New Era of Water Resource Management

by David Seckler

With current and expected constraints on additional supplies of fresh water, attention has naturally turned to "demand management." It is hoped that increased efficiency of water use will result in sufficient savings of water that was previously wasted to support future water requirements.

Physical water use efficiency can be increased by using less per unit of output. Economic efficiency can be increased by reallocating water from lower to higher valued uses. Proponents of demand management point to the successes in the energy sector of developed nations where projections of rising energy demand were largely obviated by increased efficiency of energy use.

Irrigated agriculture consumes about 80 percent of the world's developed water supplies. The water use efficiency of a typical gravity irrigation system is only about 40 percent. But sprinkler irrigation systems are about 70 percent efficient and drip irrigation systems can be as high as 90 percent efficient. It appears that at least one-half of the water currently used in irrigated agriculture could be saved through increased irrigation efficiency.

But in the field of water, "efficiency" is a tricky concept. In order to understand it, it is first necessary to understand the basic features of waterbasins.

**Waterbasins**

When a unit of water in a waterbasin is diverted from a source to a particular use, three basic things happen to it: First, part is lost to the atmosphere because of evaporation from surface areas and plants. Second, that part of the diverted water which has not evaporated drains to surface or sub-surface areas. It may drain to the sea, or a deep canyon, or similar sink where it cannot be captured and reused. In this case the drainage water is truly lost to the system. The drainage water may also flow back into a stream, or to other surface and sub-surface areas, where it can be captured and reused as an additional source of supply. In this case the water is not lost or wasted in physical terms.

The third thing that happens to water when it is diverted is that it becomes polluted. The drainage water absorbs, or "picks up," pollutants as it is used, and whatever pollutants were in the diverted water are concentrated by the consumptive use. Thus, as water recycles through the system it eventually becomes so polluted that it is no longer usable and flows to a sink.

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As population and economic activity grow in waterbasins they gradually evolve from an open to a closed state. In the open state, usable water flows out of the waterbasin (which should include estuaries) to a sink, even in the dry season. In this case, the only problem is to capture and distribute this water for beneficial use. But in the closed state, all the dry-season flow of usable water has been captured and distributed. Most of it has evaporated and whatever remains is so polluted that it cannot be used.

This creates massive "headender-tailender" problems at the level of entire waterbasins. Tailenders, at the bottom of the waterbasin, receive progressively less water and the drainage water as sources of inefficiency. This is not true for that part of the drainage water that is being reused. In order to overcome this confusion in the concept of water-use efficiency, knowledgeable people now distinguish between "real" water savings and "paper" water savings-or, as they say in California, "wet" and "dry" water savings. As illustrated in a simple example: According to an advertisement now running on television in the United States, if I turn off the water faucet when I brush my teeth, I will save 40 gallons of water each week. Similarly, it is said, water savings of more than 50 percent can be achieved by low-flow toilets and showers.

Let us look at this example more closely. By turning off the faucet, I save 40 gallons in the source of water for use elsewhere in the system. But what happened to the water that I previously had wasted before I started turning off the faucet? It went "down the drain." But then where did it go? If the drainage water was captured and reused downstream, no water was lost to the system, and turning off the faucet results only in "dry" water savings; the supply of water in the waterbasin as a whole has not changed.

The same distinction between "wet" and "dry" savings applies in the slightly more complicated case of irrigated agriculture. Assume that a group of farmers "A" is applying 1,000 units of water to their land at 50 percent efficiency. This means that 500 units of the diverted water has evaporated-mainly to meet the evapotranspiration requirements of the crop, while the other 500 units of the water is lost by surface and sub-surface drainage. But assume a second group of farmers "B" captures all the drainage water from "A" and applies it to their fields at 50 percent efficiency. Then 250 units of the drainage water has evaporated while 250 units are lost to drainage. Now the overall irrigation efficiency of the system, of "A" and "B" together, has increased to 750 units of water, divided by the 1,000 units of water diverted, or 75 percent efficiency.
Gender Inequities

As waterbasins become closed, they become by definition more efficient. This is why the scope for improving water-use efficiency is lower, and the degree of water scarcity in the future will be greater, than commonly assumed. This is the central problem of the new era of water resource management. Careful research and development work is needed to create “wet” water savings—and to avoid chasing the red herrings of “dry” water savings. The opportunities for creating “wet” water savings lie in four principal directions:

- increasing output per unit of consumptive use of water
- reducing water pollution
- reallocating water from lower to higher valued uses
- reducing losses of usable water to sinks.

While considerable progress in achieving ‘wet’ water savings can be made, it is clear that some of the most rapidly growing areas of the world also will require additional water development programs. This is another challenge in the new era of water management to design and manage these projects in a much better way—far from all important technical, economic, social and environmental perspectives—than they have been in the past.

David Seckler is Director General, International Irrigation Management Institute (IIMI).

**Ethiopia: A Future without Famine?**

by Adel El-Beltagy

Of all the countries in sub-Saharan Africa, Ethiopia per haps is the most notorious worldwide for famines. In any given year, it seems, there is one area in the country that suffers from a serious food shortage.

There are several reasons for Ethiopia’s susceptibility to hunger and its consequent dependence on food aid. One is the 3 percent growth per year in population. Another is the erosion that has denuded the country’s highlands. Deforestation has reduced closed forests to 1 percent of the land area. And poverty is rampant, with per capita income among the lowest in the world at about US$120. Yet, there is reason for fresh hope that Ethiopia could again become self-reliant in food.

Since the end of the civil war, Ethiopia has undertaken great efforts to modernize its agriculture. Young Ethiopian scientists, trained abroad, have been providing leadership and formed a dedicated and vigorous research team actively carrying out research for Ethiopia’s millions of small, resource-poor farmers. These Ethiopian scientists intend to make sure that the horrific scenes of the famine of 1984-85 will never return. In those years, drought and widespread crop failure caused millions to lose their lives and resulted in the displacement of millions more.

So grim was the famine that one journalist wrote a book on the crisis, *A Year in the Death of Africa*. But Africa does not intend to die, and at the International Center for Agricultural Research in the Dry Areas (ICARDA) we can look back with cautious satisfaction at our participation, since ICARDA’s start, in international efforts to assist Ethiopia’s scientists in safeguarding their country’s future.

**Pulses - a key source of protein**

In 1983, Ethiopia’s production of pulses was 799,000 tons. In 1985, the famine gripped the nation, it dropped to 539,000 tons. Faba bean, lentil, field pea, chickpea, and grasspea are all important in the country, but yields are low. Field pea and faba bean suffer from inbred land preparation, sowing methods, and low seed rates, while lack of weeding makes matters worse. High temperatures and low rainfall are added impediments. And, in some ways, worst of all, there has been heavy reliance on unimproved varis which are highly susceptible to biotic extremes, pests and diseases.

The Institute for Agricultural Research (IAR) in Addis Ababa, the chief body of agricultural research in the country, realized that a great deal needed to be done. IAR decided to strengthen its high pulse research. First, in 1986, it ICARDA’s Nile Valley faba bean project which already covered Egypt and (continued from page 10)