Using a nexus approach to support development and environmental planning in Ethiopia

The water-energy-food nexus provides a useful framework for reconciling sustainable resource management, ecosystems protection, and key development needs. A nexus approach can show how management decisions regarding one resource or sector affect others, and quantify those interactions. It identifies externalities, feedbacks, and potential trade-offs at different scales. Importantly for policy-makers, it can highlight where sectoral plans are incompatible and help identify mutually beneficial solutions.

Although the nexus approach is relatively new, it is already being applied around the world.[1] However, few nexus studies to date have been driven by genuine demand from decision-makers or used a consistent framework and nexus tools across locations – a combination that would allow us to map and measure the benefits of a nexus approach for planning and policy-making.[2]

This discussion brief, first published in August 2013 and updated in May 2014, describes an ongoing collaborative project in the upper Blue Nile region of Ethiopia that is one of the first to apply an integrated nexus toolkit developed by SEI. It outlines the approach taken and some initial findings.

A nexus project in the Upper Blue Nile

Since 2012, SEI and several partners[3] have been applying the nexus approach to the Lake Tana and Beles River basins of the Upper Blue Nile, comparing the outcomes of different development pathways and interventions. The purpose is to help policy-makers and planners identify opportunities to improve food and energy security – and promote economic development – while sustainably managing natural resources and reducing negative environmental impacts, in line with Ethiopia's ambitious national policies.

Ethiopia has embarked on a development and transformation pathway that aims to attain middle-income status by 2025. Key guiding policies are the national Growth and Transformation Plan (GTP) for 2011–2015 and the 2011 Climate-Resilient Green Economy (CRGE) strategy. National targets include boosting agricultural production by more than 8%, as part of an agriculture-led industrial development strategy. This will require intensifying and commercializing farming and introducing high-value food and energy crops. At the same time, renewable energy generation is to be rapidly expanded, improving local access to modern energy and providing excess power for export. Significantly, Ethiopia aims to exploit its large untapped hydropower potential, and the GTP sets a goal to increase hydropower production fivefold by 2015.

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A girl taking water from an irrigation scheme fed by the Koga dam in the Lake Tana basin.

Various trade-offs will need to be managed in implementing these plans at the regional, basin, and local levels in the Upper Blue Nile area. For example, increasing biofuel and hydropower production will put new pressure on land and water resources, even if it reduces carbon dioxide (CO_2) emissions. Intensifying agriculture will require substantially more water and energy per hectare cultivated, even as it reduces the amount of new land that needs to be brought under cultivation to reach production targets. Furthermore, this intensification could compromise attempts to protect and rehabilitate ecosystems. Figure 1 shows key interactions and the tools the project is using to explore them.

Using the nexus toolkit to support planning

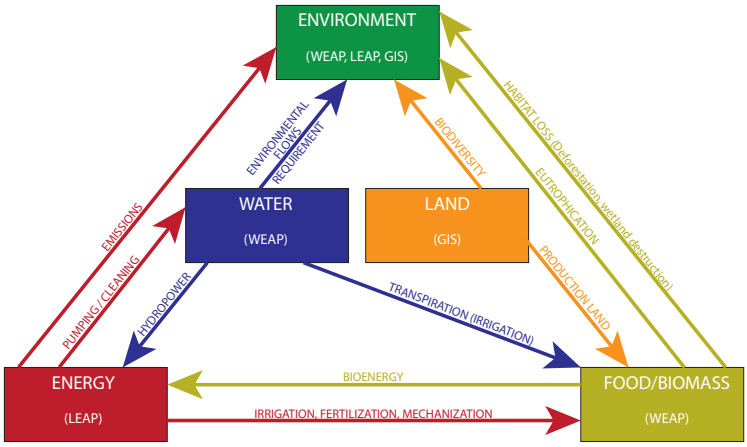
The Lake Tana/Beles area clearly illustrates many of the trade-offs implied by the national targets. It is a culturally important area in Ethiopia's Amhara region, and home to a diverse range of stakeholders. Small-scale, rain-fed farming prevails in the highlands, but there are also plans to develop biofuel production in the area. Four large irrigation dams have been or are being constructed, and a large hydropower plant was recently built, using Lake Tana as a reservoir, redirecting the water to the Beles River downstream.

The lake itself is used for fishing and tourism, and there are plans to make it a United Nations Biosphere Reserve because of its unique bird life and endemic fish species, among other things. Local watershed and land-management objectives include reducing soil erosion, land degradation, and siltation of water courses and reservoirs, as well as increasing water storage and maintaining wetlands and other ecosystems.

