

“Pink Gold Rush:” Shrimp Aquaculture, Sustainable Development, and the Environment in Northwestern Mexico

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Introduction

In Mexico, the concept of sustainable development has become an important criterion with which to frame the future use and exploitation of the country's natural resources.² For instance, the 1995-2000 National Development Plan (*Plan Nacional de Desarrollo*)

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2. The original quote reads: frenar las tendencias de deterioro ecológico y sentar las bases para transitar hacia un desarrollo sustentable, que permita una mejor calidad de vida para todos, propicie la superación de la pobreza, y contribuya a una economía que no degrade sus bases naturales de sustentación.

includes as one of its main goals: "to stop the tendencies towards ecological deterioration in order to establish guidelines for the transition towards a sustainable development which will improve our quality of life and will contribute to eradicate poverty and promote economic development without degrading the natural resource base which will sustain such development" (Plan Nacional de Desarrollo 1995:10; my translation). The development of the shrimp aquaculture industry has now been, at least in theory, conceptualized in terms of its "sustainability." For example, it has been pointed out that the Secretariat for the Environment, Natural Resources and Fisheries (SEMARNAP) "has instructed national planning agencies and fisheries institutions to give priority to the promotion of an environmentally sound and socially equitable aquaculture" (Escutia 1997). However, the expansion of the shrimp aquaculture industry in Mexico, as a result of the new agrarian and fishing reforms, has recently raised concerns about the industry's environmental impact. These concerns echo those of other Third World countries that have already experienced the environmental and social consequences of the industry's development. Yet, a much broader theoretical issue that needs to be addressed is that the industry's development is directly associated with an export market that defines and influences the social, economic, political, and environmental impacts on human communities on the northwest coast of Mexico. The historical long-term reality of this influence predates "globalization," but it is certainly accentuated in the present.

Globalization sets up inherent conflicts and contradictions that must be unraveled. One important objective of this article is to analyze the manner in which the various legal reforms undertaken by the Mexican state during the 1990s have transformed the course of the shrimp aquaculture industry. Another objective is to elucidate how the recent expansion of the industry is contributing to the degradation of coastal ecosystems and how this affects rural communities in northwestern Mexico.

The relationships between shrimp aquaculture, state policies, and coastal ecosystems are examined within a political ecology perspective. I rely on a case study of the state of Sinaloa on the Pacific coast of northern Mexico to illustrate this dynamic³. This work will contribute to the emerging literature on the globalization of shrimp aquaculture and its social and environmental consequences in Third World countries.

This article begins with a brief discussion of a political ecology perspective in which an analysis of the roots of environmental degradation and social conflict is framed by the relationship between economic development, natural resource use, and rural coastal inhabitants in Sinaloa. An overview is presented of the evolution and current state of Sinaloa's shrimp aquaculture industry, followed by a discussion of the environmental impact of the industry upon coastal ecosystems, rural coastal communities, and their

3. This article is part of a broader research project designed to analyze the relationship between *campesinos*, natural resources and the state in southern Sinaloa Mexico. This article reports on one specific aspect of the larger research project. Ethnographic research was conducted during a 10 year period, from 1989 to 1999, in various rural coastal communities in southern Sinaloa, in the municipios of Escuinapa, El Rosario and Mazatlán. Local level data for this article was collected mainly through structured and semi structured interviews with personnel at government agencies, biologists and wage workers in shrimp farms and hatcheries, members of traditional and *ejidos* fishing cooperatives, owners of shrimp farms (representing both the social and private sectors), and residents from rural coastal communities.

residents. The last section examines the recent emergence of localized social movements resisting the expansion of the industry.

Political Ecology, Natural Resources, and Economic Development in Sinaloa

Political ecology has been defined as an interdisciplinary approach to the study of the relationships between human populations and their environment. Many scholars have incorporated a political ecology perspective into their analyses of human populations and environmental change in a variety of geographic settings (Schmink and Wood 1987; Sheridan 1988; Stonich 1993, 1995; Hershkovitz 1993; Painter and Durham 1995; Grossman 1998; Andreatta 1998; Dodds 1998). Especially relevant to this research is the emphasis given by political ecology to the link between natural resource access and allocation, the distribution of power in mediating this access and allocation, and the institutions that hold this power (Painter and Durham 1995). Stonich (1995) used a political ecology perspective to analyze the way in which the expansion of the shrimp aquaculture industry impacted the natural environment and the rural population in southern Honduras. Specifically, she used a political ecology approach “to examine the interconnections among the dominant export-led development model which emphasizes the expansion of nontraditional exports, the policies and actions of the state, the competition among various classes and interest groups, and the survival strategies of an increasingly impoverished rural population” (Stonich 1995: 145). Following her lead, I use a political ecology approach to analyze the manner in which state policies and regional politics influence the manner in which the shrimp aquaculture industry is being developed and the impact upon the local environment and people in Sinaloa. I first discuss the political economy of the two most important natural-resource-based commodities in Sinaloa: agriculture and fisheries. I then present an overview of how rural coastal households have been incorporated into the export-market economy through their participation in agriculture and fishing.

The state of Sinaloa has a long history of economic development based on the use and exploitation of its natural resources for export. Government policies have traditionally encouraged large-scale, export-oriented commercial exploitation of the state’s most important resources. This exploitation has contributed to the environmental degradation of coastal ecosystems, which has, in turn, affected the livelihood of the rural coastal population.

Sinaloa’s economy is very diverse. Currently, the state generates income from mineral resources (silver, gold, copper), agricultural and fishing-based commodities, tourism, and underground drug traffic. The bulk of the formal economy is constituted, however, by the fishing and agricultural sectors, which operate mostly for export at relatively large scales. Export commodities such as winter vegetables (tomatoes, strawberries, cucumbers, bell peppers, eggplant, and chili peppers), rice, sugar, cotton, mangoes, and shrimp have provided important financial resources for the state’s economic development.

The mecca of agricultural production lies in the irrigation districts (*distritos de riego*) of the Culiacán valley. An industrial, export-oriented agriculture was developed in the central and northern regions of the state during the 1940s as part of the Green Revolution. Government policies have been crucial in promoting intensive agricultural development by providing irrigation projects and other infrastructure needed for the processing and

commercialization of agricultural products (Wright 1990). Earnings from agriculture-industry exports belong to the local and North American private companies that control production and to the lending institutions that have provided financial assistance during Mexico's various economic crises. Although commercial agriculture is improving the state's economy, there is no doubt that it also contributes to the degradation of some of the region's natural resources. Intensive, industrial agriculture has caused soil erosion and the desertification of the land. Pesticides and fertilizers end up in many of the coastal ecosystems (Páez-Osuna et al. 1998). In coastal Sinaloa, scientific research has shown that agricultural drainage is having a detrimental impact on marine organisms in lagoons and estuaries (Ramírez 1999)⁴.

