

## 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

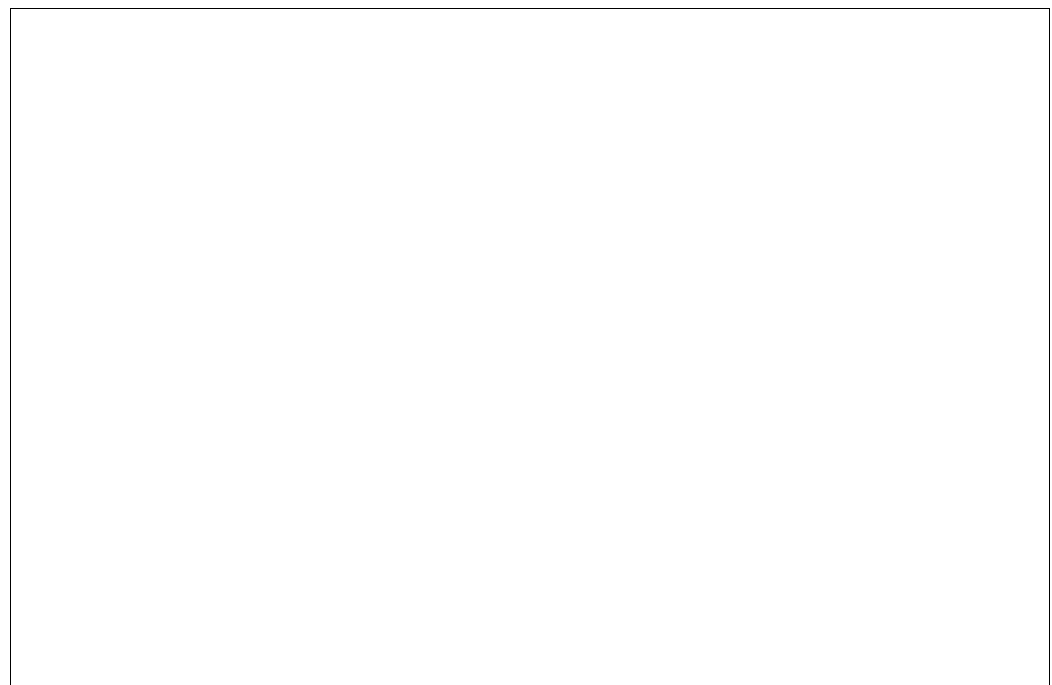
products, both timber and non-timber. The FFS is responsible for the rational management of the mangrove systems, the allocation of access rights and the overview and implementation of reforestation efforts.

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.

This article is written by Sarah Gammage, an economist with the International Centre for Research on Women, Washington DC.

## The tattered net of statistics

**Data is often gender-blind, as in El Salvador, but there are several policy benefits in making women's roles more visible**

**F**rom anecdotal evidence, casual observation and ethnographic studies, it is obvious that women are an indivisible part of the artisanal and industrial fishing economy. Yet researchers consistently underestimate the role women play in harvesting fish, in generating household and national income from fishing activities, and in providing labour to the fish processing industry that ultimately enables economies to earn much-needed foreign exchange.

This is lately because quantitative survey instruments fail to capture the gender diversity of the fishing economy, and systematically introduce biases that underestimate the role women play in the fishing economy. As a result, women's contributions remain unrecognized and policymakers fail to take account of women's roles in environmental and development planning.

A cursory examination of the official statistics for El Salvador reveals that very few women fish. The 1990 Fishing Census by the Ministry of Agriculture identifies a little over six per cent of all fishers in El Salvador and almost nine per cent in the department of La Union to be women. Yet, observing the daily activities of fishers and the pattern of household involvement in fish production and processing in El Salvador and much of Central America, this figure differs markedly.

In El Tamarindo, La Union, El Salvador, the economic and subsistence activities of the fishing households have gone on, largely unaffected by the turbulence of the civil war and the insecurities of the reconstruction period after the 1992 peace accords. Men and women continue to fish in exactly the same way as they have for hundreds of years, in wooden kayaks with

nets and paddles. The differences are that now some have motors and others have fibreglass boats.

While men fish in the open seas, the majority of female fishers confine their activities to the estuaries and shore line, catching a range of freshwater and marine fish, crustaceans and mollusc. A few women also fish in the open sea, accompanying other members of their families, to catch shrimp in the coastal waters of Usulutn, La Union and the Gulf of Fonseca.

Women are disproportionately involved in cleaning, eviscerating and processing the catch. They prepare and dry fish for sale in local and regional markets; they contribute to the value added of shrimp exports, deheading and packing the shrimp in ice; and they gather shellfish and crab in the estuaries, providing essential nutrients and proteins to supplement the family diet of corn and beans.

