UNITED NATIONS RESEARCH INSTITUTE FOR SOCIAL DEVELOPMENT

DP 74

SOME ECOLOGICAL AND SOCIAL IMPLICATIONS OF COMMERCIAL SHRIMP FARMING IN ASIA

by Solon Barraclough and Andrea Finger-Stich

March 1996

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ISSN 1012-6511

◆ UNRISD Preface

A number of recent media reports have given vivid accounts of the current and potential environmental impacts of shrimp farming in Asia and South America. These include mangrove destruction, destruction of fish stock, pollution and other forms of land and water degradation. The social impacts on local communities which live in the tropical coastal regions where shrimp aquaculture is a growing source of income have, however, received only scant attention. Shrimp aquaculture affects livelihoods by disrupting traditional systems of production, distribution and social relations. This paper highlights such social dimensions of shrimp aquaculture. It is based on the data available in the case studies covered in the current literature on the subject. The broader conceptual framework utilized to analyse policy issues is derived from the Institute's research programme on **Environment, Sustainable Development and Social Change**.

The paper looks at the recent trends of expansion of shrimp aquaculture in Asia, which supplies some 80 per cent of cultured shrimp in global markets. The remarkable growth in production over the past decade has been facilitated by evolving technologies and expanding pond areas. At the same time, however, customary production systems have been systematically replaced by more intensive ones.

Shrimp is mostly produced for export to meet the demands of rich consumers in developed countries. The governments in producing countries consider shrimp aquaculture a vital source foreign exchange and a small section of the population is apparently able to draw lofty immediate earnings. However, the main beneficiaries have been powerful national and international investors.

The paper identifies the principal actors of the shrimp industry, at the cultivation, processing, trading and consumption stages. The industry's financial sources are also considered. At one end, there are small shrimp farmers and workers and, at the other, rich farmers, fry collectors, manufacturers, processors and marketing agents, national and international investors and agencies, and high purchasing-power consumers. The paper focuses in particular on the actors which are negatively affected by the "externalities" of shrimp aquaculture, and by reduced access to natural resources.

The roles played by market forces, institutions, policies and official discourse in the growth of the shrimp industry and its social and environmental impacts are assessed critically in the paper. The partial remedial actions being attempted by private and public actors to mitigate the negative outcomes of the industry are also examined. The authors conclude that effective policy and institutional reforms are required at all levels. The possibilities of bringing about such reforms will largely depend upon the active participation of the key social actors at the grassroots level and of alliances of concerned parties in both producing and consuming countries.

The authors point out the clear need for more field-based studies in order better to understand the social and environmental implications of shrimp

aquaculture in specific social and ecological contexts. There is also the need for more policy oriented analysis, both to assist the elaboration of market and regulatory mechanisms involving all concerned stakeholders, and to control the industry from inducing further damage. The paper includes a short appendix proposing further research on these issues, and on some related questions. For example, how could commercial shrimp aquaculture bring more benefits to local groups that have so far been largely prejudiced? How could tropical coastal resources be better used for meeting the present and future food, employment and income needs of local people, while taking into account foreign exchange requirements at the national level? How could such activities be made more environmentally sustainable?

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March 1996

Dharam Ghai
Director

◆ WWF Preface to the Second Printing

Since this Discussion Paper was first published in March 1996, several events related to shrimp production and its social and environmental impacts have taken place. Many organizations have published reports on the negative effects of shrimp farming and have debated the appropriateness of launching a shrimp boycott. Interestingly, the United States has banned imports from many Asian countries because they have not used anti-turtle devices when fishing for shrimp. Though the ban was primarily to save turtles, it raised several questions about the entire shrimp trade, as well as about the appropriateness and effectiveness of the unilateral decision by the United States.

The shrimp market is not divided on the lines of production from wild catch or aquaculture. Retailers are not obliged to inform their customers about the origin of the shrimp they sell. Many countries affected by the US ban argued that most of their shrimp exports are from aquaculture and that therefore the ban was not applicable. While they were right, they ignored the production process of the farm-raised shrimp, which is at least as much of a threat to the environment — and even more so for local communities.

During the last couple of years, the shrimp industry — well aware of what it was doing to mangroves, coastal waters and local livelihoods — has been anticipating some form of opposition from consuming countries. Considering, however, the way the industry ignored multiple protests from small NGOs and poor local farmers and fishermen in the producing areas, it probably did not expect judicial intervention from the highest court in India. The Indian Supreme Court judgement declaring that shrimp farms within the 500-metre high tide zone are to be closed came as a shock to the entire industry. The Supreme Court based its judgement on five major studies, including this Discussion Paper. Several pages of this document were quoted in the court's judgement of 11 December 1996. India produces annually about 70,000 metric tons of farm-raised shrimp, worth half a billion dollars. Several public and private financial institutions and international aid agencies, the World Bank and the Asian Development Bank have actively promoted this industry; and governments have extended subsidies for technical help to boost the industry.

The most important aspect of the court's judgement is not just the technicality of violating the Coastal Zone Regulation Act (CZR-1990) but the conclusion that the shrimp industry is causing more damage to the natural resources and local economies than it raises benefits from the export of cultivated shrimp. The Supreme Court had commissioned the National Environmental and Engineering Research Institute (NEERI) to undertake an impact assessment in several Indian states in order to substantiate its decision with precise estimates of costs and benefits.

As expected, the industry is not giving up and has launched several appeals. At the time of writing of this preface, the Indian Supreme Court has, in fact, extended the deadline for implementation of its order to demolish all installations built within 500 metres of the high tide line from April 1996 to the end of July 1997. The shrimp industry is not only powerful in India but

in all of Asia (which produces about 90 per cent of the world's cultivated shrimp). The investments, both private and public, are substantial. Even though it is difficult to estimate these amounts, the investments are important enough to influence parliaments and state legislatures in most Asian countries.

The success of this Discussion Paper and the work of many local, regional and international NGOs should lead to the re-emergence of a shrimp industry that, in future, will be ecologically and socially responsible. It has certainly contributed significantly to the ongoing debate on unsustainable, quick-profit practices versus sustainable economic development, taking into consideration the environment and people.

The shrimp industry will not be the same in India or in Asia after the general raising of awareness that has occurred in the wake of the Supreme Court's decision and all the material and campaigns that motivated it. For its own survival, the shrimp industry should take serious note of the Supreme Court judgement and work without delay towards improving its own sustainability.

The present study and its organizational backing by WWF and UNRISD have played a major role in lending support to the local people whose lives have been devastated by the shrimp industry: depleting and polluting their freshwater sources; causing salinization; confiscating their land, often irreversibly,[1] and destroying mangroves as breeding grounds for fisheries, water cycle regulation, erosion control and buffering against floods, as well as the production of forest-related goods and services.

The present edition of this paper has not been updated from its 1996 version. However, the general analysis remains valid. This study also illustrates a fruitful partnership between an international non-governmental organization and a United Nations organization.

12 June 1997

Claude Martin
Director-General
WWF-International

[1] Biksham Gujja and Andrea Finger-Stich have estimated that about 150,000 hectares of coastal areas were abandoned worldwide between 1985 and 1995. See "What price prawn? Shrimp aquaculture's impact in Asia", **Environment**, Vol. 38, No. 7, September 1996, pp. 12-15 and 34-39.

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◆ Abbreviations and Acronyms

FAO	Food and Agriculture Organization of the United Nations
GATT	General Agreement on Tariffs and Trade
ICLARM	International Center for Living Aquatic Resources Management
IDA	International Development Association
NACA	Network of Aquaculture Centre in Asia Pacific
NGO	non-governmental organization
Rs	rupees
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
USAID	United States Agency for International Development

I. INTRODUCTION

During the last decade, shrimp aquaculture has become a major sector of fish farming in terms of space occupied and of market value. Nonetheless, it makes only a very small contribution towards meeting human needs for food. Shrimp exports bring substantial foreign exchange to poor countries and may contribute to regional and national short-term economic growth. Shrimp farming also generates improved incomes for some producers and labourers. The long-term negative environmental and social implications of commercial shrimp farming for livelihoods of vulnerable groups in tropical coastal regions where shrimp aquaculture is developing, however, tend to be neglected by those promoting this industry.

Fish provide nearly a quarter of the worldwide consumption of animal protein. Taking into account current population trends, while assuming constant consumption per capita and the falling productivity of ocean fisheries since the late 1980s, FAO estimates that by the year 2000 there will be a deficit of 19.6 million tons of fish and other seafood (Csavas, 1994b:50). Aquaculture primarily meeting local food requirements has received little support compared to commercial aquaculture, including shrimp farming (FAO, 1995).

Aquaculture development has been heavily promoted and subsidized by international and national lending agencies that often cite global food security needs as a justification (Huisman, 1990). This is fallacious for the major portion of shrimp aquaculture which caters to luxury demand. The shrimp industry has become a main beneficiary of these subsidies and institutional supports while it is putting at risk the livelihoods and food security of many coastal populations. The cultivation of shrimp requires large amounts of natural, financial and technical resources. Countries which have important parts of their population in need of food, such as India and Bangladesh, are presently becoming the main areas of expanding coastal shrimp aquaculture. Indeed, the industry is now being promoted in less developed areas with the support of the host governments and transnational companies that are often from higher income Asian countries such as Thailand or Taiwan Province of China. These same enterprises have frequently already exceeded production, environmental and political acceptance limits in their home countries.

Shrimp are almost exclusively produced for export to meet the demands of high purchasing power consumers in Japan, the United States and western Europe (Csavas, 1992:15). Consumption in these countries has almost trebled during the last decade, but with many fluctuations in demand, supply and price. Furthermore, shrimp consumption among high income groups in rapidly growing Asian countries is also increasing considerably. Shrimp aquaculture is, however, a rather inefficient way to produce food calories and proteins as it relies on pellet feeds derived from captured fish for from 25 to 50 per cent of its content (Primavera, 1994; Randall et al., 1990). Shrimp from intensive farms are fed about three times their harvested weight. But of the total amount of food provided, only about 17 per cent is converted into consumable flesh, 15 per cent is leached or not consumed, 20 per cent is released in faeces and the remaining 48 per cent is used by the

organism for maintenance, moulted shells and metabolism[1] (Primavera, 1994:45).

World aquaculture is overwhelmingly concentrated in Asia. Asian aquaculture of all kinds produced about 17 million metric tons in 1992, while the rest of the world accounted for only a little over 2 million metric tons. Almost half of Asian aquacultural production is from fresh-water. In 1992, crustaceans accounted for only 4.7 per cent of total volume of Asian aquaculture, while the largest share (48.2 per cent) came from fin-fish mostly produced inland; seaweed accounted for 31.3 per cent and molluscs 15.7 per cent (Csavas, 1994b:48, figure 3). If coastal aquaculture is considered alone, crustaceans made up 8.2 per cent (Csavas, 1992:figure 9), of which most are shrimp with 750,000 tons produced in 1994 (Rosenberry, 1994b). Shrimp excepted, the greatest part of Asian aquaculture production remains in domestic markets. Since only the traded part of production enters the statistics, cultivated fish make up a greater share if self-provisioning could be estimated.

The trend towards intensive shrimp aquaculture is encouraged by high profits from farmed shrimp. These profits result in growing economic power of large producers and of shrimp feed and processing industries. The spread of shrimp production contributes to decreasing land availability for other activities such as peasant agriculture, grazing, artisanal fish production, forestry and tourism. It also stimulates sharply rising land prices in many coastal areas.

Intensive shrimp farms imply high stocking densities making them very prone to the propagation of pollution and disease. Hypernutrification and eutrophisation[2] of the ponds contribute to their foul smell and pollution as do added chemicals to get rid of predators, parasites and infections. This pollution affects local ecosystems and consequently the health and well-being of local people.

After a production cycle of about four or five months, shrimp ponds under intensive use are cleaned and disinfected and the polluted sludge is removed and often disposed of unsafely. This treatment, however, does not usually suffice to maintain the ponds' productivity for more than five to ten years (Boromthanarat, 1994, Annex III:12). Entrepreneurs then move to other areas because of pollution and disease. This mode of production has been called "rape and run" (Csavas, 1994b). The altered milieu of these abandoned ponds inhibits the spontaneous regeneration of vegetation and their use for agriculture, forestry, other aquaculture or related fishing activities. These abandoned areas do not appear in worldwide estimates of areas used for shrimp farming. Areas in shrimp ponds for 1993 were estimated to include 962,600 hectares, of which 847,000 hectares were in Asia. In December 1994 these areas in shrimp ponds were estimated to have increased worldwide to 1,147,300 with 1,017,000 hectares in Asia (Rosenberry, 1993 and 1994a). Globally, areas affected by the industry's

[1] Based on a study conducted in 1992 on 4,500 hectares of intensive farms in the Philippines producing between 3 and 6 metric tons per hectare per crop, with two crops per year.

[2] Hypernutrification results from an excess load of nutrients (nitrogen, phosphorus and ammonia) in the water. Eutrophisation is the consequent increase in organic matter and decrease in dissolved oxygen. The latter often leads to phytoplankton blooms.

practices over the last decade are probably at least one third larger, or even more if the total infrastructures surrounding the ponds are taken into account.

A few voices of local people most directly affected by the negative environmental and social impacts of shrimp farming have from time to time reached the media. The promoters of shrimp production usually heed them only in so far they jeopardize their immediate profits. Furthermore, environmental problems related to pollution tend to be addressed when they affect commercial aquaculture production. For example, aquaculture is highly dependent on water quality, so that this issue has received considerable attention by large shrimp producing enterprises. But, the impacts on aquatic biodiversity and natural resource loss and conversion affecting other land and water uses and users are frequently ignored both by the industry and public agencies. Aquaculturists and supporting national and international agencies are primarily concerned with mitigating those impacts that constrain further expansion of the shrimp industry.

Tropical coastal regions are among the most densely populated areas in the world. The durable productivity of these often fragile environments, as well as the continued access by inhabitants to their resources, are essential for maintaining inhabitants' livelihoods (Hinrichsen, 1994). In comparison to most other non-traditional export crops[3], shrimp aquaculture is developing at an exceptionally rapid pace. In the communities where commercial shrimp aquaculture has been implanted, nearly everyone is affected in one way or another. Environmental and social effects often extend far beyond the villages invaded by shrimp farms. Moreover, the new activities frequently not only deprive many local people of their traditional access to the land, water and other resources necessary for sustaining their livelihoods, before alternatives become available, but they may also severely degrade the surrounding environment.