Coexisting with commercial agriculture is a subsistence agriculture, practiced by the rural population who inhabit the *ejidos* and fishing communities of Sinaloa. This seasonal, rain-fed agriculture is mostly destined for household consumption. But many *ejidos* and fishing communities have been incorporated within national and international markets precisely because of their members' participation as wage workers in the commercial agriculture sector. The reliance upon wage-labor income by a large portion of the rural population of Mexico's northwest coast has increased during this last decade. Members of many landless households, as well as of those with unproductive and infertile land, seek seasonal, short-term employment in agricultural wage labor. Migration to the valleys has become a prominent feature of Sinaloa's export-oriented agriculture. Campesinos from the highlands (*sierra*) provide the industry with needed labor during the planting season, while during the harvest season, Oaxaqueños, Michoacanos, Guerrerenses, Zacatecanos, and Duranguenses migrate to the state in search of jobs as *jornaleros* (wage laborers) (Lara Flores 1998)

There is an ideology prevalent in Sinaloa that conceptualizes the use of natural resources within an export-oriented framework. This ideology is very much linked to the role that large-scale commercial agriculture plays in the state's economy and is used to characterize the various regions of Sinaloa. This ideology has its roots in the Porfiriato, when a capitalist agro-industry emerged, fueled by capital investments of U.S. companies. The central and northern regions are thought of as being more technologically advanced because of the large-scale commercial agriculture developed there. The agricultural production is in the hands of various private companies and relies on irrigation systems, pesticides, and fertilizers. By contrast, the southern region of the state, does not have a large-scale commercial agriculture sector since most of the area has been developed by a few local wealthy families and professional elites. This ideology is also used to characterize the people who live in the state. People from the north and central region are characterized as "progressive" with an "entrepreneurial mind-set." People from the south, on the other hand, are said to be "closed-minded," "conflictive," and "against progress." These perceived differences have also given rise to a series of class struggles or "luchas de clases" over access to the use and exploitation of two of the state's most valuable natural

4. This newspaper article discusses the findings of an environmental research study designed to investigate the effects of agricultural pesticides upon organisms inhabiting in various lagoons and estuaries in Sinaloa. The research was conducted by Dr. Guillermo Galindo Reyes, a professor at the Marine Science School of the Universidad Autónoma de Sinaloa in Mazatlán.

FIGURE 1. Broom corn has recently been introduced in southern Sinaloa. People from rural communities seek seasonal employment during the harvest season.



Photo by author

FIGURE 2. Work in the chile farms as jornaleros provides rural people with short-term seasonal jobs.



Photo by author

resources: land and shrimp. Campesinos in Sinaloa have long struggled for their rights to use these resources, while government policies continue to favor their large-scale, commercial exploitation⁵.

The struggle for land has characterized much of Sinaloa's history. Indeed, many of the agrarian struggles in Mexico have taken place in this state (Bennholdt-Thomsen 1988). The struggles for control over land go as far back as the colonial period, in which the indigenous communities were dispossessed of their land. Under the slogan "the land belongs to those who work it" (*la tierra es de quien la trabaja*), thousands of landless campesinos, claiming their rights to plots of land, united to support the Mexican Revolution of 1910. The promulgation of article 27 of the Mexican Constitution in 1917 gave the Mexican state ownership of land, water, subsoil, and minerals rights, as well as providing a legal basis for agrarian reform. The massive land distributions, which took place under the presidency of General Lázaro Cárdenas, were not enough to guarantee land for many campesinos and workers (*obreros*). In Sinaloa, state policies supported the formation of ejidos and agrarian communities at the same time that these continued to favor the private-property rights of large landholders and corporations tied to the export market. As a consequence, the conflicts between the social and private sectors over the ownership of land intensified during the 1960s and 1970s, and land invasions by peasants and kidnapping and murders by others were the outcomes (Wright 1990).

The fishing industry is the other pillar of Sinaloa's economy. The state historically has been one of Mexico's primary producers, with shrimp accounting for the bulk of the yield. In Mexico, shrimp has been an important source of foreign exchange and has constituted one of the nation's top ten non-oil exports (Miller 1990). However, since 1987, overall shrimp production has declined due to climatic factors, environmental problems, and overfishing (SEMARNAP 1997).

Conflicts over the use and exploitation of fishing resources have also been part of Sinaloa's history. These conflicts, although diverse, are related to the policies entitling people organized in cooperatives to exploit the shrimp resources. Other conflicts have their roots in the export-oriented focus of the industry, the development of the *alta mar*, or offshore, sector, the type of technology used, corruption within the cooperatives and government agencies, fisheries policies, and the migratory and reproductive characteristics of shrimp.

Fishing resources played a crucial role in sustaining the various indigenous populations that settled in pre-Colombian coastal Sinaloa. The Totorames and Tahues who inhabited in southern and central Sinaloa used these as important sources of food and for economic exchange. During the colonial period, the surviving indigenous people as well as Spaniards and African slaves exploited the fishing grounds. Salted fish and shrimp were marketed to mining towns to feed the workers. Before the Revolution of 1910, the shrimp resources in Sinaloa were exploited by small companies, which had settled in the area, and by a few subsistence fishermen. The companies were granted exclusive rights to some of the best fishing grounds, but others were still available as common property to the rural coastal population (McGoodwin 1987).

During the Revolution of 1910, the companies ceased their operations, and all fishing resources again became common property. However, during the presidency of Francisco I. Madero, the national government established its "ownership" of Mexico's fishing

5. The term *campesino* is used broadly in this article to refer to the rural poor inhabiting in coastal communities in Sinaloa. *Campesinos* in these communities include fishers, wage workers, *ejidatario(a)s*, and landless workers, regardless of whether they have or not access to a plot of land.

resources, and it began to deal with conflicts by allocating fishing rights. In Sinaloa, the marshes and lagoons became national districts and were incorporated within the national patrimony of Mexico (McGoodwin 1987). By 1923, President Alvaro Obregón implemented a plan to develop fishing in the region by allocating fishing rights to different sectors of the population (Hernández Fujigaki 1988). According to this plan, the social sector, formed by the rural population, had the greatest entitlement to exploit fishing resources, but the state retained ownership rights. Fishing for the purpose of supplying national markets and for international export was also permitted.

In 1928, President Plutarco Elías Calles issued a new decree in which specific fishing areas within Sinaloa's lagoons and estuaries were allocated to the inhabitants of rural coastal communities. This allocation of fishing areas, however, was contingent on the formation of a fishing cooperative in the localities specified in the decree. Fishing for subsistence purposes was still allowed for those unable or unwilling to join a cooperative, creating a class of part-time and subsistence fishermen known as "pescadores libres" or "free fishermen."

Shrimp, considered as the country's pink gold (*oro rosado*), became the focus of Mexico's export-oriented fishing activity because of the importance and economic value of the crustacean in the international market. The Ley General de Sociedades Cooperativas enacted in 1938 by President Lázaro Cárdenas emphasized and encouraged the further organization of rural working people into cooperatives, which according to him would serve as a way of integrating the social sectors of the country (Hernández Fujigaki 1987). In 1940, President Cárdenas amended this law so that shrimp resources were reserved for sole exploitation by people organized in fishing cooperatives. The law, however, allowed people to shrimp for subsistence purposes, but any excess catch had to be sold to the cooperatives at whatever price they established. The fishing cooperatives organized in Sinaloa operated with relative success for several years because the shrimp were abundant, the overall coastal population remained stable, and no more fishing cooperatives were allowed to be organized in the region.

