Green Water Use in an Era of Growing Scarcity

Agricultural water use, the primary consumer of freshwater around the globe, is increasingly threatened by climatic stresses and demands from other sectors of society – including for domestic, industrial and livestock production, and environmental flows. As a result, developing strategies for the sustainable use of water in agriculture is paramount. Dr. Claudia Ringler and Dr. Timothy Sulser of the International Food Policy Research Institute say we should be thinking green.

The world has entered an era of growing scarcity – natural resource scarcity, financial scarcity, and scarcity of political will to join hands across poor and rich nations, as shown by the non-binding Copenhagen Accord on climate change in 2009. Harbingers of increasing scarcity levels have been the energy crisis of 2005-2007, the food price crisis of 2005-2008, and the financial crisis of 2008-2009. As a result, agriculture and food security have been brought back to the forefront, after decades of being considered of little or no interest to both policymakers and investors.

What are the drivers of growing scarcity in food and agriculture?

Key factors include population growth, economic growth, urbanisation, climate change and long-term underinvestment in agriculture and water supply, which in turn has led to the slowdown in technological advances in agriculture. Population, economic and urban growth will further increase the demand for water resources and shift water out of agriculture and into higher-valued industrial and domestic uses. At the same time, more affluent diets will translate into greater demand for more water-intensive crops, such as sugarcane and horticultural crops; livestock products; and aquaculture products.

Climate change will also affect agriculture through both direct and indirect effects on water, soils, crops, fisheries, livestock, and pests and diseases. Rainfed areas will be hardest hit from increased climate variability under climate change, putting Sub-Saharan Africa (SSA) on the spot, where temperatures are already high and only 4 percent of cultivated area receives some form of irrigation. With the number of extreme events increasing over time, rainfed production will fail more often compared to the recent past. But yield declines will likely be highest in the high-potential, irrigated areas of Asia. Other drivers, such as land use for non-food crops, exemplified by biofuels, continued underinvestment in agricultural technologies, increasing energy prices, and barriers to, as well as lack of trust in, agricultural commodity trade are further raising scarcity levels. One of the most important constraints to agriculture and food security, and the largest natural resource scarcity, however, will be water.

What can green water do to address scarcity?

Most food produced globally is grown with soil moisture that comes exclusively from precipitation, or green water. Moreover, most of the water reaching plants in irrigated systems also stems from precipitation. Only during the dry season or in systems located in arid areas, such as Egypt or Saudi Arabia, does irrigation water account for most or all water applied. Despite this, irrigation or blue water (water taken from rivers, aquifers and lakes) has typically been the focus for past policy analysis, mainly

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because human manipulation of these resources is easier to understand and manage. At the same time, many production systems classified as "rainfed agriculture" apply small amounts of supplemental water to alleviate plant stress at critical stages of production, for example, through rainwater harvesting schemes. Thus, water applications for crop production follow a continuum from purely rainfed to purely irrigated with the majority of crops produced from rainwater.

Accounting explicitly for green water resources broadens the scope of options for decision-makers trying to improve agricultural production in the face of rising food and energy prices and a degrading water and land resource base stressed by increasing demands. This is particularly true for the poorest region in the world – SSA. The SSA region depends almost completely on rainfed agriculture and malnutrition levels in the region are set to increase. Even if investments in irrigation are doubled – as donors have pledged – it would still take many generations to increase the share of area cultivated to levels seen in Asia, for example, and costs – both financial and to the environment – would be excessive.

Given that land resources available for agriculture are limited and declining in parts of the world, most future crop production growth is expected to come from improvements in crop yields. As irrigated cereal yields are 60 percent higher, on average, than rainfed yields, strategies for yield improvements often focus on how to improve or expand access to water for agriculture. In the past, the focus was only on full-control irrigation. While the expansion of irrigated agriculture is expected to significantly increase crop yields, it requires copious quantities of blue water that are not available everywhere. Limited development of water resources in some parts of the world, and growing physical water scarcity in other parts are direct constraints to the proliferation of irrigated agriculture. Thus, green water strategies, such as on-farm soil and water conservation, and other water harvesting techniques have increased in importance in many regions of the world, particularly SSA, parts of South Asia, and parts of the Middle East and North Africa. Many factors might further increase the applicability of precipitation-based agricultural water management strategies. Higher energy prices will increase the cost of 'high-tech' irrigated food production; increased use of agricultural commodities for biofuels will reduce water and land resources for food crops; and technological innovations will develop new varieties that are more resistant to droughts and floods and more tolerant to heat for both rainfed and irrigated systems.

Water productivity for crops, defined as the amount of harvested commodity per unit of consumptive water used, is a key metric of water use efficiency for different agricultural production systems around the world. Globally, 1 cubic meter of water produces 0.51 kg of grains in irrigated systems and 0.56 kg of grains in rainfed systems because of the extensive and highly productive rainfed cereal systems in North America and Europe. Water productivity is expected to increase over time for both irrigated and rainfed systems so that in 2050 productivity levels may reach 0.64 kg of grains and 0.73 kg of grains per cubic meter of water, respectively. Based on the yield gap between developed-country and SSA rainfed yields, the potential for a green water revolution in SSA is enormous. If some of the more advanced agricultural technologies – adapted to African conditions and combined with rainwater-based agricultural water management strategies – can be successfully upscaled, the region will enjoy huge advances in its agricultural output. A new project funded by the Bill and Melinda Gates Foundation is working to achieve just that (http://awm-solutions.iwmi.org) by targeting in particular poor and women farmers to improve their incomes and food security. Thus, new focus and targeted investments are needed to deploy existing knowledge to new areas. In many parts of South Asia and SSA, doubling, or even quadrupling of rainfed crop yields may be possible with existing technologies for water and nutrient management and would benefit the livelihood of millions of small-scale farmers.

Green light for agriculture

Water scarcity can easily become the number one worry for people's minds (and stomachs) if policy and investment commitments from national governments, international donors and development banks weaken further. Improving the productive use of green water will likely be the key avenue for regions such as SSA to meet their food production needs and offset growing impacts of climate variability risks to farmers. For the successful deployment of green water strategies, however, policy reform is needed on many fronts. New research on effective management of rainfed agriculture, together with widespread changes in the management of irrigation and water supplies, are jointly required to reduce poverty, address environmental sustainability concerns and ensure sustainable water and food access for all.

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Further Reading

Green and Blue Water Accounting in the Ganges and Nile Basins: Implications for Food and Agricultural Policy. 2009. Sulser, T. Ringler, C. Zhu, T. Msangi, S. Bryan, E. and Rosegrant, M. Journal of Hydrology. In Press. International Food Policy Research Institute.

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