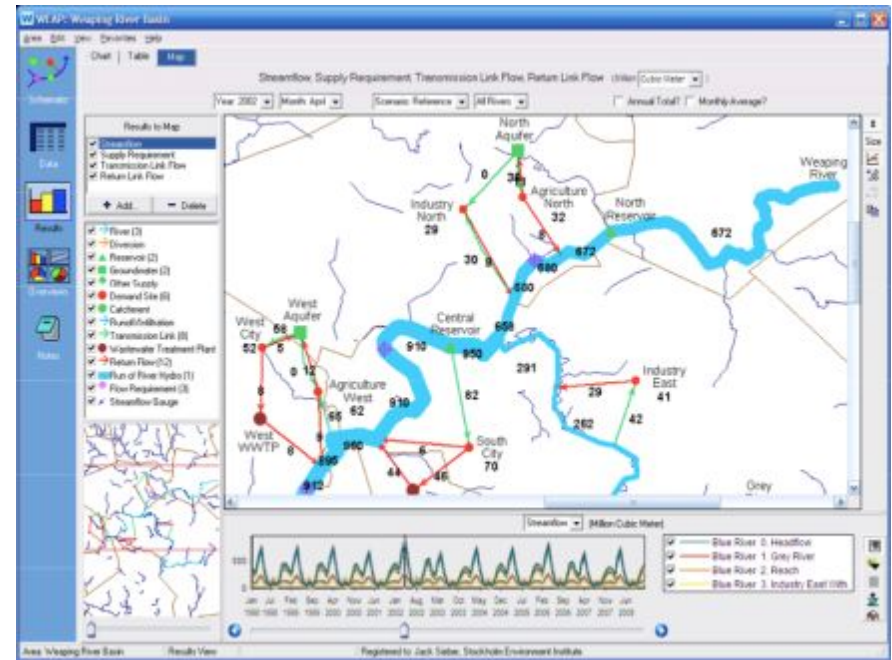
Hydropower & fossil generation
Wind & solar, less water-intensive cooling

Fuel Use
GHGs
Local air pollution
Costs

WEAP Water Evaluation And Planning

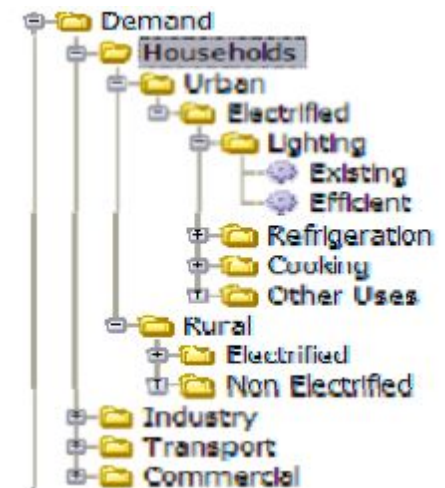
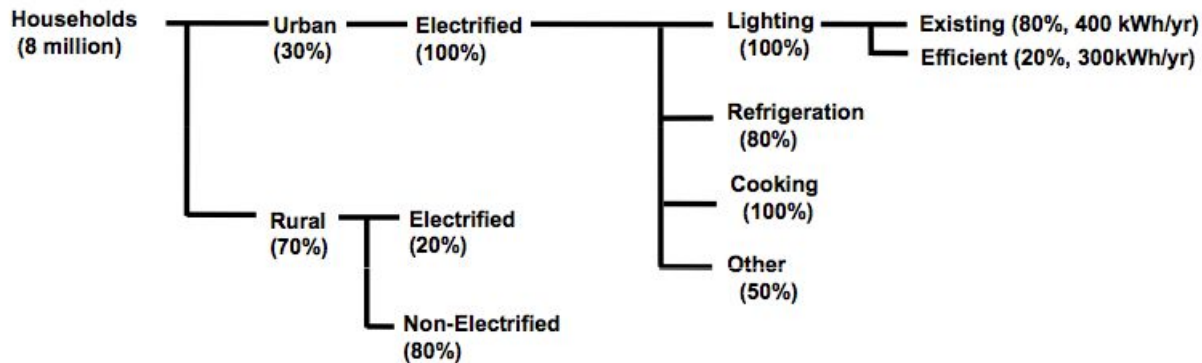
www.weap21.org

- Integrated watershed planning, matching demands and supplies
- GIS-based, graphical drag & drop interface
- Additional simulation modeling possible:
land use effects,
groundwater dynamics,
crop water use,
crop productivity,
water quality,
reservoir management &
hydropower
financial module



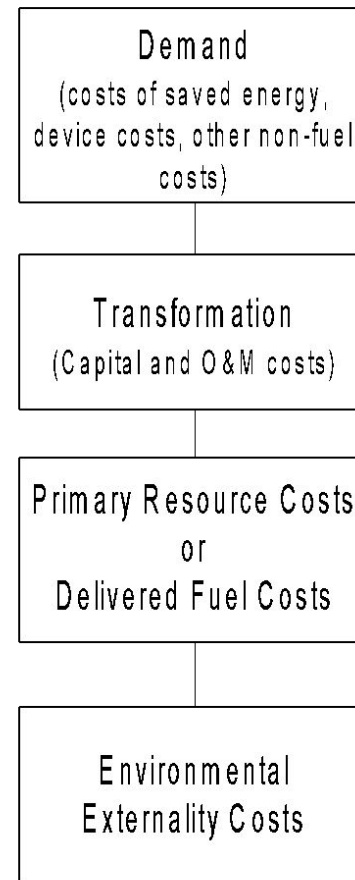
LEAP Long range Energy Alternatives Planning System

- Typically organized by sector, subsector, end-use and device.
- Users can edit the tree on-screen using standard editing functions (copy, paste, drag & drop)
- Structure can be detailed and end-use oriented, or aggregate (e.g. sector by fuel).

