

Social and Economic Issues in Aquaculture Development for Coastal Communities of Tabasco, Mexico

Eunice Perez Sanchez, James F. Muir and Lindsay G. Ross
Institute of Aquaculture, University of Stirling, FK9 4LA, Scotland, UK

Following an assessment of Mexican water resources by governmental agencies in the late 1940's, Tabasco State was identified as a potential area for aquaculture development, as the State holds 30% of National water resources and an important share of Southeast Mexican fisheries, particularly for oyster production. However, conflicts and competition for coastal resources between the expanding oil industry and fishing communities are escalating, with consequences including severe environmental degradation. Though a number of aquaculture-linked development initiatives have been promoted, evidence suggests that issues of social benefit, integrated development and livelihood enhancement are poorly understood. This paper reports the findings of preliminary social and economic surveys of coastal communities engaged in aquaculture operations, and suggests that current approaches are unlikely to deliver benefit effectively as key issues have not been addressed. Preliminary recommendations are made based on trends and issues of particular importance to coastal communities, to improve livelihoods through better access to resources and infrastructure.

Keywords: Aquaculture, socio-economics, development, Mexico, extension and research

1. INTRODUCTION

The coastal resources of Tabasco, Mexico cover an area of 11,800 km² of continental shelf, 29,800 ha of estuaries and 40 km² of mangrove forest providing a livelihood for more than 5,000 fishermen.

The National Fisheries Law exclusively entitles those Mexican citizens associated with fishing co-operatives to extract oyster, shrimp, lobster, scallop and abalone from National inland and coastal waters (Cano 1986; Arriaga & Rangel 1988). However, this no longer applies for coastal communities as the population has increased and more people, who do not necessarily belong to co-operative associations, now find a livelihood in fishing practices.

Tabasco State has an important share of Southeast Mexican fisheries, particularly for oyster production. However, conflicts and competition for coastal resources are escalating, particularly between the expanding oil industry and local communities, with consequences of severe environmental degradation (Calzada, 1997).

The oyster fishery represents about 30% of the National shellfish production. It is based on one species, the American oyster *Crassostrea virginica* (SEMARNAP 1998). It is extracted and cultured in 9.3% of Tabasco's estuary area by twelve fishing co-operatives.

Though a number of initiatives have been proposed for the support and development of these areas, the social and economic characteristics of the coastal communities have not been described. Little has been explored of the livelihood characteristics and potential options, the opportunities for social benefit, the potential for integrated resources development (REDIMAR, 1996).

This paper attempts to address the social and economic features of coastal communities engaged in aquaculture operations, with particular respect to surveys carried out in the Mecoacan estuary (Fig. 1).

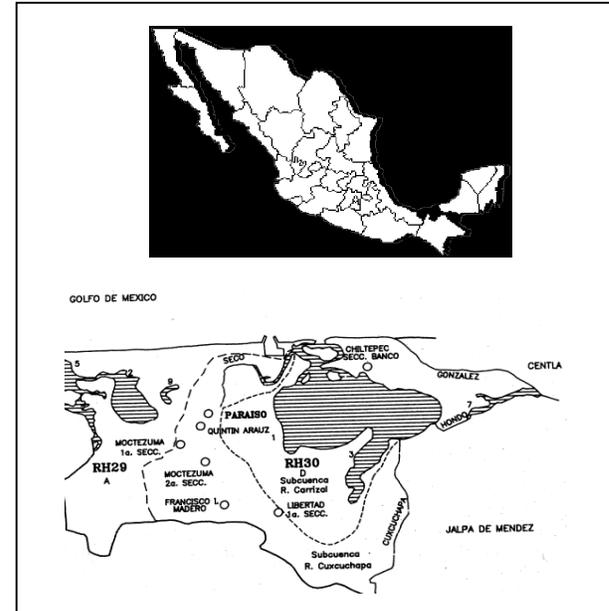


Figure 1. The Study Area

Fishing communities in Mecoacan were selected as they constitute the first fisheries co-operatives established in Tabasco and since the 1940s have accumulated a great deal of experience in managing oyster fisheries (Arredondo, *et al.* 1993). The study was designed to

compare characteristics and interactions between fishermen associated in co-operatives and free fishermen. The total number of fishermen involved in the survey was 463.

Collection of data was based on the use of rapid rural appraisal (RRA) approaches. Questionnaires and interviews were used for *ad hoc* surveys carried out on the first semester of 1999 (McCrossan 1984; McArthur 1994; Townsley 1996).

Triangulation was carried out to corroborate and compensate RRA data limitations through a series of participatory meetings. Secondary data was gathered from government agencies, non-governmental organisations and academic transcripts for geographical models generation using geographical information system (GIS) techniques.

