Water for Food – Water for Life[1]

Food and feed crop demands will nearly double in the coming 50 years. The two main factors driving how much food we will need are population growth and dietary change. With rising incomes and continuing urbanization, food habits change toward more nutritious and more varied diets—not only toward increasing consumption patterns among cereal crops but also to a shift in consumption from cereals to livestock, fish products and high-value crops.

Producing meat, milk, sugar, oils and vegetables typically requires more water than producing cereals – and a different style of water management. Increasing livestock production requires even more grain for feed, leading to a 25% increase in grains. Thus, diets are a significant factor in determining water demand. While feed-based meat production may be water costly, grazing systems behave quite differently. From a water perspective, grazing is probably the best option for large land areas, but better grazing and watering practices are needed.

Without further improvements in water productivity or major shifts in production patterns, the amount of water consumed by evapotranspiration in agriculture will grow from 70% to 90% by 2050. The total amount of water evaporated in crop production would amount to 12,000-13,000 cubic kilometers, almost doubling the 7,130 cubic kilometers of today. This corresponds to an average annual increase of 100-130 cubic kilometers, almost three times the volume of water supplied to Egypt through the High Aswan Dam every year.
On top of this is the amount of water needed to produce fiber and biomass for energy. Cotton

[1] *Source: Comprehensive Assessment of Water Management in Agriculture. 2007. Water for Food, Water for Life: A Comprehensive Assessment of Water Management in Agriculture. London: Earthscan, and Colombo: International Water Management Institute*

demand is projected to grow by 1.5% annually, and demand for energy seems insatiable. By 2030, world energy demand will rise by 60%, two-thirds of the increase from developing countries, some from bioenergy.

Fortunately, water productivity in agriculture has steadily increased in the past decades, in large part due to increases in crop yields, and will continue to do so. The pace of this increase can vary substantially according to the type of policies and investments put in place, with substantial variation in impacts on the environment and the livelihoods of agricultural populations.

The last 50 years have seen remarkable developments in water resources and in agriculture. Massive developments in irrigation infrastructure have put water at the service of people, while the world population grew from 2.5 billion in 1950 to 6.5 billion today. The irrigated area doubled, and water withdrawals tripled.

Agricultural productivity grew with the development of new crop varieties and introduction of fertilizers and irrigation. Global food prices declined remarkably (Figure 1), and the greater use of water for irrigated agriculture benefited farmers and poor people, propelling economies, improving livelihoods and fighting hunger.

In spite of these developments, in 2003, 850 million people in the world were food insecure, 60% of them living in South Asia and Sub-Saharan Africa, and 70% of the poor live in rural areas. In Sub-Saharan Africa, the number of food-insecure people rose from 125 million in 1980 to 200 million in 2000. Also, the last 50 years have witnessed changes in ecosystems, with many negative consequences.

