CLIMATE CHANGE ADAPTATION FOR AGRICULTURE AND AGRO-ECOSYSTEMS

The Critical Role of Water

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It has been said that climate change mitigation is about gases and that adaptation is about water. In a world where 70 percent of water withdrawals are used for agriculture, it is important that we develop adaptation strategies to manage the impacts of climate change on water availability, agriculture, and the environment. Adapting to changes in water availability and seasonal distribution is possible, but we need to know the direction and magnitude of these potential changes and their degree of certainty. Given the likelihood of increasing water scarcity and variability, especially in the world's poorest countries, we have to ask whether we are saddled with outdated 20th century paradigms on how we manage water supplies that are fit for agricultural production, as well as domestic, industrial, and environmental uses.

Here are the relevant facts: (a) population is expected to increase by 2 billion in the next 20 years; (b) climate change, particularly in the tropics/subtropics, where most of the poor live, is likely to impact both total rainfall and seasonal distribution; (c) burgeoning urbanization and concomitant demand for water means productive land will be lost to degradation and other nonagricultural uses; (d) increasing acreage will be devoted to plants grown for biofuel production; and (e) there will be increasing demands for environmental water for wetlands and environmental flows that support valuable ecosystem services. All of these trends are going to put existing water, land, and agricultural resources under significant pressure.

A key feature of future water management will involve adaptation to changing conditions associated with competing demand and variability in supply. Recently, provision of supply to those without clean water and sanitation was recognized as a key Millennium Development Goal. In some countries, particularly in Africa and South America, lack of finance—termed economic water scarcity—has been the key impediment to the expansion of access to clean water and adequate sanitation. In many countries in the Middle East and Asia (for example, China and India), however, the new challenge is how to manage growing demand for water in the face of supplies that are effectively fully allocated or utilized. This can be described as physical water scarcity. Increasing physical water scarcity means that real trade-offs among irrigation, other beneficial water uses, and the environment are inevitable and will require new sets of biophysical and socioeconomic tools to determine the most appropriate strategies. Climate change will undoubtedly put water users in many countries under more pressure.

As the new Director General of the International Water Management Institute (IWMI), my job is to focus IWMI's limited resources on assisting the poor in improving and retaining access to diminishing water supplies, as well as improving the productivity of their share of the resource. The good news is that a recent comprehensive assessment of water management in agriculture (Molden 2007), prepared with input from over 700 scientists, provides us with some clear directions as to what has to be done if the challenges of coping with competition for reducing water supplies are to be met in a future of climate change and population growth. The assessment asks a key question: "Is there enough land, water, and human capacity to produce food for a growing population over the next 50 years?" It concludes that

while it may be possible to produce the food, it is probable that today's food production and environmental trends, if continued, will lead to crises in many parts of the world.

The assessment details seven policy actions that must be taken to deal with the challenge (see *Box*, below). They indicate that we must rethink the old paradigms about water in order to successfully manage adaptation to climate change and other risks to our water resources, food production, and environment.

If we are to adapt to climate change, we will need to (a) think creatively about water storage systems, including groundwater storage and reuse; (b) improve basin management and water allocation processes; and (c) develop drought response strategies, including early drought warning systems, crop insurance, changing land use and cropping patterns, and increasing water productivity. All of these will have to be embraced by policy makers, governance and institutional processes, water managers, and water users. In the environmental area, adaptation will require improved understanding of ways in which agriculture and wetlands can coexist, as well as better communication to communities and politicians regarding the value of ecosystem services provided by the environment.

The conclusions of the comprehensive assessment resonate with me, especially given that I have just spent two years helping the Australian government develop strategies to deal with the worst drought since European settlement. The lessons emerging from Australia are that individual projects aimed at fixing part of the system are often useless, or even create new difficulties in the face of systemic natural resource changes. The approach has to be scientifically holistic and embrace profound reform. From a scientific perspective, this means understanding the regional drivers of water availability (for example, climate variability and change, land use change, etc.), modeling how these changes affect water availability, and analyzing what this means for water entitlement holders and their annual allocations. From there, it is possible to determine how these will impact food production, urban and industrial supplies, and the environment. The challenge is then to develop socially equitable means of sharing the diminished supply between beneficial users and the environment. Policy reform, in order to address the complex inter-sectoral and compounding effects of climate change, has to take such an evidence-based approach in order to be effective.

I expect that the above model will apply in most countries. However, it requires the water management community to start to look at the big picture and to be far more holistic and integrative than we have been in the past. It also requires donors and researchers to complement on-the-ground work with greater use of interdisciplinary teams to define the issues and develop strategic policy, institutional, and governance reforms. A key issue will be identifying how the environment can be used to provide ecosystem services that are valued by water users. It means looking at wastewater as a resource, as opposed to something to jettison into the ocean. It means developing a better understanding of how wetlands and other ecosystems provide clean water and food supply via ecosystem service functions. Above all, it means using scientific, social, and economic evidence to guide the reform process.

The CGIAR is gearing up to these challenges via a new Climate Change Challenge Program with a focus on diagnosing vulnerability of agricultural systems to climate change and development of adaptation pathways for affected systems. This will be complemented at IWMI and other centers by additional work on innovative scientific approaches, including improved prediction of climate change impacts on water availability, better ways to retain and store water to supplement diminishing rainfall and shorter wet seasons, and the development of more drought-resistant crops and improved biofuels. However, a critical need in many developing countries will continue to be for the CGIAR to assist agricultural and water management agencies to build scientific capacity and to implement policy and institutional reform to facilitate the adoption of improved responses to climate change threats. IWMI is somewhat daunted by the magnitude of these challenges, but also excited at the prospect of tackling many of them in partnership with other agencies and national land and water managers across the globe.

Key Policy Actions for Water Management in Agriculture

1. Change the way we think about water and agriculture
2. Fight poverty by improving access to agricultural water and its use
3. Manage water to enhance ecosystem services
4. Increase the productivity of water
5. Upgrade rainfed systems—a little water can go a long way
6. Reform the reform process—targeting state institutions
7. Deal with trade-offs and making difficult choices.

Source: Molden 2007.

References

Molden, D., ed. 2007. *Water For Food, Water for Life: A Comprehensive Assessment of Water Management in Agriculture*. London: Earthscan Publishing (www.earthscan.co.uk).