Conflicts over the control of natural resources inevitably arise when market forces and public policies make new uses of these resources more commercially profitable than were traditional ones. Such conflicts are especially acute where customary uses by the groups exploiting them were primarily for self-provisioning and to supply local markets, while the new ones are to meet the demands of higher income consumers elsewhere. Even those groups who retain their traditional access to natural resources may find them less productive than previously. The levels and qualities of their livelihoods are likely to deteriorate in the long run.

Social and environmental problems associated with land alienation, technological change and the commercialization of natural resources and labour are well known. They have been widely documented and analysed since the enclosures of the English commons in the seventeenth century in order to increase supplies of cheap wool, mutton and labour to meet new demands stimulated by the incipient industrial revolution. The recent rapid expansion of shrimp aquaculture with its attendant contradictory social and environmental consequences should be viewed in this historical context. It is only one small recent incident within the broader processes generating social

[3] Flower production is an export cash crop that has a comparable growth rate.

exclusion and environmental degradation. What has been happening socially and environmentally associated with the expansion of shrimp farming is in many ways similar to what happened earlier with the expansion in poor countries of other monocultures, such as banana, cotton, cocoa, tea, coffee and sugar for sale in world commodity markets. In 1993, shrimp futures were already being traded in the Minneapolis commodity exchange (Rosenberry, 1993:36), showing clearly the extent to which shrimp aquaculture has become commercialized.

New patterns of agro-industrial production and distribution are being increasingly stimulated by technological and organizational innovations. Their social and environmental impacts, however, are variable from one place and time to another. These impacts depend principally upon institutions and polices at all levels no matter whether these agro-industrial revolutions in production and marketing are "green" or "blue" (concerning aquaculture). Good research and informed debates are needed to help to generate political pressures for institutional and policy reforms that would enable the industry to be controlled in its expansion and become more sustainable socially and environmentally than it appears to be at present.

Care must be used in generalizing from fragmentary and unprecise national data as well as from a few case studies about the social and environmental implications of shrimp production. Published FAO production and trade statistics often do not separate cultivated from captured shrimp. The data concerning production trends are mostly generated for and by the industry itself. Bob Rosenberry, one of the industry's principal authorities on production and marketing trends, warns of margins of error of from 20 per cent to 40 per cent (Rosenberry, 1993:52). The reader should keep in mind that the estimates cited below are only rough approximations.

Each local situation is to some extent unique in both its social and ecological contexts. Even using similar technologies, intensive shrimp production in one situation may cause intrusion of salt-water into fresh-water aquifers, while in another place the fresh-water may be promptly replenished. Changing configurations of the coastline and ocean currents may result in wider damage when ponds are constructed or mangroves removed in some cases than in others. Pollution from shrimp ponds may contaminate drinking water in some places but in others it may not. Serious pollution from urban sewage and industry may soon force shrimp enterprises to move to new pristine areas in some places, but may not affect them as much as self-pollution from the ponds in others. Such limitations should be kept in mind when interpreting the tentative conclusions and suggestions that emerge from this partial review of the literature.

The social and environmental implications of shrimp cultivation seem to have been insufficiently or inadequately scrutinized by independent researchers. The available data concerning shrimp aquaculture reflect this paucity of critical studies. Production increases and export earnings are well publicized, but local socio-economic losses and environmental degradation affecting the well-being of coastal populations seldom appear in the balance sheets.

This paper looks at interrelated social and environmental impacts of shrimp aquaculture that have been largely neglected. We attempt a critical analysis based on available data and a few case studies appearing in the literature. The reader should keep in mind the many limitations of the present paper. It is based on information we were able to find from Geneva. Data were frequently partial, fragmentary, descriptive and probably not very comparable. We have merely attempted to place available materials in an analytical framework that links environmental with social issues, as well as to indicate gaps that call for further research.

After this introduction, we look at the recent rapid expansion of shrimp aquaculture with emphasis on Asia. A third section attempts to identify the principal actors of the shrimp industry from cultivation through processing, trading and consumption stages, including its financial and official supporters. A fourth section describes how the shrimp industry is displacing, suppressing or exploiting existing and potential alternative productive activities. We examine environmental impacts such as mangrove destruction, pollution and other forms of land and water degradation. The interrelated negative social and environmental impacts this kind of development entails are often referred to as "externalities". We scrutinize them critically to assess their importance for those most affected. We suggest that the shrimp industry's expansion often builds on existing inequalities and generates new ones. We raise questions about who seems to be benefiting and who seems to be losing and about which actors bear what kind of risks and detrimental impacts.

A fifth section looks more broadly at the roles that market forces, institutions, policies and official discourse play in the growth of the shrimp industry and its social and environmental impacts. The partial remedial actions private and public social actors are attempting in order to mitigate or remedy negative consequences of the industry are assessed critically. Finally, a short appendix proposes directions for further research on social and environmental issues related to the expansion of shrimp aquaculture. Such studies could contribute in particular to better use of tropical coastal resources for meeting present and future food, employment and income needs of local people, while taking into account the foreign exchange requirements of developing countries.

II. RECENT TRENDS IN ASIAN SHRIMP PRODUCTION

Only fifteen years ago nearly all commercialized shrimp were captured from the oceans. Capture of wild ocean shrimp tended to become more seasonal and unpredictable during the second half of the 1980s. In several Asian coastal zones, shrimp were also cultivated for local consumption in traditional *bheri* multicropping aquaculture systems during the dry season in intertidal areas. Brackish estuarine water was allowed to flow into croplands bringing with it crustacean and fish fry which would feed and grow on naturally available plankton and other vegetation. Also, traditional salt makers often used their ponds to cultivate fish and prawns during the rainy season (Sultana, 1994). By 1993, close to 30 per cent of world shrimp production came from monocropping extensive, semi-intensive and intensive aquaculture. It is estimated that by the year 2000 cultured shrimp will surpass harvested shrimp production (Maw Cheng Yang, cited by Rosenberry, 1993:34).

While there are several hundreds of classified shrimp species, Asian shrimp and prawn farming concerns only about eight warm-sea or brackish water species. About 60 per cent of Asian farmed shrimp production is from the black tiger shrimp (*Penaeus monodon*) or gambas, about another 25 per cent from the fleshy prawn (*Penaeus chinensis*), and the remainder is mainly shared by the banana shrimp (*Penaeus merguiensis*) and in minor proportions by four or five other species (Csavas, 1992; Rosenberry, 1994b). Shrimp culture has been long dependent on wild seed stocks, be it by collecting fry in shallow estuaries or by capturing live gravid females. More recently — as wild stocks are depleting and reproduction is not feasible by shrimp confined in ponds — hatcheries are being built to produce post-larvae more intensively from artificially fertilized mature female prawns whose eyes are cut to induce their spawning[4].

Globally, production of farmed shrimp increased exponentially from about 200,000 metric tons in 1985 to exceed 630,000 metric tons in 1990. Then the growth rate slowed down. World production climbed to an estimated 721,000 metric tons in 1992 but in 1993 it fell back to about 610,000 metric tons (see table 1). In 1994, world production was estimated to be 733,000 metric tons[5]. (Rosenberry, 1994a:47). Production estimates from different sources vary substantially: for example, according to FAO, total farm-raised shrimp and prawn production in 1992 was 884,075 metric tons — 23 per cent more than estimated in table 1 (FAO, 1994).

Estimates of the monetary values generated by farmed shrimp production vary widely depending on the prices and volumes assumed and the link in the production chain at which they are calculated. World production as it

[4] In natural conditions, shrimp move through about ten habitats during their life cycle. Mature shrimp breed at sea on reefs, larval and juvenile shrimp grow in mangroves to go then further upstream into low medium salinity reaches, before going back to the estuary and reefs to spawn (Ibrahim, 1995).

[5] These production quantities are estimated for live heads-on shrimp.

leaves the shrimp farms was estimated at US$ 3.4 billion in 1993, by one source (**Produits de la Mer**, 1994:83).

Assuming an average producer price of US$ 4 per kilogram[6], 1994 production of 733,000 tons would have a monetary value at the farm level of about US$ 3 billion using Rosenberry's production estimates. Prices of shrimp landed in importing countries were worth about US$ 6 billion, about double producer prices. Indeed, the United States importing firms in 1994 paid some US$ 5.50 per pound or about US$ 11 per kilogram of shrimp (Filose, 1995:231). If 80 per cent of worldwide cultivated shrimp were exported, and if import prices were for "heads-off" shrimp, this implies a considerably smaller volume than that estimated for total heads-on production. Accordingly we reduced the overall volume of produced live shrimp from 733,000 tons to 550,000 tons of traded shrimp; the average shrimp market value as an imported commodity would then be about US$ 6 billion for 1994.[7] A large share of value added within the importing countries goes to distributors, retailers and food industries which mark up the product (cost, insurance and freight included) by between 30 and 50 per cent (INFOFISH, 1991:63), raising the global retail market value of farmed shrimp to a conservative estimate of US$ 7.8 billion. These estimates do not account for price variations of imported shrimp between Japan, the United States and Europe (see figure 4, page 23), which show that Japanese were paying the most per kilogram of imported shrimp. Also, these estimates exclude other world importers — middle and upper classes from Asian countries in particular are becoming, in general, great shrimp consumers — and earnings accruing from domestic markets (China alone consumed 100,000 tons of farm-raised shrimp in 1993 — Rosenberry, 1993:52). Overall the retail market value of cultivated shrimp is well over US$ 8 billion.

About 80 per cent of world cultured shrimp come from Asia. Between 1993 and 1994 Asia has increased its production from 477,000 metric tons (heads-on) to 585,000 metric tons, with an increase in area of about 170,000 hectares to reach a total exceeding one million hectares (Rosenberry, 1993 and 1994a). The decline in production in 1993 was largely due to disease outbreaks damaging two thirds of the Chinese shrimp crop and also affecting many Indonesian and Ecuadorian shrimp farms. The main reasons for the disease outbreak were polluted waters, dense use of coastal areas for semi-intensive and intensive production and fragile shrimp due to over-medication and overstocking. China's production difficulties continued in 1994, but overall Asian production increased between 1993 and 1994 by about 20 per cent (Rosenberry, 1994a).

[6] Production costs at farm level vary widely — from US$ 1 to US$ 8 per kilogram of live shrimp — according to the price of the land and labour and the degree of intensity of production (Rosenberry, 1994a:40). We assumed an average production cost at farm level, including return on capital, of US$ 4 per kilogram of live shrimp.

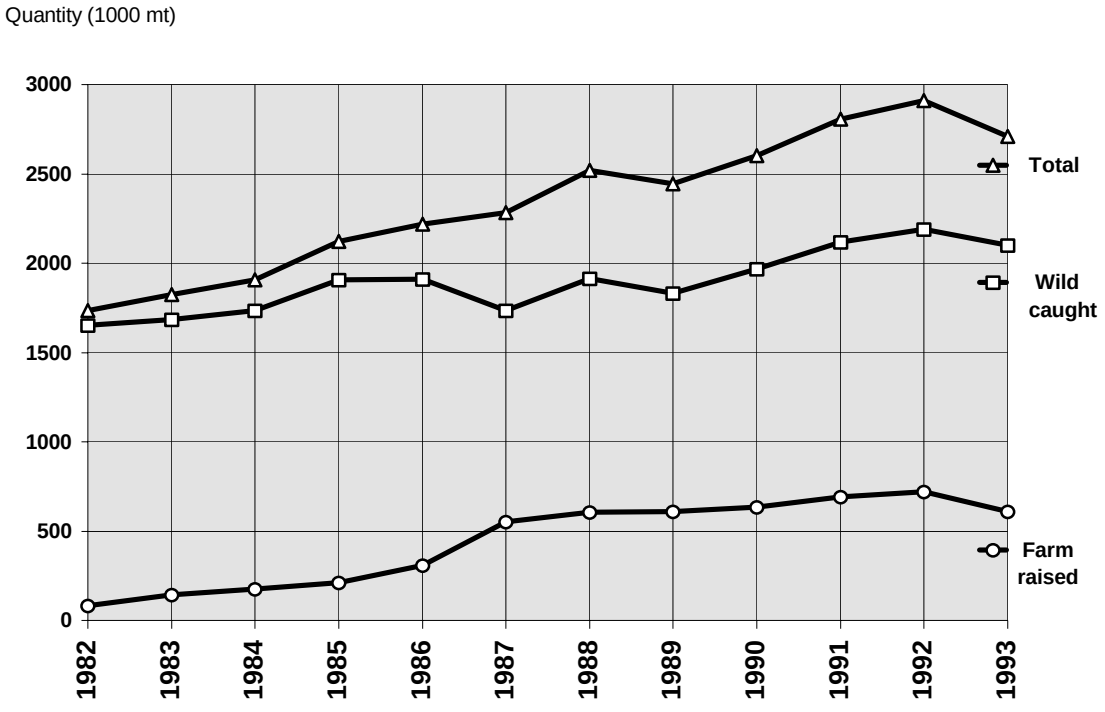
[7] FAO's estimate of the global value of cultured shrimp for 1992 comes to US$ 6 billion (New et al., 1995:15).

Table 1: World production of shrimp, 1982-1994

Thousands of metric tons			
Year	**Farm-raised**	**Wild-caught**	**Total**
1982	84	1,652	1,736
1983	143	1,683	1,826
1984	174	1,733	1,907
1985	213	1,908	2,121
1986	309	1,909	2,218
1987	551	1,733	2,284
1988	604	1,914	2,518
1089	611	1,832	2,443
1990	633	1,968	2,601
1991	690	2,118	2,808
1992	721	2,191	2,912
1993	610	2,100	2,710*
1994	733	-	-

Source: Peckham, in Rosenberry, 1994a: 47.
* The **FAO Yearbook of Fishery Statistics, 1994** estimates worldwide nominal catches for 1993 — including cultivated shrimp — at 2,892,927 metric tons.

Figure 1: World production of shrimp, 1982-1993



Source: Rosenberry, 1994a.

Shrimp aquaculture production varies widely from year to year and from place to place principally because it is particularly sensitive to disease outbreaks. Before its industry collapsed due to disease in 1988, Taiwan Province of China was the world's largest producer. In the early 1990s

China, followed by Thailand, Ecuador, Indonesia, Viet Nam, the Philippines, India and Bangladesh were the most important producers globally (see table 2). Very high densities of shrimp cultivation were reached in some coastal areas of these countries. In 1993 the abrupt drop in China's production left Thailand as the world's largest producer. Thailand has developed part of its Inner Gulf area with shrimp ponds at the incredible density of about 100 hectares of ponds per kilometre of coastline (Csavas, 1994a:figure 13). From 1993 to 1994, Thailand expanded its pond area for shrimp aquaculture from 60,000 hectares to 80,000 hectares. Most of the Thai production (85 per cent) comes from intensive farms with ponds from 0.5 to 5 hectares each (Rosenberry, 1993 and 1994a).