Conflicts became more intense as the direct result of the increase in population in the rural coastal areas of the state. The population increase was, in part, the consequence of the agrarian reform process and the formation of *ejidos*. People from other Mexican states migrated to Sinaloa from the 1930s to 1970s to acquire land and settle in *ejidos*. The land given to *ejidatarios* often was not very productive, and in order to make a decent living in agriculture, the *ejidatarios* required large amounts of capital, which they themselves lacked and the government could not provide. The *ejidatarios'* need to diversify their subsistence activities coincided with growing demand for shrimp in the international market. In *ejidos* established near lagoons and estuaries where shrimp was abundant, many *ejidatarios* began shrimp fishing. In 1972, the *Ley Federal para el Fomento de la Pesca* (Federal Law for Fisheries Development) allowed *ejidos* dedicated to inshore fishing near their lands to exploit shrimp (Lobato 1989). This aggravated the already existing conflicts within the shrimp fishing industry. These conflicts were more prevalent between the two main components of the social sector of the industry: traditional fishing cooperatives (*Cooperativas Pesqueras Tradicionales*) and *ejido* fishing cooperatives (*Cooperativas Pesqueras de Producción Ejidal*). The traditional fishing cooperatives tried to stop the operation of *ejido* fishing cooperatives by pressuring the government not to approve their formation.

FIGURE 3. Fishermen getting ready for the beginning of a new workday.



Photo by author

These conflicts over the use and exploitation of land and fishing resources are still prevalent in the region. They have been aggravated by Mexico's economic crises, climatic factors such as *El Niño*, and overall environmental changes; and by state policies, which still continue to promote the commercial exploitation of the country's natural resources. Indeed, Mexico's reliance upon its natural resources increased during the 1980s as a result of the various structural adjustment policies adopted. These policies also had a severe impact upon the quality of life and the natural environment of rural communities. During the economic crisis of the 1980s, the pressure of an increasingly impoverished rural population combined with a lack of sustainable management policies to worsen the already seriously deteriorated condition of Mexico's natural resources. Soil erosion, water pollution, deforestation, and fisheries depletion have emerged as major environmental problems that are increasingly plaguing Mexico's rural areas (Tello 1991).

From 1989 to 1994, the Mexican state underwent changes directed toward the development and implementation of a new economic model, based on market and trade liberalization and private investment. The changes adhered to the new neoliberal economic model, and they have changed the relationship between rural people and the state, and between rural people and the coastal and marine resources they traditionally used (DeWalt 1998). A significant feature of the new economic model was the amendment of article 27 of the Mexican Constitution, which allowed for the privatization of the *ejido* sector. This new model also sought to attract economic investment to rural areas by eliminating the restrictions on rural ownership (Appendini 1998). Another feature was the amendment of the General Fisheries Law (*Ley General de Pesca*) legalizing private investment, both national and foreign, in the shrimp industry. In the aftermath of these reforms, the shrimp

industry in Mexico “is undergoing a period of rapid structural adjustment” (Vásquez León and McGuire 1993:1). This has important implications for the manner in which the shrimp aquaculture industry is currently being developed, and does provides a crucial insight into the political ecology of relationships between rural peoples, the state, and natural resources.

The Shrimp Aquaculture Industry in Mexico

Shrimp aquaculture in Mexico was considered an extension and expansion of the fishing industry. As such, it initially followed the same development pattern on which the fishing industry as a whole was modeled. One of the Mexican government’s main objectives for supporting a shrimp aquaculture industry was to continue generating profits from shrimp exports (Miller 1987, 1990; Lobato 1988; Secretaría de Pesca 1987). Accordingly, a National Program for Shrimp Aquaculture (*Programa Nacional de Cultivo de Camarón*) was created by the *Secretaría de Pesca* (Secretariat of Fisheries, SEPESCA) in 1987 to delineate the basic guidelines for the development of the industry. This National Program’s plan included on its cover page a quote from President Miguel de la Madrid Hurtado, “We have fully entered into the development of aquaculture, both freshwater and marine, and especially shrimp aquaculture, with the determined participation of fishermen and *campesinos*” (SEPESCA 1987; my translation).⁶ As this statement clearly indicates, shrimp aquaculture was first conceived as a rural development strategy targeted toward the most economically marginalized sector within the fishing industry: the social sector, comprising traditional and ejido fishing cooperatives. By including the social sector within this development scheme, the government continued to support the legal framework that, since 1940, had reserved access to shrimp resources for the rural working class organized into fishing cooperatives. By targeting the rural coastal population, the government also sought to diversify the rural economy through the creation of employment opportunities for coastal communities.

During the first stage of the industry’s development, in the 1980s, only cooperatives were allowed to cultivate shrimp. As had occurred in the fishing industry, this stage was characterized by a higher level of government involvement and control. Additionally, it was characterized by constant pressure from the private sector, comprising entrepreneurs and investors, who wanted the legal right to participate in the industry. Sinaloa led the commercial development of the industry, with the greatest number of shrimp farms in the country being built in the southern region of the state. The first commercial shrimp farm, *Viveros de Camarón de Agua Dulce*, was built in Escuinapa, the state’s southernmost municipio, in 1984 by a local entrepreneur, Eligio Beltrán. Three factors made Sinaloa the target of the industry’s development (Cruz 1992 b). The first relates to the ecological and environmental features of the state. Sinaloa has an extensive littoral zone with large tracts of coastal land suitable for the construction of shrimp farms. It also possessed the climatic conditions required for the cultivation of tropical shrimp, as well as an abundant supply of wild stocks of shrimp postlarvae. Second, by making Sinaloa the focus of the shrimp industry, the government sought to relieve some of the pressure caused by the fishing

6. The original quote reads as: Hemos entrado de lleno al desarrollo de la acuicultura, tanto de agua dulce como marina, en especial a la del camarón con la participación decidida de los pescadores y los campesinos.

industry on the wild shrimp stocks by diversifying and expanding the fishing activity. The third factor that made Sinaloa appropriate for the development of the industry was political: large numbers of people had no legal access to the exploitation of the wild shrimp resources and were pressuring the government to allow them that access. The Federal Fisheries Law of 1986 was promulgated to provide a legal framework for the participation of the private sector in shrimp aquaculture. Under this law, the private sector was allowed to enter into agreements with traditional and *ejido* fishing cooperatives to cultivate shrimp (Miller 1990). However, the law did not allow the private sector to cultivate shrimp directly.

Initially, the development of a shrimp aquaculture industry in Mexico seemed promising since the country has advantageous characteristics in comparison to other Latin American countries (Lobato 1988). For example, Mexico's proximity to the United States implied that the cost of transporting the shrimp would be relatively lower than for other countries. Mexico also has many coastal areas with high levels of natural production of shrimp. Moreover, because some of the best coastal land was already in the hands of *ejidos*, shrimp aquaculture was thought to require less financial investment, since those *ejidos* wishing to participate in the industry would not have to buy land.

This first stage in the development of the shrimp aquaculture industry did not produce the anticipated results. International investors and the Mexican private sector claimed that government policies during the 1980s were effective in preventing their participation, thus retarding the industry's development (Weidner et al. 1992). Critics were also very harsh on the social sector, blaming it for having made "little progress in developing the country's potential to culture shrimp" (Weidner et al. 1992: 26). The general failure of the social sector in developing the industry could be attributed to the lack of financial, managerial, and technical support, which the economically strained Mexican government could not provide. The social sector became a victim of the "paradox of austerity⁷." That is, when the social sector needed the most support at this critical stage of the industry's development, the Mexican government lacked the necessary resources to help it. As a result, only a few of the cooperatives actually succeeded. In many cases, the experience of the social sector with shrimp aquaculture resulted in the emergence of localized conflicts that altered the social fabric of the rural coastal communities in which these projects were developed (Cruz-Torres 1991, 1992a, 1996). For the majority of Mexican rural communities, the only real benefit brought by the shrimp aquaculture industry during this first development stage was the creation of temporary, seasonal, low-wages jobs.

