

## Aquaculture

# Too great a cost

**The costs of aquaculture may far outweigh the benefits, as a cost-benefit analysis done in El Salvador suggests**

**I**n the developing world, aquaculture is a growth industry. The cultivation of shrimp and fish in tanks or excavated ponds yields high returns and earns much-needed foreign exchange. However, it is the location of these tanks and ponds that critically determines whether this is a sustainable activity, whether fragile environments are degraded or maintained and whether the net returns are the result of profit-maximizing or mere cost-shifting.

These are not rarefied questions of interest only to those pisciculturists who care about fish cultivation or to the bankers and economists who are concerned about exports and growth. Rather, it is a question of sustainability, of community rights and, ultimately, of environmental justice.

Consider the case of El Salvador, where, as in many other parts of the developing world, a substantial portion of the remaining mangroves is under threat from conversion to aquaculture. On the one hand, this represents an opportunity to generate income, to produce shrimp for export and to capitalize on the current First World penchant for this tasty delicacy.

On the other hand, the development of aquaculture contributes to the irreversible loss of a rich and diverse ecosystem that is vital to offshore and estuarine fisheries, an ecosystem that secures a collection of subsistence and industrial activities and one that hosts a multitude of irreplaceable fauna and flora. This dilemma is at the center of the development conundrum: What are the trade-offs between growth and equity? How much environmental wealth must be sacrificed to increase GDP? Who benefits and who loses?

Mangroves comprise a rich, humid ecosystem which is diverse in fauna and flora. Marine and estuarine fauna, such as crab, mussels, shellfish, shrimp and fish, are essential to coastline communities, providing them not only a source of income but also a valuable source of protein. Mangroves also provide timber and fuelwood as well as a host of other non-timber products and environmental services. Mangrove wood commands a high market value, being easily worked to make furniture and for construction purposes. For many coastal populations, it is also an important source of fuel and charcoal.

Mangroves provide security for wild and plant life, on which coastal and interior populations depend as a source of protein, skins, nuts and medicines. Mangroves also provide environmental functions, such as barrier protection, drainage and filtration, stabilizing the coastline and surrounding agricultural lands and furnishing them with natural windbreaks, fresh water and conduits.

Approximately 112,000 Salvadoran families depend directly on the 26,700 hectares of mangrove and brackish forests for their living. The conversion of mangroves to aquaculture ponds displaces the livelihoods of these families and denies them traditional access to the environmental goods and services that the mangroves provide.

**Mangrove conversion**

In addition, the conversion of mangroves for aquaculture threatens other groups whose economic interests are intimately connected to the existence of the mangroves. The mangroves secure the breeding grounds for industrial shrimp fishing, an activity which contributes to approximately 40 per cent of all

agricultural export revenues. The export of shrimp alone generated approximately 231 million colons or US\$27 million for El Salvador in 1993.

**A** little over 4,000 hectares, or almost 16 per cent, of the total remaining area of mangrove forest in El Salvador was estimated to be prime land for aquaculture. Many private investors eagerly await the opportunity to purchase land, obtain permits to clear up the mangroves, and construct ponds and tanks for shrimp cultivation.

While there are several analyses of the profits generated by such an activity, the conflicts over access rights and the true environmental costs of conversion have not been fully explored. This calls for not a mere calculation of costs and benefits, but an examination of the value society places on the environment. It is important to consider how the costs and benefits are distributed: asking who wins and who loses highlights the concentration of power and the exercise of choice.

Nominally, state legislation protects all mangrove and brackish forests. These ecosystems are state property, managed by the Forestry and Fauna Service (FFS), and subject to administration by the Director General of Natural Resources (DGNR) in the Ministry of Agriculture. The FFS has the power to authorize, control and regulate the access to, and use of, all forest

