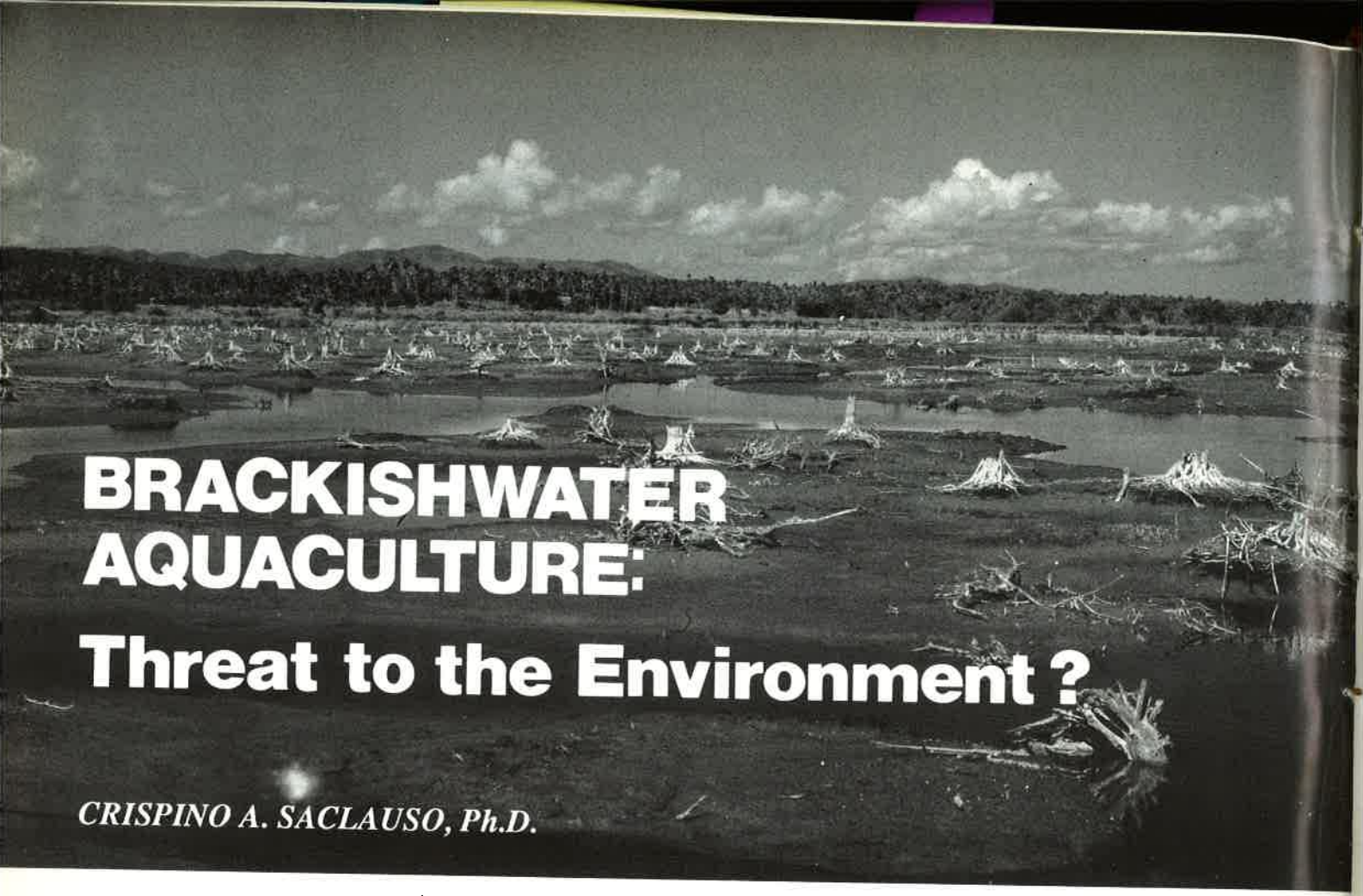

# BRACKISHWATER AQUACULTURE: Threat to the Environment?

*CRISPINO A. SACLAUSO, Ph.D.*

*A mangrove swamp newly converted into a fishpond*

Growing developing-country populations and the corresponding per capita protein requirement continually pressure both the marine and aquaculture sectors to increase. In the near future, however, the fishing sector is expected to reach its asymptote because of rising energy costs and the decline in fish stocks. A shift from marine fisheries to aquaculture is therefore forseeable. Inevitably, aquaculture activities will intensify and extend, undoubtedly with environmental implications, either direct or indirect. The following Philippines case study makes this point.