1 For a comprehensive list of nexus studies and events, see the Nexus Resource Platform website: http://www.water-energy-food.org.

2 There are notable exceptions, such as case studies in Burkina Faso (Hermann et al. 2012) and in Mauritius, where the nexus approach has been adopted for policy-making (Welsch et al. 2012).

3 SEI's partners in the project, "The Food, Energy and Environment Nexus: A Case Study in Ethiopia", are Naturschutzbund Deutschland (NABU), the International Water Management Institute, the Ethiopian Institute for Water Resources, and Bahir Dar University.



The Lake Tana/Upper Beles nexus study is using participatory scenario modelling to analyse the outcomes of different development and resource use pathways. Scientists and stakeholders are developing these scenarios jointly, and the scenarios are then tested through integrated modelling using the SEI nexus toolkit: the Water Evaluation and Planning (WEAP) system, dynamically linked with the Long-range Energy Alternatives Planning (LEAP) system.[4] Both tools are widely used by sectoral planners, and their recent integration makes it possible to jointly assess the potential impacts of different resource allocations for food and energy production, as well as cross-sectoral interactions.

The data and assumptions used in the models are based on inputs from partners and stakeholders, and the modelling results are discussed at workshops with local actors from multiple sectors. This iterative, joint learning process helps ensure that the results of the nexus analysis are accurate and relevant to the issues raised by stakeholders. The two main scenarios examined so far are (a) business-as-usual and (b) meeting the GTP and CRGE targets.

Initial results

The project has already compiled baseline data and set up a WEAP–LEAP application for the Lake Tana and Beles River basins. Initial results reveal important interactions across sectors, as well as clear trade-offs, such as the fact that increased water withdrawals for irrigation upstream may reduce water availability for hydropower generation and environmental requirements downstream. However, the analysis also shows opportunities for improved natural resources management: with small changes in hydropower dam operation rules, it should in fact be possible to meet both environmental flow requirements and energy production goals, albeit with slightly larger inter-annual variations in energy production. Moreover, if upstream irrigation dams allow for higher downstream flows during the dry season, this would not only benefit hydropower production, but also ensure that environmental flow requirements are met.

Another preliminary finding is that energy transitions and agricultural transformations are linked. The widespread use of traditional biomass for cooking leads to large-scale loss of organic matter and nutrients from agricultural soils, which hinders productivity improvements. At the same time, agricultural intensification relies on increased energy inputs for irrigation, mechanization and fertilizer production. Shifting away from traditional biomass – by producing modern bioenergy on croplands or through other local energy innovations – could thus be important for transforming agriculture.

The project has also conducted a social network analysis to map actors relevant to the nexus issues addressed (see Stein 2013). This highlighted a need for bridging institutions and benefit-sharing mechanisms across sectors and scales.

Conclusions

Through the Upper Blue Nile project, the nexus toolkit is already helping planners at the national and basin levels to better understand the complex relationships between different sectors. It has revealed the energy implications of agricultural intensification, but has also shown how some easily implemented measures could yield major win–win outcomes for agriculture, energy and environmental planning. The insights offered by the nexus approach, and the nexus toolkit, could be a great help to Ethiopia's planners as the country pursues its vision for sustainable development.

Further reading

Hermann, S., et al. (2012). Climate, land, energy and water (CLEW) interlinkages in Burkina Faso: An analysis of agricultural intensification and bioenergy production: Climate, land, energy and water (CLEW) interlinkages in Burkina Faso: An analysis of agricultural intensification and bioenergy production. *Natural Resources Forum*, 36(4). 245–62. DOI:10.1111/j.1477-8947.2012.01463.x.

Hoff, H. (2011). *Understanding the Nexus*. Background Paper for the Bonn2011 Conference: The Water, Energy and Food Security Nexus. Stockholm Environment Institute, Stockholm. http://sei-international.org/publications?pid=1977.

Purkey, D.R., et al. (2012). *Integrating the WEAP and LEAP Systems to Support Planning and Analysis at the Water-Energy Nexus*. SEI Factsheet. Stockholm Environment Institute, Somerville, MA, US. http://sei-international.org/publications?pid=2145.

Stein, C. (2013). *How Understanding Social Networks Can Help to Govern the Nexus: A Case from the Blue Nile Basin*. SEI discussion brief. Stockholm Environment Institute, Stockholm, Sweden. http://www.sei-international.org/publications?pid=2394.

Welsch, M., et al. (2014). Adding value with CLEWS – Modelling the energy system and its interdependencies for Mauritius. *Applied Energy*, 113. 1434–45. DOI:10.1016/j.apenergy.2013.08.083.

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4 See http://www.weap21.org and http://www.energycommunity.org.