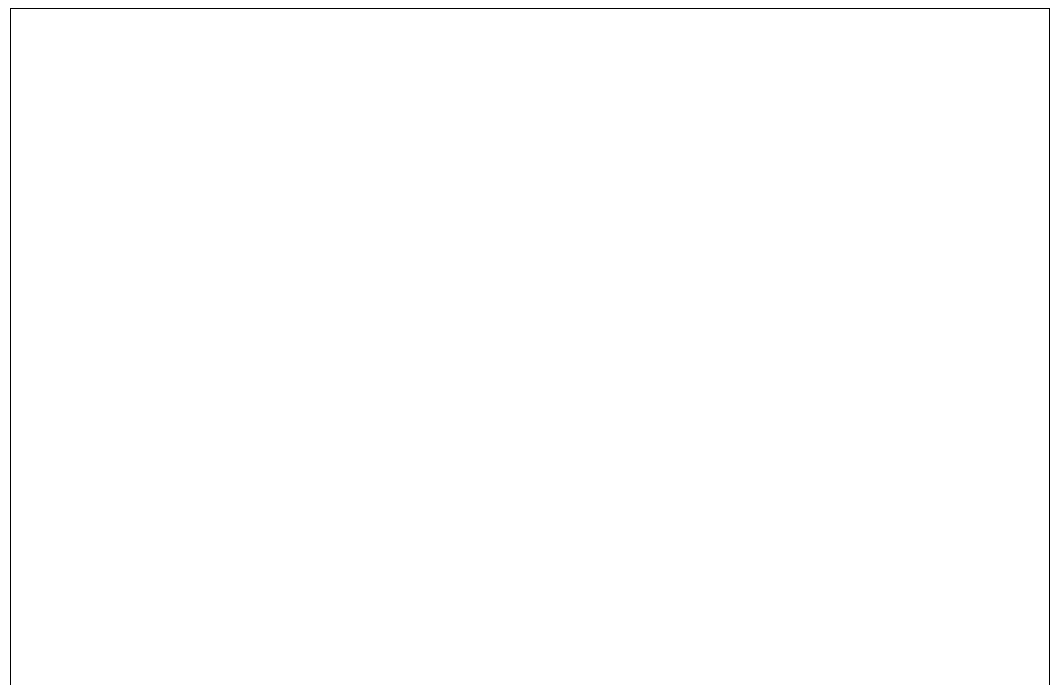
products, both timber and non-timber. The FFS is responsible for the rational management of the mangrove systems, the allocation of access rights and the overview and implementation of reforestation efforts.

Despite this, however, the DGNR has little authority to enforce regulations and is significantly under-resourced, as it has been subject to substantial downsizing under structural adjustment agreements to reduce the size and cost of government.

Before May 1992, petitions for rights to use forest land to convert to agriculture, salt or shrimp ponds were made to the FFS in the Ministry of Agriculture. This agency would review the claims, and, if approved, estimate the number of trees to be cut down, apply a stumpage fee, and levy a state tax accordingly. In a similar fashion, usufruct rights to state-owned land were also granted by the FFS, and stumpage fees levied if land use entailed the destruction or loss of tree cover.

**Stumpage fee**

The stumpage fee paid to the state was 25 centavos (less than US\$0.05 in 1992) for each mangrove tree felled. In May 1992, this rose to 2.5 colons (US\$0.29) per tree. The stumpage fee was unrelated to the replacement cost of reforestation or to the environmental damage suffered as the result of deforestation. It also remained too low to provide an effective



disincentive for illegal felling or encroachment.

**M**any aquaculture investors and timber merchants went ahead and cleared land before seeking permits to do so. Due to staff and budget constraints, the stumpage fee scheme was generally self-reporting, requiring those who had committed such an infraction to declare the extent of the mangroves cleared after the event. Occasionally, the Forestry Service was able to verify the amount of mangroves cleared, but, in general, the stumpage fees levied were not subject to effective monitoring or enforcement.

In response to extensive mangrove deforestation, a logging ban was introduced in May 1992 that forbade further clearance and forest conversion. The ban extends to all uses including fuelwood, construction and commercial trade. Licences to convert tracts of forest to agriculture, shrimp ponds or salt flats have been temporarily suspended.

However, the logging and clearance ban applies only to trees which are still being serviced by the tides. If it is possible to establish that the tides no longer service an area of mangrove, an application can be made to remove the remaining mangrove trees. There is no preclusion for the strategic construction of barriers that may temporarily starve existing

mangroves of tidal waters and enable the applicant to qualify for land conversion rights.

In part because of the inability to enforce existing legislation, and in part because of initiatives to expand aquaculture and promote investment in export-oriented activities, mangrove conversion continues. It is often assumed that the most profitable decisions are taken and El Salvador can only benefit from the conversion of mangroves for aquaculture. While planners and policymakers like to believe that rational decisions are made about the allocation and use of all goods and services, reality tends to belie that assumption,

Ask an artisanal fisher in El Salvador whether the benefits from the conversion of mangrove forests to aquaculture ponds outweigh the costs, and the reply would probably be, "Most certainly not." A similar reply would most likely come from fishers elsewhere in the world. But ask an aquaculturist and he would probably reply that it depends acutely on how the ponds are managed and the intensity of the activity. Ask an investor in aquaculture and he would most likely reply that he neither knows nor cares.

#### **Bottom lines**

This is because investors are concerned about their bottom lines—the profits that they reap—and as long as they do not bear

the costs of environmental degradation, and are not forced to compensate those who have lost livelihoods, and as long as their profits are not compromised, they have no reason to be concerned.

To answer the question of whether benefits outweigh costs, a group of economists, socio-biologists and artisanal fishers decided to calculate the costs and benefits from aquaculture. We chose a site in western El Salvador in the Department of La Union in the Gulf of Fonseca.