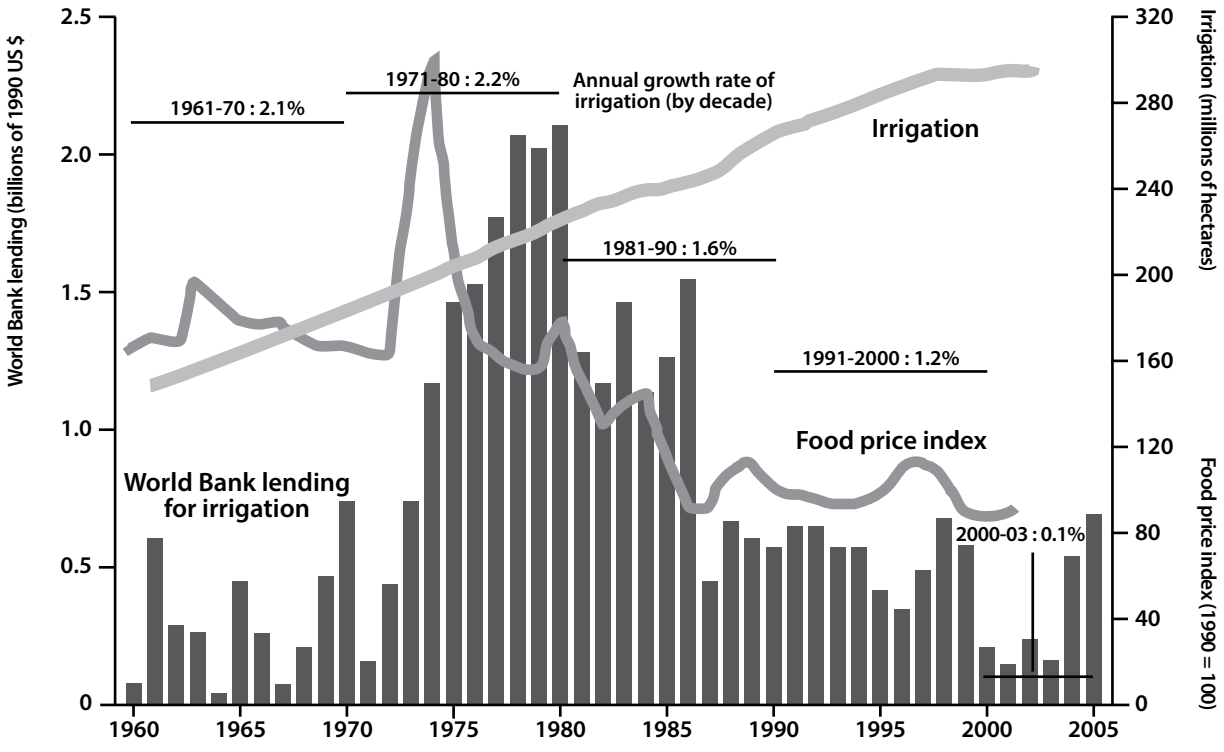


*Figure 1. **Irrigation expanding, food prices falling***

Source: Based on World Bank and Food and Agriculture Organization data

The Millennium Ecosystem Assessment pointed out that growth in agriculture has been responsible for much of this change. Agricultural practices have contributed primarily to the loss of regulating ecosystem services – such as pollination, biological pest control, flood retention capacity, and changes in microclimate regulation – and to the loss of biodiversity and habitats. Our message: better water management can mitigate many of the negative consequences.

"Growth in agriculture has been responsible for much of the loss of biodiversity and habitats and of regulating ecosystem services. Better water management can mitigate many of the negative consequences."

Upgrading rainfed agriculture to meet future food demand

Today, 55% of the gross value of our food is produced under rainfed conditions on nearly 72% of the world's harvested cropland. In the past, many countries focused their 'water attention' and resources on irrigation development. The future food production that should come from rainfed or irrigated agriculture is the subject of intense debate, and the policy options have implications that go beyond national boundaries.

An important option is to upgrade rainfed agriculture through better water management practices. Better soil and land management practices can increase water productivity; an example is adding a component of irrigation water through smaller scale interventions such as rainwater harvesting. Integrating livestock in a balanced way to increase the productivity of livestock water is important in rainfed areas.

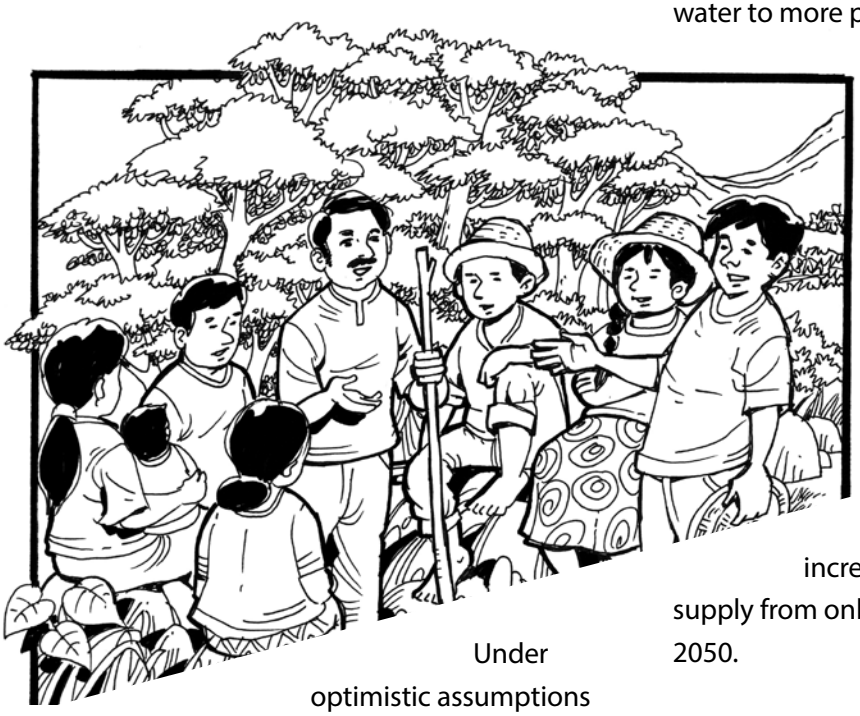
At the global level, the potential of rainfed agriculture is large enough to meet present and future food demand through increased productivity. An optimistic rainfed scenario assumes significant progress in upgrading rainfed systems, while relying on minimal increases in irrigated production, by reaching 80% of the maximum obtainable yield. This leads to an average increase of yields from 2.7 metric tons per hectare in 2000 to 4.5 in 2050 (1% annual growth). With no expansion of irrigated area, the total cropped area would have to increase by only 7%, compared with 24% from 1961 to 2000, to keep pace with rising demand for agricultural commodities.

