SIWI

Comprehensive assessment of water management in agriculture

water for food, water for life issuebrief#2

A little water can go a long way:

Reducing rural poverty through better management of rainwater

Past agricultural water-management efforts have focused on large-scale development from rivers, lakes and aquifers. But new findings from the Comprehensive Assessment of Water Management in Agriculture show that better rainwater management is actually the key to helping the greatest number of poor people. Why? Because most of the world's poor depend on rainfed farming systems in areas where variable rainfall, dry spells and droughts make farming a precarious livelihood. Reducing vulnerability to water-related risks and improving productivity will greatly reduce poverty and hunger in these areas.

According to the Comprehensive Assessment, improving rainfed farming could double or quadruple yields. This promises huge social, economic and environmental paybacks. Efforts would be needed to improve farmers' access to markets, credit, and inputs like fertilizer (which raise productivity). But, the first step would be to target water—because without water when and where they need it, rural people risk crop failure and hunger.

Box 1. Key steps for tapping rainwater's potential to boost yields and incomes

1. **Make more rainwater available to crops when it is most needed**—by capturing more rainfall, storing it for use when needed for partial to full irrigation, using it more efficiently, and cutting the amount that evaporates unused. Water harvesting, supplemental irrigation, conservation agriculture/tillage, and small-scale technologies like treadle pumps and simple drip-irrigation kits, are all proven options.

2. **Build capacity**—efforts should ensure (i) that extension services can get rainwater-exploitation techniques out to farmers and work with them to adapt/innovate for their specific context, and (ii) that water planners and policy-makers can develop and apply rainwater management strategies. Farmers organizations, water users associations, and other community water management institutions—both formal and informal—also need to be supported.

3. **Expand water and agricultural policies and institutions**—rainwater management needs to be specifically included in management plans for upper catchments, and at farm level to ensure the productive use of rain.

The technologies for upgrading rainfed agriculture already exist. And in some cases they have been around for thousands of years. Plus they are simple, cost little and bring high returns. The challenge is adaptation and adoption of technologies and practices. For example, conservation tillage, which disturbs the soil as little as possible to avoid moisture loss, is practiced on 45 millions hectares, mostly in South and North America, but the spread of this practice to Asia and Africa, where it has proven potential, has been slow.

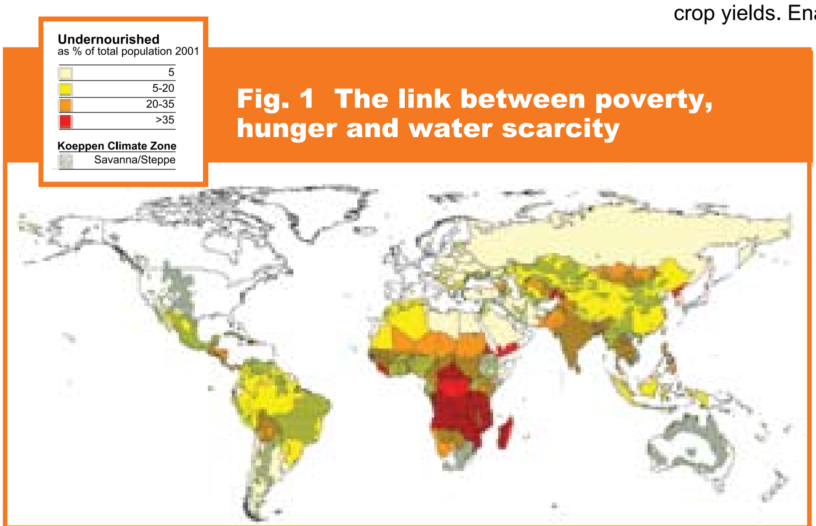
In some areas, it is the revival of traditional technologies and practices that needs to be encouraged, rather than the uptake of new technologies. In Rajasthan, the restoration of *paals*, traditional water harvesting structures that had fallen into disuse, allowed farmers to gain a second cropping season, improve their productivity and reduce groundwater pumping costs—all resulting in a general economic uplift in *paal* villages. With a shift in priorities and policies (Box 1), and by learning from the past, millions of malnourished people could tap into rainwater and turn it into much-needed food and income.

Why upgrade rainfed farming?