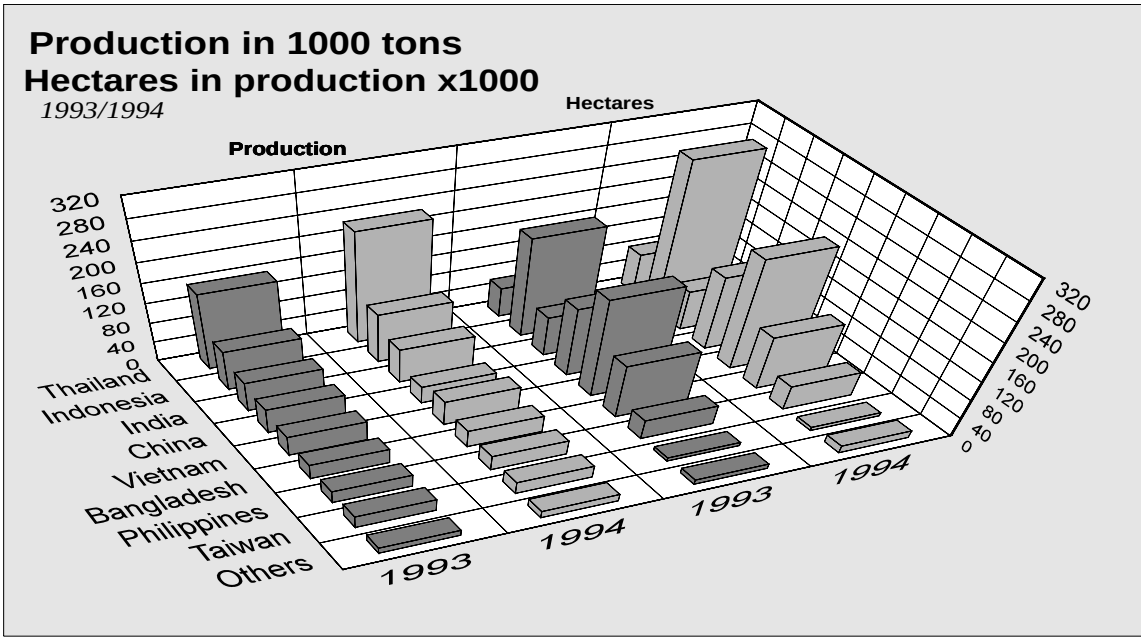
The progression of cultured shrimp production has been facilitated both by evolving technologies and expanding pond areas. Customary production systems are being replaced by more intensive ones. This has been encouraged by increasing demand from high income countries, together with governmental and lending agency support and subsidies. Shrimp yields per hectare in many areas increased within a few years from an average of 100 kilograms per hectare per crop to an average of about 1,000 kilograms per hectare per crop for semi-intensive shrimp farms, and to between 2,000 and 10,000 kilograms per hectare per crop for intensive forms of production. There can be from two to three crops per year for semi-intensive and intensive types of shrimp farming. Yields beyond 8,000 kilograms per hectare per year, however, involve high risks of heavy shrimp mortality due to overstocking and self-pollution (Hirasawa, 1992). Water in intensive ponds has to be exchanged more frequently, in order to supply clean water and dissolved oxygen necessary for the growth of the shrimp. Asian-wide average pond productivity per hectare per year increased from 563 kilograms annually in 1993 to 575 kilograms in 1994. Intensification still includes a minority of shrimp farms in most Asian countries and production increases are in part due to the increase of pond area for all types of farms taken together.

Table 2: World shrimp farming statistics by region and by country, 1993-1994

	% of production by hemisphere		Tons of heads-on production (1,000 t)		Hectares in production ('000 ha)		Kilograms per hectare (kg/ha/yr)	
Ecuador	68	68	90	100	90	90	1,000	1,111
Colombia	7	7	9	10	3	3	3,333	3,846
Honduras	7	7	9	10	8	11	1,125	909
Mexico	7	8	9	12	8	12	1,125	1,000
United States	2	1	3	2	1	1	3,333	2,887
Others	9	9	12	14	6	13	2,000	---
Western Hemisphere	**100**	**100**	**132**	**148**	**116**	**130**	**1,142**	**1,136**
Thailand	32	39	155	225	60	80	2,583	2,813
Indonesia	17	17	80	100	200	300	400	333
India	13	12	60	70	80	80	750	875
China	11	6	50	35	140	150	357	233
Vietnam	8	9	40	50	200	225	200	222
Bangladesh	6	6	30	35	110	110	273	318
Philippines	5	5	25	30	40	50	625	600
Taiwan	5	4	25	25	7	7	3,571	3,571
Others	2	2	12	15	10	15	1,200	1,000
Eastern Hemisphere	**100**	**100**	**477**	**585**	**847**	**1,017**	**563**	**575**

Source: **NAGA**, the ICLARM Quarterly, 1994:30; Rosenberry, 1993 and 1994b:3 and 14.

Figure 2: Quantities of cultivated shrimp and hectares in production by Asian country, 1993-1994



Source: Rosenberry, 1993, 1994.

Extensive farms can flood over 100 hectares; although they are commonly much smaller; intensive and semi-intensive ponds vary from less than 0.5 hectares to about 5 hectares. Semi-intensive farms for the most part use minimal external inputs and rely on the capture of wild shrimp fry and only occasional feeding. Intensive ones use hatchery raised post larvae, pellets of mixed feeds, chemical fertilizers, medication, etc. Feed costs average 50 per cent of production costs for intensive and semi-intensive farms reaching over two thirds of current operating costs for some intensive farms. Shrimp are fed four to five times per day. In 1994 feed mills worldwide produced one million metric tons of shrimp feed. Feed manufacture requires considerable inputs of commercial energy and sophisticated technology in order to produce nutritious and physically stable pellets. Even the best pellets, however, lose about 20 per cent of their protein and most of their other nutrients within one hour of being immersed in the ponds (Rosenberry, 1994a:42-44). While labour input is relatively low, the energy costs of more intensive forms of shrimp production are high. Commercial energy inputs include the production of nutrients, feed, veterinary and sanitary products; the pumping and aeration of water[8]; the production and use of automated feeding and harvesting devices; the raising of shrimp larvae in hatcheries; the freezing, packaging, storing and transporting the product to distant consumers.

Different farming systems vary greatly in the amount and rate of exchange of pond water as well as in the salinity of the water that is used. Optimal growth of shrimp is believed to occur in a salinity one third below that of average sea-water salt content, as this favours phytoplancton beneficial to the growth of the shrimp. On the other hand, sea-water is less inclined to become infested with pathogens. Fresh-water from irrigation channels is also

[8] Keeping water oxygen levels at 6-9 milligrams per litre (Ibrahim, 1995).

often loaded with harmful nutrients and chemicals (shrimp farms being at the tail end of irrigation systems). If the fresh-water is pumped from underground wells it often causes a fall of water tables, and may thus result in the salinization of fresh-water aquifers. Many Thai farms, however, pump in only sea-water (with an average daily exchange of 20 to 30 per cent) in order to bring in natural foods (compensating for lesser growth of phytoplancton). This sea-water based system also uses sea-water reservoir ponds that accumulate water from high tides and allow sedimentation, temperature elevation, and some phytoplancton growth before the water is introduced into grow-out ponds. In semi-intensive systems (with a water depth of about one metre) the pond water is exchanged at a rate varying between 50 per cent per week and 30 per cent per day, using natural tidal flows or pumping. Intensive shrimp production (with ponds from one to three metres deep for super-intensive farms) requires a change of about 30 per cent of pond water per day and up to 50 per cent for super-intensive systems (Kongkeo, 1990:table 3). Systems using large quantities of fresh-water tend to be particularly vulnerable because high-quality water is becoming a scarce resource nearly everywhere.

The environmental and social implications of the rapid expansion of intensive shrimp aquaculture are staggering. Thailand has about 2,600 kilometres of coastline (Csavas, 1994b), and less than half of this is on its Inner Gulf. If its 80,000 hectares of ponds (85 per cent of which are intensive) were spread evenly along its entire coast, there would be a continuous belt of ponds some 300 metres wide. Of course, this is not the case as in some areas ponds penetrate several kilometres inland, but even so, large areas of its coastline are entirely occupied by intensive shrimp farms. According to the literature reviewed, intensive ponds have a maximum life of only five to ten years (Boromthanarat, 1994). Abandoned ponds can no longer be used for shrimp and there are few known alternative uses for them except some other types of aquaculture. Apparently they can seldom be economically rehabilitated for other uses such as cropland. If these assertions are accurate, within a decade or two there would be practically no mangroves, salt marshes or agricultural lands that were usable left in the coastal margins of the country, assuming it continues production near present levels.[9]

The situation in Bangladesh could become even more dramatic. The country has 700 kilometres of coastline and is estimated to have 110,000 hectares of shrimp ponds. At present, these ponds are nearly all extensive. Even though many traditional users are losing access to some of their resources, there has been less environmental damage associated with extensive than with semi-intensive or intensive shrimp farms. If these ponds were evenly spread along the coastline, it would imply a continuous belt over 1.5 kilometres wide. If these extensive ponds are turned into intensively managed farms, the ecological and social impacts will be even greater. Future generations may have a very heavy burden to bear as a consequence of intensive shrimp farming in these countries.

[9] Taiwan Province of China, the world's largest producer in 1988 with 10,000 hectares of ponds, had only 7,000 hectares of ponds in operation in 1993. Further research should be carried out on what has happened to its abandoned ponds and on what the ecological implications have been.

III. VARIOUS ACTORS IN THE SHRIMP INDUSTRY

Most of the literature on shrimp aquaculture is relatively uncritical concerning its social impacts. One reason for this neglect is because its authors seldom distinguish between the different actors who are involved and affected. This section attempts to identify the principal actors throughout the shrimp production chain from the producer up to the consumer, including official agencies and lending institutions. Section IV will focus on actors who are not included in the industry, but are negatively affected by externalities and by reduced access to natural resources.

Commercial shrimp aquaculture is considered to be an industry because it integrates the whole production chain of which the cultivation stage is only the first link. It also involves many inputs and technologies which are produced by other industries. The industries producing the inputs and aquaculture technologies and those which are processing and marketing the product employ many more workers than does production at the farm level.

Commercial aquaculture combines many elements from fisheries and agriculture. Aquaculture, in contrast to the fishing industry, has no professional identity. As a result it has received little attention by national and international labour organizations. In Ecuador, which has been among the leading exporters of shrimp for over a decade, efforts to organize labour unions by shrimp industry workers have been consistently broken (Snedaker et al., 1986). The International Labour Organization has no data on employment in shrimp aquaculture. Some Asian governmental agency and FAO reports give crude estimates of overall employment in aquaculture. There is almost no information breaking down employment according to the different labour categories at each level of shrimp production. Consequently, we have to make inferences based on fragmentary data taken from somewhat non-comparable Asian country reports.

◆ Shrimp Farmers And Labourers

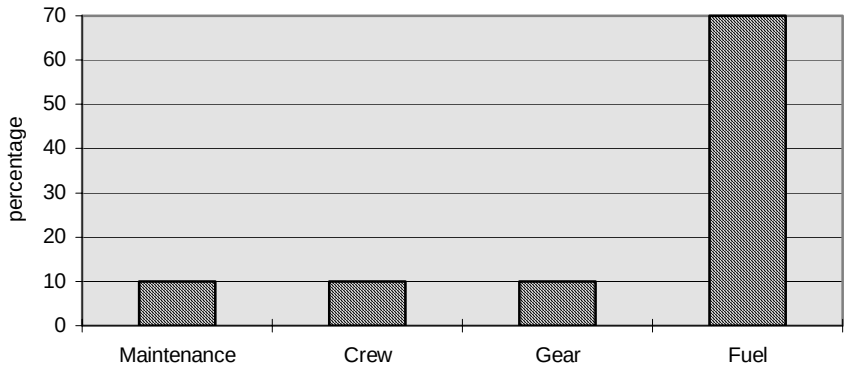
There is apparently an average of one to three persons working on a full-time basis per hectare of semi-intensive and intensive shrimp pond and up to seven for extensive ponds. Worldwide, shrimp farms covered approximately 962,600 hectares in 1993 and may have employed the full-time equivalent of over one million workers.[10] This farm level employment includes temporary low-paid construction workers and permanent maintenance labourers (handling, pumping, feeding, pond water treatment and harvesting), supervisors, and guards to prevent the theft of shrimp from the grow-out ponds. A few temporary employment opportunities are given to engineers, heavy equipment operators, researchers and consultants. In East Java and Viet Nam employment costs have been estimated to be about 6 per cent of total operating costs in intensive shrimp farming (Chong, 1992) compared

[10] The development of about 30,000 hectares of shrimp ponds would employ about 30,000 to 40,000 people on a full-time basis for an investment of approximately US$ 100 million (FAO/NACA, 1994b:55).

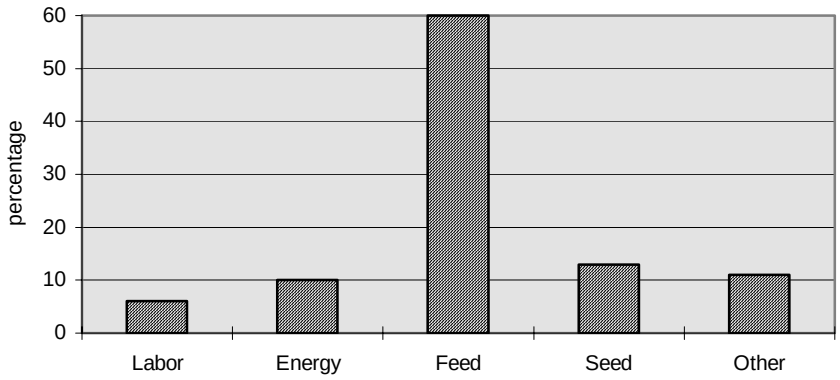
with about 30 to 40 per cent in traditional extensive shrimp production (Kongkeo, 1990). With the tendency to develop more semi-intensive and intensive modes of shrimp production, labour as a portion of total costs is being reduced by using more energy and technical inputs. "Aquaculture (shrimp) can hardly be regarded as a mass employer" (Ben-Yami, 1986).