But focusing only on rainfed areas carries considerable risks. If adoption rates of improved technologies are low and rainfed yield improvements do not materialize, the expansion in rainfed cropped area required to meet rising food demand would be around 53% by 2050. Globally, the land for this is available, but agriculture would

then encroach on marginally suitable lands and add to environmental degradation, with more natural ecosystems converted to agriculture.

"A growing population is a major factor behind today's water scarcity, but the main reasons for water problems are lack of commitment and targeted investment, insufficient human capacity, ineffective institutions, and poor governance."

Potential of improving irrigated agriculture



Under optimistic assumptions about water productivity gains, three-quarters of the additional food demand can be met by improving water productivity on existing irrigated lands. In South Asia—where more than 50% of the cropped area is irrigated and productivity is low—additional food demand can be met by improving water productivity in irrigated agriculture, rather than by expanding the area under production. But, in parts of China and Egypt and in developed countries, yields and water productivity are already quite high, and the scope for further improvements is limited. In many rice-growing areas, water savings during the wet season make little sense because they will not be easily available for other uses.

An alternative strategy is to continue expansion of irrigated land because it provides access to water to more people and can provide a more secure food future. Irrigation could contribute 55% of the total value of food supply by 2050. But that expansion would require 40% more withdrawals of water for agriculture, surely a threat to aquatic ecosystems and capture fisheries in many areas. In Sub-Saharan Africa there is very little irrigation, and expansion seems warranted. Doubling the irrigated area in Sub-Saharan Africa would increase irrigation's contribution to food supply from only 5% now, to an optimistic 11% by 2050.

Potential of trade to release pressure on freshwater resources

By importing agricultural commodities, a nation "saves" the amount of water it would have required to produce those commodities domestically. Egypt, a highly water-stressed country, imported 8 million metric tons of grain from the United States in 2000. To produce this amount of grain Egypt would have needed about 8.5 km^3 of irrigation water (Egypt's annual supply from Lake Nasser is 55.6 km^3). Japan,

a land-scarce country and the world's biggest grain, importer, would require an additional 30 billion cubic meters of crop water consumption to grow the food it imports. Cereal trade has a moderating impact on the demand for irrigation water because the major grain exporters–the United States, Canada, France, Australia, and Argentina–produce grain in highly productive rainfed conditions.

A strategic increase in international food trade could thus mitigate water scarcity and reduce environmental degradation. Instead of striving for food self-sufficiency, water-short countries would import food from water-abundant countries. But poor countries depend, to a large extent, on their national agriculture sector, and the purchasing power required to cover food needs from the world market is often low. Struggling with food security, these countries remain wary of depending on imports to satisfy basic food needs. A degree of food self-sufficiency is still an important policy goal. And despite emerging water problems, many countries view the development of water resources as a more secure option to achieving food supply goals and promoting income growth, particularly in poor rural communities. The implication is that under the present global and national geopolitical and economic situation, it is unlikely that food trade will solve water scarcity problems in the near term.