The second stage of the industry's development, which was initiated after the reforms to article 27 and the fishing laws, is characterized by less state intervention and greater participation of the private sector. This new development model fits within the prevalent ideology of natural resource use in Sinaloa. Government officials assert this ideology of resource exploitation to explain the social sector's failure to develop the industry's potential. As in the case of agricultural development, the failure is also explained by a perspective of differential regional development. According to government officials, most of the failed shrimp aquaculture projects were located in the southern region of the state. This failure is explained by blaming the shrimp aquaculture cooperatives in southern

7. Davis (1989) uses this phrase when referring to the critical moments when government restructuring needed to be most far reaching were those when it lacked essential resources and maneuvering space. (as cited in Gonzalez de la Rocha and Escobar Latapí 1991:3.)

Sinaloa for not having the “entrepreneurial” and “progressive” attributes necessary for the successful operation of the projects. In the central and northern region of the state, shrimp farms owned by the social sector are still operating successfully.

The legal reforms spurred the even more rapid development of the industry, which is reflected today in the increased number of shrimp farms in operation, the type of systems used, and the amount of income generated from shrimp exports. Five Mexican states along the Pacific coast (Sonora, Sinaloa, Nayarit, Oaxaca, and Chiapas) and two along the east coast (Tamaulipas and Campeche) have developed shrimp aquaculture. Sinaloa is currently the state with the largest number of shrimp farms and the highest production levels of cultivated shrimp (Instituto Nacional de la Pesca 1998) (Table 1).

TABLE 1. Shrimp Aquaculture Production Production in Mexico, 1989-1997

State	Years						
	1989	1992	1993	1994	1995	1996	1997
Sinaloa	2,806	6,418	8,727	8,853	10,243	7,763	11,100
Sonora	3	1,338	2,054	3,206	3,630	3,200	3,800
Nayarit	24	247	812	323	614	250	500
Tamaulipas	4	50	93	343	534	259	400
Baja-Sur	2	112	83	75	35.7	40	50
Chiapas		160	76	231	355	290	300
Guerrero				99	273		200
Tabasco				8	170	150	150
Veracruz					5.6	6.0	6.0
Campeche				15	20		36
Total:	2,839	8,325	11,845	13,153	15,880	11,958	16,542

Source: Secretaría del Medio Ambiente, Recursos Naturales y Pesca (SEMARNAP). Mazatlán, Sinaloa, Mexico

Within the state of Sinaloa, the majority of the shrimp farms are in the municipios of Escuinapa, Guasave, and Navolato (SEMARNAP 1997). According to the most recent statistics, provided by the Secretaría del Medio Ambiente, Recursos Naturales y Pesca (SEMARNAP), 75 percent of the overall development of the industry is concentrated in Sinaloa (SEMARNAP 1998). Currently, 167 shrimp farms operate in the state, of which 65 percent are semi-intensive, 25 percent are extensive, and 10 percent are intensive (SEMARNAP 1998)⁸. In general, the private sector owns most of the semi-intensive projects, while the social sector continues operating most of the extensive systems. How many shrimp farms are currently in the hands of the private sector is hard to estimate, since statistics are unavailable. However, a reliable source estimated that 60 percent of all shrimp farms currently operating in the state belong to the private sector⁹. Although the Fisheries Delegations (*Delegaciones Federales de Pesca*) are required to keep a list of all shrimp farms, it is not categorized by type of ownership. Many shrimp farms once owned

by the social sector have been sold or rented to private and foreign investors, further complicating the picture. For the most part, these transactions have been executed only by the parties involved, and often the shrimp farm retains its original name, making it more difficult to know who the real owners are. Usually the personnel at the local *Delegación de Pesca* find out about these transfers of ownership informally through gossip or when they collect production data at the shrimp farm.

FIGURE 4. View of a Shrimp farm in Sinaloa



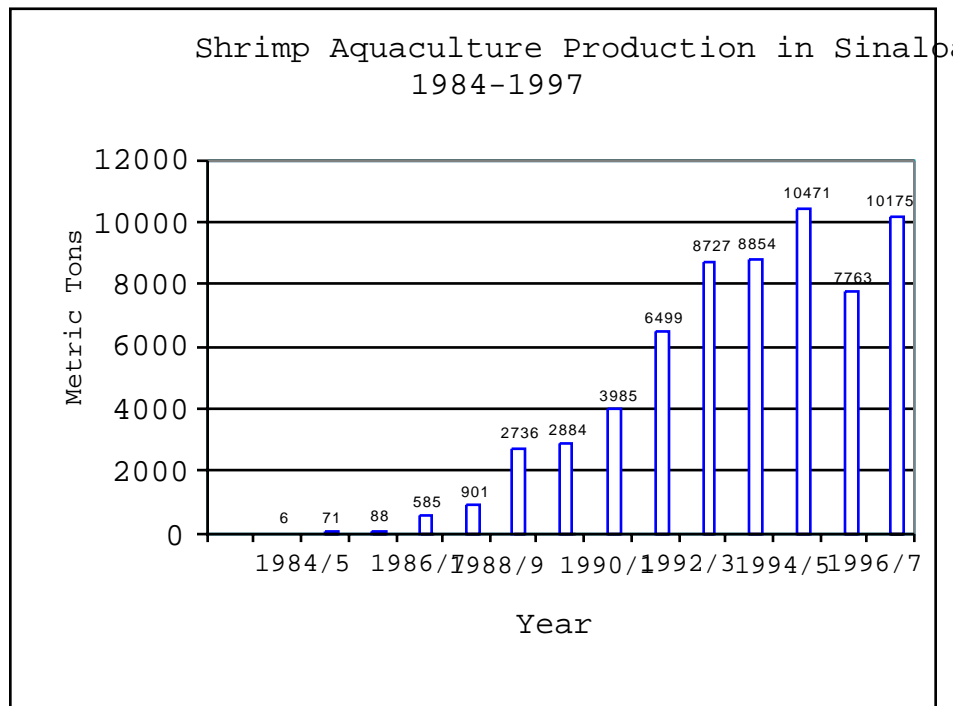
Photo by the aiuthor

In Mexico overall, the production of cultivated shrimp grew from 2,839 metric tons in 1989 to 16,540 metric tons in 1997 (SEMARNAP 1998). Between 1984 and 1997, production in Sinaloa grew from 6 metric tons to 10,175 metric tons, reaching a peak in 1995 at 10,471 metric tons (Table 2).

8. Extensive systems have the following characteristics: low density of biomass, low production volumes, limited water exchange; and do not usually require supplemental food and fertilizer. Semi-intensive systems have: high stocking densities, higher rates of water exchange, supplemental food and fertilizer. Intensive systems require fast daily water exchange, high stocking densities, formulated feed, smaller pond size; and have the highest production volumes.

9. Licenciado José Luis Gutiérrez, personal communication.

FIGURE 5. Shrimp Aquaculture Production in Mexico, 1989-1997



Source: Secretaría del Medio Ambiente, Recursos Naturales y Pesca (SEMARNAP). Mazatlán, Sinaloa, Mexico

The area in production grew from 13 ha in 1984 to 1,400 ha in 1996. In 1995, the industry generated US\$468,705, which represented 24 percent of the shrimp industry's overall profits (Instituto Nacional de la Pesca 1998). According to SEMARNAP, the industry provided employment to people at shrimp farms, hatcheries, centros de acopio (where wild larvae are harvested and sold), and packing plants. It was estimated that in 1992, 558 permanent and 218 seasonal jobs were created (Instituto Tecnológico y de Estudios Superiores de Monterrey 1994). During 1998, the shrimp industry overall employed approximately 18,000 people, but the exact number of jobs it created is still unknown.