## Conversion of mangrove swamps to aquaculture

Recent statistics show that about 50% of the Philippines' mangrove forests have been developed into brackishwater fishponds. Thus, considering other users, the extent of mangrove destruction has been estimated at 322,154 ha (206,525 for aquaculture and 115,629 for other activities, e.g., saltmaking, logging, dumping of mine tailings, etc.) or 73.45% of the country's mangrove forests. While other forms of aquaculture may be carried out in mangrove swamps without necessarily destroying the stand, the likelihood of destruction is very high considering that these areas are being made available for fishpond development. The government has, in fact, earmarked an additional 35,000 ha for aquaculture by the year 2000.

## Social and human costs

In its pristine state, the mangrove swamp teems with myriad life forms - sources of sustenance for the poor human communities built around it. This otherwise common heritage of all mankind, becomes the private domain of the rich - the only social group which can afford the capital-intensive conversion of mangroves to aquaculture.

While entrepreneurs investing massive capital for fishpond development may hire local workers, including mangrove dwellers, they often bring their own trusted people. As a result, many poor people who depend on mangrove swamps for their livelihood are eventually dislocated. The picture would not be so grim if displaced mangrove dwellers were absorbed by the new industry. For instance, for 206,525 ha of brackishwater fishponds, an average of one employee to a hectare is employed, but it has not been established whether these employees are the previous occupants of the mangrove areas (Table 1).

The conversion of mangroves to aquaculture may also encroach upon other low-cost culture systems like oyster and mussel farming. Once converted into fishponds, they cease to be the nutrient sink of the contiguous coastal zone. This is aggravated by chemicals and excessive organic loads eventually released by these fishponds into the environment. Fishpond development will therefore affect, not only those who depend directly on mangrove fisheries, but also the poor families engaged in small-scale aquaculture.

## Ecological costs

The mangrove forest is an open ecosystem made up of complex interrelated parts. These components interact, not only amongst themselves, but also with other major adjoining ecosystems like seagrasses, corals and beach vegetation.

Table 1. Resumé of information on Philippine brackishwater fishponds in operation (1980-1984).

| Item | 1980 | 1981 | 1982 | 1983 | 1984 |
|---|---|---|---|---|---|
| Area (ha) | 176,230.55 | 195,831.89 | 195,831.89 | 196,269.16 | 206,525.35* |
| Investment (thousand pesos) | 1,762,3051 | 5,874,9572 | 5,874,9572 | 5,888,0753 | 6,195,7602 |
| Men employed3 | 176,230 | 195,831 | 195,831 | 196,269 | 206,525 |
| Production (tonnes) | 135,951 | 170,431 | 180,484 | 183,773 | 198,729 |
| Value (thousand pesos) | 1,386,700 | 1,874,741 | 2,184,392 | 3,122,698 | 5,116,683 |

1Based on the average development cost of ₱10,000 per hectare.
2Based on the average development cost of ₱30,000 per hectare.
3Based on the average of one employee to every hectare.
*US$1 = ₱8 in 1980; ₱20 in 1984.
Source: BFAR, 1984. Fisheries Statistics of the Philippines, 364 p.
*123,508.41 privately owned, 83,016.94 government owned

The mangrove forest is the foodbase of the complex food web of marine organisms including valuable estuarine and nearshore fisheries and ultimately, the fisherman at the top of the food web. Using this area for aquaculture destroys the sanctuary, the nursery and breeding grounds for countless terrestial and aquatic fauna and the nutrient sink that supports the fisheries of contiguous coastal zones, thereby affecting fry abundance and catch by fishermen.

It is difficult to quantify the decrease in marine fish catch attributable to mangrove destruction; but many marine fish are found as juveniles in mangrove swamps, and destroying this habitat could lead to failure in recruitment.

Without mangrove vegetation in the coastal zones, shorelines inevitably erode with tidal actions and periodic inundations. For instance, in 1976, a tidal wave in a province of Mindanao claimed lives and properties hundreds of meters from the shore. This could have been prevented had the mangrove forest protecting its coastal shores not been destoryed in pursuit of "progress".