Figure 3: Costs of shrimp trawling and shrimp culture in Indonesia

Shrimp trawling costs in the Arafura Sea (US$ 4.10/kg.)



Shrimp aquaculture costs in West Java (US$ 4/kg.)



Source: Chong, 1992:34 (cited in Csavas, 1992:17).

Compared to other production systems taking place in the same coastal areas — mostly rice production — labour requirements for shrimp aquaculture are very low. One study in Indonesia reports that rice production employed an average of 76 workdays per hectare per crop cycle. In the same area, a semi-intensive shrimp farm employed about 26 workdays per hectare (McCoy, cited in Bailey and Skladany, 1991), and an extensive shrimp farm about 45 workdays per hectare per cycle (Hanning, 1988). Extensive shrimp production in West Bengal, on 100 bighas[11], was reported to employ about one third less labour than when the same area was used for rice paddy. In

[11] One bigha equals 0.67 hectares.

West Bengal, extensive shrimp production, called *Jalkar*, lasts seven to eight months per year, after which rice paddy cultivation takes over for the remaining months of the year. In this case, labour costs amount to about 7 per cent of the shrimp production total costs (Centre for Communication and Development, undated:25). Workers hired for the eight month period of shrimp production leave their jobs after that period and are hired afresh every year. Average wages in the mid-1980s were about Rs. 180 per month (at 1985 exchange rates, approximately US$ 18). The wages of managers and guards in the mid-1980s were around Rs. 300 (or about US$ 30) a month. Workers lived on the site and often worked at night when the shrimp feed. A West Bengal non-governmental organization says: "the conditions of work and employment are totally dependent on the owners' whims and fancies". Generally about half of the people employed in the *Jalkar* come from distant villages, especially the guards who are believed to be more reliable if they have no local connections. In the *Jalkar* system, shrimp production provides twice as much money income to the pond- or *Jalkar*-owner than would rice production. The benefit to small landowners who are forced to lease their land has been considerably less. In some cases, their rental income has been inferior to what they could gain from rice paddy cultivation, especially if direct consumption benefits are taken into account (Centre for Communication and Development, undated).

These employment and labour figures do not show the employment lost with the development of shrimp farms. Such social costs and environmental "externalities" will be discussed later. It appears from the available literature that for similar areas both traditional aquaculture and agriculture generate more employment than does commercial shrimp farming. In any event, the type of employment generated by shrimp farms is often not available to local people (Snedaker et al., 1986; Centre for Communication and Development, undated). In Bangladesh, the Department of Fisheries estimates that about 75 per cent of the shrimp farmers in the early 1970s were not natives of the coastal areas in Khulna and Satkhira districts (Sultana, 1994:2). In the sample village of Chokoria Sundarban area[12], only 10 out of 300 households obtained leases of shrimp ponds. Leases of 10 acre (4 hectare) shrimp farms in a former mangrove area were beyond the reach of most local farmers (Sultana, 1994:7-9). Many of the shrimp farm owners came from the business or service sector. In the Polder 17/2 area[13], they leased land from local farmers as well as from the government and inundated several hectares beyond the leased land, forcing other land users out of the area and into less secure or more difficult income earning activities (Sultana, 1994: 11).

Extensive shrimp farms produce about one ton of product per growing cycle per ten or more hectares of land. Intensive farms require important investments in other capital besides land (in order to increase stocking densities, water exchange capacities, etc.). Overall production costs (including construction and operating costs) for traditional extensive methods are estimated at US$ 1-3 per kilogram of live shrimp. Land and labour are the principal inputs of extensive shrimp farming. These production costs are commonly undervalued in less developed countries. On the other hand, purchased inputs, costs of energy and technical devices, on

[12] In Cox's Bazar District.
[13] In the Dumuria Thana of Khulna District.

which more intensive methods rely, tend to reflect their prices in world markets. Operating costs for semi-intensive and intensive farms range from US$ 3-6 per kilogram of live shrimp (Rosenberry, 1993:23-24).

◆ National and Transnational Investors and Agencies

Shrimp farm owners or operators producing for international markets have to adopt more intensive technologies in order to remain competitive as there are sharp limits to the land and water resources still available for extensive production. This requires access to financial resources and expensive technology. These are provided most of the time by urban entrepreneurs supported by foreign investors and industries. Wealthy investors, such as transnational corporations, tend to be very influential and therefore likely to obtain preferential access to public or private lands, water, credits, markets, tax holidays, subsidies, licences, foreign exchange and technology (FAO/NACA, 1994a:29; Ben-Yami, 1986; Kowalewski, 1987).

The allocation of resources for shrimp farming, and the distribution of benefits, varies greatly from one social context to another. For instance, in the Philippines where the control of land and other resources has traditionally been highly concentrated with a small élite, most shrimp production is in the hands of a few large entrepreneurs and investors. In Thailand, however, land ownership has, on average, been rather widely dispersed. There, small- and medium-sized shrimp farmers who were previously cultivators and fishermen could frequently move into shrimp farming and in this way improve their incomes substantially. In the 1980s, large feed and other input manufacturers, processors and marketing companies became increasingly important. They have played a crucial role in intensifying Thailand's shrimp production and thereby increasing their own profits. These large enterprises are often joint ventures with transnational investors based in Japan, Taiwan Province of China, Europe or North America who also provide additional economic and technical backup.

In most cases the large enterprises do not attempt to own the shrimp production units. In Thailand in 1990 they owned only some 10 per cent of the total number of shrimp farms and produced less than 20 per cent of the total output. A few large corporations, however, had oligopolistic control over the feed production sector, with only nine enterprises sharing 80 per cent of the market at the beginning of the 1990s. By promoting co-operatives and societies in which the shrimp farm owner or farmer was only one member, these large enterprises could closely control production practices (prescribing exactly the type and quantity of inputs to use and having exclusive control over the output) (Weigel, 1993:399).[14] In this way they could reap profits while passing on many of the risks to small "independent" producers. Shrimp farmers' profits tend to fluctuate greatly from one crop cycle or year to another. Processors and trading enterprises have more stable incomes, as they tend to have important shares of the market among the 50 countries which cultivate shrimp. The trend is to encourage intensive shrimp

[14] Some of these large enterprises include Charoen Prokphand, S.T.C. Feedmil Co., Aquastar Co., Unicord Feed Co., Lee Feed Mill Co., Krungthai Feed Mill Co.; large transnational corporations such as Mitsubshi and Cargill are also involved.

farms developed on the farmers' own units but with substantial financial and technical backing (Platteau, 1989).

Governments have often played an essential role in launching commercial shrimp production. The state has frequently provided cheap credits and facilitated access to land, water and modern inputs as well as to export markets. Traditional common property management systems are seldom suitable for shrimp production geared to export markets. Common property régimes previously accommodated seasonal multicrop aquaculture combined with agriculture for local consumption. The high returns in convertible foreign currency from shrimp aquaculture make it an industry which has been greatly favoured by governments, as well as by national and transnational banks: "The state (is) transforming multiple-use/multiple-user resources historically used by coastal residents to single-use private property owned by local and national élites ..." (Bailey, 1988:32).

A study concentrating on Amphoe Hua Sai and Ranot, two districts of southern Thailand[15], reports that around 3,000 shrimp farmers controlled 20,876 rais (about 3,367 hectares) in ponds. Most of these pond owners (about 93 per cent) were also their operators, but this area seems to be exceptional in this respect. The financial incentives to enter the shrimp business were very high. Thai aquaculturists in the Ranot district, who were previously growing mainly rice, increased their income by as much as ten times (Aquastar Laboratories Ltd., 1994:7-8). Most of their ponds were used intensively. In the districts studied, shrimp farmers were moving in from other areas where they had been producing shrimp for several years (most of them from three to five years) (NACA, 1994b:21-22). Shrimp farming is a full-time activity for most shrimp farmers in this area, as 80 per cent of shrimp farmers reported that shrimp were their only source of income.

For all Thailand, however, it was estimated that 70 per cent of all shrimp producers had other sources of income: 32 per cent as traders, 16 per cent as fishermen, 8 per cent as rice farmers, 7 per cent as labourers and another 7 per cent as government employees (NACA, 1994b:22). It was estimated that only 20 per cent of the shrimp farmers owned their farms, that 77 per cent had access to the land through a collaboration with relatives and friends[16], and that only 3 per cent of the shrimp farms were actually owned by a company.[17] These figures, however, do not show how much pond area each of these groups controls. As shown above, the influence of large corporations in the shrimp industry does not depend on their ownership of the land under production. Large corporations control financial and technical inputs as well as processing and marketing channels. In this way they indirectly controlled in 1991 about 76 per cent of all Thai shrimp farms (ibid.:121, table 37).

Thai aquaculture has thrived in part due to the phenomenal recent growth of the Gulf of Thailand trawl fishery. Thai trawlers fished down the food chain to smaller and smaller fish. In this way their total fish production did not fall

[15] Provinces of Nakhorn Si Thammarat and Sonkhala.

[16] The study does not say who those relatives and friends are and what type of contract binds their support.

[17] This illustrates the extremely approximate nature of the data because Weigel, cited in an earlier paragraph, estimated 10 per cent.

substantially, but 70 per cent of their landings were "trash fish" used as animal feed. "The trawl fishery of the Gulf has therefore become a fish meal producer that has enabled the aquaculture industry to develop with relatively low feed costs" (Christy et al., undated:52).

The case of Aquastar, a large Thai corporation active in the shrimp industry, shows how multinational capital is used, with the active support of governments and banks, for vertically integrating the shrimp production chain.[18] Aquastar provides farmers with credit, production inputs, technical know-how and other devices for their entry into shrimp production. An arrangement with the Bank of Thailand and the Bank of Asia allows the farmers to have access to low interest loans for construction and operating costs. The Thai Lands Department looks at the individual land holding of each farmer and "redraws the land boundaries in order to give each farmer clear title to the area of his pond". We will see in the next section that this procedure of "land consolidation" often occurs at the expense of customary local users having less formalized access rights (Fegan, 1994:18).

The World Bank participated actively in the launching of the shrimp industry in Asia. Out of an investment of US$ 1.7 billion in 1992 for Indian agriculture and fisheries, the World Bank allocated US$ 425 million for aquaculture development (Mukherjee, 1994). A substantial part of this sum seems to be destined for intensification and expansion of shrimp ponds. The involvement of the World Bank in shrimp aquaculture, and the development of related hatcheries and other shrimp facilities, illustrates the trend towards internationally organized vertical integration of this industry (O'Neil, 1994:10-11; Sfeir-Younis and Donaldson, 1984). We do not know how much the World Bank has actually invested in shrimp aquaculture in tropical countries, but partial and dispersed information suggest the importance of these credits.[19] In 1985 the Bank planned to invest US$ 200 million in aquaculture projects dispersed in Indonesia, Thailand, the Philippines, Sri Lanka, Malaysia, Bangladesh and China (Scura, 1985, cited in Bailey, 1988:33).

Recently, in India, the World Bank group's IDA has been actively promoting sizeable shrimp farming projects in West Bengal, Orissa and Andra Pradesh. Its loans help finance development of 13 sites covering a total land area of about 6,000 hectares with a net water-spread area of about 3,800 hectares. The land is divided into shrimp farms of 0.5 to one hectare. It is presumed that each pond will be leased to one small farmer family beneficiary, according to the project document. The project is meant to provide employment and income for 5,200 families. Each shrimp farmer would have the possibility of earning about Rs. 30,000 (about US$ 900) per year (**Fish Farming International**, 1994a:4). Water exchange, technical advice and the management of common facilities (including channels) and services (including technical advice and provision of inputs) would be the responsibility of the Brackish Water Fish Farming Development Agency financed through an annual service charge levied on behalf of each farm unit

[18] This enterprise is currently also investing in India and other South-East Asian countries.

[19] The World Bank has not released recent information on its credit policy concerning shrimp aquaculture, but an undated technical paper (from the late 1980s) mentions a sum of US$ 180 million investment over five years (Christy, et al., undated).

(FAO/NACA, 1994b:85-87). Overall, the World Bank would invest Rs. 400,000 per hectare (about US$ 12,000).

The donors' justification for their investments in aquaculture has been that it is going to help meet developing countries' food needs. In practice, funds destined for aquaculture have been largely diverted into the production of farmed shrimp which is a luxury export commodity, even though original plans often called for fin-fish production for domestic consumption (Luna, 1984)[20]. Incomes reaching the producing areas are unevenly and unsustainably allocated among different groups of its populations. Support for inland small-scale fin-fish aquaculture, which is less capital intensive, but is more efficient in producing protein to meet the local population's requirements, is often diminished to the extent shrimp farming has been favoured (Bailey and Skladany, 1991:66-73).

◆ Fry Collectors and Hatchery Workers

Shrimp farming has until recently depended primarily on wild shrimp fry (larvae and post-larvae) which ranged second after feed expenses in the production costs of semi- and intensive shrimp farms. In many cases, the collection of fry led to the local depletion of wild shrimp. High technology hatcheries are now being rapidly installed. Actually, considerable employment was created for local people, mostly women and children, in the collection of wild fry from estuarine waters. Local employment and complementary income opportunities will decrease to the extent this activity is displaced by hatcheries, but this is hardly mentioned in the literature. There were about 50,000 part-time fry collectors in West Bengal for about 33,000 hectares in shrimp culture (FAO/NACA, 1994b:58). For 100 shrimp post-larvae, the collector got approximately US$ 1, but what this income means to local people in different areas raises many questions which can only be answered by case studies. There are a number of other unanswered questions as well. How much post-larvae can one gather in how much time? To what extent is shrimp fry collection combined with other tasks? Who is earning and controlling the resulting income?

Between 1993 and 1994, for all Asia, the number of shrimp hatcheries doubled, according to Rosenberry, from 2,759 to 4,208 (Rosenberry, 1993, 1994b). The installation of these hatcheries is often promoted with governmental support. In Bangladesh in 1993, for example, the government owned two of the country's four hatcheries. In order to facilitate the further development of the shrimp industry, the government of Bangladesh has recently decided to sell its hatcheries to the private sector. It also provided US$ 50 million in credit to encourage the installation of new shrimp farms. The government hoped to double export earnings from shrimp in 1994, and again in 1995, to reach US$ 625 million (McElroy, 1993-1994).