Environmental Impact of Shrimp Aquaculture

The relationship between shrimp aquaculture and the environment in Mexico needs to be systematically addressed as the sustainable development of the industry becomes a priority. In Mexico, research on the current and potential environmental impact of the industry is starting to emerge, as many of the environmental problems already experienced by other Third World countries appear. Scholars working on the topic of shrimp aquaculture and the environment have highlighted the most common environmental

problems caused by the industry and the consequences for the rural coastal population in Third World countries. These problems include the loss of mangrove forests (DeWalt et al. 1996; Meltzoff and LiPuma 1986; Stonich 1991, 1995; Stonich et al 1997; Bailey, 1988, 1992, 1998; Weidner et al. 1992; Phillips et al. 1993; Flaherty and Choomjet 1995), degradation of coastal wetlands and lagoons (DeWalt 1998; Weidner et al. 1992), reduction in the stocks of wild shrimp (Weidner et al. 1992; Pullin 1993), loss of terrestrial habitats (Phillips et al. 1993; Meltzoff and LiPuma 1986), and water-quality deterioration (Vandergeest and Flaherty 1998, Boyd and Clay 1998). In Latin America, research on the environmental impact of the shrimp aquaculture industry has focused on Ecuador and Honduras. In these two countries, researchers have demonstrated that the most important environmental issues are related to the degradation of mangrove ecosystems, water pollution, the capture of wild shrimp postlarvae, water-quality deterioration, and the transformations of coastal ecosystems (Meltzoff and LiPuma 1986; Stonich 1995; Stonich et al 1997; DeWalt et al. 1996).

In Mexico, environmental problems associated with the industry's development are most prominent in Sinaloa, Sonora, and Nayarit, which are the states with the highest concentration of shrimp farms. The rapid proliferation in the number of shrimp farms, most semi-intensive in type, is affecting the coastal ecosystems and the rural communities that depend on the resources provided by these ecosystems. In contrast to extensive systems, semi-intensive and intensive systems of shrimp aquaculture production require higher quantities of fertilizer, supplementary feed, water, and stocking densities, which leads to greater waste production (Beveridge et al. 1997).

Debate in Mexico is growing over what the real impact of the industry has been or will be. This debate has been handled in different ways by the various sectors involved in the industry. Compared to five years ago, there seems to be greater awareness today, especially on the part of government agencies, regarding the potential environmental impact on Mexico. When Mexico joined the Commission on Sustainable Development, it agreed to follow the guidelines of Agenda 21 set by the United Nations Conference on Environment and Development. Mexico's 1995-2000 National Development Plan established a National Fisheries and Aquaculture Program and a National Environmental Program. The latter created a Sub-program for Coastal Zones, which works with the UN Global Action Program for the Protection of the Marine Environment against Land-Based Activities (Escutia 1997). As a result, new Mexican legislation requires an Environmental Impact Assessment (EIA) prior to granting approval for construction of any new shrimp farm. The National Ecology Institute (INE) approves or rejects construction based on the EIA, which is usually done by a private consulting company hired by the people proposing the shrimp-farm construction. According to a source, there is a problem in having a private consultant company performing the study, since the results are not always reliable¹⁰. Many times, prospective shrimp-farm owners pay large sums of money (*la mordida*) to the consulting company so the latter will alter the results in the owners' favor. Another problem related to Environmental Impact Assessments is that the same format is frequently used regardless of the particular characteristics or special circumstances of the geographic area under study. As a consequence, many factors that could determine if a proposed site is appropriate for a shrimp farm are often overlooked, because they are not included in the evaluation. Additionally, since the EIA is a relatively new requirement,

10. Lourdes Patricia Lyle, personal communication.

many shrimp farms that were built before 1989 were never evaluated, and it is likely they do not meet safety standards.

Despite the regulations, the debate, and the greater awareness, there is a consensus that the aquaculture industry is transforming the coastal ecosystems of Sinaloa in a way that is affecting the livelihood and quality of life for residents of the many rural coastal communities. The coastal lagoons and estuaries that characterize Sinaloa contain a diversity of habitats including mangrove forests, salt-marshes, inter-tidal pools, swamps, freshwater inner lagoons, and brackish and seawater systems (Páez-Osuna et al. 1998). A key environmental concern is the impact of shrimp farm construction on ecosystems. This issue is most prominent in the southern region of the state, where a single lagoon system can contain many shrimp farms. During the rainy season, the region's lagoons are habitats and nurseries for postlarvae and a variety of fishery resources, which form the basis of the commercial fishing activity and are also exploited by the rural coastal communities as common property. When these lagoons dry up with the end of the rains, they have traditionally been mined for salt both by individuals gathering it for home consumption as well as by some cooperatives, such as one in the municipio of Escuinapa. Today, in order to guarantee a permanent water supply to the shrimp farms, canals have been built to connect the lagoons with estuaries or the ocean, leading to permanent flooding.

The government has granted concessions, mostly to private investors, to build shrimp farms in these coastal lagoons. In many instances, the cooperatives' historical entitlement to the use of these lagoons has not been recognized by the government when granting these concessions. Moreover, the concessions have converted a highly diverse coastal ecosystem into a monocrop system. This has resulted in a greater marginalization and displacement of the social sector and in an increased distrust of the government agencies in charge of developing the aquaculture industry. By transforming common-property lagoons into a privately owned resource, the concessions have exacerbated Sinaloa's social conflicts.

A second environmental concern is about the potential effects of shrimp ponds effluents on coastal ecosystems (Páez-Osuna 1998). In Sinaloa, the use of pesticides in the commercial agriculture sector has long been a direct source of coastal water pollution. Other direct sources include sewage effluent and industrial discharges. The discharge from shrimp ponds is considered to be one of the more recent and serious direct sources of pollution in Sinaloa's coastal waters (Galindo Reyes et al. 1997). Shrimp-farm wastewater contains large amounts of organic material, fertilizers, chemicals, and antibiotics, which cause eutrophication in the lagoons and estuarine systems. While I conducted ethnographic fieldwork in the southern region of the state, members of several fishing cooperatives reported their concern with water-quality deterioration and its effect on the natural productivity of the lagoons and estuaries in which they fish. According to the fishermen, "*las granjas camarónicas nos están matando los peces y los camarones porque desaguan sus desechos en el estero*" (the shrimp farms are killing the fish and shrimp because they discharge wastes in the estuary). In Sinaloa, wastewater from shrimp aquaculture activities has been linked to the formation of phytoplankton blooms, eutrophication, and the development of red tides in coastal marine waters (Páez-Osuna et al. 1998)¹¹. For example, in 1997 four phytoplankton blooms were recorded in semi-

11. Eutrophication will eventually lead to hypoxia or anoxia which will cause the death of coastal and marine organisms.

intensive shrimp systems (Cortés-Altamirano and Agraz-Hernández 1994). In all four cases, these were harmful blooms that had a detrimental effect upon the shrimp in the ponds. The clustering of ponds, a practice in some municipios of the state, is currently producing substantial effluents. If effluent volumes continue to increase as more shrimp farms are built, fishing resources in these coastal ecosystems will be put at risk (Weidner et al. 1992).

