


Nutritional outcomes of irrigation expansion

Piyush Mehta, Marc Müller, Meredith T. Niles & Kyle Frankel Davis

 Check for updates

Assessing linkages between irrigation expansion and child diet diversity in the global south revealed larger diet diversity improvements in water-stressed regions. Future irrigation planning should explicitly incorporate nutrition-sensitive strategies to ensure food security of local communities while maintaining sustainable water withdrawals.

BASED ON Mehta, P., Muller, M., Niles, M. T. & Davis, K. F. Child diet diversity and irrigation expansion in the global south. *Nat. Sustain.* <https://doi.org/10.1038/s41893-025-01584-y> (2025).

The policy problem

Governments and development agencies have promoted irrigation as a strategy to boost agricultural productivity, increase farmer incomes, and enhance rural food security and nutrition. However, such investments often assume an idealized supply chain that reliably links increased agricultural production with local improvements in food security — an assumption that hinges on farmer decisions about cropping choices (that is, that the irrigated crops will be nutritious) and points of sale (that is, that the added crop production will be locally sold and consumed). Understanding whether this assumption holds in reality and whether these linkages vary depending on the local availability of water is critical for crafting irrigation policies and investments that account for the multiple steps connecting irrigation expansion with food security outcomes.

The findings

We found a positive link between irrigation and higher child diet diversity — a key indicator of micronutrient intake and development. However, examining linkages between irrigation expansion and local changes in child dietary diversity, we found that the benefits of irrigation are concentrated in regions without sufficient water resources to support it, suggesting a trade-off between dietary improvements and water stress. By contrast, newly irrigated areas with sufficient water tended to produce higher fractions of cash crops and export-oriented food items with weaker associations to improved local diets. This concentration of dietary benefits in places where irrigation has expanded despite insufficient water availability points to persistent trade-offs between competing sustainability objectives. These findings indicate that while irrigation can enhance local food security, its success in improving nutrition depends on the broader context of water availability, agricultural practices and cropping choice.

The study

We combined new global gridded (5 arcmin) data on the irrigated area from 2000 to 2015 alongside georeferenced demographic and health survey data covering 70,817 rural households across 26 smallholder-dominated countries. This dataset enabled us to examine the relationship between irrigation expansion and child dietary diversity via the agricultural production pathway. For each survey cluster (~15 households), we calculated average individual diet diversity scores (IDDS) for children aged 6 months to 5 years, using 24-hour recall data across 10 food groups. For each survey cluster, we assessed current and historical (10, 20 and 30 years prior) irrigation levels. We then used mixed-effects regression models to evaluate associations between irrigation status or expansion and IDDS, controlling for a suite of agroecological and socioeconomic factors known to influence food security and nutrition. Finally, we used global water scarcity data to identify where irrigation is expanding despite antecedent water stress, and we combined this information with crop-specific data on export propensity and nutritional quality.

Messages for policy

- Irrigation expansion is associated with improved child nutrition, but this positive association is strongest where water resources are too scarce to sustainably irrigate.
- Planning for irrigation expansion should prioritize long-term water sustainability by ensuring sufficient availability and avoiding competition with existing uses.
- Nutrition-sensitive irrigation policies — for example, irrigation prioritized for locally consumed nutrient dense foods — are crucial to ensure that irrigation benefits are translated into improved dietary outcomes for children in rural areas.
- Measures — whether regulatory or incentive-based — should aim to limit the risk that irrigation expansion displaces local food staple production in favour of export-oriented cash crops.

Piyush Mehta ^{1,2}, Marc Müller ^{3,4}, Meredith T. Niles ⁵ & Kyle Frankel Davis ^{1,6}

¹Department of Geography and Spatial Sciences, University of Delaware, Newark, DE, USA. ²Environmental Systems Research Institute, Redlands, CA, USA. ³Eawag–Swiss Federal Institute for Aquatic Science and Technology, Dübendorf, Switzerland.

⁴Institute for Water, Environment and Health (INWEH), United Nations University, Richmond Hill, Ontario, Canada. ⁵Department of Nutrition and Food Sciences, Food Systems Program, Gund Institute for Environment, University of Vermont, Burlington, VT, USA. ⁶Department of Plant and Soil Sciences, University of Delaware, Newark, DE, USA.

✉ e-mail: piyush@udel.edu; kfdavis@udel.edu

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Further reading

1. Mehta, P. et al. Half of twenty-first century global irrigation expansion has been in water-stressed regions. *Nat. Water* **2**, 254–261 (2024).
This article highlights global trends in irrigation expansion and the sustainability of irrigation expansion in terms of water stress.
2. Niles, M. T. et al. Climate impacts associated with reduced diet diversity in children across nineteen countries. *Environ. Res. Lett.* **16**, 015010 (2021).
This article explores the broader implications of climate change on food security and child nutrition.
3. Müller, M. F. et al. Impact of transnational land acquisitions on local food security and dietary diversity. *Proc. Natl Acad. Sci. USA* **118**, e2020535118 (2021).
This article shows that large-scale land acquisitions boost global crop yields but threaten local food security by prioritizing exports.

4. Burney, J., Woltering, L., Burke, M., Naylor, R. & Pasternak, D. Solar-powered drip irrigation enhances food security in the Sudano-Sahel. *Proc. Natl Acad. Sci. USA* **107**, 1848–1853 (2010).
This study investigates the role of small-scale irrigation technologies in improving food security.
5. Bryan, E., Chase, C. & Schulte, M. *Nutrition-Sensitive Irrigation and Water Management* (World Bank, 2019).
This report provides guidance on project design and monitoring for nutrition-sensitive irrigation and water management investments.

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Competing interests

The authors declare no competing interests.