"But even in an optimistic investment scenario, by 2050, the cropped area will increase by 9% and water withdrawals for agriculture will increase by 13%".

What Policy Actions are Needed?

Policy action 1. **Change the way we think about water and agriculture.**

Thinking differently about water is essential for achieving our triple goal of ensuring food security, reducing poverty, and conserving ecosystems. Instead of a narrow focus on rivers and groundwater, view rain as the ultimate source of water that can be managed. Instead of blueprint designs, craft institutions while recognizing the politically contentious nature of the reform process. And instead of isolating agriculture as a production system, view it as an integrated multiple-use system and as an agroecosystem, providing services and interacting with other ecosystems.

Policy action 2.
Fight poverty by improving access to agricultural water and its use.

Target livelihood gains of smallholder farmers by securing water access through water rights and investments in water storage and delivery infrastructure where needed, improving value obtained by water use through pro-poor technologies and investing in roads and markets. Multiple-use systems, operated for domestic use, crop production, aquaculture, agroforestry and livestock can improve water productivity and reduce poverty.

"A wider policy and investment arena needs to be opened by breaking down the divides between rainfed and irrigated agriculture and by better linking fishery and livestock practices to water management".

Policy action 3.
Manage agriculture to enhance ecosystem services.

Good agricultural practice can enhance other ecosystem services. In agroecosystems, there is scope to promote services beyond the production of food, fiber and animal protein. Agricultural production does not have to be at the expense of other services that water provides in rivers and wetlands. But because of increased water and land use, and intensification, some ecosystem change is unavoidable, and difficult choices are necessary.

Policy action 4.
Increase the productivity of water.

Gaining more yield and value from less water can reduce future demand for water, limiting environmental degradation and easing competition for water. A 35% increase in water productivity could reduce additional crop water consumption from 80% to 20%. More food can be produced per unit of water in all types of farming systems, with livestock systems deserving attention. But this optimism should be met with caution because in areas of high productivity only small gains are possible. Larger potential exists in getting more value per unit of water, especially through integrated systems and higher value production systems and through reductions in social and environmental costs. With careful targeting, the poor can benefit from water productivity gains in crop, fishery, livestock, and mixed systems.

Policy action 5.
Upgrade rainfed systems–a little water can go a long way.

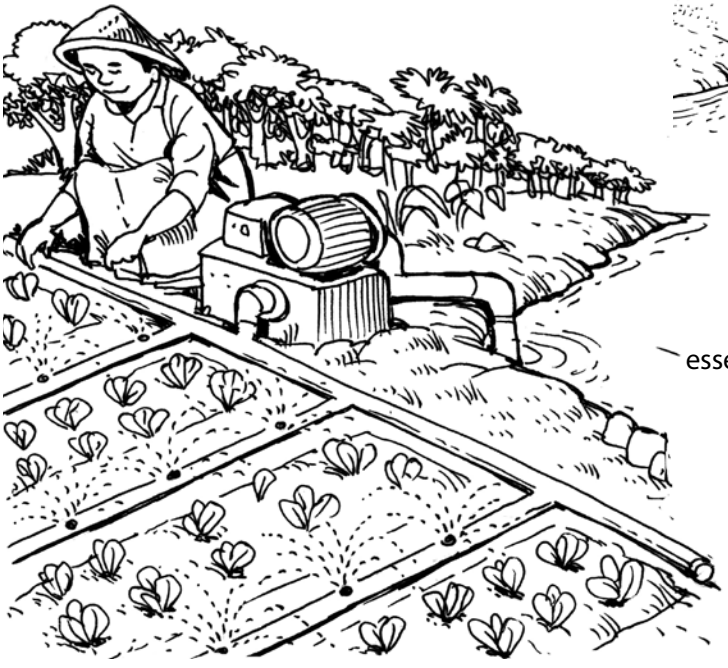
Rainfed agriculture is upgraded by improving soil moisture conservation and, where feasible, providing supplemental irrigation. These techniques hold underexploited potential for quickly lifting the greatest number of people out of poverty and for increasing water productivity, especially in Sub-Saharan Africa and parts of

Asia. Mixed crop and livestock systems hold good potential, with the increased demand for livestock products and the scope for improving the productivity of these systems.

