FARMING FISH TO SAVE WATER

I read with interest the article by David Pimentel et al. entitled "Water Resources: Agriculture, the Environment, and Society" (*BioScience* 47: 97–106). It may seem strange, but the farming of fish is surprisingly efficient in terms of water use. When the world is trying to save fresh water and grow more and better food at the same time, this option ought to be considered.

Pond production of channel catfish (*Ictalurus punctatus*) yields an average of approximately 4200 kg/ha of fish on a feed input of 5900 kg/ha (Schwartz and Boyd 1994). Using Pimentel et al.'s figures, I calculate that it takes approximately 1.54 million liters of water to produce 1 metric ton of typical catfish food, containing 48% soybean meal and 41% cornmeal (Lovell 1989). A high estimate of water usage in pond culture of catfish in the Southeastern United States is 17.5 million liters per hectare per year, if all the water from pond draining is lost (Boyd 1995). Adding the amount of water needed for feed production and the amount lost to evaporation and seepage from, and draining of, ponds gives an estimate of 6300 liters of water per kg of channel catfish produced. In the best ponds (i.e., those with low seepage and evaporation rates), and with reuse of pond draining water for irrigation, the figure is 3350 liters per kg, less than the amount needed to produce broiler chickens according to Pimentel et al.

Another common fish production system in the United States is the flowing-water raceway. Production of trout in such systems requires approximately 600,000 liters of water per metric ton of fish per day (Stevenson 1987), and the feed has practically no grain or water consumptive components. A conservative estimate of time to market size (30–35 cm) is 14 months (Bardach et al. 1972). This translates into a water usage of 252,000 liters per kg if all the water is discarded. However, because trout raceway water can be cleaned and replaced into the watershed, the actual amount of water lost in trout production might be minimal. If 75% of the water were recycled, consumptive use would again be less than that for broiler chickens as calculated by Pimentel et al.

Tilapia (family cichlidae) culture in ponds is growing rapidly, both in the United States and elsewhere. Although growing the feed used by commercial growers requires approximately the same amount of water needed for catfish feeds, *tilapia* can take advantage of natural food webs fueled by manures and other agricultural byproducts in place of feeds for part of the production cycle (Green 1992). If the first two months of *tilapia* feed is replaced by manures and pond draining water is recycled, the amount of water needed to grow the feed and replace seepage and evaporation losses is 2800 liters per kg of *tilapia*. *Tilapia* have the added advantage of not requiring particularly fresh water. In fact, they probably do a little better if the water is a bit brackish.

Fish production, surprisingly, is therefore remarkably efficient in its consumptive use of water. As the data discussed here demonstrate, the production of fish should be considered when food security in the face of growing demand for fresh water is being discussed.

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References cited

Bardach JE, Ryther JH, McLarney WO. 1972. Aquaculture: the farming and husbandry of freshwater and marine organisms. New York: John Wiley & Sons—Interscience.

Boyd CE. 1995. Source water, soil, and water quality impacts on sustainability in aquaculture. Pages 24–33 in Sustainable aquaculture 95. Proceedings of the PACON Conference on Sustainable Aquaculture; 11–14 June 1995; Honolulu. Hawaii Chapter, Pacific Congress on Marine Science and Technology.

Green BW. 1992. Substitution of organic manure for pelleted feed in *tilapia* production. Aquaculture 101: 213–222.

Lovell T. 1989. Nutrition and feeding of fish. New York: Van Nostrand Reinhold.

Schwartz MF, Boyd CE. 1994. Effluent quality during harvest of channel catfish from watershed ponds. The Progressive Fish-Culturist 56: 25–32.

Stevenson JP. 1987. Trout farming manual. 2nd ed. Farnham (UK): Fishing News Books.