Current or future loss of traditional fishery productivity implied by the excessive collection of fry should be weighed, on a case by case basis,

[20] While multicropping of shrimp with milkfish — appreciated as a source of protein in many developing countries — is technically feasible, economic conditions do not encourage it. In 1984, in South Sulawesi (Indonesia), a kilogram of prawn was worth four or five times a kilogram of milkfish (Yosuke, 1987:17).

against the current employment and revenue opportunities generated through the collection of wild fry. As will be discussed later, such an analysis should also include the risks of reduced biodiversity induced by the over-exploitation of wild fry.[21] Risks of biodiversity loss due to the collection of wild shrimp fry should also be weighed against the risks of escape from hatcheries of shrimp that are disease contaminated or have possibly been rendered dangerous for other species through genetic manipulation (Pullin, 1992). Hatcheries may not be the only alternative to shrimp fry. Prudent management of natural nursery habitats, such as mangroves, could possibly make both traditional fishery production and wild shrimp fry collection for limited shrimp aquaculture compatible.

◆ Manufacturers, Processors and Marketing Agents

Shrimp production involves manufacture of numerous inputs such as shrimp feed, fertilizers, pesticides and veterinary drugs, as well as of technical devices for water treatment and pond operation. The off-farm post-harvest production links also include processors and marketing agents (packaging, transport, export-importers, industries further transforming the product, different levels of wholesalers and retailers, restaurants and supermarkets). There are, however, few data available concerning the social composition, employment conditions and organizational structure of processing and marketing links in the shrimp production chain. A study conducted in Indonesia in 1984 reported that a cold storage factory hired mostly young women who earned no more than US$ 1 per day (Yoshinori, 1987). As was seen above, with the growth and intensification of the shrimp industry, manufacturers, processors and marketing agents are becoming increasingly powerful actors in the production chain. These sectors have grown even faster than the shrimp farming sector itself; for instance, several Asian countries report excessive freezing facilities. These providers of inputs and services in turn push direct producers to expand and intensify their production.

It is difficult to separate those off-farm related industrial and commercial activities which are exclusively related to shrimp aquaculture from those which are related to overall aquaculture production. The feeds, pharmaceuticals, pesticides, technical tools and infrastructure (such as transportation, port and freezing facilities etc.) are similar and largely interchangeable between shrimp and other aquacultural and fishery producers. The technology and inputs are mostly manufactured in the higher income countries of Europe, North America and Asia. Processing involves deheading, skinning, cleaning, sorting, weighing and freezing the shrimp. In most countries it implies low-paid and precarious employment done mostly by women, and often also by children (Sultana, 1994:13).

The numbers of intermediaries vary widely, as do their role and economic power. In Japan, shrimp-specialized primary wholesalers handle 70 per cent of imported shrimp — the remainder being distributed through central wholesale markets. International standards for shrimp exports and imports

[21] "For every single shrimp prawn in the pond almost a hundred other fish or shrimp are killed" (Csavas, 1988 or 1989:84).

have already been established, which facilitates marketing (ITC/UNCTAD/GATT, 1991). There are cases where each link of the production chain belongs to a different actor. City based agents or intermediaries may bring the shrimp to the freezing and packaging plants. The same, or another agent, may take them for export. Marketing agents may play an important role in exchanging the information necessary to equate supply and demand, to control quality and to facilitate transfer of technology. A study conducted in Bangladesh found that traders did not collude to exploit producers. There was considerable competition among traders that allowed producers to secure fairly equitable deals (de Campos Guimarães, 1989). In Japan, however, distributors tend to band together to plan their purchases at stable price and quality (**Tradescope**, 1992). As we said earlier, the general tendency is towards vertical integration of the production chain, with large seafood companies as providers of inputs, technology and credits increasingly controlling all stages from production to packaging and marketing[22].

◆ High Purchasing-Power Consumers

The United States is now the world's largest shrimp market. It has been estimated that at least 50 per cent of the shrimp imported into the United States comes from aquaculture (Csavas, 1993:45). The United States imports primarily from Ecuador, Thailand, China, Bangladesh and India. In 1992, United States shrimp consumption reached 2.5 pounds (1.1 kilograms) per capita (Rosenberry, 1993:32). Japan accounts for a third of international trade in seafood, and it imports more than 4 million tons of fish products from over 120 countries each year (Kakuta, 1994). The strong yen helped Japanese importers to dominate the market until 1992. The Japanese per capita consumption rate of shrimp reached a record of 3 kilograms per year in 1989. The value of cultured shrimp in Japanese imports of seafood increased from 29 per cent of the total in 1986 to 46 per cent in 1991.[23] Europe[24] is also increasing its overall shrimp imports; from 1993 to 1994 alone they rose by 7 per cent (FAO, 1994:398-399). Besides, there is a growing market among the expanding middle- and upper-classes of the newly industrializing Asian countries.

According to FAO, worldwide shrimp consumption grew by nearly 4 per cent annually between 1970-1988 (Maw Cheng Yang, cited by Rosenberry, 1993:34). As shown in table 1 and the related graph, production of farmed shrimp has been increasing much more rapidly than shrimp captured at sea. In the early 1990s, overall shrimp production was increasing faster than demand, when farmed and captured shrimp production combined grew by an

[22] In Thailand, the Aquastar corporation is an example. An example in Indonesia is the Indonusa Royal Group, which processes and packages shrimp and other seafood products as well as owning over 100 hectares of shrimp ponds.

[23] In 1993, Japanese shrimp imports (frozen, fresh and chilled) reached 301,271 metric tons which is three times the amount of 1984 (FAO, 1994).

[24] FAO gives estimates for European imports of cultivated and captured (frozen, fresh and chilled) shrimp for the following countries: Spain, France, Denmark, Italy, United Kingdom, Belgium, Germany, Sweden, the Netherlands, Portugal, Norway, Switzerland, Ireland, Austria and Poland (FAO, 1994).

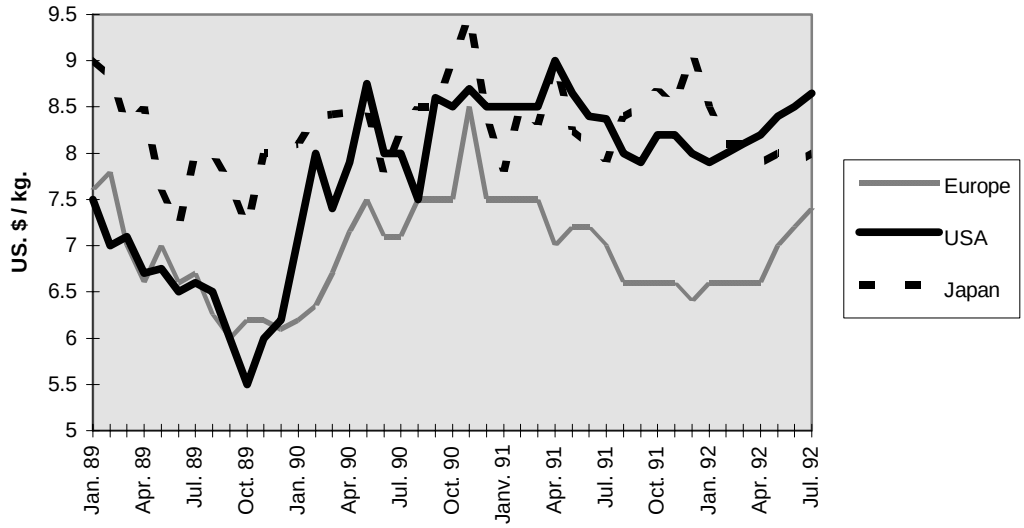
average of 156,000 tons per year from 1990 through 1992.[25] A sudden global production collapse in 1993 induced overall prices to rise by 30 per cent between 1993-1994 (Renard, 1995:47). Thai producers argue that annual consumption growth of between 2 and 3 per cent would be more realistic for the near future and that a production increase in 1994 below 75,000 metric tons might have helped prevent shrimp prices from falling. Fluctuations in shrimp prices make it a risky venture for producers, but attract the interest of speculators.

As a luxury item, shrimp is subject to great fluctuations in demand. Demand could suddenly collapse if consumers became widely convinced that the consumption of shrimp was hazardous to health or that shrimp were produced in a socially and environmentally unsustainable manner.[26] Until recently, cultured shrimp had the reputation of being fresher and safer to consume than captured shrimp. Cultured shrimp, however, are also prone to bacteriological, viral or chemical contamination, leading to health problems that may be publicized and deter consumers (Barg, 1992; Martínez-Espinosa and Barg, 1993). There are some controls by importers; Japanese buyers, for example, have a network of supervisors to ensure that quality requirements are met during production (Rosenberry, 1993:10). The United States Food and Drug Administration samples imported seafood to prevent entry of products that have been adulterated or spoiled or contain poisonous and non-allowed additives (Martin and Flick, 1990:351-364). In addition, the culinary quality of cultivated shrimp seems to deteriorate with artificial feeding. Japanese consumers have recently been reported to prefer captured shrimp which, with modern freezing techniques installed on shrimp trawlers, have superior freshness and quality (Rosenberry, 1993:32).

[25] As was seen in the second section of this report, cultured shrimp production fell in 1993, but again grew substantially in 1994.

[26] An Ecuadorian environmental group — Accion Ecologica — has already launched a boycott to protest against shrimp aquaculture that has meant the destruction of vast stretches of the country's mangroves (Kohr, 1995).

Figure 4: Importers' prices for Black Tiger shrimp cultivated in South-East Asia, 1989-1992



Source: Josupeit, 1992:16.

Large corporations that control the whole production chain claim that they are more capable of controlling health and environmental factors than are small producers. They often attempt to use this argument to provide themselves with a competitive advantage in order to by-pass smaller or less integrated production units (Weigel, 1993). But the volatility of the market induces commercial producers to maximize short-term profits and to neglect investments for making the industry environmentally and socially more sustainable.

IV. ENVIRONMENTAL AND SOCIAL IMPACTS: CONFLICTS AND "EXTERNALITIES"

This section looks at several actual and potential conflicts between commercial shrimp producers and other social actors. Aquaculture relies on the natural environment for land, water, feed and seed, as do capture fisheries and agriculture. The expansion of shrimp aquaculture inevitably generates competition with other users of these same resources, including peasant farmers, artisans, fishermen, local élites, local traders, conservationists, urban consumers, the tourist industry and some state agencies. Many of these conflicts result from direct competition in the use of land, trees, water and labour among the users of mangroves and other coastal resources. These users of coastal habitats include local farmers, livestock holders, woodcutters, fuelwood gatherers and fisherfolk, and many others.

A major portion of the conflicts arising from the expansion of shrimp farming are the result of environmental and social degradation that is not included in the costs of shrimp production. Where the industry assumes no responsibility for damages to other groups arising from its activities, economists call them "externalities". For example, abandoned ponds are usually virtually unusable for other purposes for indefinite periods without costly rehabilitation, which is seldom undertaken. Mangrove destruction, flooding of crops, salinization or pollution of land and water associated with the expansion of shrimp farming all affect the local people depending on these resources.

The key question is who is bearing the costs and who is enjoying the benefits? The social and environmental costs of the expanding shrimp industry are closely inter-related. We discuss these relationships under two headings:

- **Natural resource and ecosystem degradation** — The shrimp industry is polluting and degrading water, forests and soils. Public health, biodiversity, and the sustainable productivity of ecosystems are endangered.
- **Deterioration of local livelihoods —** Shrimp aquaculture is changing customary patterns of natural resource use by appropriating these resources for its own purposes while abrogating or restricting rights of local users. This in turn affects livelihoods more widely by disrupting earlier systems of production, distribution and social relations.

These two themes provide a convenient way to organize the discussion of environmental and social impacts. In reality, however, this distinction between natural resource degradation and the deterioration of local livelihoods does not correspond to the way local people experience the impacts of shrimp aquaculture. For instance, biodiversity loss is both an effect of change in resource use and of pollution. Food insecurity for many local groups is induced by their decreased access to land, water and forest resources as well as by diminished productivity of polluted environments. Those who are negatively affected voice their concerns about these impacts as a whole — that is, as they experience them in their daily lives. This paper is concerned with the way local people´s livelihoods are being affected by shrimp farming. The reports of local people's experience in this section, therefore, inevitably blur the distinction between impacts primarily caused by ecological degradation and those resulting from social disruption.

◆ Natural Resource Degradation: Pollution, Biodiversity Loss And Health Hazards

Water pollution

Shrimp aquaculture both causes water pollution and is affected by it. Estuarine waters are the recipients of urban, industrial, agricultural and aquaculture pollution. Shrimp aquaculturists consider their crop failures to be mainly due to organic and inorganic pollution coming from other sources. Waste and sewage from urban and industrial centres and from modern

agriculture frequently pollute shrimp ponds with heavy metals, pesticides and other toxic products.[27]

In areas densely covered with intensive shrimp farms, however, the industry is responsible for considerable self-pollution and particularly for bacteriological and viral contamination. Each hectare of pond produces tons of undigested feed and faecal wastes for every crop cycle. These ponds discharge ammonia, nitrites and nitrates. The latter is fatal to fish when it binds with the haemoglobin of their blood (Ibrahim, 1995). Nitrates induce the growth of phytoplancton, protozoa, fungus, bacteria and viruses, such as the Vibrio group growing in shrimp faeces which is in large part responsible for the 1988 collapse of production in Taiwan Province of China (Lin, 1989). The overuse of fertilizers and of veterinary and sanitary products such as antibiotics adds to the water pollution problem. It also contributes to the decreasing resistance to disease of the shrimp stock. Where intensive shrimp farms are densely spaced, waste laden water tends to slosh from one pond to another before it is finally discharged into the sea. Shrimp producers are extremely concerned about assured supplies of clean water as it is vital for their immediate economic returns.

The large amounts of sedimentation in intensive shrimp ponds are posing serious disposal problems. From 100 to 500 tons of sediment per hectare per year are apparently accumulating.[28] Ponds are cleaned after each crop cycle and the sediments are often discarded in waterways leading into the sea, or they are sometimes used to build dikes. Their putrefaction inside and outside the ponds causes foul odours, hypernutrification and eutrophisation[29], siltation and turbidity of water courses and estuaries, with detrimental implications for other water users as well as for the local fauna and flora.

Salinization of fresh-water sources and of soils is a common problem associated with shrimp farming. Pumping fresh-water from ground water aquifers into the ponds often lowers the water table which in turn causes sea-water to flow inland into fresh-water sources. The pollution of agricultural land is also caused by salinization from sea-water that has been pumped in and is often flushed out within terrestrial environments. The implications of salinization and falling ground water tables on surrounding populations and overall biomass productivity, as well as biological diversity are among the worrisome impacts of shrimp aquaculture. In the district of Ranot, in Thailand, which is densely covered in many areas with intensive shrimp farms, an average of 33 cubic metres of fresh-water per day is pumped in for each metric ton of shrimp produced. The area's average ground water level decreased from 3 metres below the surface in 1989 to 7 metres below the surface in 1991 (NACA, 1994b:46). Where high densities of shrimp farms were installed in Taiwan Province of China and the Philippines, sinking water tables have been reported to cause sinking land levels: coastal land in an area of Taiwan Province of China sank by some three metres, causing rice

[27] Ecuador has lost many tons of shrimp because of pesticides released from banana plantations ("Tauro Syndrome") causing the shutting down of 12,000 hectares of ponds in the Gulf of Guayaquil (Khor, 1995:20).