A quantitative survey of 110 mangrove households and 489 individuals was undertaken in 1993 and 1994 in El Tamarindo. The purpose of the survey was to document the nature and extent of the relationship men and women had with the resource base. To capture information about seasonal variation in fishing and agricultural activities, the survey was undertaken during both the wet and dry seasons.

### **Primary occupation**

It revealed that 50 per cent of men in El Tamarindo fished as their primary occupation. A further three per cent were involved in fish processing and marketing. However, only one woman declared herself to be a fisher, and only six per cent stated that they were actively

involved in fish processing and marketing. The majority of female respondents defined their occupation to be 'housewife', and did not perceive their fishing activities to shape their occupational identity.

**Y**et, the household consumption and expenditure data revealed that almost 29 per cent of the women in El Tamarindo earned an income. At first glance, this appeared to be contradictory. How could we reconcile the women's economic activities with their stated occupations? In search of more data about how these women earned their income, we added a time allocation questionnaire to the survey. This consisted of detailed questions about how all members of the household spent their days, breaking down the array of household and market activities into their component tasks. Using the additional data, we were able to determine that almost 26 per cent of women fished either in the estuary or close to the shore line; approximately 60 per cent cleaned the fish and processed the catch; 33 per cent mended the nets, along with other household members; 42 per cent cleaned the boats and helped their husbands haul the catch in from the beach; and 17 per cent sold the produce in local markets, restaurants or bars.

If both men and women fish, and are equally visible in the fishing economy of

El Tamarindo, why then do the official statistics state that only nine per cent of all fishers in La Union are women? Perhaps the answer lies in the use of survey and census questionnaires that are too rigid in their definition of what constitutes a fisher, too inflexible in their precoded responses, and too gender-blind to seek out both male and female respondents.

The majority of survey instruments are precoded. The expected responses to the questions are laid out as a range of potential answers, so that the enumerator only has to check off the correct category. This offers very little flexibility and precious little time to delve deeper into the subtleties of the responses.

In most questionnaires, to qualify as a fisher, the respondent must: fish regularly for an extended period of time; concentrate his/her activities in the open sea; and demonstrate the possession of (or access to) fishing capital, such as a boat, nets, and a motor. Since the questionnaires are structured to capture this information, they may filter out those who fish sporadically, without capital and close to the shore line or in the estuaries. The individuals who are excluded in this fashion tend to be women.

#### **Questionnaires faulty**

Another reason why women are consistently not identified as fishers is because many questionnaires are directed

at a single household head, the principal breadwinner in the family. The survey usually requires the respondent to identify himself or herself as a household head and state an income that sustains the majority of the household expenditure.

**A**lmost 80 per cent of women in El Tamarindo did not declare themselves to be household heads, although they were subsequently found to be significant decision-makers in the household and to contribute consistently by providing much-needed family income. Unless women are actively sought out as survey respondents, much of the information concerning their lives, their activities and their roles in the household economy will not be revealed.

Typically, surveys directed solely at the 'household head' fail to document or value the activities of other household members, regardless of their gender. This is particularly important for policymakers concerned with the extraction of fisheries resources, or conservationists who would like to harness the skills of all individuals whose livelihoods depend on their environment, to ensure its protection.

If there is any genuine concern about poverty and income inequality, it is also important to realize that a failure to understand the nature of each individual's contribution to household survival, and the constraints faced in generating income, may result in the inappropriate application of transfers or the wrong targeting of those facing economic scarcity. Where households depend on fragile ecosystems, poverty can prove an overriding constraint that limits all individuals' ability to change their resource use and adopt more sustainable practices.

As women are not recognized as fishers, they do not have access to the financial and physical resources and extension services they need to improve their productivity and increase their incomes. Moreover, their ability to undertake resource conservation, to fish sustainably, or switch the focus of their fishing activities may be severely limited by their lack of fishing capital. Women's lack of access to fishing capital, credit and extension services is thrown into sharp

contrast when we compare their experience with that of male fishers.

According to the survey, the majority of men in El Tamarindo earned more than women, although the women worked longer hours and undertook both market and household activities. On average, men earned US\$ 72.29 and women US\$ 29.19 a week. Men were disproportionately able to offer fishing capital (boats, nets and motors) as collateral and, therefore, had better access to credit. This enabled them to overcome cash shortages and make investments in upgrading technologies, or switching to different modes of extraction and different fisheries.

Approximately 70 per cent of those individuals who had obtained formal credit from a bank or agency had secured the loan by offering the boat and motor as collateral. The majority of these loans were used to purchase new equipment and to upgrade or repair the boats, nets and motors that they already owned. The recipients of such loans were all men.

