Comprehensive assessment of water management in agriculture

water for food, water for life issuebrief#11

Health risks and opportunities in agricultural water planning and management


Photo: Kande Matungulu

Comprehensive Assessment (CA) findings show that investments in agricultural water development and management can significantly contribute to human health—even beyond improved nutrition and income. But to tap this potential, both health opportunities and health risks need to be assessed during the planning and design phases of water and agriculture projects—including everything from construction and rehabilitation of large-scale irrigation systems to scaling up water harvesting initiatives.

By factoring health issues into water and agriculture decision-making, benefits can be enhanced and many health risks can be minimized or even eliminated entirely. And in cases where reliable safeguards are not feasible, stakeholders, planners and policy-makers need to be aware of potential adverse health tradeoffs.

So how do we get the maximum health benefits from agricultural water investments? The first steps are improving collaboration between relevant sectors through, for example, conducive policies and resource allocations; integrating a health impact assessment best practice into water resources planning; and creating greater awareness of water-agriculture-health issues among planners, farming communities, and personnel working in health, irrigation, and agriculture.

Box 1: Health risks and opportunities in developing and managing water for agriculture

Health risks and opportunities are site-specific. In general, planners, managers and farming communities should be aware of the following:

Risks:

- Habitat creation for mosquitoes and snails that transmit diseases such as malaria and schistosomiasis.
- Reduced quality or quantity of accessible domestic water supplies—caused by, for example, over-pumping of groundwater, lining irrigation canals to reduce seepage, and polluting drinking water supplies with agro-chemicals.
- Exposure risks for farmers, local communities, and consumers from pathogens, heavy metals, and other toxins in wastewater used for irrigation.

Opportunities:

- Environmental control to reduce transmission of malaria and other vector-borne diseases.
- Improved water availability for non-agricultural uses, including domestic uses.
- Safer use of nutrient-rich wastewater for irrigation, and, as a result, reduced dumping of raw wastewater into surface supplies.
- Increased income and household food security, leading to better nutrition and improved health.

Does more irrigation mean more malaria?

According to the CA analysis, irrigated area will likely expand in the next 50 years to keep up with food demand and cope with climate change. Expanding irrigated area could mean expanding breeding sites for mosquitoes, as well as other disease vectors, particularly in dry areas and during dry seasons. For example, with the construction of the Indira Nahar Pariyojana irrigation project in Rajasthan's Thar Desert, the nature of malaria transmission shifted from seasonal to perennial, and the number of cases in the area increased from only a few thousand to 300,000 per year.

There have been similar findings in other areas, ranging from Africa to East Asia, but there are also documented cases where malaria incidence remained the same or was actually reduced after the introduction of irrigation. These differences are for the most part due to site-specific social and biophysical factors, such as mosquito species, livestock management practices, and the location of villages relative to water sources. By boosting incomes, the introduction of irrigation can also reduce malaria by making it possible for people to invest in better health care, insecticide-treated nets, and structurally improved housing.

Nearly half the people at risk of malaria live near irrigation schemes or dams (see Table 1). But risk is not limited to large-scale water development projects; water harvesting and small dams to improve access to water for agriculture and other purposes can also introduce new breeding sites. The thousands of water harvesting ponds being constructed by the Ethiopian government have on the whole brought many benefits, but in some areas they have also been associated with increased malaria incidence.

Table 1: Global estimates of people at risk of four vector-borne diseases

Estimated numbers of people at risk **(in millions)**	Malaria	Lymphatic filariasis	Japanese encephalitis	Schistosomiasis
People at risk globally	>2,000	>2,000	1,900	779
People at risk near irrigation schemes, globally	851.3	213	180–220	63
People at risk near dams, globally	18.3	n.a.	n.a.	42
People at risk near dams and irrigation schemes, sub-Saharan Africa	9.4	n.a.	n.a.	39
People at risk near dams and irrigation schemes, excluding sub-Saharan Africa	860.3	n.a.	n.a.	66

Sources: Erlanger, T. E. *et al.* 2005. Effect of water resource development and management on lymphatic filariasis, and estimates of populations at risk. *American Journal of Tropical Medicine and Hygiene*, Vol. 73(3): 523–33. Keiser, J. et al. 2005. The effect of irrigation and large dams on the burden of malaria on global and regional scale. *American Journal of Tropical Medicine and Hygiene*, Vol. 72, pp. 392–406.
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Quoted in: UN World Water and Development Report 2006 (see references).