[28] Since some 10 tons of feed are used to produce about 5 tons of shrimp per hectare per year, this raises questions about where such incredible quantities of sediment come from (Rosenberry, 1994a:42).

[29] See footnote 2.

fields to become lakes and buildings to collapse (Chiang, Liu and Kuo, undated).

Biodiversity losses

The impacts of shrimp aquaculture on biodiversity (the totality of genes, species and ecosystems in a region), are multiple. Shrimp aquaculture affects biodiversity for many reasons already mentioned. Shrimp ponds cover vast coastal land areas and they pollute large volumes of water. Modified water circulation systems are altering wild fish and crustacean habitats. The risks of disease spreading out of the ponds into wild stocks are increasing. Pollution from shrimp farms contributes to the increasing frequency of "red tides" and endangers other native fauna and flora.

The negative impacts of released raised shrimp on the genetic diversity and resilience of indigenous shrimp are mostly unknown, but are believed by some specialists to be considerable (Pullin, 1992; Ibrahim, 1995). Genetic engineering is apparently becoming increasingly important in shrimp farming. It is used to produce disease resistant stocks, to develop vaccines or other veterinary drugs and to elaborate artificial feeds. These new feed formulas may allow faster and better assimilation and may contain less expensive protein than fish meal.

In addition to the very visible and possibly irreversible degradation of coastal ecosystems, shrimp aquaculture may have unforeseen indirect impacts on biodiversity. For example, with the clearing and levelling of coastal areas, such as those of Bangladesh, ecosystems and populations are becoming more vulnerable to flooding and tropical storms. The sedimentation of estuaries negatively affects coral reefs and remaining mangroves, and their roles as nursery beds for numerous fish species.

Health hazards

Health hazards to local populations living near or working in shrimp farms have been observed in several places. For instance, in Tamil Nadu (Quaid-e-Milleth district near Pondicherry) an approximately 1,500 acre shrimp farm has been reported to have caused eight deaths from previously unknown diseases within a period of two months following the installation of the aquaculture farm (Naganathan et al., 1995:607). There are numerous hazards to public health along the shrimp production chain, from the farmers through the various processors to the often distant consumers. The workers employed on shrimp farms handle several potentially dangerous chemicals, and may be exposed to unsanitary working conditions.

The literature makes several references to the lack of regulation and registration of drugs in aquaculture. The shrimp industry sees its own interest in having standards on "permitted levels of residue" in cultured seafood similar to those in poultry and livestock. Some aquaculturists also advocate a system of penalties to discourage the use of harmful chemicals (NACA, 1994b:III-25). According to an ICLARM report, the consumption of aquaculture products from places such as Manila Bay in the Philippines, the Deep Bay of Hong Kong and part of the Inner Golf in Thailand "undoubtedly exposes the consumers to high levels of contaminants

especially micro-organisms" (Pullin, 1993:315). Health risks for aquaculture consumers are associated with both chemical and biological contaminants. Concerns have been expressed about exposure to mercury, cadmium, organo-chlorinated pesticides, dioxins and antibiotics (Barg, 1992:32, table 11). For crustaceans such as shrimp which need clean water to grow, risks of biological contamination are more likely to occur during the processing stage. Infestations with salmonella, or human pathogens such as Vibrio parahameolyticus, are greatest during peeling, gut removal and cleaning the shrimp before they are frozen (Pullin, 1993:315).

Pollution and other types of natural resource degradation induced by shrimp farming were mentioned earlier in this report. The literature reviewed provided considerable information and analysis of strictly "environmental" problems directly affecting the industry. More complex questions concerning, for instance, biodiversity losses were, however, seldom taken into account by the industry. The related social implications received even less attention. The following sub-section deals at greater length with local level social and environmental impacts of shrimp farming. An attempt is made to consider these issues from the perspective of local people.

◆ Changing Natural Resource Use and Deteriorating Livelihoods

According to an ICLARM report: "Aquaculture development and innovations and indeed intervention of any kind in the agrarian system of developing countries must not cause economic shifts or changes in access to resources" (Pullin, 1993). Intensive shrimp production hardly seems to meet these standards. Social and environmental changes resulting from expanding shrimp aquaculture in coastal areas are due in large part to the conversion into shrimp farms of land, water and forests formerly dedicated to other uses. Shrimp farms often expand at the expense of agriculture, aquaculture, forests and fisheries that are better suited in many places for meeting local food and employment requirements.

In monetary terms, shrimp farming is the most profitable enterprise in Asian aquaculture. For many countries it is an important source of export earnings. For instance, in Bangladesh shrimp exports in 1993 brought in more foreign exchange, after rice, than any other agricultural export. In India, from 1992-1993, shrimp exports accounted for 67 per cent of the value of all foreign exchange earnings from seafood, although they were only 36 per cent in terms of quantity (Erkman, 1994). But who benefits and who pays the costs of those foreign exchange earnings?

The nature, severity and extent of the social impacts of shrimp farming differ widely from one place to another. Intra-communal social categories of users are differentiated by characteristics such as class, caste, occupation, ethnicity, age and gender. Each group may experience divergent impacts. Local ecosystems and the types of land uses which are being displaced, as well as the local and national socio-economic contexts, all influence their impact on local populations (Peterson, 1982). In areas already converted to the production of export crops, where the land is controlled by large landowners — such as the sugar barons of the island of Negros in the

Philippines, for example — the introduction of shrimp farming implied that many landless workers who had lost their jobs with the collapse of sugar production in the mid-1980s could find employment opportunities and income from shrimp production. Most of the profits, however, went to the big landowners. On the other hand, if land is owned by small peasant farmers and if they live in a state which respects their land rights, benefits may be more widely diffused. In some cases, at least a few small peasants may become considerably better off by becoming sub-contractors to big shrimp producers or joining producer co-operatives.

Where the land is legally owned by the state, as is usually the case of mangroves, the distribution of benefits and costs primarily depends on state policies. These in turn are largely shaped by the political influence of different social groups such as peasants, local élites, outside investors and environmentalists, in national and local power structures. The pace, level and strategy of national and sub-national economic "development" can be a crucial variable in the assessment of social impacts of shrimp aquaculture. In Malaysia, for example, the Land Acquisition Act was amended in 1991 to allow state governments to acquire land not only for "public utility" purposes (hospitals, schools, roads, etc.), but "for any purpose beneficial to the economic development of Malaysia" (Murray, 1995). This implies, according to this article, that the state governments can acquire land for private development projects. The loss of paddy lands, or of access to coastal fisheries, as a result of shrimp pond construction may be less devastating for many poor peasants in the labour-scarce and rapidly growing Malaysian economy than in the labour surplus slow-growing one of Bangladesh. In wealthier and fast-growing economies, finding alternative livelihoods for displaced peasants is generally more feasible than in less industrialized and lower income ones. For some members of the communities affected, however, access to alternative livelihoods may be slim. In particular, people with less social mobility, such as older women who have lost access to land, may suffer severely.

Shrimp aquaculture is expanding in many areas that in the past had been managed under some kind of common property régime. This is particularly the case in coastal zones where fisherfolk require easy access to beaches and where multiple uses by different users of land, water and forest resources have made exclusive control by individuals untenable. Several case studies mention that due to the expansion of modern shrimp ponds in coastal areas, local fishermen can only reach the beach by trespassing at great risk on shrimp farms or by taking a long detour. Local people have not only lost access to their fishing grounds and to their sources of riverine seafood and seaweed, but they have also relinquished social and recreational activities that they traditionally enjoyed on their beaches. Moreover, coastal lowlands and mudflats are used during the rainy season by many coastal communities for the extensive farming of fish and crustaceans — practices which have traditionally been regulated through customary common property régimes. Since the latter have frequently had no formal legal status, the customary holders of areas appropriated for shrimp farms have been easily dispossessed, usually without compensation.

With these caveats in mind, let us look at a few cases where modern shrimp farming has had some rather serious negative consequences for many people

as well as for their environment. We attempt here to cite cases that bring out several of the contradictions associated with divergent social and economic contexts.

Mangrove deforestation

Mangrove forests constitute an important component of coastal ecosystems in tropical regions of both hemispheres. They thrive in tidal estuaries, salt marshes and muddy coastlines. Mangroves are dominated by trees and shrubs of the Rhizophor genus. Some species have the peculiar faculty of rooting from the seed still attached to the tree. Mangroves were regarded as being practically worthless by colonial settlers and urban dwellers, but coastal indigenous populations had been using them sustainably for many centuries as sources of firewood, construction materials, nurserybeds for fish and crustaceans and as protection against storms and floods. During recent decades mangroves have been disappearing rapidly, victims of urbanization, commercial logging, unrestricted fuelwood collection, charcoal making, river impoundment and, more recently, shrimp pond construction.

The ecological role of mangroves is now widely recognized and many tropical countries have adopted legislation designed to protect them. These rules, however, are often inoperative in practice. For instance, Malaysia constituted a National Mangrove Committee which specifically prohibited the clearing of mangroves for the installation of shrimp farms, but the practice is still continuing (FAO/NACA, 1994c). This implementation difficulty is in part due to the fact that riverine and coastal ecosystems, such as mangroves, have customarily been used under common property régimes serving multiple uses and users. The privatization of this kind of land will inevitably harm customary users who have few means to defend their rights. Their customary rights have never been formalized and the benefits they gain do not enter either private commercial or national economic accounts, as they are principally from self-provisioning. Users of these ecosystems are often marginalized (Bailey, 1988:37; Skladany, 1992).

Mangrove destruction has been accelerated by commercial shrimp farming. The early phase of the industry's expansion depended upon extensive shrimp farms using large areas located in intertidal zones. From available data, it seems that in countries where shrimp aquaculture has become important, 20-50 per cent of recent mangrove destruction has been a result of clearance for shrimp ponds (Ong, 1982; NACA, 1994a; Sultana, 1994; Rabanal, 1976; CAMP, 1990; Quarto, 1995b). Considerable mangrove destruction has also occurred in countries which have not been developing shrimp aquaculture, such as in several coastal regions of East Africa (Bailey, 1989; Barraclough and Ghimire, 1995).

The construction of dikes and canals causes erosion and increased sedimentation. The World Bank has recently claimed that its major project of shrimp aquaculture in India will undertake reforestation of mangroves to replace those destroyed by ponds installed throughout the 13 project sites dispersed over Andra Pradesh, Orissa and West Bengal (FAO/NACA, 1994b:85-90). Mangrove reforestation, however, faces many technical and economic obstacles. Moreover, customary users of destroyed mangroves usually do not have access and management rights over the newly afforested

areas. In any case, former users who are prejudiced in shrimp farm areas will not benefit from afforestation projects undertaken elsewhere. Furthermore, afforestation projects in other areas frequently imply that still other customary users of natural resources will be deprived of their rights.

Mangroves are well adapted for traditional extensive shrimp farming, but high construction costs and acid sulphate soils make them less attractive for semi-intensive and intensive shrimp ponds (Barg, 1992). Conversion of mangroves to shrimp farms significantly reduces the natural propagation of wild captured shrimp as well as other fish. Moreover, their protective role for low-lying coastal regions is rapidly diminished with their replacement by shrimp ponds.

After the mid-1980s with the adoption of more intensive modes of production, shrimp ponds were also built further inland and fewer mangroves were destroyed in relation to the industry's spread. By then it was widely acknowledged that replacing mangroves with shrimp farms was often uneconomic. A study conducted in the Philippines found that well-managed mangroves may be worth from US$ 1,000 to US$ 10,000 per hectare for forestry and fishery products per year, excluding other social and ecological services. In comparison, shrimp culture provided an average of net profit of about US$ 11,600 per hectare per year (Primavera, 1994), but for no more than five to ten years. These estimates suggest that the conversion of mangroves into shrimp ponds in this case would be undesirable, even on purely economic grounds. Moreover, expanding ponds further inland often displaced agricultural activities and implied changes in water circulation in addition to damages from the pumping in of sea-water, salinization and discharge of wastes. This often degraded the surrounding land as well as the mangroves downstream.

Studies should be undertaken to estimate in a more systematic way the direct and indirect causes and impacts of the destruction of mangroves associated with the expansion of the shrimp industry. Measures designed to mitigate damages should take more account of social implications. Even though there is no authoritative study of mangrove deforestation in general, and much less of mangrove deforestation due to shrimp farming, we cite some estimates found in the literature in order to illustrate the importance of this ongoing process.

In Thailand mangroves were reduced by half during the 1980s, but shrimp ponds were not the only cause of this deforestation. It is estimated, however, that in 1992 some 34 per cent of the country's shrimp pond area had been in mangroves a decade earlier (NACA, 1994b:15). In Malaysia from 20 to 25 per cent of the mangrove area in the Peninsula has been earmarked for aquaculture use (Ong, 1982). In the Philippines between 50 and 60 per cent of mangrove denudation is attributed to fish and prawn culture (FAO/NACA, 1994d:section 5.1.3.2; Pollnac, 1992:17). In the early 1990s the Sundarbans, which constitute the biggest remaining mangrove area in the world, covered about 1.2 million hectares in India and Bangladesh. At that time, mangroves had already shrunk to half the area they occupied at the turn of the century. In the West Bengal (India) part of the Sundarbans, about 35,000 hectares of mainly extensive shrimp ponds have replaced mangroves (FAO/NACA, 1994b:26). In Bangladesh, in Rampur and the Charandeep

block of the Sundarbans area, the Department of Forests estimates that 9,250 hectares of mangroves have been destroyed to make way for shrimp ponds (Sultana, 1994:14).

Coastal dwellers used these mangroves for collecting fodder, fuel, and medicinal plants, and for fishing and hunting. According to women from the Jaladas community in the Polder 17/2 in Bangladesh[30],

> Our misery started since the clearance of mangrove forest. In the past the mangrove forest provided us with life, not only we lost our income from the forest, our work load and drudgery in our life also increased (...) If we went to the mangrove forest for a day to collect forest products we could live on that for three or four days (Sultana, 1994:12).