A third environmental concern is the impact of the industry on mangrove ecosystems. Although industry supporters argue that it is debatable, the impact of the shrimp aquaculture industry on mangrove forests has been significant. The ecological importance of mangrove ecosystems has been well documented. They are considered one of the most productive ecosystems, equaling sugarcane fields and surpassing tropical rainforests (Flores-Verdugo et al. 1992). Mangrove forests protect shorelines and prevent coastal erosion while providing habitats and nurseries for a variety of coastal marine organisms and birds. During the 1990s, the relationship between shrimp aquaculture and mangroves has become a global concern. In many Third World countries, it has been demonstrated that shrimp aquaculture has resulted both directly and indirectly in the degradation of mangrove forests. The destruction of large tracts of mangroves for the construction of shrimp farms in Thailand, Indonesia, Ecuador, and Honduras is considered one of the most direct contributions of shrimp aquaculture to the degradation of natural resources in those countries. In many other instances, discharge from the shrimp ponds has contributed, indirectly, to the degradation of mangrove forests.

FIGURE 6. A partial view of a mangrove forest in southern Sinaloa.



Photo by the author

In Mexico, there are approximately 123 coastal lagoons, most bordered by mangrove swamps. Mexico is home to four mangrove species: red (*Rhizophora mangle*), white (*Laguncularia racemosa*), black (*Avicennia germinans*), and buttonwood (*Conocarpus*

erecta L.). Mexico's mangrove forests cover approximately 660,000 ha (Flores-Verdugo et al. 1992). The largest is on the Pacific coast of Mexico between the southern region of Sinaloa and the northern region of Nayarit: The Teacapán-Agua Brava-Marismas Nacionales mangrove ecosystem comprises 113,238 ha (Flores-Verdugo et al. 1997). Sinaloa's mangrove forests serve as nesting and feeding grounds for a large number of resident and migratory birds and as nurseries for shrimp, which form the basis of the inshore fishing industry (Schmidt 1976). The trees are also used by the rural population as firewood and lumber. Over time, mangrove ecosystems in Sinaloa have been transformed by mining, agriculture, and the cattle industry. Mangrove extracts were used for tanning and mangrove wood was used in the construction of the haciendas. During the 1940s and 1950s, the use of insecticides and the draining of wetlands for the eradication of malaria also harmed Sinaloa's mangrove ecosystems (Flores-Verdugo et al. 1992). Currently, the shrimp aquaculture industry is also contributing to the ecological transformation of these ecosystems (Ramírez-Zavala et al. 1997). The extent of this transformation is a very controversial issue in Mexico. It has been estimated that by 1994, 10,000 ha of mangrove forests were destroyed to build shrimp ponds (Flores-Verdugo et al. 1992). Untreated shrimp-pond effluents are also contributing to the damage.

In response to pressure and criticisms of various international organizations that claimed that the Mexican shrimp aquaculture industry is harming the country's mangrove ecosystems, industry representatives met in Mazatlán, Sinaloa on March 12, 1998. During this meeting, representatives from the Cámara Nacional de la Industria Pesquera (CANAINPES), the social sector (including the high-seas fishing cooperatives, ejido fishing co-ops, and shrimp aquaculture co-ops, SEMARNAP, *Instituto Nacional de la Pesca* (National Fisheries Institute), Ocean Garden Products, *Asociación Empresarial Pesquera de América Latina* (Latin American Entrepreneurial Fishing Association), and the state government of Sinaloa together promulgated and signed the Mazatlán Declaration¹². The Declaration constituted an agreement among all groups invited to exploit the shrimp resources of Sinaloa in a sustainable manner. The fear of a proposed shrimp embargo in response to campaigns by environmental organizations such as Green Peace spurred the formulation of this agreement¹³. The primary goals of the agreement were "to bring together the sectors involved in Mexican shrimp production in order to present a united front to defend our full and free rights to the sustainable exploitation of the country's resources in the face of international pressures by certain pseudo-environmental groups. These organizations are conducting negative and slanderous campaigns of disseminations to influence governments, and consumer opinion generally, against Mexican shrimp products, in the hope of bringing about economic sanctions against Mexico, similar to those that the country's tuna industry has suffered for many decades" (Cámara Nacional de la Industria Pesquera 1998: 20; my translation)¹⁴. The Declaration reiterates its commitment to exploit the shrimp resources in a sustainable manner: "All participants involved in the fishing industry and shrimp aquaculture agree to establish a comprehensive program for the sustainable exploitation of shrimp which shall include coordinated management of information and scientific research aimed at

12. The full text of the Mazatlán Declaration is reprinted in *Panorama* Volume 3, No.3 (March/April), 1998, on pages 20-21.

13. See Green Peace Report *Shrimp: The Devastating Delicacy: The Explosion of Shrimp Farming and the Negative Impacts on People and the Environment*.

minimizing the environmental impacts from the exploitation of these resources, along with cooperation aimed at developing technology and ecologically viable fishing techniques and aquaculture systems" (Cámara Nacional de la Industria Pesquera 1998:20; my translation)¹⁵. Whether or not the Mazatlán Declaration was enacted out of an honest and sincere concern for the sustainable development of the industry or just as an economic strategy to a proposed shrimp embargo is difficult to ascertain. However, while I was conducting fieldwork, people from the Centro Regional de Investigaciones Pesqueras were concerned that if the shrimp embargo were to take place the social sector would bear most of the consequences since they are the most marginalized sector of the shrimp industry and lack the financial resources and government support to defend themselves. During an embargo, they believed that the private sector would band together to protect its interests and would not support the social sector.

A last environmental concern in Sinaloa is the impact that shrimp aquaculture is having on the wild shrimp stocks. In Sinaloa, and in Mexico in general, the shrimp aquaculture industry has two sources of supply for postlarvae: hatcheries and wild stocks. Currently, nine hatcheries operate in Sinaloa. Most produce white or blue shrimp, but because of a viral disease, similar to the Taura Virus Syndrome, that affected the production of white shrimp, many hatcheries opted for the production of blue or "super" shrimp¹⁶. The prices for shrimp larvae last year fluctuated between US\$5.60 and \$12.00 per million larvae. People involved in the shrimp aquaculture industry believe that the hatcheries business is very risky given the high cost of construction and operation balanced against the likelihood of an infestation by the virus.

Despite the increase in the number of successful hatcheries, the shrimp industry continues to rely largely on the natural production of postlarvae. SEMARNAP has

14. The original quote reads: "buscar la integración del sector productor de camarón mexicano en un frente unido para la defensa del derecho libre y soberano a la explotación sustentable de nuestros recursos ante las presiones internacionales de ciertas organizaciones pseudoecologistas que intentan, mediante la desinformación y la calumnia, influir en la opinión de gobiernos y del público consumidor en general, para crear una animadversión hacia nuestros productos, que nos podría llevar a enfrentar sanciones de tipo económico, como las que hemos enfrentado injustamente desde hace décadas con el atún."

15. The original quote reads: "Todos los participantes del sector productivo pesquero y de acuicultura del camarón acuerdan establecer un programa integral para el aprovechamiento sustentable del camarón que incluya el manejo coordinado de la información e investigación científica para minimizar el impacto ambiental de la utilización de los recursos, coadyuvando en los procesos de cooperación orientados hacia el desarrollo tecnológico y de prácticas de pesca y de sistemas de cultivo ecológicamente viables..."