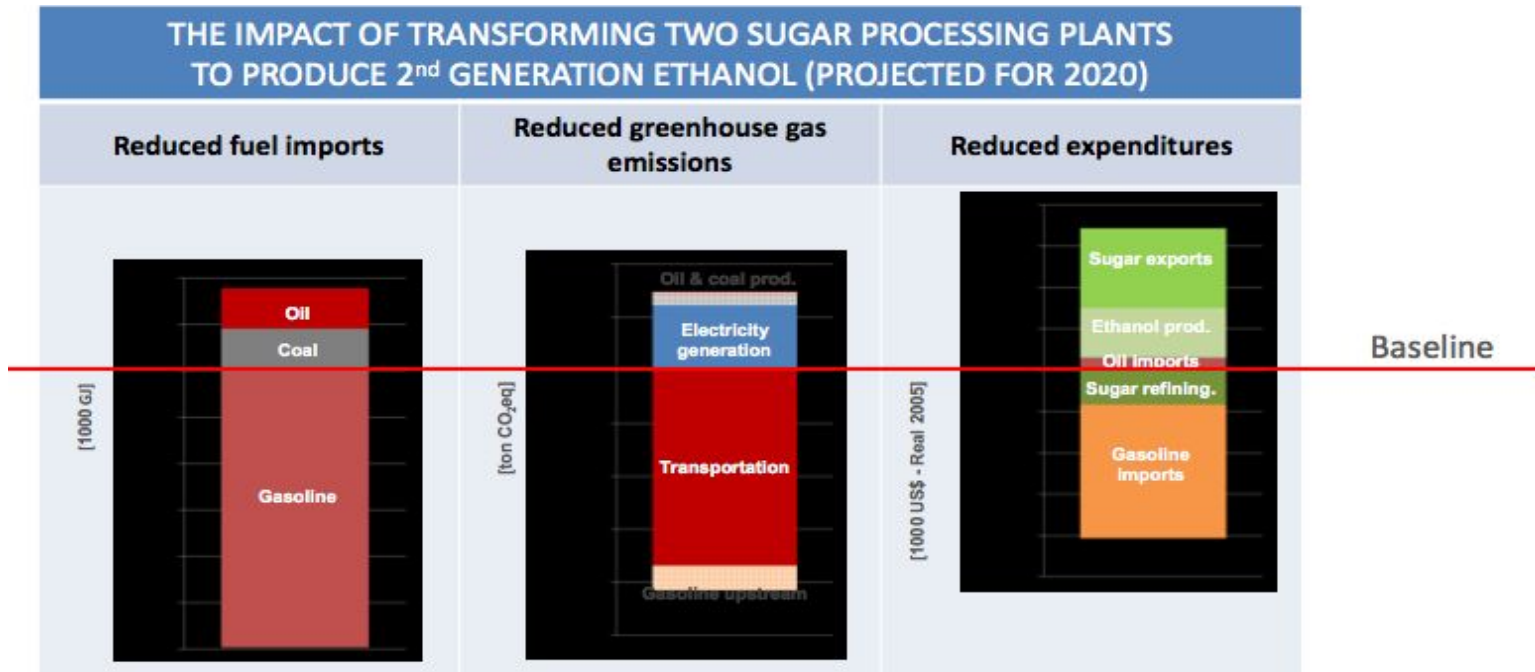


Cost-Benefit Analysis ("externalities") in (WEAP) LEAP

- Societal perspective of costs and benefits (i.e. economic not financial analysis).
- User specifies boundaries
- Cost-benefit analysis calculates the Net Present Value (NPV) of the differences in costs between scenarios.