The idea was simple- We would calculate the value of the forest assuming that it is deforested at current rates, and the value of all the benefits that it would secure if it were to remain the same size and not converted. We would compare these values with those in which all the land potentially available for conversion to aquaculture was excavated to form shrimp ponds.

These three different scenarios were labelled: the current management strategy; the partial conversion strategy; and the sustainable management strategy. We would account for all the costs and benefits, the loss of fuelwood and timber, the loss of fish in the estuaries and at sea, and compare these to the benefits generated by selling a high value-added product which earns foreign exchange.

The approach we chose synthesized qualitative and quantitative methods, using rapid rural and participatory appraisal techniques and survey instruments to gather information.

We constructed a household survey to develop estimates of the demand for timber and fuelwood and the use of other forest products such as herbs, spices, mammals and crustacea. We undertook a fishing survey to estimate the returns from marine and estuarine fishing activities,

These data were added to Ministry of Agriculture's data on industrial and artisanal fisheries. We surveyed shrimp, farms and collected data on yields, shrimp larvae production, costs of operation and profits. We gathered data on the price of fuelwood and timber. All this information was combined to develop a measure of the value of the mangroves over time, taking

account of their different growth and regeneration rates.

The data was used to estimate the importance of mangroves for marine fisheries. Since mangroves provide the breeding grounds for many marine and estuarine fish, the total production of fish is intimately related to the extent and density of the mangrove areas.

Using multiple regression techniques, we demonstrated that the size of the artisanal and industrial catch was a function of the total extension of mangroves. This allowed us to monetize the fisheries production that the mangroves supported.

A group of local community members, fishers, NGOs and forestry service employees helped design the hypothetical sustainable management option. A harvesting scheme was developed that would enable fuelwood and timber to be harvested by the local community. A compensation scheme was devised to incorporate local fuelwood traders into the management of the mangroves to ensure that illegal deforestation did not continue.

Each household was expected to purchase an improved fuelwood or propane gas stove using a soft loan facility operated by the management committee and financed from income collected by the Ministry of Agriculture for industrial drag-net trawling violations.

Since costs and benefits occur over time, they must be discounted to reflect a single value that has meaning at one point in time. A dollar today is not the same as one dollar tomorrow. Therefore, all figures were discounted by the real rate of interest on long-term government bonds, 7.08 per cent, so as to express them in terms of current values.

#### **Costs and benefits**

After all costs and benefits were accounted for, both for the conversion option and for the sustainable management option, we were able to compare the net benefits (benefits minus costs) and answer the question: do the final benefits from aquaculture outweigh the costs?

Table: Net Present Value of the Different Scenarios from 1994 to 2050 at Current Market Prices (Thousands of 1992 colons)

Mangrove Management Options	Net Present Value in Thousands of Colons
<b>Current Management Strategy</b>	
Fuelwood and timber	17,552
Artisanal shrimp and fish	718,608
Industrial shrimp	859,236
Rustic salt and shrimp	3,275
<b>Total</b>	<b>1,598,671</b>
<b>Partial Mangrove Conversion</b>	
Clearance logging	55,445
Fuelwood and timber	10,010
Artisanal shrimp and fish	700,981
Industrial shrimp	724,514
Shrimp ponds	105,721
<b>Total</b>	<b>1,596,671</b>
<b>Sustainable Management Strategy</b>	
Fuelwood and timber	23,809
Artisanal shrimp and fish	761,652
Industrial shrimp	1,444,080
Rustic salt and shrimp	3,275
<b>Total</b>	<b>2,232,816</b>

We are able to conclude that the net present value of the sustainable management strategy exceeds that of the other two management options. The net present value of benefits reaped under sustainable management exceeds that generated under partial mangrove conversion by US\$ 73,120,115 (in 1992, \$1=8.7 colons).

If the period for which these benefits were calculated was longer, say 100 years instead of 56, the benefits from the sustainable management option would far exceed those from the other proposed management strategies.

In this light it would seem that conversion of mangrove areas to aquaculture farms needs to be reconsidered. Evidently, mangroves need not be deforested to cultivate shrimp.

There are alternatives for the design and operation of aquaculture ponds that do not degrade the environment, displace artisanal fishers and cause the irrevocable loss of biodiversity.

There are other means of assigning access rights to the mangroves and allowing for the continued, yet sustainable, use of these forests. Concerns about environmental justice and sustainability should guide our choices about all decisions to transform, degrade or utilize natural environments.

The chorus of investors and exporters who champion growth at the expense of equity and short-term profits at the expense of biodiversity must not drown the voices of communities whose livelihoods are lost nor the voices of those who value the continued existence of mangroves.

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