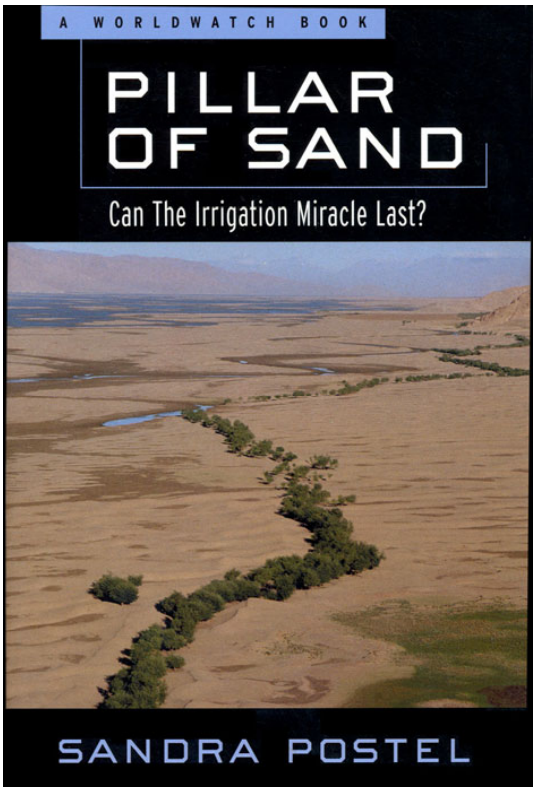
title **Pillar of Sand – Can The Irrigation Miracle Last?**



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http://www.globalwaterpolicy.org/index.htm
also written “Last Oasis – Facing Water Scarcity” that is reviewed on this site

Sandra Postel lives in Amherst, Massachusetts, where she directs the Global Water Policy Project. She is a Pew Fellow in Conservation and the Environment and a former vice president for research at the Worldwatch Institute.

category World Irrigation Issues

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of note Sandra Postel's previous book, *The Last Oasis*, is in eight languages and was the basis for a public television documentary that aired in 1997-98. In November 2002, Postel was named one of the "Scientific American 50" by *Scientific American* magazine, a new award recognizing contributions to science and technology. She was also named a Pew Fellow in Conservation and the Environment in 1995.
http://www.worldwatch.org/node/1748

who will be interested in this book?

Anyone interested in world irrigation and food supply issues and how they apply to local concerns. The book is split between “waving the issues flag” and providing very interesting ideas and solutions being used in the world now.

why read this book?

A good introduction to history of irrigation, how some civilizations rose with irrigation and then fell with water supply or soil salination problems. Postel gives a detailed look at current world irrigation and water supply techniques and issues. With some 40 percent of world food supply coming from irrigated land and a rising world population, irrigation will be even more important in the future.

There are detailed chapter notes.

review / outline by Lance Brown, vistadelsol@telus.net

Overview

Postel reviews the role of irrigation in the rise of civilizations (and in some cases, fall) and explores the interconnected issues of population growth, sustainable agriculture, and water scarcity. She also looks at how climate change may affect agriculture and water supply for irrigation, a subject even more important now then in 1999 when this book was written,

Many points Postel discusses pertain directly to BC, but a few stand out:

- Water pricing can encourage efficient use – but commercial users must be able to pass on any added costs. In a California utility water system, 80% of a farms water remains at previous low price; the next 10% is part of supply cost; the last 10% is at supply cost. In BC, water license costs have risen but in areas that no not see supply as limited (other than Southern Interior, Gulf Islands, etc) pricing is not linked to efficient use – once a license is paid for then all the water can be / should be used as a "right". Some BC cities and irrigation districts now use water meters. Any user that uses stored water has (or should have) self-interest in water use efficiency, but those using run-of-river do not have the same direct payback from any water efficiency they may employ.
- The selling/trading of water can encourage water efficiency. In BC, the notion has been that water saved by a sector (ag, domestic, industrial) would stay with that sector and not shifted to other sectors. But Postel's previous book (*The Last Oasis*) considers that in the future world water supply will be looking at irrigation water savings for cities. In *Pillars of Sand* this idea is looked at in some detail.
- The BC water licensing system does not provide for licencees to shift part of all of their water to other uses or users, except on a permanent basis with a license change. As Postel discusses, this leads to the "historic right versus future economical potential" conflict. Water banking is discussed as a possible solution, now used in some areas.
- Depletion of ground water is a world wide problem – in BC, with no ground water licensing, it is particularly acute.