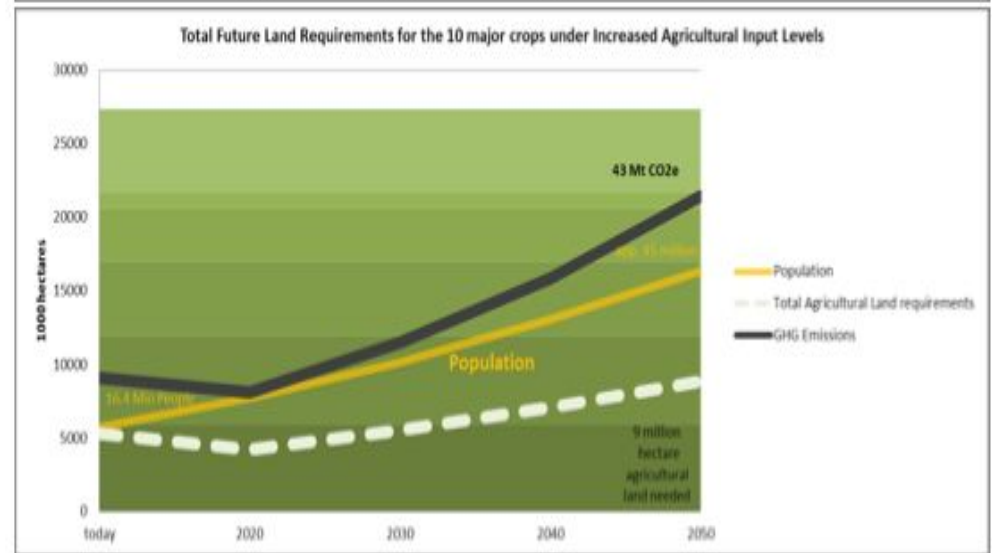
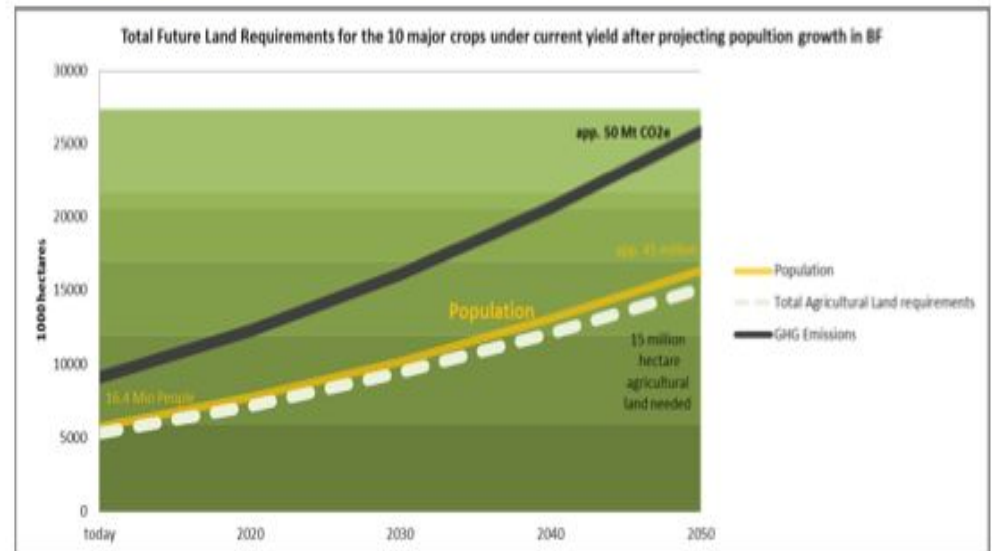
Previous case studies (KTH, SEI) Mauritius



- Energy Security in changing Climate conditions
- Small island with clear boundaries- data availability
- Producer and exporter of sugar (occupying 80 % cultivated land area)
- Dependent on fuel imports for its energy requirement
- Highly vulnerable to climate change
- Nexus („CLEWs“) approach formally adopted for national policies by the government

Previous case studies (KTH, SEI) Burkina Faso

- Increasing Population (water demand, energy access, food security)
- Land locked country
- Population increase and urbanization (centralized demand)
- Dependence on one main export crop (cotton)
- Continuous deforestation
- No own fuel resource – Dependence on wood for as energy source
- Agricultural intensification on suitable land for food security, biofuel production and reduced emissions.



Previous case studies (KTH, SEI) California

- Water for Energy and Energy for Water
- The water sector accounts for 19% of California's electricity consumption
- Importation of water from North to South California
- Proposed scenario: introduce a share of water supply (5%) from desalination of sea water
- Result: quantified tradeoff: increased energy consumption vs water saved (not imported)

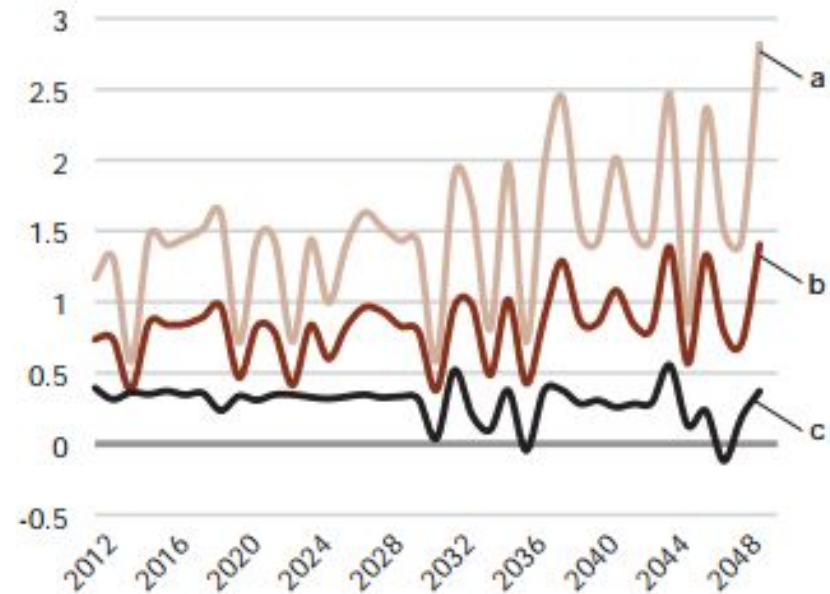


Figure 3. Changes in DESAL Scenario compared with BAU

- a. Increase in water-sector electricity use (TWh)
- b. Increase in water-sector GHG emissions (million tonnes CO₂e)
- c. Reduction in water imports (billion m³)

Application of the nexus concept to the Ethiopian Blue Nile

Supporting ongoing activities, plans and strategies

e.g. GTP & CRGE:

agricultural intensification / commercialization / irrigation,
renewables / hydropower / bioenergy crops

Identifying pathway to achieve goals such as:

- improved water use efficiency (GTP)
- avoiding further cropland expansion (CRGE)

For discussion: how are the national goals broken down into Blue Nile planning and management?