16. A special report published by Juan Carlos Ramírez in the local newspaper, *El Debate*, provides the following information about the shrimp virus in Sinaloa. The virus, although in many ways similar to the Taura Virus, differed in that it only affects shrimp weighing five grams or less. The virus first appeared in 1995, in the municipio of Guasave, and a few months later reached the coast of Nayarit. In Sinaloa the virus was named: síndrome de Petatlán. The main hypothesis developed to explain its arrival in Sinaloa claims that apparently shrimp postlarvae produced in a Guatemalan hatchery and later sold to a Sinaloan shrimp farm owner were already infected. The virus began to spread in Sinaloa when the infected postlarvae were sold to other shrimp farms in the state.

established several *centros de acopio* or sites for the capture of wild shrimp larvae. The right to sell postlarvae from these sites has been granted for a period of 25 years to the fishing cooperatives that have their fishing grounds nearby, thus benefiting the social sector. The wild postlarvae are preferred by most shrimp-farm owners because they are thought to be healthier and more resistant to viral diseases. The social sector is very dependent on wild stock because it is cheaper than hatchery-produced postlarvae

Although it is unclear whether harvesting of large numbers of postlarvae annually is contributing to the depletion of fishing resources in Sinaloa, it has become a primary concern. It is well known that in the process of gathering the larvae, the fry of many fish and other shrimp species are also captured. The existence of a “black market” for the illegal selling of postlarvae supports the idea that shrimp aquaculture is contributing to over-exploitation. The reliance of the industry upon wild postlarvae has contributed to the aggravation of the conflicts over the access to the exploitation of the fishing resources in the region. The social sector blames the private sector for fishing too many shrimp larva in order to fulfill their stocking needs. There have been several cases of violent confrontations between fishing cooperatives and shrimp-farm personnel.

The overall environmental impact of shrimp aquaculture in Sinaloa has not been studied. Yet it is known that the commercial agricultural sector has damaged the coastal ecosystems of Sinaloa. The agricultural use of pesticides, herbicides, and fertilizers has contaminated lagoons, estuaries, and the coastal zone in general (Galindo Reyes 1988). The use of fertilizers has also resulted in ground-water and soil contamination (INEGI 1995). Intensive, large-scale, commercially oriented agriculture developed in the region, which relies primarily on large irrigation systems, has reduced the supply of freshwater to estuaries and coastal lagoons, leading to such problems as hypersalinity, a reduction in organic nutrients, a decrease in oxygen, and a decrease in the number of freshwater organisms entering the lagoons and estuaries (Galindo Reyes 1998).

We can speculate that regional damage is extensive given that the effects of commercial agriculture are now combined with shrimp aquaculture. However, not until the appropriate analysis of these combined effects are known can we make definitive statements about the regional consequences for either long- or short-term environmental problems. However, the increasing concern of various sectors of the local population regarding the impact of the aquaculture industry has encouraged stakeholders to develop various forms of resistance to the industry’s expansion.

The Emergence of a Local Resistance to the Industry

The global concern over the negative impact of commercial shrimp farming on the environment and humans has fueled the emergence of various grassroots social movements to resist the expansion of the industry (Stonich and Bailey 1998; Goss et al. 1998). Among the causes igniting this resistance are local people’s concerns with increasing pollution, and the loss of common-pool resources (Stonich and Bailey 2000). In Mexico, resistance to the industry’s expansion is slowly starting to appear and for the most part, this opposition has been developed by several of the fishing cooperatives in southern Sinaloa and northern Nayarit. Activities of fishing cooperatives in these sates have included confrontations with personnel of shrimp farms and negotiations with government agencies in order to limit the expansion of the industry. Although there is an environmental NGO based in Mazatlán, the Consejo Ecológico de Participación Ciudadana del Municipio de Mazatlán (CEMAZ), it has not yet become involved in the resistance¹⁷.

Among the most important grassroots organizations to oppose large-scale shrimp aquaculture near fishing grounds is the Federation of Fishing Cooperatives of Southern Sinaloa -- Los Guerreros del Sur, which comprises 21 fishing cooperatives with a total of 2,000 fishermen. In 1998, the Guerreros del Sur openly opposed the construction of a shrimp farm in their granted fishing area. They claimed that seven cooperatives would no longer be able to fish in the area because the shrimp farm would invade their space. They were also concerned about the potential effects of discharge from the shrimp ponds. They took the case to government agencies, such as the *Delegación Federal de Pesca* (Federal Delegation of Fisheries), the *Centro Regional de Investigaciones Pesqueras* (Regional Center for Fisheries Research) in Mazatlán, and the *Instituto Nacional de Ecología* (National Ecology Institute) in Culiacán, but they did not receive any support. However, members of the Guerreros del Sur informed me that instead these agencies lent their support to the private company interested in building the shrimp farm.

The National Ecology Institute approved the private venture based on the results of the EIA conducted by a private consulting firm hired by the private company, based on the assumption that the area has not been previously granted to fishing cooperatives. The Guerreros del Sur then sent a letter to President Ernesto Zedillo asking to stop the construction of the shrimp farm. The company is now suing the Federation for allegedly preventing the construction workers from finishing the farm. This is not the first time that the Guerreros del Sur have taken action against the shrimp aquaculture industry. The Federation had previously prevented the construction of a shrimp farm in another nearby community. In that case, the majority of the members of this community supported the effort, and the shrimp farm was not constructed. Members of this Federation have also actively opposed the collection of wild shrimp larvae in coastal areas near their fishing grounds. In some instances, they showed up with truncheons to confront marine biologists and other shrimp farms personnel to demand they stop harvesting shrimp larvae.

A number of fishing cooperatives in northern Nayarit have also opposed the construction of a shrimp farm near their fishing areas. In this case the fishermen have accused a private company of destroying large tracts of mangroves with their shrimp-pond operations. The fishing cooperatives were joined by an environmental organization, Grupo Manglar. Together they requested that an EIA be done in order to assess adequately the extent of the impact. According to the scientist who conducted the study, it appears that the company is responsible for destruction¹⁸. Reportedly, one of the canals that supplied water to the ecosystem was blocked during the construction of the shrimp farms. The case has gone to court, and there is widespread hope that the company will need to reforest the area at its own expense.

The resistance to the shrimp aquaculture industry in Sinaloa has so far only taken place at the local level, mostly through the efforts of fishing cooperatives and community groups. In Mexico, this resistance has not spread nationwide as it has in many other countries, such as Honduras, Ecuador, Thailand, or Indonesia. However, as more shrimp farms are built in Mexico, and as many more people are displaced from the areas that

17. This Environmental NGO was organized on July 2, 1990, by a group of academics and citizens in Mazatlán. Its work has concentrated on issues of coastal pollution. Currently CEMAZ operates several projects, including the cultivation of a nursery of native plants, and the rehabilitation and conservation of estuaries and lagoons.

18. Dr. Francisco Flores Verdugo, personal communication.

traditionally provided them with the natural resources needed for their survival, a more national-level resistance to the industry is likely to emerge. As more people become aware of the potential effects of the shrimp aquaculture industry, the fishing cooperatives and community groups opposing the expansion of the industry will get more support.