2. THE FISHERY SECTOR

2.1 Background

The fisheries of Mecoacan area are based on estuarine and marine species. The most important are oyster *C. virginica*, crab *Callinectes spp* locally know as “jaiba”, spanish mackerel *Scomberomorus maculatus* “sierra”, king mackerel *S. cavalla* “peto”, belted bonito *Sarda sarda* “bonito”, red snapper *Lutjanus campechanus* “huachinango” and cutlassfish *Trichiurus lepturus* “cintilla”.

Oyster culture has been the major aquaculture practice in Mecoacan estuary for restocking and extensive production based on rafts systems. In the last fifteen years aquaculture has been promoted and introduced as an alternative to fishing. Extensive culture practices such as enclosures and ponds for tilapia and shrimp have been introduced with limited success through Federal and State programmes.

The Mecoacan fishery sector has been particularly affected by the adverse impacts of the oil industry and of unmanaged aquatic ecosystems and resources. Since 1985, a constant reduction of production has been recorded, particularly in coastal fisheries (Moguel 1994).

As a consequence, and due also to rising populations, and increased pressure on resources, Tabasco’s coastal zone has been a focal point of social conflicts and environmental problems. Over the last 10 years several development programs have been devised to improve fisheries production and develop aquaculture, such as shrimp and tilapia farming.

In Mecoacan, the fishing cooperatives have played an important role in the development of coastal management. In 1992, after a drop of 80% in production from natural areas and culture systems, the four fishing co-operatives of Mecoacan, represented by 538 members denounced the activities of Pemex (Petroleos Mexicanos – the national

oil industry) and asked for government intervention (Moguel, 1994).

In 1993 an agreement was signed by Mecoacan co-operatives, Pemex and government agencies to develop programs for the assessment of pollution sources, enhancement of wastewater treatment plants, reallocation of oil facilities, mangrove reforestation, and development of aquaculture projects, among other issues (Santo Tomas, 1996).

However, to date, a range of factors has held back any attempt to improve coastal communities and their fisheries, including the short length of programs, the lack of trained personnel, and prejudice and lack of co-operation with extensionists by fishing communities.

2.2 Capture fisheries

Coastal fisheries are conducted by fishermen in shallow waters close to shore, mostly within a limited distance of 2 to 3 miles. The bulk of fisheries are conducted in the Mecoacan estuary using small boats, some 23% powered by outboard engines. Fishing is operated with traditional gears, mainly hooks, lines and cast and bag nets.

Tabasco’s total share in national fishery production was 3.02% in 1996 with a total volume of 46,894 MT, valued at Pesos 230 million (US\$ 23.2 million). In 1996, 26,084 MT were produced in aquaculture systems (SEMARNAP 1996).

Added value processing is not widely practiced. The product is often sold fresh and gutted. In the case of marine fish species, and to a lesser extent for shrimp, freezing is employed. Salted, gutted and dried products are also processed.

The survey showed that local labor force is an underused resource; in particular women, who provide more than 50% of the labor in fisheries processing.

2.3 Aquaculture

National and State Fisheries Programs have widely recognized Tabasco as a potential region for aquaculture development due to its vast water resources. Nationally, a greater contribution is expected from aquaculture to support and ensure food supplies for domestic consumption and export.

However, despite the availability of water resources, only 10% of these have been used for aquaculture since the 1940s, mainly for extensive and semi-intensive operations. Production in Tabasco is focused mainly on oyster and tilapia, representing 50% of the total volume produced. These are based on wild seed capture in the case of oyster farming and subsidized seed production for tilapia (Velazquez 1994; Rodriguez 1996).

Until the 1980s the fishing and culture of oyster were regulated through user rights granted to fishing co-operatives by the Federal Fisheries Office, which distributed oyster beds and culture sites under

Government founded programs. After the fishery collapsed in 1992 due environmental impacts caused by oil spills and severe weather conditions, culture sites were gradually abandoned and the fishery became an open access resource exploited by fewer than 50% of fishermen (Arredondo *et al.* 1993; Moguel 1994).

3. FISHERY ACTIVITIES AND STRUCTURES

3.1 Fishing co-operatives and interactions

The first fishing co-operatives in Tabasco were organized in the early 1940s and established in Mecoacan estuary. Fishing licenses were granted and quotas were established by the Federal Fishery Office to extract oyster, as this was the major fishery and local fishermen did not practice marine fishing.

Structure and membership have changed over time; the co-operative located at the NE end of the estuary divided into two different associations due to management corruption, while the others have increased the number of members due to affiliation of fishermen family members. At present, there are four fishing co-operatives “Andres Garcia”, “Puente de Ostion”, Boca de los Angeles” and “Mecoacan” with 229, 54, 108 and 117 members respectively.

In the early 1990s, fishing co-operatives applied for shrimp, crab and marine fishing licenses in order to ensure their livelihood until the oyster fishery recuperated after the 1992 collapse. These new fishery arrangements allowed co-operative members to obtain more fishing gear, extend their skills, and capture a wide range of species.