A couple of interesting quotes Postel presents:
"There is no such thing as a post-agricultural society", Harvard anthropologist Timothy Weiskel.

"The tragedy of the commons - each person acting out of self-interest will lead to collective action that destroys the common resource. Freedom in a commons brings ruin to all", Ecologist Garrett Hardin (perhaps an overly dramatic quote, but this might apply to ground water use?)

Chapters & Points of Interest

1. *New Light on an Old Debate*
    - human history linked to controlling, supplying, and using water
    - many agricultural sites are water-scarce; many watersheds flow out-of-sync with crops
    - ditch irrigation in Mesopotamia (Iraq) was foundation for civilization to grow
    - soil salination became a problem; now worldwide 1 ha in 5 affected to some degree
    - food from cropland, rangeland, and fisheries (last two are at limits and shrinking)
    - cropland will have to produce more food in the future
    - worldwide crops get 70% of water from rainfall & 30% from irrigation, but if more food production is required it will have to come from irrigated land, but where is the water?
    - increased irrigation efficiency will be essential
2. *History Speaks*
    - irrigation in Mesopotamia; Babylon; Indus, Yellow, & Nile River basins; early N. America
3. *Irrigation's Modern Era*
    - growth of irrigation; 1800 (8 mil ha), 1900 (40 mil), 1950 (100 mil), 1995 (255 mil)

- India, China, US, and Pakistan account for just over one-half of irrigated land
- 40% of worlds food is from the 17% of cropland that is irrigated
- British built canals in India starting in 1817
- by 1800 in the US, Spanish built 160 acequias (irrigation canals) in New Mexico (see *Mayordomo* reviewed elsewhere on this site)
- by 1890 Mormon settlers in Utah had 100,000 ha irrigated; California had 400,000 ha
- with US aware of British canal work in India, dam building started (1902 Roosevelt Dam on Salt River) and large concrete dams – over 150 m high (1935 Hoover Dam on the Colorado River at 220 m)
- this encouraged British to build large dams in India in mid-1900;s
- although from 1902 - 1952 US Bureau of Reclamation had brought 2.7 mil ha under irrigation (of total 10 mil ha) it was less than brought under by private and local projects in the last half of the 1800's as new water projects were becoming uneconomical
- Russia , with 84% of river runoff into Artic or Pacific Oceans away from populated areas and arable land, started diversions from rivers flowing into the Aral Sea with disastrous results

4. *Running Out*
   - many aquifers and rivers are over used
   - Yellow River now runs dry for it's last 600 km for 100 + days a year
   - many aquifers have reduced recharge due to changes in surface conditions
   - siltation of reservoirs reduce capacity by estimated 1% per year (loss of 66 bil m^3/yr)
   - climate change may cause change of snow melt patterns
5. *A Faustian Bargain*
   - irrigation causing soil salination issues with some water and soil types
   - Aral Sea; Pakistan; India; China; US
6. *Water Wars I: Farms Versus Cities and Nature*
   - transferring farm allocated water to cities for domestic use
   - a cubic metre of water used in industry in China generates more jobs and 70 times more economic value then when used in agriculture
   - in India, some farmers have abandoned farming to sell their water to cities
   - in Indonesia, some factories buy or rent farms for their water
   - in Malaysia, golf courses have more than tripled, adding demand for water
   - in Arizona, Calif., Colorado, cities are buying water, water rights, or land with water
   - some countries rely on "virtual water" – importing grain to make up for their lack of water
7. *Water Wars II: Irrigation and the Polities of Scarcity*
   - battles have been fought over water going back 5,000 years
   - today, concerns arise over Jordan River (3 nations); Tigris-Euphrates (3 nations); Nile River (10 nations)
   - issues over historic water use versus future economical potentials
   - water treaties to include regional food security arrangements
8. *The Productivity Frontier*
   - world food production relies more & more on irrigated land but new water supplies are dwindling
   - while the Green Revolution expanded food production with fertilizers & chemicals, now a "Blue Revolution" is needed regarding water use
   - not all irrigation efficiency improvements "save" water as excess water may already be used downstream in some form
   - to truly save water in a basin it must be tracked as to where it goes and what functions it performs