Malnourishment is associated with water-scarce areas where people mainly practice rainfed farming—with no or very limited areas under irrigation (Fig. 1). In fact, most of the world's 840 million malnourished people rely directly on agriculture and natural ecosystems, such as fisheries, for their food and incomes. Add to this the fact that around 70% of the world's poor live in rural areas where non-agricultural livelihood options are limited, and it is clear that improving small-scale rainfed agriculture could slash poverty and hunger.

Evidence indicates that every 1% increase in agricultural productivity translates into a 0.6-1.2% fall in the percentage of absolute poor. And, the Assessment found that average per-hectare rainfed yields in developing countries could easily be increased by 100%. The efficient soil, water and crop management practices used on commercial farms and research stations, for example, commonly give yields that are 2-4 times higher than those of small-scale farmers in the same areas.

Fig. 1 The link between poverty, hunger and water scarcity



The countries with the greatest percentage of undernourished people are for the most part found in the dry sub-humid, semi-arid and arid tropics. People there rely on rainfed farming for food and incomes, but variable rainfall, dry spells and droughts make farming a risky business.

Such 'yield gaps' are greatest for maize, sorghum and millet in sub-Saharan Africa—which means that these provide key opportunities for reducing poverty and hunger.

Low-yielding farming systems in hot tropical regions also offer the largest opportunities to improve water productivity. In these systems, evaporation rates are high—often equal to or exceeding 50% of rainfall. By reducing these evaporation losses and improving yields, it is possible to grow double the amount of food with the same amount of water.

Why focus first on water?

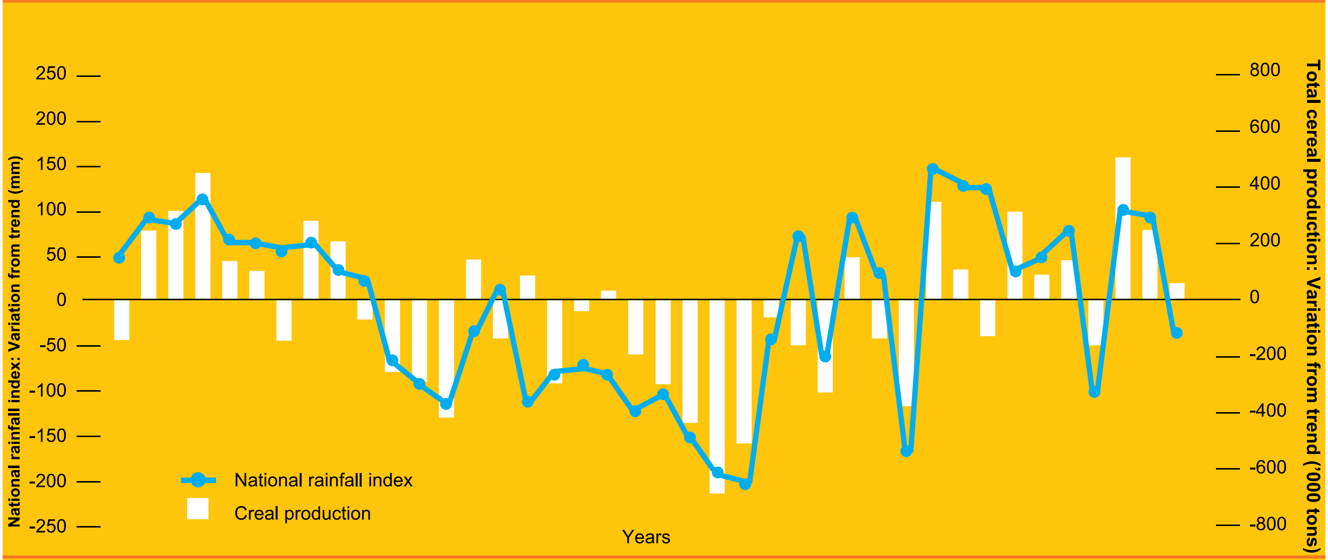
Improving water availability is the first step to raising farm productivity, for three main reasons.

- It cuts the yield losses that result from dry spells—which can claim one out of every five harvests in sub-Saharan Africa (see Fig. 2).
- It gives farmers the 'security' they need to risk investing in other inputs like fertilizers and high-yielding varieties. Farmers dare not risk the little they have buying inputs for a crop that may well fail for lack of water.
- It allows farmers to grow higher-value crops, such as vegetables or fruits, for market. These are more sensitive to water stress and need more costly inputs. Farmers can then move away from relying entirely on low-value staple food crops and earn cash incomes—valuable rungs on the ladder out of poverty.