The women of Polder 17/2 now walk seven to eight kilometres collecting cow dung for fuel from grazing fields. Women now also need to earn cash incomes to buy the products they formerly collected themselves:

> Our economic condition has deteriorated significantly since we lost income from the mangrove forest products and resources; the prices for housing materials, dyes for fish net, floor mat are very high; before we used to collect them from the mangrove forest, now we have to buy them from the market; vegetables, wild fruits, medicine all need to be bought now; hunting of wild animals and birds are not possible anymore (Sultana, 1994:12).

Even those working on the shrimp farms in the Chokoria Sunderban said that their income would not compensate for the income they lost from the mangrove. Farmers in the Polder 17/2 claim that they had no chance to escape the shrimp business since the choice was either opting for "joint cultivation" or leasing the land to outsiders (Sultana, 1994:1).

Mangroves also protected coastal villages from flooding, cyclones and tidal waves. In 1991, after the installation of shrimp ponds, a tidal wave in the same Chokoria part of the Sundarbans took thousands of lives. A similar tidal wave in 1960 did not harm anybody from the villages as they were still protected by the mangroves (Sultana, 1994:14).

Encroachment upon agricultural land

To what extent are shrimp farms replacing and damaging local food production systems? Or is shrimp aquaculture merely replacing one cash crop by another more lucrative one? Are shrimp farms competing with surrounding farmers' needs, salinizing their land, using and polluting their irrigation and drinking water, or is it offering them better ways to earn a livelihood? Much of the coastal land in Asia recently converted into shrimp farms was previously used for food crops and farm animals. A study in Thailand's Inner Gulf area, for example, suggested that about half the area used for shrimp ponds had been producing rice (paddy), another one fourth had been in coconut plantations and the remainder in mangroves or salt flats (NACA, 1994b:49).

[30] See footnote 13.

The increasing need for land by shrimp entrepreneurs has meant a dramatic rise in land prices in many areas. A study in India notes that after the installation of shrimp farms near a village, land prices rose by 20 per cent. Local farmers could no longer afford to purchase land, while indebted farmers were tempted to sell their holdings (Mukul, 1994:3076). In the Ranot district of Thailand, land prices rose by about 80 per cent between 1987 and 1993 (Aquastar Laboratories Ltd., 1994:7-8). In another area of Thailand, Pak Phanang, land prices went up from the equivalent of US$ 50 - 75 per hectare in 1985 to US$ 50,000 - 75,000 per hectare in 1991 (Boromthanarat, 1994). In Negros (the Philippines), thousands of hectares in sugar plantations were converted in the mid-1980s into prawn farming. Conversion slowed down in 1989 when Japan, the main importer, decreased temporarily its demand for shrimp (Ofreno, 1993).[31]

When extensive shrimp farming is combined with paddy cultivation, it should not always be viewed as a multicropping pattern advantageously replacing the fallow period of a seasonal monocrop production. In Bangladesh, for instance, the land previously used for the production of rice and paddy during the wet season was often used in the dry season for pasture and cultivation of beans, melons, pumpkins, jute and other less water-demanding crops (Sultana, 1994:11). According to this case study, the average number of cows and buffalo per household prior to shrimp farming was 11, but afterwards it dropped to 3. Sharecropping becomes less interesting when the land is under water for several months. Indeed, sharecroppers receive land for the cultivation of rice paddy for shorter periods than before in order to leave more time for shrimp growth. Rice yields are falling with the increasing salinity of the land (de Campos Guimarães, 1989). After the farming of shrimp, the harvests of paddy and local rice varieties average only one to two thirds of yields recorded prior to shrimp cultivation.

This same case study of Bangladesh shows that women and children have been most adversely affected by the conversion of mangrove and agricultural land into shrimp ponds. The income controlled by women and their possibilities for self-provisioning decreased after the introduction of shrimp farming. In the Polder 17/2 area they had less access to fodder and grazing land, and were forbidden to let ducks and poultry run near ponds for fear they would feed on the shrimp. In addition, their home gardens were flooded in the dry season during which they used to grow vegetables. To cope with those changes, women from Chokoria Sunderban often engaged in daily wage labour, in drying fish or making nets and mats they would sell after long journeys to markets, leaving children back home and risking robbery and harassment on the way. When the men did the marketing, however, the women tended to lose control over the income from their work. Furthermore, men often lost their previous jobs because of decreased harvests of fish and timber (with the depletion of mangroves and degraded ecosystems) and because of their reduced access to the coast. Shrinking agricultural areas and

[31] These problems are not limited to Asia. In Ecuador, conversion of mangroves and cropland into shrimp ponds began even earlier. Since the mid-1970s, large landowners have received support from the state and international aid agencies. USAID provided loans for over $ 6.5 millions between 1987 and 1990 for development of seven large shrimp farms (Stanley, 1990).

decreased soil fertility further reduced labour and income opportunities. Men increasingly migrated to seek employment in cities, or working on fish trawlers for big fishermen, leaving women and children alone for long periods. Even the few farmers who leased their land for shrimp farming, or who stayed on their land under some joint cultivation contract, say that their income was less than what it was prior to the shrimp business (Sultana, 1994).

Polluted waters

As seen earlier, shrimp farms use both sea- and fresh-water to replenish their ponds. This heavy demand on water brings shrimp enterprises into competition with other users of these water resources. In areas where commercial shrimp ponds have been constructed there is frequently insufficient fresh-water left to meet customary needs for irrigation, drinking, washing, or other household and livestock related uses, and water supplies may be contaminated. Ground water salinization has been reported in several places. This often means that people — most of the time women — have to bring water from more distant wells. In a village in Tamil Nadu (Nagai-Quaid-e-Millet district, Pompuhar region), after the expansion of shrimp farms on about 10,000 hectares, women have to walk two to three kilometres to fetch drinking water that previously was available nearby (Bhagat, 1994). In the Nellore district of Andhra Pradesh, a case study conducted by Vandana Shiva reports that there was no drinking water available for the 600 fisherfolk of the village of Kurru due to aquaculture farms salinizing ground water. She adds that "after protest from the local women, drinking water was supplied in tankers" (Mukul, 1994).

Depleted fisheries

Local stocks of native fish and crustaceans are being depleted in many places because of the removal of mangroves which served as nurserybeds, and also as a result of indiscriminate overfishing of wild shrimp fry (over 90 per cent of randomly caught fry are often wasted (Biksham Gujja, WWF, Gland, Switzerland, personal communication, 1994). Natural fisheries are also frequently damaged by pollution caused by overloads of nutrients, sediments and chemicals from shrimp farms. In an Indian coastal village, Ramachandrapuram, fishermen reported that the value of their average catch of shrimp used to be Rs 50,000 per catamaran per month, but after one year of operation of nearby aquafarms their catch was ten times smaller (Mukul, 1994). In the Chokoria part of the Sundarbans of Bangladesh, fishermen have reported an 80 per cent drop in fish capture since the destruction of the mangroves and building of dikes for shrimp farming (Sultana, 1994). Frequently, fisherfolk protest because their traditional access to the coast has been restricted or because stocks of wild crustaceans and fish have disappeared.

As was mentioned earlier, the expansion of shrimp farming frequently crowds out public and private investments in other types of aquaculture (both coastal and inland) that are less profitable financially, but that have been or would be much more effective in meeting local needs for food and employment (Bailey and Skladany, 1991; FAO, 1995). Opposition by local people to shrimp farm expansion, however, is usually triggered by immediate threats to their livelihoods, and seldom reflects lost opportunities to use financial and natural resources for other non-customary purposes.

Impediments to other land uses

Commercial shrimp farmers tend to invest where possible in pristine coastal areas where there is little pollution and where land is cheap. This often puts them in conflict with the rapidly expanding tourist industry. Tourism, like shrimp farming, brings in large amounts of foreign exchange. It attracts substantial investments and is profitable for transnational investors and national and local élites, just as the shrimp industry is. As a result, tourism interests are much more likely to be taken into account in environmental impact assessments of proposed shrimp farming projects than are the interests of peasants and fisherfolk.

The growing populations of coastal areas in tropical countries are in constant need of additional space for housing and facilities. Low-income residents of coastal villages depend mostly on communal and state lands to meet their requirements for additional space. In Sri Lanka it was reported that over 80 per cent of all shrimp farms were located on state owned lands and that this caused many conflicts with villagers attempting to expand into the same areas (FAO/NACA, 1994e:26-27).

◆ Social Disruption and Disempowerment

Weigel called the shrimp industry's expansion in Thailand "aquacultural colonization" (Weigel, 1993). By this he meant the commercialization of land and labour. Traditional production and exchange systems were disrupted and power relations radically changed in many places affected by commercial aquaculture. The local markets providing labour and bringing fish protein to inland areas were displaced by distribution channels going to high-income urban consumers (Skladany, 1992:35). Export-oriented aquaculture such as shrimp farming is associated with the "Green Revolution" kinds of technologies, resource uses and related social and environmental impacts. The "Blue Revolution" is using large quantities of commercial inputs for producing a single crop, while it neglects the livelihood needs of local people and their environmental requirements (Bailey and Skladany, 1991; Mukul, 1994; Shiva, 1994).

Some analysts question whether private property régimes are the most suitable ones for the sustainable management of aquatic resources, including coastal aquaculture. Jomo, on the basis of his study on the crisis of fisheries in Malaysia, says:

> the very success of capitalist development in fishing has undermined the very sustainability of the fishery resources, and hence the fishery products. (...) Because of the common property nature of fisheries (...) unbridled competition cannot lead to economically optimal investment (Jomo, 1991).

Most commercial shrimp farms are private properties, but many of the water and other resources they use or affect have the same common property attributes as those of ocean fisheries.

The introduction of new shrimp farm technologies has proceeded with no concern about local knowledge, practices, preferences and resource use. The control of local resources has shifted from communities to external institutions. Weigel shows how in Thailand an environmental discourse has been adopted by large shrimp corporations to advance their own ends. They claim that intensive farms save mangroves and that their sophisticated capital intensive technology reduces environmental damage. The production of technology to manage environmental risks affecting shrimp yields is in fact a lucrative and growing business which is mainly located in higher income countries. In other words, the extensive shrimp farmers, not the large corporate intensive producers, are alleged to be the cause of shrimp farming's negative environmental impacts. Much of the literature cited earlier, however, shows that this distinction does not hold. In our opinion, these issues could be investigated empirically rather easily through several well-selected and well-designed case studies.

The literature suggests that national governments have somewhat different positions concerning the expansion of shrimp farms from one country to another. Within the same country different government agencies often have contradictory policies. These range from active promotion of shrimp farming to *laissez faire*, and from strict control (at least on paper) to hands off. Governments in countries such as Thailand, Malaysia and Bangladesh have

been promoting expansion of the shrimp industry by facilitating the acquisition of land and credit, by offering tax favours and import-export privileges.

In India, several states are attempting to formulate new legislation to guide and control aquaculture development and in particular shrimp farming. Indian shrimp farms have been developed mostly on privately owned lands, and have received relatively little formal and financial support from the national government (ICICI & SCICI Ltd., 1994). Land rights, however, are primarily regulated by the governments of individual states. Several Indian state governments are actively promoting both foreign and domestic investments in shrimp farms. Some states allow leased land to be mortgaged, while others do not. Differences in state policies are one of the principal reasons why aquaculture spread more rapidly in Andra Pradesh and Tamil Nadu than in many other coastal states.

Where conflicts arise with local groups previously using shrimp farm resources, government agencies tend to support the commercial aquaculturists. In Malaysia, India and Bangladesh, however, courts at the national level have sometimes backed local people's organizations in legal appeals claiming their rights had been violated by shrimp aquaculture development. But when a governmental institution backs local people in their opposition to shrimp pond development that would damage their livelihoods, their case is still not won. Projects that are temporarily blocked are frequently resumed again with the backing of local élites or of some other state agency. Local people usually receive no compensation for lost resources and livelihoods.

Local farmers in Malaysia succeeded in having the High Court declare as void the land acquisition procedure of Kerdha state for the development of a big tiger prawn project. The Land Acquisition Act provides the state with the authority to acquire land for any public purpose, and for any purpose which "in the opinion of the state is beneficial to the economic development of Malaysia or to the public or any class of the public, and for mining, residential, agricultural, commercial or industrial purposes". The High Court, however, considered that a US$ 24 million prawn project — the biggest in the country — did not meet the public purposes and interests criteria. The majority of the (approximately 100) landowners from whom the land was acquired did not want to relinquish their land (altogether 207 acres), mainly rice paddy. The state court, nevertheless, overruled the High Court's orders on the grounds "that the State government was the rightful owner of the land" (**Utusan Konsumer**, 1994:7; **Fish Farming International**, 1994b). In Malaysia the states (not the federal government) have jurisdiction over land, minerals and water (up to three miles off the coast) (ICLARM, 1988).

In the Chilka lake region (some 900 square kilometres of water surface in the Indian state of Orissa), local people with the support of a High Court judgement of September 1993, managed to stop a large joint venture between TISCO (a Tata branch) and the state of Orissa. Their victory was short lived. Soon after, local élites managed to take control of the same land and water to install their own shrimp ponds: "The Tata ouster has brought in

its wake a greater evil in the form of local *dadas* who flout all norms with impunity" (Kar, 1994).

In some cases local élites are able to take over the shrimp business themselves, while in others their interests are subordinated to those of outsiders. In her Sundarbans case study of Bangladesh, Sultana illustrates this latter version of changes in power relationships associated with the introduction of commercial shrimp farms:

> the traditional power structure has been destabilised and it is now controlled by the outside shrimp producers. The new power elites with their urban background, economic strength and connections with the bureaucracy and the administration are able to have absolute control over the local elite and people (Sultana, 1994:15).

This helps explain why local élites sometimes oppose shrimp projects sponsored by outsiders — as seems to be the case of Indian groups opposing the World Bank investment of US$ 80 millions in shrimp farming (about 80 per cent of all Bank investment in aquaculture in the country) (Erkman, 1994:26).

In most places, high initial investment requirements together with restricted access to land and water resources limit entry into the shrimp industry to the wealthy. In Bataan (Philippines) prawn cultivation has been controlled by the wealthiest thirty or forty families (Broad and Cavanagh, 1993). As was seen in section II, a recent tendency is to construct large-scale integrated shrimp production systems (with on-site hatcheries and processing plants). This sometimes allows modest farmers to enter the business under the control of corporations that provide them with credit, inputs and supervision and that purchase their product. In several countries local farmers are forced to lease their land to shrimp entrepreneurs. In some cases, farmers become wage labourers on their own land, often working as guards. Others become landless agricultural labourers if they can find other employment. These landless workers frequently migrate to urban centres (Sultana, 1994).