Application of the nexus concept to the Ethiopian Blue Nile

proposed focus on biomass production,
tradeoff analyses / testing different strategies, e.g.

small- vs. large-scale storage

water for hydropower vs. water for agriculture

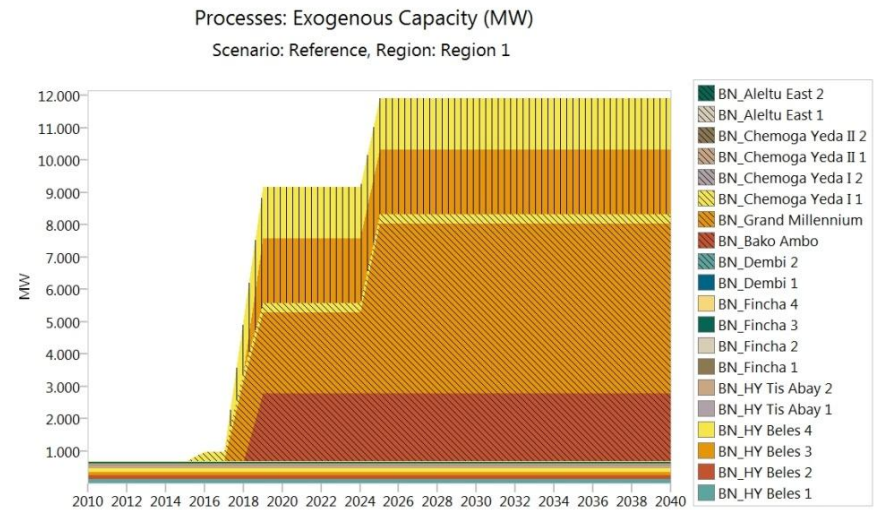
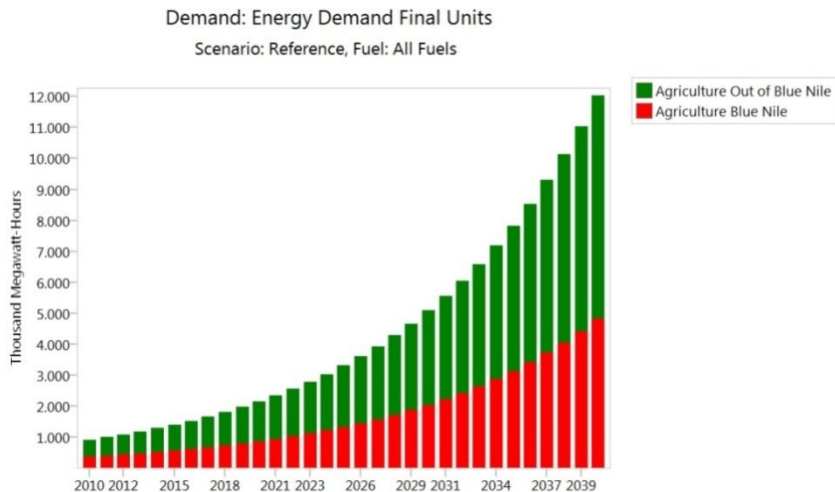
water for biofuels vs. water for food production