While I was conducting ethnographic fieldwork in Sinaloa in 1998, a number of stakeholders expressed their concerns about the environmental impact of the industry. For the most part these were fishermen and ejidatarios, but entrepreneurs in urban areas who were concerned about the impact of the industry on the inshore fishery and its effects on the region's economy also showed concern. Many of these people strongly believed that the very poor fishing season of 1998, which was considered as the worst in the history of the region, was due to the rapid proliferation of shrimp farms in the area and their negative impact upon the resources. Although some attribute that year's unproductive fishing season to environmental factors, such as El Niño, or to poaching, there is no available data to support any of these hypotheses.

Although more completely integrated long-term studies need to be done to assess the depth and breadth of the impact of the aquaculture industry on coastal ecosystems and the rural population of the region, there is no doubt that industrial aquaculture farming has had important ecological and social impacts, which in the long run may lead to the further erosion of the coastal and marine ecology and the ability of rural households to make a living.

Conclusion

The sustainable development of Mexico's natural resources seems to have become a priority. As the aftermath of the country's election as a member of United Nations' Commission on Sustainable Development, the Mexican government has tried to follow the guidelines adopted by Agenda 21 of the United Nations Conference on Environment and Development (UNCED). Although government officers and supporters of the industry claim that the industry is being developed in a sustainable manner, so far this "sustainability" has largely focused on economic aspects. Shrimp aquaculture in Mexico, as in many other Third World Countries, has been depicted as having a great potential to contribute to the economic development of the country through the generation of export profits and the creation of jobs in rural areas. Supporters of the industry claim that it generates millions of dollar every year, and justify its further expansion based on the potential creation of new jobs, which assumes will help to improve the lives of the rural coastal population. Moreover, according to a representative of the National Chamber of the Fishing Industry (*Cámara Nacional de la Industria Pesquera*) Mexico has only two choices concerning shrimp aquaculture development and the rural coastal population: "to provide these coastal villagers with new job opportunities; or to let them live as they as always lived and as the natural productivity becomes insufficient, they will begin to tear apart the environment in their struggle to satisfy their most basic needs" (Escutia 1997:6). Statements like these, echoing a paternalistic tone which undermines the knowledge that rural people possess about their natural environment and their ability to manage their own natural resources are very common among supporters of the industry. However, as of today, only a few fishing and *ejido* cooperatives have benefited in some way from profits generated in the shrimp aquaculture industry. They have directly benefited through their production from shrimp farms or indirectly through the sale of wild postlarvae. A small portion of the rural population has also benefited from employment, which has been

limited mostly to seasonal, low- wage, temporary jobs as construction workers, as security guards, or as wage laborers in hatcheries.

By not addressing issues concerning social and environmental sustainability, supporters of the industry failed to comply with some of the basic principles established by Agenda 21 of the UNCED. For the shrimp aquaculture industry, the coastal and marine ecosystems and the rural communities in Sinaloa the most relevant and applicable of these principles are the following¹⁹: 1) Human beings are at the center of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature; 2) In order to achieve sustainable development, environmental protection shall constitute an integral part of the development process and cannot be consider in isolation from it; 3) To achieve sustainable development and a higher quality of life for all people, states should reduce and eliminate unsustainable patterns of production and consumption and promote appropriate demographic policies; and 4) Indigenous people and their communities and other local communities have a vital role in environmental management and development because of their knowledge and traditional practices. States should recognize and duly support their identity, culture, and interests and enable their effective participation in the achievement of sustainable development.

The analysis of the expansion of the shrimp aquaculture industry, following the legal reforms of the 1990s, shows that the industry is following a pattern of capitalist economic development. This pattern favors the short-term benefits obtained from income revenues instead of long-term goals of coastal and marine ecosystems conservation and support for the livelihood of the rural population. Moreover, the commercial, export-oriented nature of the industry seems to have aggravated environmental problems and social conflicts that have long existed in Sinaloa. A few questions remain to be answered concerning the relationship between shrimp aquaculture, rural coastal communities, and the environment in Sinaloa. What is the price being paid by the rural coastal population and the natural environment in exchange for the economic benefit of a few? There is very little reason to believe that either local, regional, national, or transnational capital will be reined in by itself to somehow reduce the effects of this mode of production. Rather, it basically falls to the continued political pressures applied by local, regional, national, and even transnational forces to have any impact at all. These groups must create either mitigation interventions or generate alternative social and technical arrangements that create optional extractive and production models to enhance rather than reduce the ability of both the coastal ecosystems and human beings to survive.

The other question is whether it could be possible at all to develop a socially, environmentally and economically sustainable shrimp aquaculture industry. The sustainable development of this industry in Mexico, as in many other Third World countries, given their economic realities, is proving to be very difficult and complicated to achieve. This already constitutes one of the greatest challenges these countries are currently facing. Let us hope that as they find a way to achieve this goal, rural people and the coastal environment will no longer continue to become victims of the "sustainable development" paradox.

19. This information was taken from the Rio Declaration on Environment and Development enacted during the United Nations Conference on Environment and Development. It can be found on the United Nations Web site, <http://www.un.org/documents/ga/conf151/aconf151261annex1.htm>

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Abstract

This article examines the effects of the changes associated with the neoliberal economic model on the development of the shrimp aquaculture industry in Mexico. It uses a political ecology approach to analyze the relationship between state policies, recent expansion of the industry, and the environment in Sinaloa, Mexico. The analysis reveals the ways in which shrimp aquaculture is currently having a negative impact upon coastal ecosystems and rural people. It also shows how a local resistance to the industry's expansion is emerging, and the role played by fishing cooperatives in this process. The article proposes that in order to achieve the sustainable development of the shrimp industry, special attention should be given to environmental and social factors as well.

Keywords: Mexico, shrimp farming, environmental degradation, sustainable development, coastal ecosystems, political ecology,

Resumen

Este artículo examina los efectos provocados por los cambios asociados a las políticas neoliberales en el desarrollo de la industria de la camaronicultura en México. Mediante la utilización de un acercamiento político ecológico se analizan las relaciones existentes entre las políticas estatales, la reciente expansión de la industria, y el medio ambiente en el estado de Sinaloa. El artículo revela las distintas maneras mediante las cuales el cultivo de camarón está impactando o podría impactar de forma negativa los ecosistemas costeros

sinaloenses y a la población rural que depende de éstos para su supervivencia. De acuerdo al artículo, los factores sociales y ambientales merecen una atención especial dentro de las políticas estatales para poder lograr el verdadero desarrollo sustentable de la industria.

Palabras claves: México, cultivo de camarón, degradación ambiental, desarrollo sustentable, ecosistemas costeros, ecología política

Résumé

Cet article analyse les effets et changements associés au modèle économique néolibéral appliqué au développement de l'industrie aquaculture des crevettes au Mexique. L'article adopte une approche basée sur l'écologie politique pour analyser la relation entre les politiques d'Etat, le développement récent de cette industrie et l'environnement dans la région de Sinaloa au Mexique. Cette analyse démontre les conditions à travers lesquelles l'aquaculture des crevettes est actuellement entrain d'affecter négativement et l'écosystème du littoral et la population rurale. L'article examine aussi l'émergence d'une résistance locale à la croissance de cette industrie et le rôle des coopératives de pêche dans ce processus. L'article propose que pour arriver à un développement durable de l'industrie des crevettes au Mexique, une attention spéciale doit être attribuée aux facteurs environnementaux et économiques.

Mots clés: Mexique, culture des crevettes, dégradation environnementale, développement durable, écosystèmes des littorales, politique écologique.