Fighting vector-borne diseases

If water, agriculture, and health sectors collaborate, water management can actually contribute to malaria control programs. Changes in the design and operation of irrigation infrastructure and in how land, water, and livestock are managed can reduce transmission risk of malaria and other vector-borne diseases (see Table 2). For example, rehabilitation of the Mushandike scheme in Zimbabwe effectively controlled schistosomiasis by installing structures to avoid standing water and to ensure flow velocities high enough to dislodge the snails that serve as an intermediate host for the disease.

In some cases, there are opportunities to simultaneously reduce vector populations and increase water productivity—for example by reducing waterlogging, letting paddy fields dry out between irrigation applications, and introducing larva-eating fish into rice fields and ponds. Of course, what types of interventions are appropriate depends on the context—the vector species in question, the environment, and the prevailing water and land management practices.

Links between irrigation and domestic water supplies

Although they are managed separately, in many areas agricultural and domestic water supplies are inextricably linked. Irrigation seepage from fields and unlined canals may recharge groundwater used for drinking or people may use water directly from irrigation canals to meet domestic as well as agricultural needs.

While some irrigation departments informally support domestic use of irrigation water, for example by releasing water to fill community storage structures, they are generally not equipped with the capacity or the mandate to address the variety of health risks associated with this practice. Also, because domestic uses are rarely formally incorporated into irrigation management regimes, domestic users find their access to this source of water cut off during annual canal closures.

Incorporating water for domestic uses into irrigation planning and management can be a start. If irrigation managers are educated about domestic use of irrigation water and associated health issues and are able to work with communities and health personnel to reduce risks, people can derive optimal benefits from having regular access to large quantities of water. For example, where groundwater is too saline for drinking, shallow groundwater from irrigation seepage may provide a safer source of drinking water than surface water. Encouraging the tapping of such sources and promoting low-cost point-of-use water treatment methods and technologies can help reduce the significant health risks of diarrhoeal diseases.

Table 2: Examples of measures to reduce vector-borne diseases in irrigated areas

Target	Measures
Reduce habitats for disease vectors (i.e. stagnant and slow-flowing water)	Repair leaking canals and bunds Drain or fill in seepage pools and burrow pits near agricultural fields Redesign hydraulic structures into free-draining ones Cement-line canals Clear canals, structures and drains of vegetation and silt Avoid open storage reservoirs Promote rotational flows Use alternative irrigation techniques (sprinkler, drip)
Reduce people-vector contact	Site villages away from (potential) breeding sites Stable livestock between people and breeding sites Screen windows and eaves Ensure that health centers are equipped and functional before construction of the irrigation system and that health staff are trained in water-related diseases Treat in-migrating laborers from high-transmission areas
Reduce contact with water sources where schistosomiasis is present	Construct crossings for canals and drains Provide safe laundry and bathing sites

Source: Adapted from McCartney et al. 2007 (see references).

Alterations in the design of new and existing irrigation schemes can also reduce health risks and better meet the multiple water needs of poor communities. This might mean building or reviving community domestic-supply reservoirs, adding pipes and taps to canals to help with water collection, or building steps in canal banks for laundry and bathing. Such alterations can also prevent drownings and reduce schistosomiasis.

Making wastewater irrigation safer

As competition for freshwater grows, the use of wastewater and low quality water will become increasingly common in agriculture. Millions of small farmers already rely on wastewater—including domestic and industrial effluent and urban drainage water—as a vital source of irrigation and nutrients. But this practice does carry health risks—it can expose farmers and produce-consumers to pathogens (particularly intestinal helminths such as hookworm and roundworm) and, in the case of industrial wastewater, may also contain heavy metals. There are also potential risks of contaminating groundwater used for domestic supplies and providing vector breeding sites.

But the reality is that large-scale wastewater treatment is currently not an affordable option in most developing countries, given the magnitude of capital and maintenance investments required. In addition, treatment eliminates nutrients in wastewater, significantly reducing its value to farmers. A viable alternative is proposed by the third edition of the WHO Guidelines for the Safe Use of Wastewater, Excreta and Greywater in Agriculture and Aquaculture (see references). Instead of focusing only on the quality of wastewater at its point of use, the new guidelines recommend defining realistic health-based targets and assessing and managing risks along the entire continuum—from wastewater generation to consumption of produce cultivated with wastewater—to achieve those targets. This allows national authorities to develop a regulatory and monitoring system in line with socio-economic realities.

