Will There Be Enough Water to Produce Food for a Growing Population?

By 2025, scientists estimate that the world population will have increased from 6 billion in 1999 to 8 billion, or approximately double what it was in 1974. To keep pace with the growing population, the United Nations Food and Agricultural Organization predicts that food production will have to double by 2025, and so will the amount of water consumed by food crops. Will the supply of freshwater be able to meet this increased demand or will water supply limit global food production?

Growing crops consume water through transpiration (loss of water from leaves as part of the photosynthetic process) and evaporation from plant and soil surfaces. The volume of water consumed by crops worldwide—including rainwater and irrigated water—is estimated at 3,200 billion m^3 per year. An almost equal amount of water is used by other plants in and near agricultural fields; thus, it takes 7,500 billion m^3 per year of water to supply globally crop ecosystems. Grazing and pasture land account for another 5,800 billion m^3 and evaporation from irrigated water another 500 billion m^3 for a total of 13,800 billion m^3 of water per year for food production, or 20% of the water evaporated and transpired worldwide. By 2025, therefore, humans will be appropriating almost half of all the water available to life on land for growing food for their own use. Where will the additional water come from?

Although the amount of rainwater cannot be increased, it can be more efficiently used through farming methods such as terracing, mulching, and contouring. Forty percent of the global food harvest now comes from irrigated land, and some scientists estimate that the volume of irrigated water available to crops will have to triple by 2025—a volume equal to that of 24 Nile Rivers or 110 Colorado Rivers.[2] A significant saving of water can, therefore, come from more efficient irrigation methods, such as improved sprinkler systems, drip irrigation, night irrigation, and surge flow.

Additional water could be diverted from other uses to irrigation. But this may not be as easy as it sounds because of competing needs for water. For example, if water were provided to the 1 billion people in the world who currently lack drinking and household water, less would be available for growing crops. And, the new billions of people to be added to the world population in the next decades will also need water. Already, humans use 54% of the world's runoff and increasing this to more than 70%, as will be required to feed the growing population, may result in loss of freshwater ecosystems, decline in world fisheries, and extinction of aquatic species.

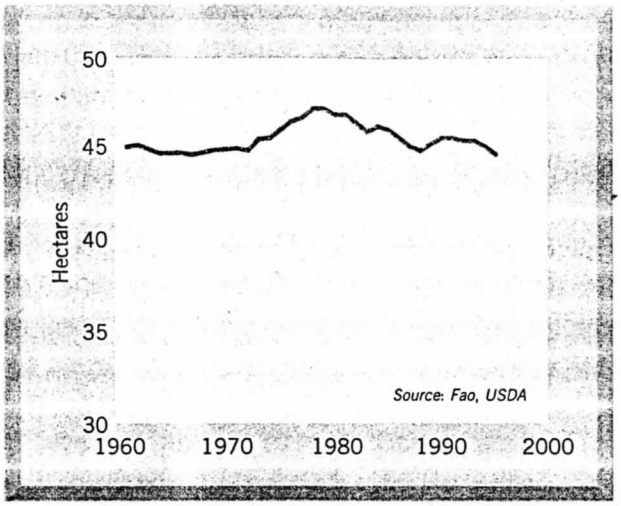
Irrigation projects are costly to construct and fewer sites than in the past are now available that are acceptable ecologically and socially. As a result, irrigation has been growing slower than population in recent years. If this trend continues, the irrigation gap will become even larger. Irrigation has also been responsible for salinization of agricultural areas, which makes them less suitable for growing crops and requires more water to flush the salts from the soil. In many places, groundwater and aquifers are being used faster than they are replaced—a process that is unsustainable in the long run. Many rivers are already so heavily used that they release little or no water to the ocean. These include the Ganges and most other rivers in India, the Huang He (Yellow River) in China, the Chao Phraya in Thailand, the Amu Dar'ya and Syr Dar'ya in the Aral Sea basin, and the Nile and Colorado Rivers.

Two hundred years ago, Thomas Malthus put forth the proposition that population grows more rapidly than the ability of the Earth to grow food and that at some time the human population will outstrip the food supply (see A Closer Look 5.1). Malthus might be surprised to know that, by applying science and technology to agriculture, food production has so far kept pace with population growth. For example, between 1950 and 1995, world population increased by 122% while grain productivity increased 141%. Since 1995, however, grain production has slowed down (see graph) and the question remains as to whether Malthus will be proven right in the next century. Will science and technology be able to solve the problem of water supply for growing food for

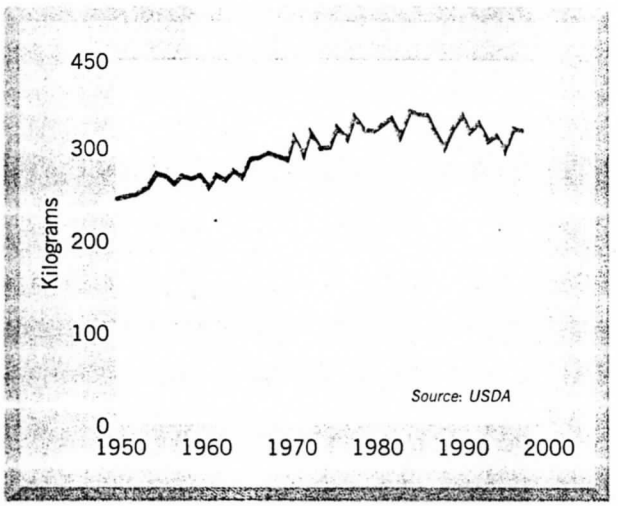
Estimated Water Requirements of Food and Forage Crops

Crop	*Liters/kg*
potatoes	500
wheat	900
alfalfa	900
sorghum	1110
corn	1400
rice	1912
soybeans	2000
broiler chicken	3500
beef	100,000*

* Includes water used to raise feed and forage. (*Source:* From Pimentel et al., 1997, p. 100.)



World irrigated area per thousand people, 1961–1995. (*Source:* From Brown et al., 1998, p. 47.)



World grain production per person, 1950–1997. (*Source:* From Brown et al., 1998. p. 29.)

people or will water prove a limiting factor in agricultural production?

Critical Thinking Questions

1. How might changes in diet in developed countries affect water availability?
2. How might global warming affect estimates of the amount of water needed to grow crops in the 21st century?
3. Why is withdrawing water from aquifers faster than the replacement rate sometimes referred to as "mining water."
4. Many countries in warm areas of the world are unable to raise enough food, such as wheat, to supply their populations. Consequently, they import wheat and other grains. How is this equivalent to importing water?
5. Malthusians are those who believe that sooner or later, unless population growth is checked, there will not be enough food for the world's people. Anti-Malthusians believe that technology will save the human race from a Malthusian fate. Analyze the issue of water supply for agriculture from both points of view.

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