Only one woman, a household head whose husband had left her and who fished with her sons, declared the boat and all the fishing capital to be hers. The majority of the remaining women who fished, or collected molluscs and crustaceans in the estuary, used tackle and capital that they did not own, which were loaned to them temporarily by male family members.

Due to their inability to access credit with which to purchase fishing capital and improve productivity, the women's incomes are substantially lower than those of men. This is because they are dependent on a particular set of coastal resources that have a lower market value. Furthermore, without fishing capital, they are unable to switch to offshore fisheries that yield higher returns and can be fished more sustainably.

#### **Limited access**

The majority of women who fished did so in the estuary or close to the shoreline. The women were confined to a resource base by their limited access to capital and by the time constraints they faced balancing their productive activities with their household



tasks. They fished for resources that were increasingly scarce, or contaminated from pesticide run-off and siltation.

**T**he establishment of shrimp farms and salt ponds in the mangroves had encroached upon their fisheries and destroyed many of the breeding grounds for molluscs and crustaceans. Increasingly, the resource base on which they depended was being threatened, and more women were competing for limited resources. As a result, the resources were being depleted too rapidly and extracted unsustainably.

Since women are less visible as fishers, they are also less likely to receive extension services that furnish them with the required knowledge and inputs to change cultural practices and extraction patterns. None of the women who fished in El Tamarindo had ever received a visit from the fishing service of the agricultural ministry, or been invited to a local meeting to discuss fisheries resources. While the number of visits by fisheries extension agents of the Ministry of Fishing was extremely low for all fishers, many of the male fishers had met with the local representative and regularly registered their catch with the fisheries census monitor.

Without access to such knowledge and information, combined with their lack of fishing capital, the women of El

Tamarindo were unable to switch to different fisheries and to halt their unsustainable extraction of estuarine resources.

This invisibility of women means that their rights are more likely to go unrecognized. Local legal, economic and political institutions determine the allocation of common property and the use to which that property may be put. In societies where women depend disproportionately on the commons, such institutions determine the nature and scale of women's production activities and their degree of environmental dependence.

In El Tamarindo, the consensus was that estuary fishing had become unsustainable and was threatening offshore fisheries by depleting breeding grounds and undermining a source of nutrients for marine fish. Recognizing local opinion and the Ministry of Agriculture's concerns, the community leaders imposed an informal ban on estuary fishing.

#### **Poor institutions**

Consequently, women's access rights were not preserved and a vital source of household protein lost, while women's income-earning activities were displaced. Although the institutions that allocate access rights may not be appropriately structured to enable women to conserve the commons, they may not be immutable.

In several villages in Mozambique's Inhaca Island, for example, women who traditionally fished the estuarine resources of one large mangrove ecosystem institutionalized the customary allocation of resource rights. Women began by limiting the number of fishers in the inter-tidal zone. Each inter-tidal area was delimited and assigned to an individual village or group of houses in such a way as to ensure that the number of fishers was in proportion to the size of the resource base.


By pressuring the community institutions that guaranteed resource rights, the women were able to secure their individual economic needs by clearly designating and enforcing property relations. The women carefully defined who had access to particular inter-tidal areas, prevented encroachments by outsiders and limited fishing for particular species to specific periods. In this way, they were able to gain the full benefits of conservation efforts, while continuing to meet their subsistence requirements.

In noting the contributions women make to the fishing economy, the evidence from El Tamarindo is not isolated. Yet, on the whole, the body of knowledge on women's fishing activities remains extremely small. Without a doubt, the role that women play as fishers supports households and generates income in many developing countries. In Pangasinan and Bataan in the Philippines, women generate, respectively, almost 34 per cent and 25 per cent of total household income from their primary fishing activity in the estuaries and lagoons. Cumulatively, they dedicate a little over 10 months of the year to these activities.

However, such examples of the careful documentation and quantification of women's economic activities in the fishing sector are rare. As a result, policymakers have little information about women's roles and contributions. Conservation and development policies may, therefore, be inappropriately designed.

As the data from El Tamarindo shows, the effective revision of survey instruments to include the full range of activities that women perform in the fishing economy is

a prerequisite to enabling social and political institutions to respond appropriately and ensure the sustainable use of fisheries resources. Researchers should judiciously use qualitative and quantitative methods to gather information about fishing populations. In this way, policymakers can be better informed about the needs of women fishers and be better able to channel resources to support changes in resource use and extraction.

Fishing data need not be gender-blind. By overcoming the systematic exclusion of women from statistical surveys and reports, women may become more visible and their activities more prominent. Furthermore, attempts to change resource use, generate alternative income-earning opportunities for fishers and relieve resource dependency will become more focused and more targeted once they are informed by rigorous qualitative and quantitative data that describe the multiplicity of women's roles in the fishing economy. 

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