Water for Agriculture: Producing More with Less

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It is common knowledge that a 60% increase in food production will be necessary to feed the world in 2050, and water is essential for agricultural production if it is going to meet rising food needs. In the last century, water was considered an infinite resource, yet water stocks are dwindling. Moreover, water consumption has increased six-fold over the last century, which is twice the population growth rate.

'Agricultural water' can be classified in two main categories: so-called 'blue water' used to irrigate crops (groundwater, lakes, dams), and 'green water' for rainfed farming (soil moisture, which accounts for two-thirds of global water resources). Meanwhile humans use more water for agriculture than any other activity, even though agricultural water consumption varies markedly between countries and regions and between types of farming systems. Currently about 40% of the world's food is produced on nearly 20% of irrigated land (310 million ha worldwide, including 5% in Africa and 35% in Asia). Crop productivity on irrigated land is 2.7-fold higher than that of rainfed agriculture, which is nevertheless practiced on 80% of global cropland, mainly in ACP countries.

Family farming is more water-efficient than agribusiness, yet smallholders are often hampered by a lack of access to water. Both types of agriculture must nevertheless coexist. Technical and organisational innovations, tailored public policies and research are jointly needed to enable ACP agriculture to adapt to these new constraints.

Between droughts and floods

Climate change is having variable impacts on the Western African region. Rainfall is, for instance, declining in western Sahel (Senegal, southwestern Mali) while increasing in central Sahel (Burkina Faso, southwestern Niger), in addition to changes to the seasonal monsoon. Clearly many uncertainties remain but, according to scenarios developed by climatologists from the Institut de recherche pour le développement (IRD), the French development research agency, and their international partners, rising temperatures will reduce the length of crop cycles and increase water stress due to the higher water evaporation rate, thus causing a 16-20% decrease in crop yield In the western Sahel and 5-13% in the eastern part of this region.

Crop yields are already dropping, with livestock farming and fisheries also being affected. Less forage is available for grazing livestock, and changes in streams (drying, modified flow rates and floodlands) have prompted a decrease in fish stocks.

Lake Chad is emblematic of the changing situation in the Sahel. Formerly one of the largest lakes in the world, it is an essential source of water for crop and livestock farmers, and fishers in four countries (Cameroon, Chad, Niger and Nigeria). But the lake has shrunk in size from 20,000 km2 to 2,000 km2 over the last 50 years. Repeated droughts from 1970 until 1990 resulted in severe drying, affecting the livelihoods of some 20 million rural people living around the lake, who have been forced to adapt to the changes.

Climate change has led to increased pressure on groundwater throughout ACP countries. The decline in aquifers – underground layers of porous and permeable rock bearing free-flowing water – is degrading wild habitats and causing salinisation of irrigated lands worldwide. This phenomenon, accelerated by rising sea levels, is turning previously fertile land into unproductive wasteland in hard hit Caribbean and Pacific island states, as well as in coastal areas of Western Africa, from Mauritania to Nigeria.

Water is a major land issue as land and water grabbing are interlaced. Many investors do not hesitate to take resources away from poor local smallholders. Meeting water needs is one of the main drivers of the global land rush (see Spore 170: Water grabbing – the hidden cost of land acquisition). This is a complicated issue because it is often hard to determine who exactly owns a water source, while water rights, access and uses are wide-ranging and complex.

Solutions at the state level

States have addressed water shortage problems head-on by developing strategies to deal with both national and international shortages. Irrigation is one of the main implemented solutions. Irrigated agriculture has contributed to laying the foundations for global food security, but large-scale water projects under way in ACP countries – mainly funded by international donors and development banks – have not always achieved goals initially set out.

According to Jean-Philippe Venot, geographer and senior researcher at IRD, large dams are often designed on the basis of highly optimistic assumptions. Meanwhile populations displaced as a result of these projects are not always allocated land. This is the case for the Kandaji dam in Niger; although construction was launched in 2012, it has yet to be completed and its future is

uncertain. In this region, the World Bank is now facing a major problem regarding the resettlement of 38,000 people who had, until recently, been living on the fertile banks of the Niger River. These people have been promised irrigated land and new homes. In Burkina Faso, the Bagré hydroelectric dam, which was built some 20 years ago, presently only irrigates 3,000 ha of land, out of the 30,000 initially planned and local people have received 1-2 ha of land per household. Furthermore, fewer agro-investors than expected have responded to the investment call, and so far only 300 ha have been allocated to agribusinesses. In the last 5-6 years, a new project funded by the World Bank, the African Development Bank and the government of Burkina Faso has promoted agro-entrepreneurship in the area. It is expected that displaced family smallholders will also benefit from irrigated plots. However, the areas to be allotted are still small and often below viability thresholds, unless there is very substantial cropping intensification, which remains beyond the means and capacities of many of these farmers.