## Recent advances in brackishwater aquaculture

While both intensive and extensive aquaculture development could increase the food production capacity of the aquatic environment, these could also bring about adverse ecological conditions if not properly guided. Mangrove die-off is not only caused by direct felling of the stand - it can also be effected by simply disconnecting the forest from adjoining systems by constructing earthen embankments.

On the other hand, intensive aquaculture, while momentarily arresting further conversion of mangroves to aquaculture, is beginning to manifest drawbacks, i.e., environmental degradation.

***Using the mangrove forest for aquaculture destroys the sanctuary and breeding grounds for countless terrestial and aquatic fauna***

### Increased stocking densities

In recent years, especially with the development of sophisticated culture systems for *P. monodon,* stocking densities previously unimaginable are now common. Extensive shrimp culture previously adopted a stocking density of 1-2 per $m^2$, but new systems now accomodate as many as 50 per $m^2$.

Needless to say, this stresses the pond environment because of metabolites deposited, excess feed (feeding is indispensible at this density) and complications arising from intense intraspecific interactions of a highly crowded shrimp population. Overcrowding results in poor growth of individuals either directly, through deterioration of water quality, or through social mechanisms which govern the overall performance of the population. Individuals weakened by stressful conditions are susceptible to parasites and disease-causing organisms which become ubiquitous in highly intensive systems where excessive organic loading provides favorable conditions for their growth.

Consider, for example, the feeding regimes in the culture of *P. monodon.* Enormous amounts of food ranging from as low as 0.972 t to as high as 19.44 t are dumped in the pond over 4-5 months. Since the estimated amount of food converted to shrimp flesh is only 20% on dry weight basis, the remaining 80% takes the forms of feces, urine and gases (carbon dioxide and ammonia). These excreta provide the major source of nutrients for both pathogenic and nonpathogenic organisms.

In addition, ponds are drained periodically, either for water replacement, preparations or for harvests. Excess material washed out with the water is exported to other systems or back to the original system (see Fig. 1). The implications to other users of the common waterways become clear. For instance, the widespread incidence of diseases in shrimp farming is attributed to pollution from excessive organic loading in intensive fishfarming. Most of the reported diseases (80%) in fishfarming are caused by protozoans.

### Use of chemicals and drugs

While the impact of chemical use in fishfarming has not been properly assessed, in due course, accumulated chemical residues will adversely affect not only the industry, but consumers as well. Most alarming is the use of chlorinated hydrocarbons which are non-biodegradable; although even chemicals which contain organophosphate as an active ingredient can also result in fish kills if not allowed to degrade in the pond before being released to adjacent areas.