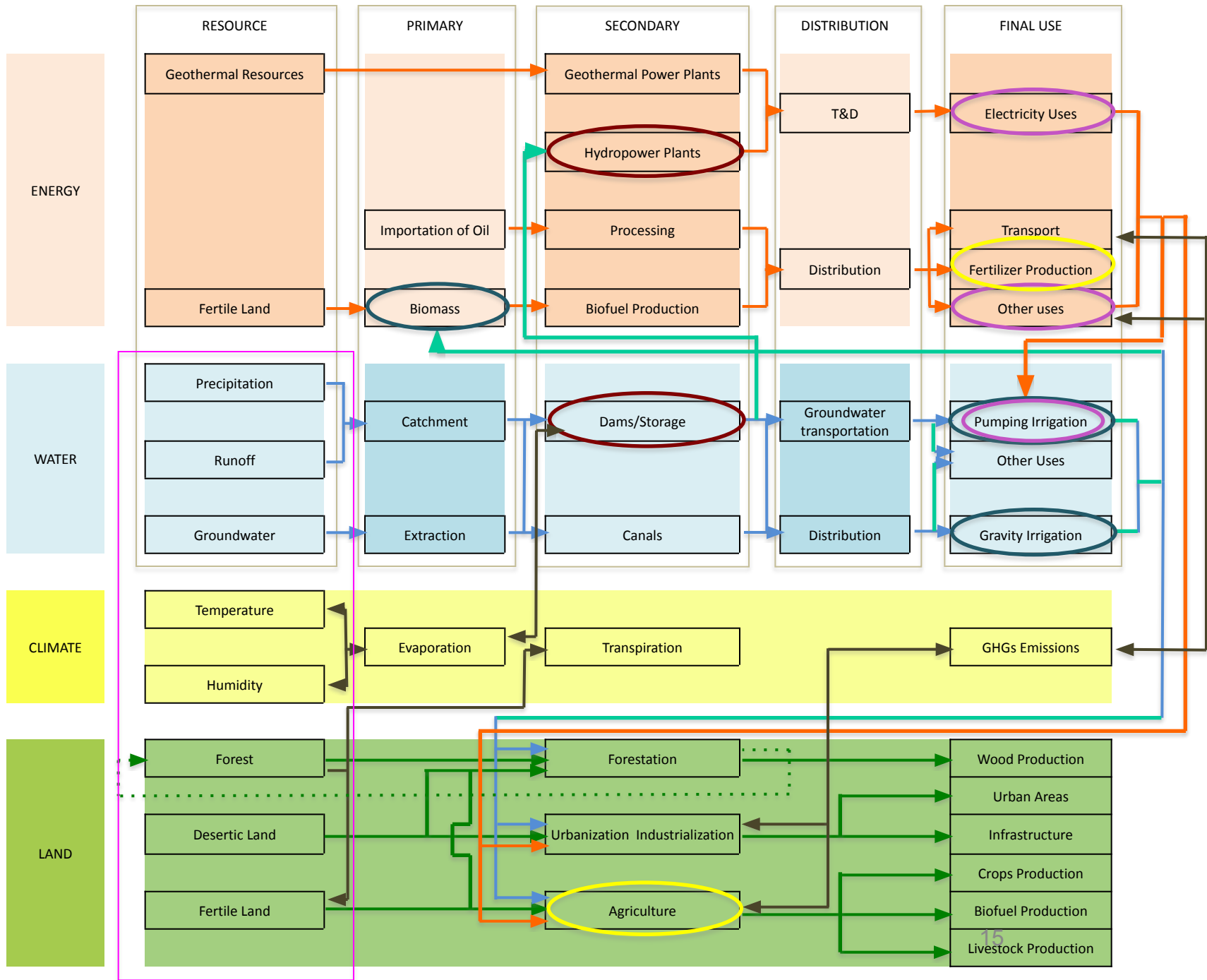
energy for agricultural intensification

goal: „improved landscape configurations“ for resilience

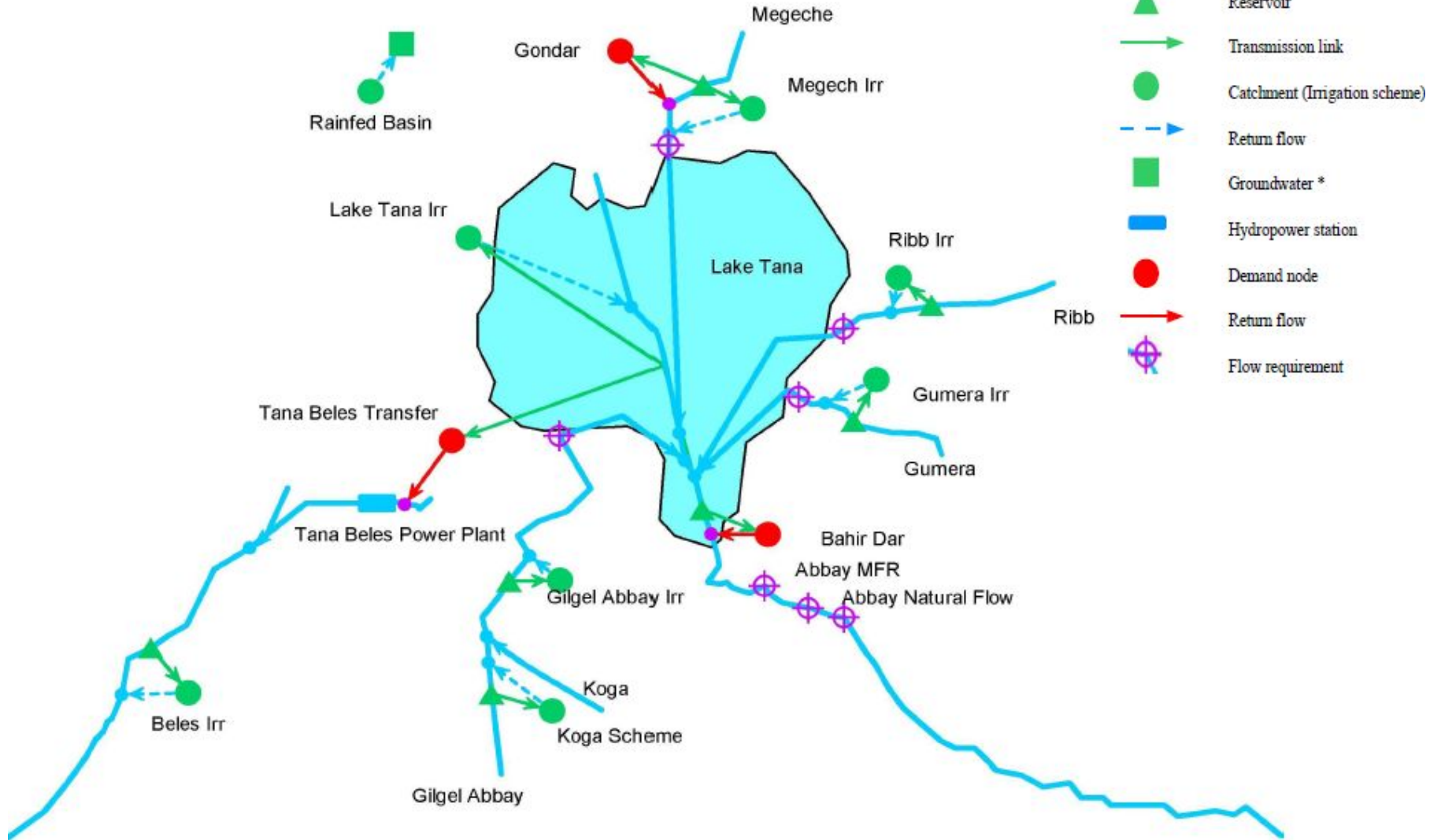
Initial LEAP model for Ethiopia / Blue Nile