- 4 ways to improve water productivity: (1) capture more - Chapter 4; (2) shift uses - Chapter 6; (3) reduce evaporation and unrecycled losses - this Chapter; (4) use farming practices that do more with water - this Chapter
- drip irrigation saves water – only about 1% of worlds total irrigated area
- climate monitoring to schedule irrigation by evapotranspiration (ET)
- low-energy precision application sprinklers can be up to 95% efficient
- high frequency irrigation; bio-engineering plants; water recycling

9. *Thinking Big About Small-Scale Irrigation*
   - use of small, human-powered Treadle pumps in Bangladesh
   - pedal pumps in Kenya; small, low cost drip and sprinkler systems
   - 3rd world acceptance of new ideas – treat as customers not recipients of charity
   - cultivating wetlands; planting flood plains after floods recede; capture rainfall and runoff and channel to cropland
10. *The Players and the Rules*
   - massive subsidies or failure of large public-funded water projects
   - from 1950-1993 World Bank lent $31 bil with few water laws, regulations, policies
   - water pricing or selling/trading water to encourage efficient water use
   - but some water rights systems (use or lose; beneficial use) can inhibit efficient use
   - water banks between farmers/farmers or farmers/cities are used
   - in some countries, privatization of water supply systems increases agricultural productivity as users become involved in the management
   - without any regulations, land ownership implies the right to ground water
11. *Listening to Ozymandias*
   - a summary of issues discussed
   - countries may have to change diets to more water-efficient foods; increase domestic and industrial water efficiency
   - water is essential to life; generally there are no substitutes for water in most of its uses

other overview **Worldwatch Institute** press release, July 20, 1999
(a Washington, DC-based nonprofit research organization that analyzes global environmental and development issues and is the agency presenting this book)

Spreading water shortages threaten to reduce the global food supply by more than 10 percent. Left unaddressed, these shortages could lead to hunger, civil unrest and even wars over water, according to Sandra Postel, a leading expert on global water problems.

"Some 40 percent of the world's food comes from irrigated cropland," says Postel, "and we're betting on that share to increase to feed a growing population." But, while irrigation accounts for two-thirds of global water use, less than half that water reaches the roots of plants. "Without increasing water productivity in irrigation, major food-producing regions will not have enough water to sustain crop production," she says.

Moreover, the productivity of irrigation is in jeopardy from the overpumping of groundwater, the growing diversion of irrigation water to cities, and the buildup of salts in the soil.
"Our civilization is not the first to be faced with the challenge of sustaining its irrigation base," says Postel, director of the Global Water Policy Project in Amherst, Massachusetts, and a senior fellow at the Worldwatch Institute. "A key lesson from history is that most irrigation-based civilizations fail. As we enter the third millennium A.D., the question is: Will ours be any different?"

Today, irrigation problems are widespread in the grain-growing regions of central and northern China, northwest and southern India, parts of Pakistan, much of the western United States, North Africa, the Middle East, and the Arabian Peninsula.

Water tables are dropping steadily in several major food-producing regions as groundwater is pumped faster than nature replenishes it. The world's farmers are racking up an annual water deficit of some 160 billion cubic meters -- the amount used to produce nearly 10 percent of the world's grain. The overpumping of groundwater cannot continue indefinitely. Eventually the wells run dry, or it becomes too expensive to pump from greater depths.

Meanwhile, the amount of irrigated land per person is shrinking. It has dropped 5 percent since its peak in 1978, and will continue to fall. And one in five hectares of irrigated land is damaged by salt -- the silent scourge that played a role in the decline of ancient Mesopotamian societies.

So much water is being diverted for irrigation and other human uses that many major rivers now run dry for large portions of the year, including the Yellow in China, the Indus in Pakistan, the Ganges in South Asia, and the Colorado in the American Southwest. The Yellow River, the cradle of Chinese civilization, ran dry for a record period in 1997, failing to reach the sea for 226 days.

