How can managing water in agriculture contribute to food security and public health?

Evidence from Africa, and propositions for further work.

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Water, Food and Public Health in a Changing World
Conceptual framework of the links between agriculture and health

Fig. 1. Conceptual framework of the links between agriculture and health

Multi-dimensional Poverty Index

Three dimensions of poverty

- Health
  - Nutrition
  - Child mortality

- Education
  - Years of schooling
  - School attendance

- Standard of living
  - Cooking fuel
  - Sanitation
  - Drinking water
  - Electricity
  - Housing
  - Assets

Poverty and food security vs Multidimensional poverty

Share of the population living in extreme poverty, 2017

The share of individuals living below the 'International Poverty Line' of $1.90 per day.

Share of population living in multidimensional poverty, 2014

Proportion of people who are poor according to the Multidimensional Poverty Index (MPI). The MPI weights ten indicators of deprivation in the context of education, health and living standards. Individuals are considered poor if deprived in at least one third of the weighted indicators (see source for more details).

Share of the population that are undernourished, 2017

Share of individuals who have a habitual energy intake lower than their requirements.

Poverty vs. educational attainment, 2014

Vertical axis measures the average number of years of total schooling across all education levels, for the population aged 15-64. Horizontal axis measures the share of population living below 3.105 international dollars per day. Colours represent world regions. Bubble sizes are proportional to the total country population.
Primary school children were provided with meat-, milk-, and vegetable & oil based meal supplements at schools in Kenya over the course of 5 terms. Initial test scores were subtracted from final test results to reveal the impact of supplements on cognitive development against that of a control group. Meat based supplements had the highest impact on test scores, followed by milk group.
Key Questions:

• How can we increase yields and reduce post-harvest losses to secure access to nutritious food?
• What can farmers do to increase productivity/profitability to secure their access to nutritious food – interdependencies with resilience, ecosystems and infrastructure?
• How can better understanding of soil moisture and nutrient dynamics reduce water use and fertilizer losses?
• How can farmers integrate into a wider food system as part of rural economies: value adding, job creation, and better diets?
• How can integrating dryland, irrigation, inland fisheries, aquaculture, and livestock production provide more profitable outcomes, and improve diets and health?
Figure 1. Transitioning underperforming smallholder irrigation schemes in Africa towards profitable and equitable irrigation systems (Bjornlund et al., 2018).
Building absorptive and adaptive capacity, addressing systemic challenges and creating feedbacks from markets to build human livelihoods, dignity and pride

**Innovation systems:**
Inclusive system analysis & innovation

**Interventions and learning:**
Building adaptive capacity

**Inputs and production:**
Profitable & resilient cropping systems

**Market development:**
Accessible and functional markets

Building analytical capacity to identify and act on strong leverage points

Interventions with farmer friendly technologies

Developing diverse and integrated sustainable production systems

Generating income, stimulating rural economies and the capacity to reinvest.
Learning systems: 
Creating and environment for learning and sharing

Figure 3. Knowledge system developed from Chameleon and Wetting Front Detectors.

Parry, et al. (2020).
Increases in water productivity by farmers with and without tools

Increases in yield and income with reduced irrigation

Figure 8. Water productivity (WP) before and after the introduction of the tools, for farmers with and without tools.

Figure 10. Influence of changes on households’ yield and income (for those reporting changes).
Increased spending on food, education and assets

Figure 11. Changes in household spending patterns in the last four years (showing the proportion of farmers now spending on different activities compared to four years ago).
Reduced conflict

**Figure 12.** Households’ perceptions of changes in conflict within the scheme over the last four years.
Figure 4. Influence diagram illustrating the systemic changes brought about by the soil moisture and nutrient monitoring tools (Loop A) and the agricultural innovation platform (Loop B) at Silalatshani irrigation scheme.
<table>
<thead>
<tr>
<th>DISCONNECTION</th>
<th>INTERCONNECTEDNESS</th>
<th>LINEAR</th>
<th>CIRCULAR</th>
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Thinking in systems

• The behaviour of the system is determined by the interactions and dynamics between the components of the systems – not only by the components itself.

• Need to intervene at a range of strong leverage points (multi- and trans-disciplinary teams)

• How can the multifunctionality of water be leveraged to improve public health?
  More crop per drop: Water productivity
  + More nutrients per drop: Nutritional Water Productivity,
  + More income per drop
  = Increased Food Diversity per drop

• To achieve positive outcomes R&D and policies should focus on the interdependencies between:
  • Agriculture
  • Environment
  • Public health
  • Education

• What are the trade-offs and synergies in use and investments between these three sectors?
Appreciate your Attention
Wetting Front Detector

Figure 2. Wetting Front Detectors are placed at two depths in the ground and facilitate the testing of nitrate in the field (Virtual Irrigation Academy, 2019).