- National Model on LEAP (to be linked with Blue Nile Basin Model on WEAP and eventually with Land Use using GAEZ)
- Disaggregation of data from Blue Nile Region





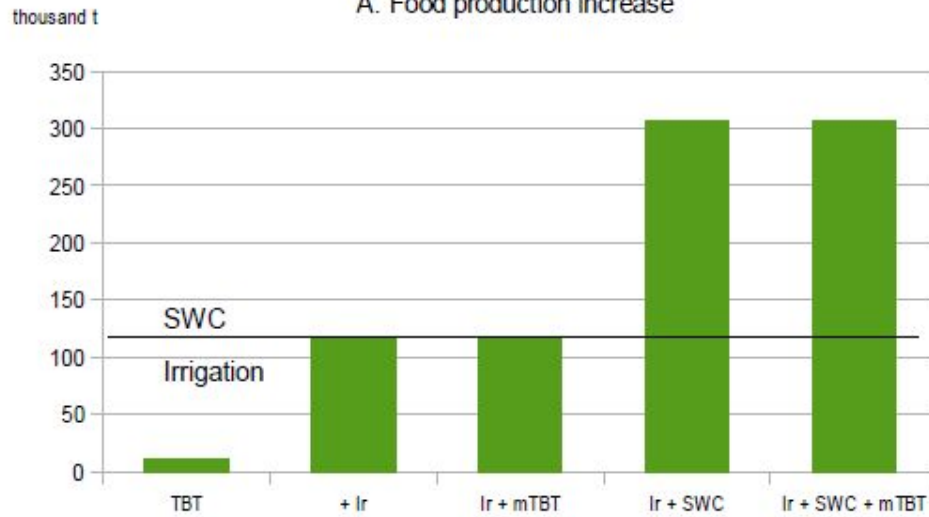
Initial WEAP model for Lake Tana



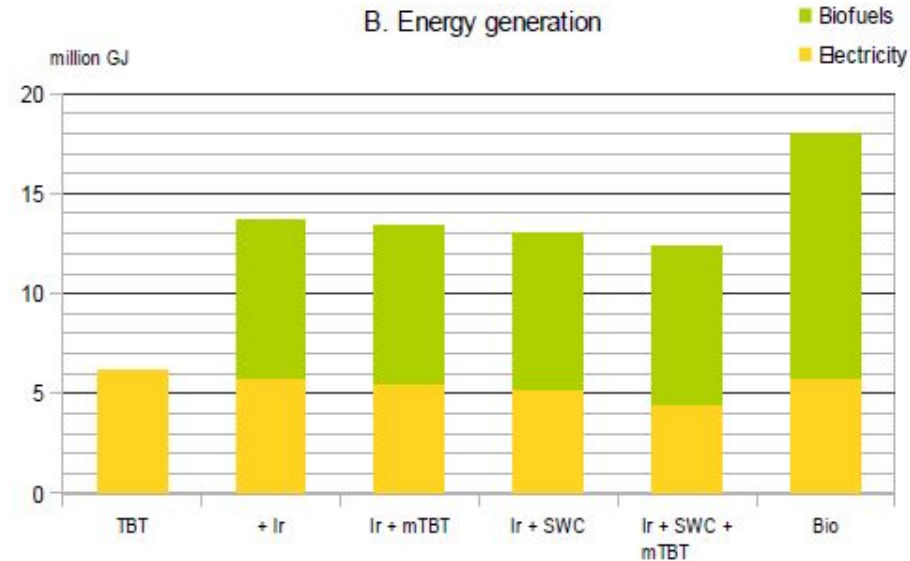
Initial WEAP model for Lake Tana