In terms of annual rainfall, there is generally enough water for food production, even in the so-called 'dry lands'. The difficulty is that this rainfall is concentrated in a few months of the year and is extremely variable, with frequent dry spells occurring even during the rainy season. In semi-arid and dry sub-humid agro-ecosystems, crops experience short periods of water stress almost every growing season. While these dry spells may not cause complete crop failure, like meteorological droughts which occur on average up to twice every decade in dry semi-arid regions, they have a big impact on crop yields. Enabling farmers to bridge these dry spells, through better moisture retention in the soil profile or through irrigation from water harvesting or groundwater, is the key to improving productivity and reducing poverty in these areas.

Of course, to reach full yield potential, rainwater management must be combined with better land management. Soil degradation leads to productivity decline and, along with reliable water supply, is one of the most pressing challenges faced by small-scale rainfed farmers, particularly in sub-Saharan Africa. Investments, such as the addition of organic matter, that maximize rainwater infiltration and the soil's ability to hold water, therefore lead to a win-win outcome: more water in the soil for crops, better soil fertility, and less soil loss and degradation. It also means better water quality downstream, which benefits aquatic ecosystems.

Fig. 2 Relation between rainfall and cereal production 1960 - 2000, Burkina Faso



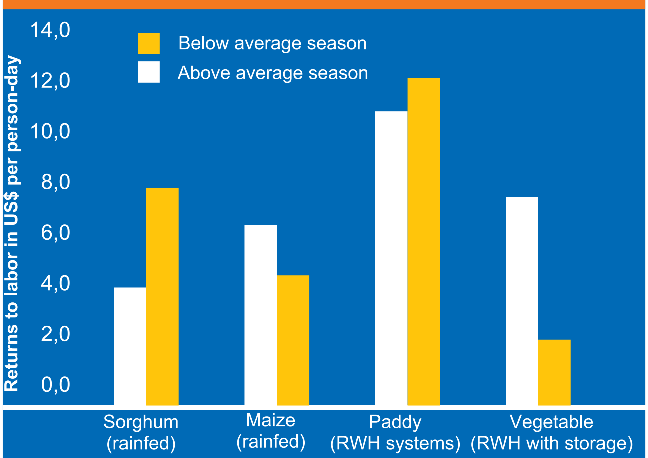
Yields are closely tied to rainfall. This can be seen by lining up the national rainfall index for Burkina Faso, where less than one percent of agricultural land is irrigated, with the total annual cereal production. In most cases, during drier than normal years, cereal yield took a corresponding plunge, whereas during wetter than normal years it received a boost. What can't be seen from this graph is when during the growing season rain shortfalls occurred—it is these short dry spells which greatly lower yields.

Source: "Reinventing irrigation" by Faures et al in Water for Food, Water for Life

Benefits of managing rainwater

Recent studies in Tanzania (Fig. 3) and Gujarat, India show that rainwater harvesting can be used to successfully upgrade rainfed agriculture. In Gujarat, for example, public investments in rainwater harvesting in one watershed allowed individual farmers to invest in wells, pumps, sprinklers, drip irrigation, fertilizer and better pest management. This meant they could shift from growing low-value cereal crops like sorghum to high-value commercial crops like maize, groundnut, cotton, and vegetables.

Fig. 3 Returns to labor under different rainwater harvesting (RWH) systems



Rainwater harvesting in a semi-arid area of Tanzania allowed farmers to switch from purely rainfed cropping (of sorghum and maize) to a new crop—paddy rice. This increased returns to labor to more than US$12 per person-day, and thus helped to reduce poverty.

Source: Hatibu 2005 in *Water for Food, Water for Life*

The Assessment also showed that small investments providing 100 liters of water per square meter for supplemental irrigation during dry spells when crops are flowering or at the grain-filling stage could more than double agricultural and water productivity. This may sound like a lot of water, but it is around the same amount used by an average urban, middle-class person daily, and it is generally less than 10% of the amount used in full irrigation. Water for such irrigation can come from limited macro-catchments, micro-dams, rainwater harvesting, local springs, shallow groundwater, or conventional water resources schemes.

Supporting and enhancing local capacities

With the abandoning of indigenous water legacies in favour of modern water infrastructure development, the capacity to adapt, adopt and implement local water management has declined. The challenge now is to restore that capacity and nurture institutions for community land and water management. Without this foundation, efforts to revive successful traditional technologies and practices and to get people to adopt and adapt new ones will continue to flounder.