The following are some chemicals and drugs reportedly used for aquaculture in

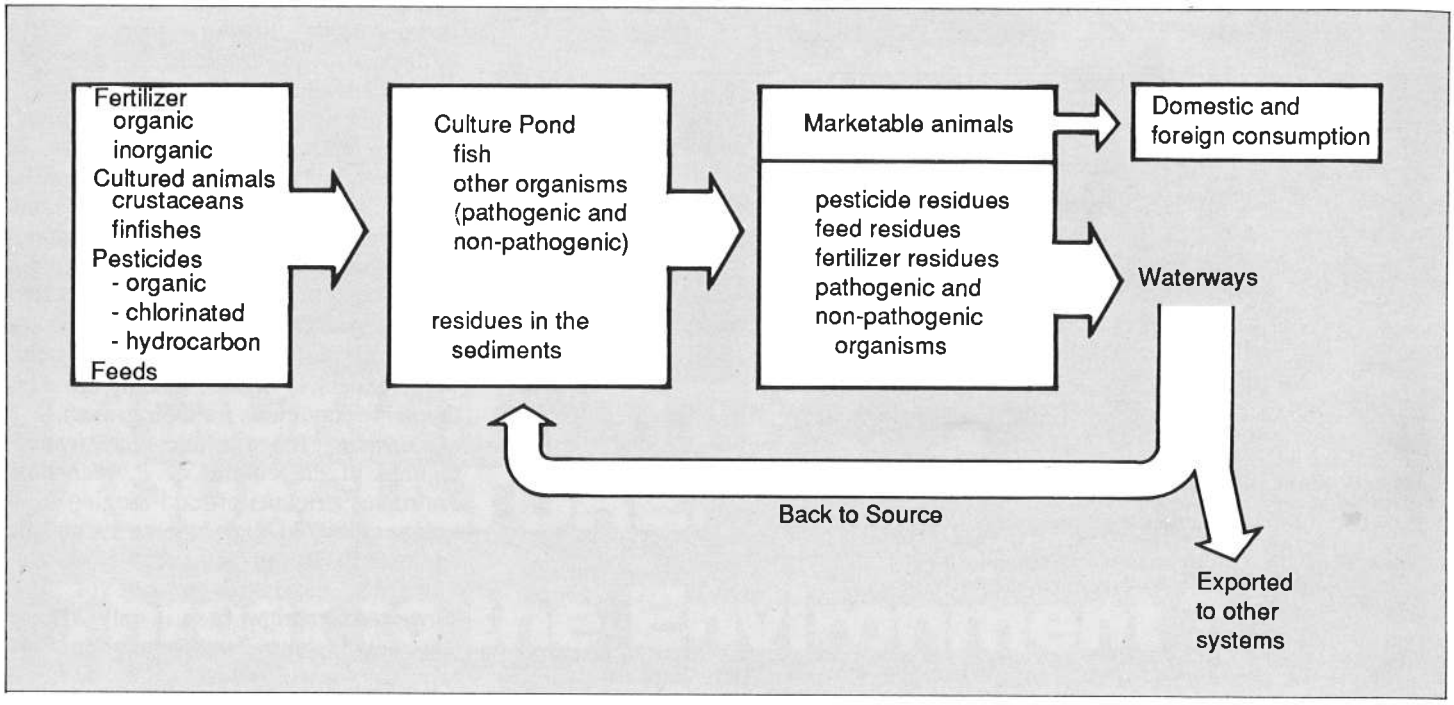


*Fig. 1. The dynamics of an intensive brackishwater pond*

***What used to be sugarlands and rice paddies are now fishfarms . . . displacing agricultural activities and the social groups who depend on them***

the Philippines:

*Daimetin* - used to purify and sanitize water (absorbs ammonia, carbon dioxide, hydrogen sulfide and other toxic pollutants that retard growth and foster diseases). Active ingredient: zeolite (volcanic mineral)

*Tan-Pax-So* - improves growth of plankton and *lablab;* complete fertilizer containing N, P, K and essential trace elements such as Ca, Mg, S, Fe and Boron.

*Hai-Chon-Por* - algaecide; organic chemical

*F.G.C. Mycin* - shrimp medicine

*Endrin* - for pests, predators and competitors

*DDT* - for pests, predators and competitors

*Gusathion* - for pests, predators and competitors

*Brestan* - for pests and predators

*Malachite green* - algaecide

*Copper sulfate* - algaecide

*Formalin*

*Potassium permanganate*

*Bromosept*

*Flourine*

**Competing use of land and water resources**

Nontraditional areas have been converted to fishponds. What used to be sugarlands and rice paddies are now fishfarms for the intensive culture of *P. monodon*, displacing agricultural activities and the social groups who depend on them.

Because farms are in nontraditional areas, competition for the use of limited waterways and groundwater arises. In Negros Island, for instance, numerous deepwells which extract tremendous volumes of groundwater sometimes affect the amount and quality of water available for domestic consumption. Other possible consequences of this excessive extraction are the caving in of land surfaces and seepage of seawater into freshwater tables.

**Recommendations**

- Governments must draw up and implement a program for environmental conservation and management and provide alternative sources of livelihood for people displaced by the conversion of mangrove forests into fishponds.
- The use of chemicals and drugs in aquaculture must be regulated by the relevant food and drug administration. Labels for chemicals and drugs must indicate their active ingredients and the public must be informed of possible hazards.
- The scientific community and the private sector must undertake collaborative studies on the environmental effects of various aquaculture activities and inputs.
- A worldwide network of cooperation and information exchange must be established for the resolution of widespread problems.

*Dr. CRISPINO A. SACLAUSO is Assistant Professor of the College of Fisheries, University of the Philippines in the Visayas (UPV), and Deputy Director of the UPV-CIDA McGill Food Systems Development Project, Iloilo, Philippines.*