Some far-reaching projects are striving to overcome these stumbling blocks. The World Bank Irrigation Sahel initiative (see interview, p. 30), for instance, has avoided large-scale/small-scale development project dichotomy and is seeking to optimise the prevailing situation.
Richard Munang, Africa regional climate change coordinator, United Nations Environment Programme, stated in The Guardian that, “Irrigation cannot be understood in isolation: Irrigation policy must be considered alongside other elements including improved markets, institutional and legal transparency, research and development, and ecosystem management.”

Farmers adapt

By and large, farmers always adapt to water shortages. Farmers have, for instance, abandoned their rainfed millet croplands along the shores of Lake Chad – which they could no longer rely on as the lake was drying up – and moved to more humid fertile lands to grow food crops (maize, cowpea, rice and sorghum). Many 5-10 m deep locally-built wells are found throughout Africa, supplying water for market gardens and rice crops.

Farmers also often grow these crops in lowland areas. In many African countries such as Burkina Faso and Mali, diesel pumps are being increasingly used to tap water from small reservoirs. The environmental impact of this popular practice is, however, in question because of the amount of diesel used.

Farmers have been successfully implementing climate-smart agriculture practices designed to control desertification via soil conservation and management techniques. This includes assisted natural regeneration. In Niger, for example, more than 5 million ha of land has been restored, with over 200 million trees regenerated or planted (see Spore Special Issue: Doing business in a time of climate change, p. 19) over a 30 year period. No-tillage and low input conservation agriculture, including agroforestry, reduces water loss by evaporation.

Drought-tolerant seed selection is not exclusive to research. Well preserved millet biodiversity has led to natural and human-driven selection – farmers noticed that the earliest emerging plants were more drought-resistant and thus selected their seeds for planting in subsequent crop seasons.

Water users' associations (WUAs) are being formed in many countries as a means to cope with water shortages by helping farmers use water more efficiently. In Niger, the Ruwanmu (Hausa word meaning 'our water') small-scale irrigation project depends on WUA support to improve water resource appropriation by users to enhance water use, management and protection. In Madagascar, a network of craftspeople who make very simple drip irrigation systems with local materials has been set up. This has enabled family farmers, with very little investment, to irrigate their gardens and produce vegetables for self-consumption or for market.

Mobilised research

Researchers from a broad range of disciplines are actively involved in addressing these crucial issues. Innovative 'big data' initiatives for agriculture were identified in CTA's ICTUpdate magazine on the data revolution for agriculture. This includes the AquaCrop crop water productivity model developed and disseminated by FAO since 2009, which has benefitted agricultural researchers and extension agents. This model is designed to improve crop yields under water shortage conditions. Farmers can then be advised – on the basis of the analysis of different parameters – on effective ways and times to irrigate crops to obtain the best possible yields.

Drought-tolerant seeds are also a major issue. Farmers from the Republic of Palau are now growing salt-tolerant taro varieties to cope with flooding in their crop fields.

CTA now organises fairs in which plant breeders tell farmers about drought-tolerant seeds, in responsible collaboration with commercial seed producers. One will be held in June 2016 in Mali, and another could take place later in the year in Eastern Africa. These fairs are conducted in partnership with the International Crops Research Institute for the Semi-Arid Tropics and the CGIAR Research Program on Climate Change, Agriculture and Food Security.

Groundwater – another potential source of water for agriculture – is still available in Africa despite increased pressure on this resource. The problem is that groundwater is not necessarily accessible or available at the right places. Karen Villholth, principal researcher at the International Water Management Institute, is coordinating a project to map groundwater resources. She claims that groundwater irrigation could strengthen food security and increase smallholders' income. This, however, requires significant investment and tailored policies because groundwater irrigation – although practiced slightly more in sub-Saharan Africa – is not widespread in Africa compared to the rest of the world (1% of cultivated land in Africa compared to 14% in Asia).

Many social science research initiatives are finally focusing on the organisation and collective action dynamics of farmers. According to Venot, these combined actions undoubtedly account for the bulk of the irrigation projects under way, especially in semi-arid Sahelian areas.
A study published in Environmental Research Letters in 2016 (http://tinyurl.com/j4c2ugq) indicates that global food production could be boosted by 41% if all farmers were to adopt tailored water management methods. These researchers modelled 35 ambitious yet achievable water management strategies and found that improved irrigation could halve the global food gap.