These arrangements were also taken by the increasing numbers of non-members as an opportunity to extract any species available to co-operative fishermen, as they claimed to have the same rights to ensure their livelihood. The issue was not discussed with the co-operatives and there is no regulation for non-members, who capture species regardless of fishery laws, fishing season and zone.

The competition exerted by non-members is now significant, as in most of the cases they work for middlemen and brokers, locally know as “coyotes”, who provide boats and outboard engines. The financial and political power of these agents acts to increase capitalization and effort, and tends to break any social controls, which may have existed. This condition has promoted the movement of co-operative fishermen from estuary to marine fishing, not only because the resources are theoretically abundant and enforcement vessels are absent, but also because the perceived higher income results in a reduced need for participation in co-operative production.

3.2 Income sources and levels

Fishermen working in marine fisheries receive an income for their catch approximately 67% greater than estuarine fishermen (Table 1). The survey findings suggested that labor conditions enforced by middlemen and brokers are extremely poor and stressful. Even though marine fishermen receive a better income they are commonly in debt, as their operating costs are typically equal to or as much as double their total earnings

Table 1. Number of Fishers, fisheries and income levels.

Group of Respondents	Estuary fisheries	Average income*	Marine fisheries	Average income*
Co-operative:				
Andres Garcia	140	117(12.3)	70	660 (69.4)
Puente de Ostion	33	260 (27.3)	8	612 (64.4)
Boca de los Angeles	79	149 (15.6)	3	421 (44.3)
Mecoacan	92	165 (19)	16	553 (58.2)
Non-member fishermen	19	161 (16.9)	8	381 (40)
TOTAL	363	166 (17)	105	471 (49.5)

*Pesos/week (US\$ equivalent)

In most cases, the conditions described above were found to be the main reason for migration out of the State. The major migration movement of the local population is to neighboring States and to the United States.

In general, fishermen have a second or even a third job to complement their fishing income, which usually contributes the smallest income input. Agriculture represents the second important source of employment among co-operative fishermen (fig. 2). The major agriculture production activities are coconut and cocoa.

Access to other sources of employment is restricted due the requirement of skilled personnel, particularly in the oil industry and related companies.

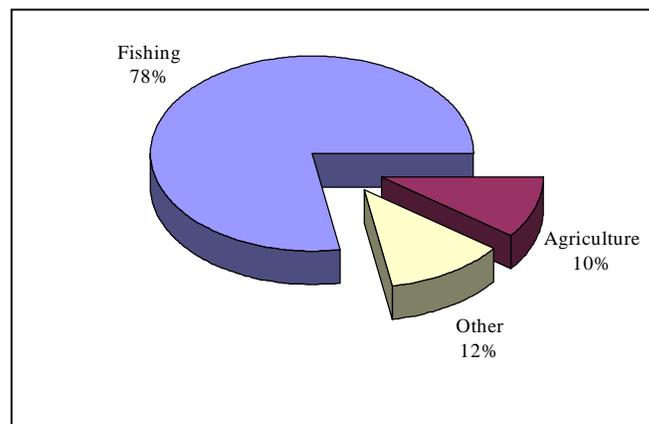


Figure 2. Employment distribution among Mecoacan fishing communities.

3.3 Role of women

Women participate as co-operative members only as long as their equivalent male relative is a member. Female membership ceases when their relative emigrates for employment or is deceased. Women's participation is restricted to Co-operative general meetings as they are not considered capable and skilled for fishing. Their practical participation is reduced to the processing of the catch, from they do not obtain a payment, as this activity is considered to be part of their family duties.

More widely, self-employment is common among women and children who sell food, oyster or other products in the community or by the road.

The survey showed that women are the group with a constant record of migration out of Mexico. They are legally hired by seafood companies to work seasonally for processing and packaging crab.

4. ENVIRONMENTAL ISSUES

4.1 Petrochemical impacts

As in many other areas, seasonal changes and local weather conditions, with the usual consequences of unpredictable resource availability and access, regularly affect marine and estuarine fisheries. However, Mecoacan fishing communities also have to face the effects on the environment caused by Pemex petrochemical plant and drilling sites located on the coastline and around the estuary.

The impacts on oyster fisheries have been profound. The accumulation of hydrocarbon compounds in sediments and the water column represents a major constraint. The threats regarding human health and therefore consumer preference have also influenced the availability of markets for Mecoacan oyster. Thus, the introduction of products in competitive markets has not been achieved because of possible heavy metal pollution caused by recent oil spills and unmanaged petrochemical wastes from PEMEX petrochemical plant (Moguel, 1994; Botello & Ponce 1998; Villanueva & Paez 1998).