Box 2: Avoiding health risks in aquaculture and livestock management

The CA has identified better integration of livestock and aquaculture into irrigated systems as an opportunity to increase water productivity, incomes, and food security. But to realize the full benefits, water, land, and animals need to be managed to safeguard against the following health risks:

- Livestock can contaminate surface drinking water supplies—putting people at risk for diseases such as cryptosporidiosis, which can be fatal to children and people with HIV/AIDs.
- As with irrigation, livestock watering ponds and aquaculture ponds can provide a habitat for some disease vectors.
- Hoof prints when filled with rainwater make excellent breeding sites for some species of disease-carrying mosquitoes. (On the other hand, livestock can divert mosquitoes that are looking for a bloodmeal away from people, thus reducing malaria transmission risk.)
- Intensive aquaculture, with a high dependence on pesticides, fertilizer and antibiotics, can reach concentrations harmful for farmers and consumers.
- Wastewater use in aquaculture can contribute to the incidence of parasitic (fluke) infections in consumers of raw or inadequately cooked fish or aquatic plants.

Incorporating health into water management and planning

This brief has outlined various ways of enhancing health benefits and reducing health risks associated with agricultural water use. But implementing these in a piecemeal manner is unlikely to yield significant or sustainable returns. Issues at the interface of community health status and agricultural water use need to be factored into irrigation development and management plans and into public health management plans and strategies. A key instrument is health impact assessment (see box 3).

Box 3: Health Impact Assessment

Health Impact Assessment (HIA) is a combination of procedures, methods and tools by which a policy, program, or project can be judged as to its potential effects on the health of a population and the distribution of those effects within the population. In the end, the rationale for HIA is economic: to avoid the transfer of hidden costs of development to the health sector.

To be effective, HIAs should result in policy recommendations or specific planning, design, construction and management options, laid down in an intersectoral public health management plan. The success of any HIA depends on a regulatory framework that commits planners, managers and funding agencies to implement the recommendations, and the capacity of the health sector to monitor compliance, evolving health status, and health outcomes.

Recommendations for mainstreaming HIAs into planning processes include:

- Effective coordination with environmental impact assessment procedures.
- Harmonization and development of consistent HIA policy and regulatory frameworks for the evaluation of health hazards and risks, and the planning and management of health safeguards and their promotion in agricultural water development.
- Comprehensive coverage of environmental and social determinants of health, including, for example, migrant laborers and livestock.

Photo: Robert Bos, WHO

Accra, Ghana. A man wades barefoot into a wastewater collection pit to get water for irrigating an urban vegetable plot.

To address the issues outlined in this brief will require concerted action from all relevant sectors at multiple levels. The top recommendations from the CA are:

1. Require health impact assessments for water projects and ensure funding for implementation of recommendations.
2. Create mechanisms and incentives for cooperation and knowledge-sharing between sectors—health, agriculture, livestock, aquaculture, irrigation, domestic water supply and sanitation.
3. Train engineers, irrigation managers, and other professionals to incorporate health safeguards into water infrastructure planning and management and to enhance multiple-use water services.
4. Raise public awareness of water-related health issues, such as the importance of washing produce before consumption in areas where wastewater irrigation is practiced.
5. Improve monitoring of health impacts of water development projects to ensure compliance with recommendations from health impact assessments and to provide evidence as public-health management plans are implemented.
6. Support research on water-health-agriculture issues and ensure that the knowledge gained contributes to the evolution of improved agricultural and irrigation policies, decision-making procedures, and institutional arrangements.

World Health Organization

Comprehensive assessment of water management in agriculture

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The Comprehensive Assessment of Water Management in Agriculture (CA) is a five-year initiative to analyze the benefits, costs, and impacts of the past 50 years of water development and management in agriculture, to identify present and future challenges, and to evaluate possible solutions. The CA's Issue Brief series, published by the International Water Management Institute (IWMI), presents key findings from the main Assessment report *Water for Food, Water for Life: A Comprehensive Assessment of Water Management in Agriculture* (Available from Earthscan, www.earthscan.co.uk). More on the CA donors, co-sponsors (CBD, CGIAR , FAO, Ramsar), process and publications can be found at: www.iwmi.org/assessment.

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This brief brings together health-related knowledge from multiple chapters of Water for Food, *Water for Life: A Comprehensive Assessment of Water Management in Agriculture*. It was compiled by Priyanie Amerasinghe, Eline Boelee, Robert Bos, Flemming Konradsen, and Wim van der Hoek.

Additional references:

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