Policy action 6.
Adapt yesterday's irrigation to tomorrow's needs.

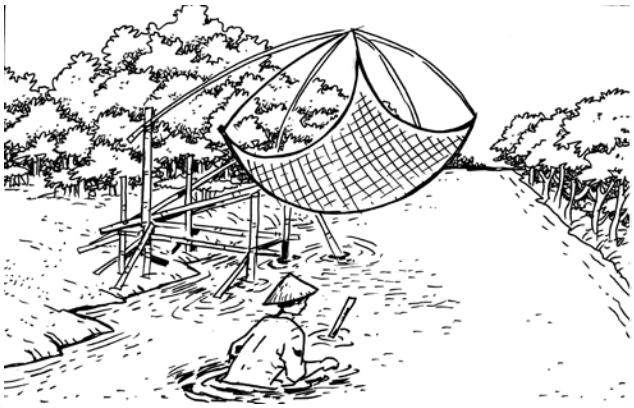
The era of rapid expansion of irrigated agriculture is over. A major new task is adapting yesterday's irrigation systems to tomorrow's needs. Modernization, a mix of technological and managerial upgrading to improve responsiveness to stakeholder needs, will enable more productive and sustainable irrigation. As part of the package, irrigation needs to be better integrated with agricultural production systems to support higher value agriculture and to integrate livestock, fisheries, and forest management.

Policy action 7.
Reform the reform process – targeting state institutions.



Following a realistic process to suit local needs, a major policy shift is required for water management investments important to irrigated and rainfed agriculture. A wider policy and investment arena needs to be opened by breaking down the divides between rainfed and irrigated agriculture and by better linking fishery and livestock practices to water management. Reform cannot follow a blueprint. It takes time. It is specific to the local institutional and political context. And it requires negotiation and coalition building. Civil society and the private sector are important actors. But the state is often the critical driver, though state water institutions are often the most in need of reform.

Policy action 8.
Deal with trade offs and make difficult choices.



Because people do not adapt quickly to changing environments, bold steps are needed to engage with stakeholders. Informed multi-stakeholder negotiations are essential to make decisions about the use and allocation of water. Reconciling competing demands for water requires transparent sharing of information. Other users–fishers, smallholders without official title, and those dependent on ecosystem services–must develop a strong collective voice.

With the inevitable increases in world food demand, agriculture will require more land and water. Part of the increase in food production can be achieved by improving crop yields and increasing crop water productivity, through appropriate investments in both irrigated and rainfed agriculture as in the Comprehensive Assessment scenario. But even in an optimistic investment scenario, by 2050 the cropped area will increase by 9% and water withdrawals for agriculture will increase by 13%, taking resources away from other ecosystems. One challenge is to manage this additional water in a way that minimizes the adverse impacts on, and where possible, enhances ecosystem services and aquatic food production, while providing the necessary gains in food production and poverty alleviation. Doing so will require a water-food-environment policy agenda suited to each country and region.

Summary notes

There is a need to invest in water, but the type of investment and how it is carried out make all the difference. The Comprehensive Assessment's view on investments is broad and considers a range of options. It includes investments in improving management, building effective institutions to meet changing demands, and increasing knowledge and human capacity. Despite good intentions, it is difficult to make meaningful investments in crafting institutions and empowering people to make better choices about water. It is often easier and politically more expedient to build large infrastructure without considering alternatives and the environmental costs. This must change.

A combination of investment, policy and research approaches will clearly be needed, and each strategy will have risks and tradeoffs. Any strategy will require a concurrent policy shift. The global policy and economic environment will provide the overall framework for local agriculture, but local conditions will dictate the choices for future water investments in agriculture.

Change does not always require governments to spend huge sums of money. Many informed investment decisions can save money – a lot of money. When the conditions are right, individuals will invest in water for their own welfare.

Contact Persons

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Key Reference

Comprehensive Assessment of Water Management in Agriculture 2007. *Water for Food, Water for Life: A Comprehensive Assessment of Water Management in Agriculture. London:* Earthscan, and Colombo: International Water Management Institute.

Tag: Comprehensive Assessment on Water Management in Agriculture