quantifying upstream \leftrightarrow downstream effects and tradeoffs

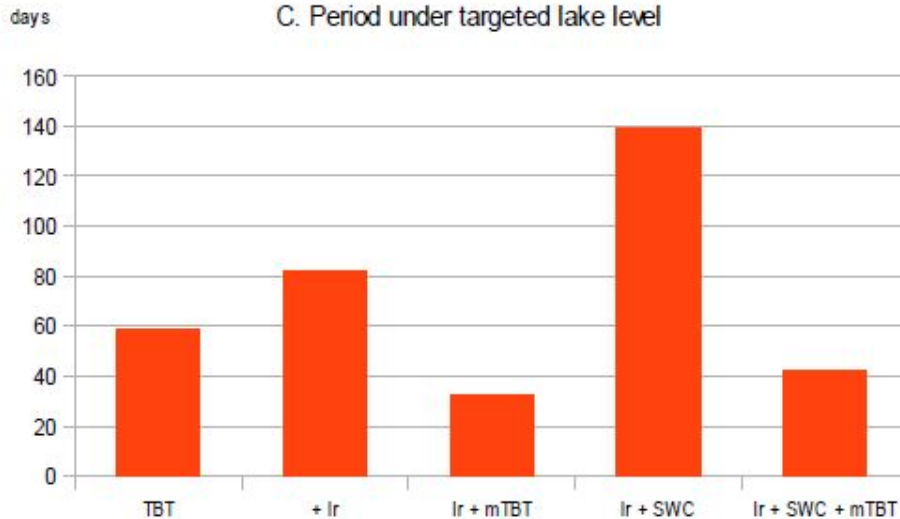
A. Food production increase



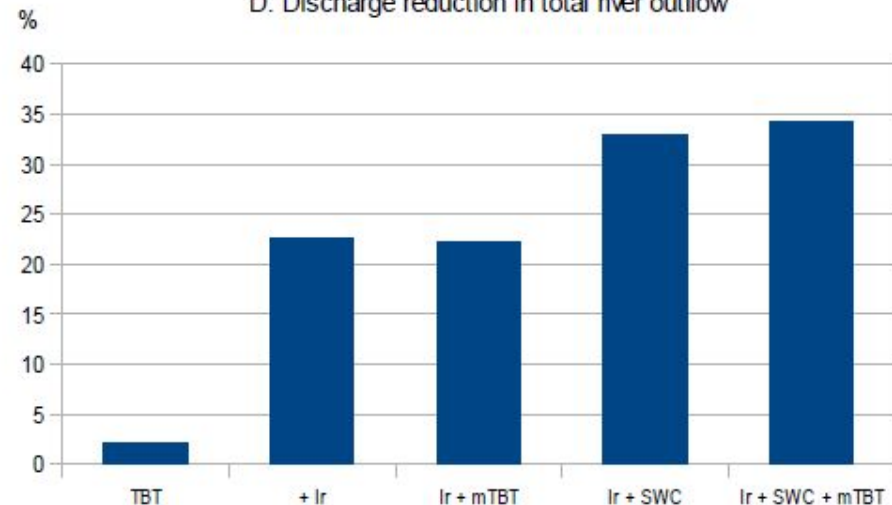
B. Energy generation



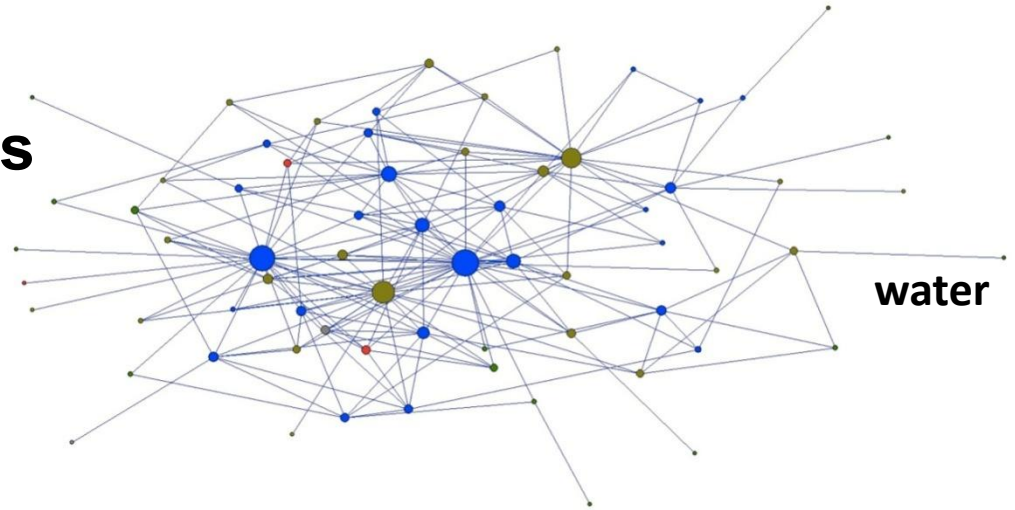
C. Period under targeted lake level



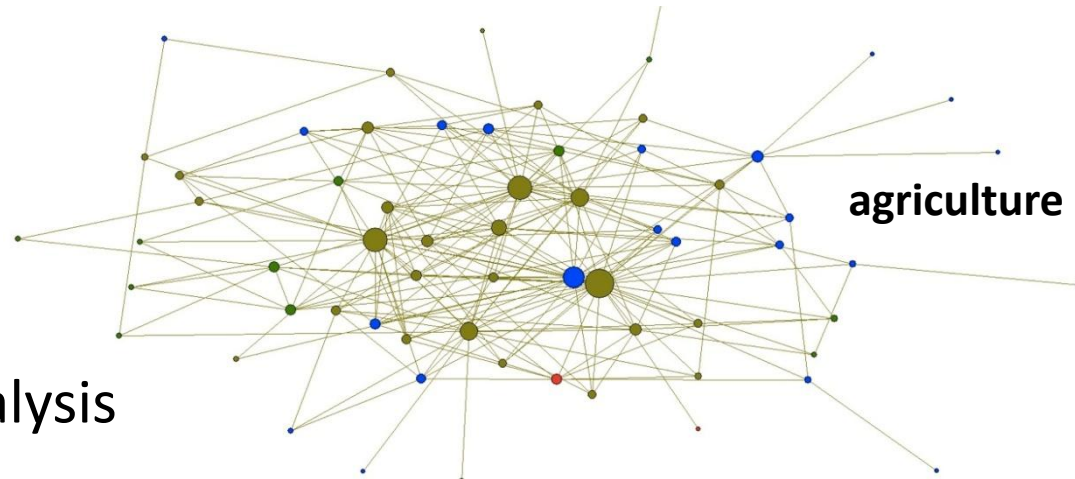
D. Discharge reduction in total river outflow