With population growing rapidly in many of the most water-short regions, water problems are bound to worsen. The number of people living in water-stressed countries is projected to climb from 470 million today to 3 billion by 2025. Already many countries do not have enough water to meet domestic demands for food, creating a source of potential political instability.

Water-short countries are increasingly turning to the world grain market. In the swathe of countries from Morocco across North Africa and the Middle East to Iran, virtually every nation is facing water shortages as rising populations draw against a limited supply and as irrigation water is diverted to satisfy growing urban demand. To meet their food needs, these countries are importing grain. Importing a ton of wheat is the equivalent of importing 1,000 tons of water.

Jordan is already importing some 91 percent of its grain, Israel 87 percent, Libya 85 percent, Saudi Arabia 50 percent, and Egypt 40 percent.

"As water shortages continue to mount, it is dangerous to presume, as many officials do, that there will be enough exportable grain to meet the import needs of all these countries at a price they can afford," says Postel. "Most of the growth in water-stressed populations will be in South Asia and sub-Saharan Africa, where the majority of the world's poor and malnourished are today."

In five of the world's hot spots of water dispute -- the Aral Sea region, the Ganges, the Jordan, the Nile, and the Tigris-Euphrates -- the population of the nations within each basin is projected to climb between 44 and 75 percent by 2025.

Some 260 rivers flow through two or more countries, but in most cases there is no treaty among all the parties that sets out how that river water should be shared. In the absence of water-sharing agreements, tensions are bound to rise.

Irrigation's heavy water demands are also damaging the health of the aquatic environment -- shrinking wetlands, reducing fish populations, and pushing species toward extinction. "Using water as inefficiently as we do today, meeting the food demands of the projected 8 billion people in 2030 would result in costly losses of ecological services that the economy depends upon," Postel says.

To meet the challenges of a water-short world, Postel proposes a "Blue Revolution" to dramatically boost water productivity. "Most farmers today irrigate the way their predecessors did hundreds of years ago,"

says Postel. "Just as raising land productivity helped meet food needs during the last half of this century, boosting water productivity will be the agricultural frontier during the next century. The challenge today is to substitute technology and better management for water."

Postel describes a diverse and creative mix of "Blue Revolution" strategies:

- Farmers in countries as diverse as India, Israel, Jordan, Spain and the United States have cut their water use by 30 to 70 percent and raised crop yields by 20 to 90 percent by using drip irrigation systems that deliver water directly to crop roots.
- In the Texas High Plains, farmers using highly efficient sprinklers raised their water efficiency to more than 90 percent while simultaneously increasing corn yields by 10 percent and cotton yields by 15 percent.
- Rice farmers in Malaysia saw a 45 percent increase in their water productivity through a combination of better scheduling their irrigations, shoring up canals, and sowing seeds directly in the field rather than transplanting seedlings.
- Israel is now reusing 65 percent of its domestic wastewater for crop production, freeing up additional freshwater for households and industries.

Postel shows that a special effort is needed to lift the water productivity of millions of very poor farmers who cannot afford some of the more advanced technological solutions. "Helping small-scale farm families raise their incomes and improve their food security can be a powerful engine of economic growth in the world's poorest regions," she says.

In Bangladesh, farmers have purchased 1.2 million treadle pumps, a human-powered device which to an affluent Westerner looks remarkably like a Stairmaster exercise machine. These pumps cost $35, but typically return more than $100 in the first year of operation. In Kenya, Chad, Zambia and India, farmers are combining indigenous water-management techniques with inexpensive new technologies like low-cost sprinklers, bucket-drip systems, small-scale pumps, and check dams.

For the "Blue Revolution" to succeed, Postel says, it is up to governments and water authorities to adopt new rules of the game for irrigation. Government subsidies totaling at least $33 billion a year make it cheaper to waste water than to conserve it. Legal barriers often make it difficult for farmers to sell any water they save through conservation practices. And the failure to regulate groundwater overpumping leaves the world vulnerable to sudden cutbacks in food production as water tables drop to greater and greater depths.