





# The Water-Energy-Food Nexus: From Science to Implementation

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## 1. The Nexus in Action at the Farm Level

Photo credit: IFPRI Flickr

#### Supporting investment in seed technologies with higher nutrient use efficiency, transpiration efficiency and tolerance of abiotic and biotic stresses

- Analysis of alternative technology impacts on water use, fertilizer needs, food security and nutrition
- Assessment of regulatory and other policy constraints to development and uptake of technologies
- Continued innovation in seed technologies is essential to addressing growing water scarcity, food security and energy challenges [i.e. fertilizer needs]





Encouraging use of advanced irrigation technologies (requiring energy access) for improved food and nutrition security (Ethiopia, Ghana, Tanzania)



Source: IFPRI-ILSSI Datasets, endline

### Agricultural transformation will accelerate in areas where electricity and irrigation systems are jointly sited



Irrigation potential

Large-scale

3.2 million ha

Small-scale

14.8 million ha

**Total** 

18.0 million ha



#### Investing in clean energy in Ethiopia improves agricultural productivity through increased soil fertility and increases benefits from rainfall and other inputs

- Removal of cow dung from crop fields for cooking reduces soil fertility and agricultural productivity
- Use of cow dung for cooking emits dioxins and chlorophenols damaging to human health
- Using alternative energy sources for cooking improves utilization of rainfall and other inputs, resulting in higher incomes and food and nutrition security





#### Investing in clean energy can unlock \$4 billion of value along selected food value chains in Ethiopia alone—saving water and improving nutrition



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Source: Borgstein, Mekonnen and Wade 2020



### 2. WEF Nexus at the Meso Level

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- Introducing a Water-Energy-Environment-Food Nexus framework and indicators into the Niger Basin Authority Operational Plan can unlock synergies and reduce tradeoffs
- 1) All 351 investment projects were ranked for their contributions to water, energy, food security and environmental sustainability
- 2) Upstream investment impacts on downstream WEF outcomes required modeling
- 3) Results can improve synergies across NBA investments and reduce tradeoffs
- 4) Methodology was simple enough for direct adoption and use by NBA stakeholders





#### Implementation of regional energy trading can reduce tension over water and improve food insecurity in the Eastern Nile region

- Electricity trading scenarios outperform a reference scenario that assumes no energy trading, lowering systems cost by 4-7%
- Greenhouse gas emissions are lower in a trading scenario
- Trading of electricity can reduce tensions around water sharing
- Trading of electricity can improve water use efficiency, agricultural productivity and food security







# 2. The Nexus at the Global Level

Assessing agricultural water pollution to 2050 helps identify investments and policy instruments to reduce environmental, health, water and food security impacts



Growth in loadings 2005-2050



Source: Xie and Ringler (2017)

Assessing water, energy and food security impacts of a tax on fossil fuels is important as impacts depend on a series of national characteristics

- A tax on fossil fuels can support food security if large climate mitigation impacts are achieved
- If fossil fuels are replaced by biofuels, water and food security impacts might well be negative
- Water security impacts similarly depend on replacement fuels for water extraction and treatment





Number of people at risk of hunger

IFPRI



Source: Ringler et al. (2016)

### Conclusions

- The G-20 needs to increase investment in agricultural Nexus solutions as they hold the key to food and water security as well as for environmental sustainability. Such investments need to be aligned with energy investments.
- Single-sector investments in water [or energy or food] security will affect energy and food [and water] security as well as environmental sustainability. Joint assessments and synergistic investments are key given budgetary constraints
- Political structures continue to prevent cross-sectoral investments at higher levels
- Simple cross-sectoral tools that can identify synergies should be prioritized, but need to be supported by more complex analyses