Implementing the nexus

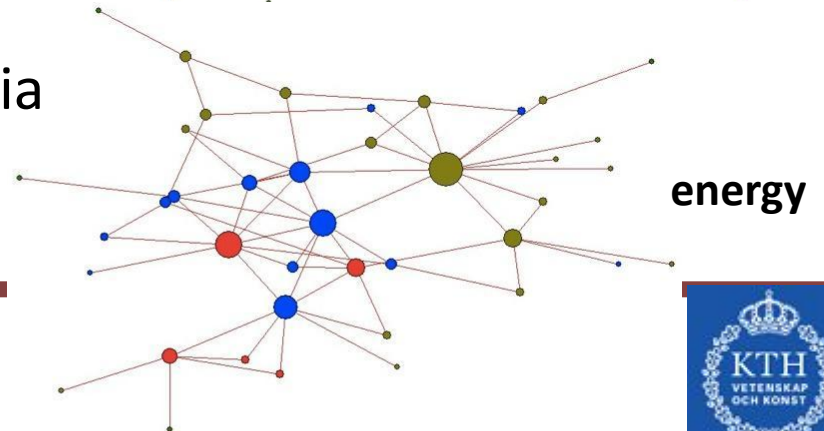


do sectors cooperate?

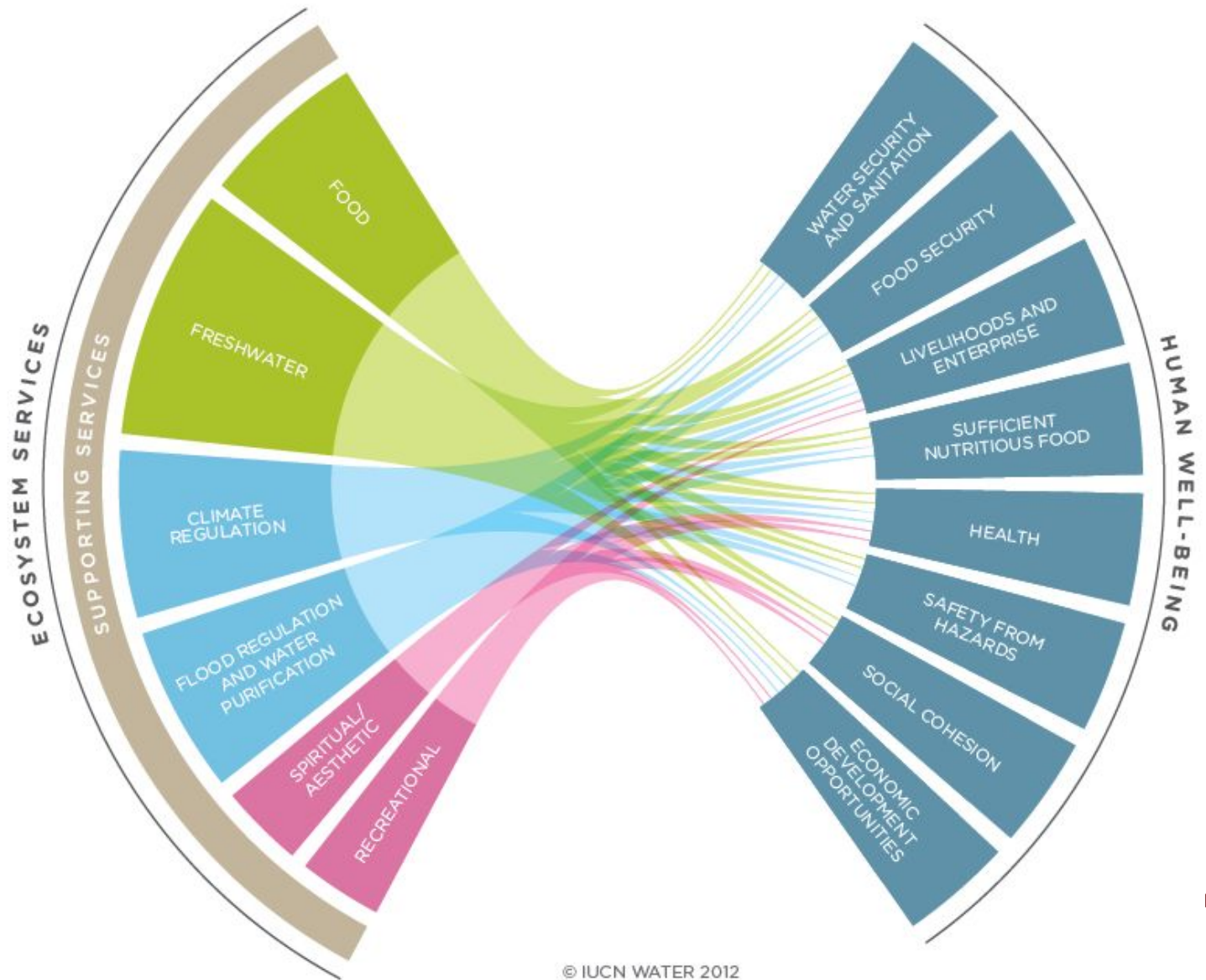


institutional network analysis

inter-agency coordination, e.g. via
interministerial steering group
(CRGE)



The nexus and (healthy) ecosystem services



The nexus and (degraded) ecosystem services