Knowledge is another key component in upgrading rainfed agriculture. At present, there is little uptake or use of new research or traditional rainwater management knowledge. This is true across the board—from small-scale farmers to policy-makers, particularly in West Asia, North Africa and sub-Saharan Africa.

Extension efforts in rainfed areas have to date focused on disseminating inputs (like fertilizer) rather than water-management knowledge. Staff should be trained to help farmers learn how best to invest in water management, as well as how to manage their water, land and crops in an integrated way. Problems are obvious here, as many countries are scaling-down extension services and agriculture and water institutions are losing contact with farmers because of lack of field staff.

Next steps

The Comprehensive Assessment has made clear that we need to consider the whole spectrum of agriculture (from fully irrigated to fully rainfed) when considering poverty-reducing investment options in water management—one option cannot fit all situations. But, the Assessment has also suggested that improving small-scale rainfed agriculture would give the highest payoffs in terms of poverty and hunger reduction.

We have to recognize that upgrading agriculture in rainfed areas is possible, but will require a shift in thinking (Box 2). Decision-makers need to revisit current strategies for irrigation, to ensure (i) that they support the need for small-scale irrigation in 'rainfed' areas far from large-scale schemes, (ii) that they fulfill local development needs by allowing for multiple uses, e.g. drinking, cooking, washing and watering backyard-gardens, aquaculture, livestock water ponds, as well as small-scale farming, (iii) that they provide support to communities in developing their own strategies and solutions to suit local capacities and preferences, and (iv) that they take an adaptive approach to ensure that small-scale development is environmentally sustainable and does not damage wetlands or other fragile ecosystems (see CA brief on Agro-Ecosystems).

Box 2. Actions needed to rethink policy and institutions for better rainwater management

Broaden the current water-management focus on 'blue' water (rivers, lakes, groundwater etc.) to include valuable resources largely ignored at present. These include 'green' water (the rainfall stored in the soil) and more intermittent water sources (such as streams in gullies that only flow for a few hours after rain).

Link policy and decision-making strongly between different levels—local, district, river-basin, and national.

Manage water more efficiently upstream, not just to conserve downstream water resources and control erosion (as is currently the case) but to improve agricultural productivity—'crop per drop'—and profitability in upstream areas where most of the poorest people live.

Focus more on the small-catchment scale, to manage water for rainfed agriculture (this often corresponds to the community, small-township or village scale); current river-basin-scale planning ignores small catchments and tributaries vital to farmers.

Craft supporting policies to develop markets, access to credit, secure land tenure, water rights, and roads from rainfed areas to markets.

Strengthen mechanisms for generating and disseminating knowledge on rainfed farming—from research to extension.

Take an inter-sectoral approach to agriculture and water at policy and local levels; the legal, policy and management actions of ministries dealing with water, agriculture and the environment need to be more closely connected, to allow integrated water resources management (IWRM).

Comprehensive assessment of water management in agriculture

For more information. Email: comp.assessment@cgiar.org **Visit: www.iwmi.cgiar.org/assessment**

CA - 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 main Assessment report, *Water for Food, Water for Life: A Comprehensive Assessment of Water Management in Agriculture,* is published by Earthscan (forthcoming). More on the CA donors, co-sponsors (CBD, CGIAR , FAO, Ramsar), process and publications can be found at: http://www.iwmi.cgiar.org/assessment.

SIWI - Independent and Leading-Edge Water Competence for Future-Oriented Action. The Stockholm International Water Institute (SIWI) is a policy institute that contributes to international efforts to find solutions to the world's escalating water crisis.

Swedish Water House - Building Networks for Water Sustainability. The Swedish Water House supports international policy development and co-operation through knowledge generation and dissemination and partnership building primarily within the areas of sustainable river basin management and integrated water resources management. It supports the Ecosystem component of the CA.

This Brief is based on the book *Water for Food, Water for Life: A Comprehensive Assessment of Water Management in Agriculture*, 2006 (forthcoming), in particular on the Chapter 8 'Managing Water in Rainfed Agriculture' by J. Rockström, N. Hatibu, T. Oweis, S. Wani, J. Barron, C. Ruben, A. Bruggeman, Z. Qiang, and J. Farahani.

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