4.2 Other pollution issues

A third significant source of water pollution comes from unmanaged fisheries by-products and the poor sewage network in the area. The impact of these pollution sources has not been comprehensively recorded. However, Rodriguez (1998) carried out a microbiological analysis

of oyster from a pilot farm located at the NE end of the estuary close to one of the most densely populated Ejidos (= parish). The findings showed that despite the oyster originating from a site assumed to be significantly impacted by a population settlement, these farm products were free of *Salmonella spp*, *Vibrio cholerae* and *Aeromonas spp*.

However, though such results are partially reassuring, this does not guarantee product safety, as growing populations, poor and sometimes deteriorating infrastructure, locally high waste levels, and seasonal environmental changes within the estuary may all contribute to environmental and human health risks.

5. DEVELOPMENT PROGRAMS

5.1 Background

Though many programs have been developed in the past decade, participation of communities and fishing co-operatives in the formulation and implementation of management frameworks and policies has been limited. In most cases, programs simply reflect political agenda commitments and only involve bureaucratic processes.

These programs have neither fully achieved their objectives nor have they proposed alternatives for reducing the accelerated degradation of coastal resources. The development of vertical and horizontal integration of the fishery industry is not a current or immediate management goal for co-operatives and local fisheries agencies, despite development plans which include such medium and long-term objectives (Gov. Edo. Tab. 1995). On the other hand, the characteristics of fishing culture such as self-reliance, freedom from regimentation, indifference to community affairs and marginalisation from regional development are very well established in Tabasco's coastal areas. This condition has made the application of management frameworks and the participation of local communities a very difficult task.

5.2 Aquaculture development

The case of aquaculture programs is not very different. Though some 80% of fishermen and their families are potentially capable of managing farm sites and culture technologies (Figure 2), it is rather doubtful whether aquaculture would be economically attractive to most of them, as the survey showed that they were not keen to manage aquaculture production due previous unsuccessful experiences.

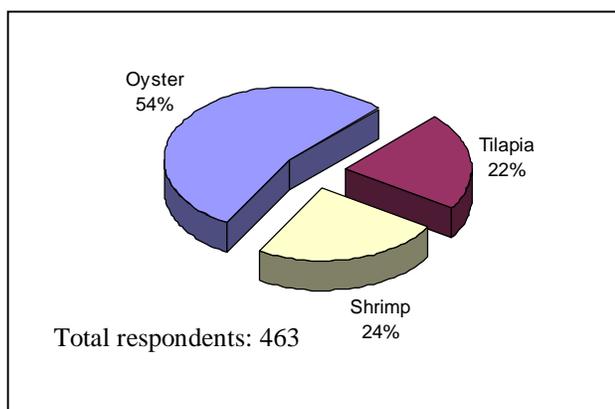


Figure 2. Distribution of Fishermen with Aquaculture Experience

However, they are aware that they may improve product availability and quality through the development of culture sites, as a few fishermen's groups are still farming oyster and tilapia with some success. However, current operations have typically low outputs of product and financial return, due the lack of technical assistance, financial aid and to poorly developed markets.

6. CONCLUSIONS AND RECOMMENDATIONS

Tabasco represents a potential region for aquaculture development due to its vast water resources. However, it appears that policies have to date been reactive to problems, rather than proactive to opportunities. Aquaculture has been introduced in order to compensate co-operatives for production losses or to provide a shorter-term source of food and income during or following adverse weather periods. Failures to achieve household income improvements through past programs can be seen to have resulted in:

- (a) Power struggles inside fishing co-operatives leading to increasingly disorganized and unregulated production
- (b) Indifference amongst members in supporting the operations of co-operatives
- (c) Lack of communication between co-operatives and Federal and State Fishery Agencies
- (d) Regulations corrupted by fishermen and officers: seasonal quotas are not observed and fines are settled unofficially between fishermen and officers
- (e) Co-operative structure dysfunction: non-member fishermen working for co-operatives with membership privileges and members working for middlemen and brokers
- (f) Mismanagement of co-operative resources: use of facilities for personal interests and business, grants of credit to family or non-members
- (g) Poor market structure and distribution channels
- (h) Diminished confidence externally concerning the

reliability and quality of fishery products

The principal elements of these programs were intended to increase employment opportunities and improve income-generating operations of fishing co-operatives. However, they have failed to increase interest in communities with registered aquaculture experiences and have reduced group organization.

It is clear that the current approaches are unlikely to benefit these communities since important social and economic issues have not been assessed or tackled. For genuine and positive change to be realized, fully integrated approaches would be required with a particular focus on community participation and organization, marketing assistance, training, stronger coordination among institutions and organizations and encouragement of entrepreneurship with emphasis on value addition in production. Income earning opportunities may also be diversified through the encouragement of development projects such as post-harvest activities, management of recreational areas, rural enterprises and cottage industries.

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