According to several case studies, social cohesion and security frequently diminish in villages penetrated by commercial shrimp farming. Outside ownership of shrimp farms, and the perception by villagers that traditional land rights have been violated, often leads to internal social divisions and theft. Stealing shrimp requires only a few minutes and can be worth the wages of several days. This explains the presence of armed guards watching most ponds (de Campos Guimarães, 1989; Centre for Communication and Development, undated).

Case studies in Bangladesh and India's West Bengal and Tamil Nadu have found that when outsiders took over extensive traditional shrimp farms they were helped by the police who threatened angry farmers. Pond guards have been hired from outside to avoid their complicity with villagers. In order to control theft more effectively, additional bunds have been built to divide the ponds (de Campos Guimarães, 1989). Living in villages near shrimp ponds in some cases resembled living in the vicinity of war stricken areas:

> Violence and coercion are regular phenomena in the shrimp culture area. Local people do not have freedom of movement in their own

> village. Anyone moving after dusk even in the public road could be accused as thieves and be beaten or to be put on jail by the shrimp *gher* owner. Local people are constantly watched by the guards of the shrimp *gheres* and harassed by them (Sultana, 1994:15).

Similar observations were made in the case study from West Bengal cited earlier. The case reported above in India's Chilka Lake area stated:

> (...) Matters are now fast coming to a head with villages around the lake pitted against each other. There are at least three to four villages where armed police have been deployed to keep a watch over the deteriorating law and order (...) the allurement of prawn dollars has reduced this once tranquil wetland and the surrounding villages to a veritable battleground, with guns and bombs being used in bloody clashes. The losers are invariably the fishermen who are being slowly edged out of the flame by the Mafia, thanks to an apathetic administration (Kar, 1994).

Previous to the development of commercial shrimp farms in this area, most local people were fishermen who were able to live from local resources. Now they face unemployment and even starvation (Kar, 1994).

The village of Tennampattinam in the Nagai-Quai de Millet district of Tamil Nadu is another example. The houses of 34 landless families were burned down because their inhabitants opposed installation of a shrimp farm and some of the injured opponents were not even admitted to the hospital. In Tamil Nadu several popular movements oppose shrimp farm expansion. For instance, 64 villages of the Nagai-Quai de Millet district are organizing opposition groups. They are supported by existing movements such as the Gandhian Gram Swaraj Movement and the Land for Tillers. Hundreds of farmers evicted from their farms have been threatening to take back their lands from the shrimp corporations in order to cultivate them again, but they have had to face violent police repression (Mukul, 1994:3076; Naganathan et al., 1995; Quarto, in Das, 1995: 21-29).

The case studies cited above are not mere anecdotes. Enough is provided about their institutional and policy contexts to allow the analyst to treat them as "modal types" (in the Weberian sense) that are representative of much more widespread processes and consequences.

V. POLICY AND INSTITUTIONAL DETERMINANTS

While recent expansion of commercial shrimp aquaculture has brought benefits to some social groups, many others have been prejudiced. Moreover, the well-being of unborn generations has probably been negatively affected in several places by the degradation of the natural environment. This is similar to what happened earlier in other lucrative export-oriented commodity production systems. The rapid recent expansion of shrimp farming and its differential social and environmental impacts have been largely determined by commercial interests, policies and institutions at sub-national, national and international levels. In this section, we review a

few of the socio-economic and political processes and relationships that appear to have been most prominent in determining the industry's growth and its consequences. Many of the issues raised in this report would apply to other luxury-oriented branches of aquaculture (Kane, 1993). We also examine a few attempts of reforms aimed at diminishing social and environmental damage.

◆ Market Forces

The immediate stimulus for the expansion of commercial shrimp farming in the 1980s was the rapidly growing demand for shrimp in high-income countries. This occurred at the same time that capture of wild ocean shrimp was becoming more expensive and erratic, due in part to over-fishing and the degradation of many natural shrimp habitats. With rising prices for shrimp, it became profitable to develop new capital-intensive "blue revolution" technologies in order to increase dramatically the yields from shrimp farms. Shrimp processors, importers and input manufacturers have positioned themselves to take advantage of growing demands of consumers and producers. As was seen above, many of these enterprises became large-scale industries with excess capacities and with ologopolistic influence over markets

These large shrimp enterprises in turn promoted further increases in consumer demand and in production in order to maintain or increase their profits. For example, the *sushi* restaurant and catering industry in Japan is a multi-billion yen enterprise. The high value of the yen makes Japan a particularly attractive market for frozen shrimp imports. The *sushi* industry promotes consumer preferences to "eat out, to eat fast and to eat fat-free" (Mizuno Yu, 1987). *Sushi* enterprises are now also expanding rapidly in the United States.

Production of farm-raised shrimp worldwide increased from an estimated mere 84,000 tons in 1982 to over 700,000 tons in 1994. Effective demand is projected to continue to increase during the second half of the 1990s, although at a slower rate. In 1994 there were an estimated 1,147,000 hectares of shrimp farms in production worldwide, of which over 85 per cent were in East and South Asia. Farmed shrimp production during the coming decade is likely to continue to expand both by incorporating new areas into ponds and from more intensive technologies. Because of the short life-span of intensive shrimp ponds, abandonment of polluted ponds will tend to augment the areas affected by shrimp farming even more rapidly than increases in production might suggest.[32]

Market forces at the national level stimulate shrimp aquaculture disproportionately in relation to fin-fish aquaculture, in part because the former brings in much more foreign exchange. Lower income domestic fish consumers cannot compete in world markets with high-income consumers of shrimp. This induces governments to encourage and subsidize shrimp

[32] Approximate calculations suggest that about 150,000 hectares may have been abandoned between 1985 and 1995, and that possibly another 100,000 will be left in an unproductive or severely degraded state by the year 2000 (Finger and Gujja, forthcoming). This issue requires more empirical research.

production disproportionately in relation to fin-fish aquaculture for domestic consumption. Both the state and its most influential wealthier support groups covet foreign exchange for imports of consumer goods, capital goods and industrial inputs as well as for debt servicing and capital flight towards secure investments abroad. Similarly, the diversion of less marketable fish and cereals from human consumption to shrimp feed is profitable even when large portions of national populations lack sufficient protein. Limited and usually highly subsidized industrial energy is also channelled into shrimp production and processing because this is more profitable for those controlling it than are most other uses — such as the production of staple food.

At local levels, shrimp farming is often more lucrative for élite groups controlling natural resources and political power than are traditional, mainly self-provisioning systems. The landless and near landless have little economic or political influence to prevent alienation of their traditional life support systems. Moreover, invariably some members of these vulnerable groups can be co-opted into supporting the expansion of shrimp farming by sharing with them a few crumbs of the benefits. This often makes local level resistance highly divisive and difficult.

A big worry of many large shrimp producers and related enterprises is that supply may increase more rapidly than demand, leading to depressed prices and ultimately to bankruptcy (Maw Cheng Yang, in Rosenberry, 1993:34).[33] Of course, maintaining high shrimp prices will only contribute to improving social and environmental impacts of shrimp farming if profits are used to internalize social and environmental costs. As was seen earlier, some members of the industry urge self-discipline in production increases in order to stabilize prices. As with other commodities where production is partly dependent on the decisions of numerous producers, and freedom of entry by new producers is not prohibitively expensive, effective self-regulation of production by the industry is practically an impossible task. Nor can it be done effectively by the national state in a single producing country. There are already numerous competing producers in other countries and many more countries could potentially enter the industry. International co-operation among shrimp exporting countries in order to regulate exports and stabilize prices would be desirable from the viewpoint of many large producers. Experience with other commodities, however, suggests that cartels of commodity producers, even when supported by their national governments, have almost invariably been ineffective in the medium term if they did not have the co-operation of the principal consumer countries as well. Even then, they have usually eventually broken down (Barraclough, 1991).

The problems for the industry in controlling production and prices are paralleled by those of setting standards to minimize negative environmental

[33] Maw-Cheng Yang, an economist at the World Bank, estimates that if cultured shrimp production increases at 10 per cent per year during the decade of the 1990s (which implies an overall 260 per cent increase), real shrimp prices will decline by 14 per cent over this period of time. If, however, farmed shrimp production grows by only 5 per cent annually during the 1990s, by the year 2000 shrimp prices will be 23 per cent higher than the 1988 level. Of course, these estimates imply several assumptions about the dynamics of the coastal shrimp industry as well as about consumer demand.

and social impacts that could easily make shrimp farming non-viable over a period of several years. No matter how concerned the industry's leaders become about these problems, there is little they can do by themselves to mitigate them even when technical and political solutions seem to be clearly available. Competition among producers would obviate their application unless there were enforceable standards and incentives. Present trends suggest that without effective international standards the industry will flourish and then partially collapse in country after country, as it has already done in Taiwan Province of China and, more recently, in China, leaving behind a degraded environment (numerous abandoned ponds, etc.) and many ruined livelihoods. As long as there is sufficient demand, however, the transnational shrimp business will attempt to expand. Present trends indicate that shrimp farming will spread rapidly to other low-income countries of Asia, South America and Africa to take advantage of pristine coastal areas, lower labour costs and less stringent regulations (Skladany, 1992:35).

The industry has shown considerable concern about quality standards and the promotion of improved management practices and technologies, since failure in these areas could lead to huge losses throughout the whole industry from producer to retailer. A few deaths or illnesses from contaminated shrimp in importing countries, for example, could be catastrophic for sales if they were publicized by the mass media. While consumers might simply shift from shrimp to another apparently "cleaner" product, the hardest hit would be the shrimp farmers. On the other hand, thousands of deaths and injuries in a poor producing country caused by floods that were worsened by mangrove destruction resulting from shrimp pond construction may have little immediate negative consequences for the industry's global profits.

For any industry, self-regulation to deal effectively with clear and certain threats to short-term profits is much more feasible than dealing with diffuse threats to its longer term survival. In order to internalize some of the environmental and social costs and shape policies to prevent or mitigate these costs which cannot be internalized, enforceable, international standards dealing with the shrimp industry's externalities are necessary. This paper cannot specify what such standards should be, as this implies some degree of agreement among the principal social actors about numerous contentious political and technical issues. This literature review, however, brings out the urgent need for all concerned parties to begin discussions leading to the evolution of such international standards. The following discussion on policies and institutions may help by suggesting some criteria as well as highlighting several problems that will have to be overcome.

◆ Policies and Institutions

Market forces and their effects are social products subject to social control. They are not handed down from on high by some divine edict. Policy implies a conscious course of conduct by any particular social actor in respect to certain issues in order to advance towards perceived objectives. Public policy refers to lines of governmental action, often but not necessarily at the level of the nation state. Policy has much more to do with purposeful courses of action than with rhetoric.

Institutions, on the other hand, are bundles of rules and regulations governing social relations established by custom or accepted law that structure behaviour in fairly predictable ways. Institutions are sub-sets of social relations that correspond with settled habits of thought and action. Policies tend to be issue oriented and volatile while institutions are more stable and difficult to change. Institutions can be extremely resistant to policies designed to reform them and can persist for long periods even in the absence of policies. Institutions may often be policy focused, and after a policy has become generally accepted it may become institutionalized.

Viewed in this light, the complex interactions among policies and institutions largely determine social behaviour in any given ecological and socio-economic context. This is why we conclude this review of the literature about Asian shrimp farm expansion by looking at several policy and institutional issues.

Policies in countries importing farmed shrimp can be crucial for the industry. These usually take the form of setting sanitary and other quality standards. Consumers in high income countries constitute a potentially very powerful interest group. A shift in consumption patterns might overwhelm the policies of producers, investors, processors and retailers. Consumer preferences not only affect demand, but also the policies of shrimp importing countries.

The policies of investors and entrepreneurs in the shrimp industry are primarily directed at facilitating investments and increasing profits. Those of affected peasant producers and artisanal fisherfolk are usually aimed at maintaining and improving their livelihoods while at the same time minimizing risks. Public policies, however, are always more complex. Every political system is in part an arena for attempting to resolve conflicting interests. Public policies are therefore inevitably to some degree contradictory.

Public policies in Asian farmed shrimp exporting countries have frequently been designed to promote the expansion of commercial shrimp farming, as it can be highly remunerative for several of the state's influential support groups. At the same time, policies may be adopted in response to concerns of other support groups to mitigate the negative social and environmental impacts of shrimp farming. The priority given to these often conflicting objectives in shrimp producing countries largely depends on the relative strength of the different social actors in determining public courses of action. The state usually has policies designed to placate groups with conflicting interests. In most situations support groups that benefit from expansion of commercial shrimp farming seem to be much more influential in shaping public policies than are those groups that would be prejudiced.

The remainder of this section briefly looks at four overlapping public policy approaches to directing the shrimp industry towards social goals and especially to minimize its social and ecological damages. These are regulatory legislation; economic incentives and disincentives; environmental (and social) impact assessments and, benefit-cost analyses. Several institutional constraints are also mentioned. These four approaches are essentially complementary, although they are often discussed as if one could be substituted for another.

Regulatory legislation

A recent comparative study of legislation regulating shrimp farming concluded that:

> ... most countries relied on preventive measures to avoid harm and reduce or eliminate risk of harm caused by aquaculture. They include (i) setting of standards, (ii) restrictions and prohibitions, (iii) licensing, and (iv) environmental impact assessment (...) Little attention is given to the various economic incentives and disincentives which are likely to affect conduct towards the environment and could induce changes in behaviour or produce revenues to finance aquaculture environment policy programmes (van Houtte, 1994:15; see also FAO/NACA, 1994g).

This same comparative review indicated that few countries had legal provisions for compensation to aquaculturists damaged by pollution from other sources. Practically none envisioned compensation to third parties negatively affected by externalities arising from shrimp farming.

In the literature reviewed, discussion of policy issues concentrated mostly on the declared aims of national legislation regulating shrimp farming. The policies pursued by sub-national political units or by international bodies received little attention. Policies of non-governmental organizations, corporate enterprises, or of popular organizations such as labour unions, co-operatives and traditional communities were seldom mentioned. This can partially be explained by the fact that contributors to these documents seem to equate policy with the stated intentions of national laws, regulations and programmes. They seldom dealt with institutional constraints that frequently distorted the outcomes of legal regulations even when serious attempts were made to apply them. They often failed to distinguish between purposeful courses of action and official declarations of intent, although several reports mentioned that shrimp farms had frequently been installed illegally (Quarto, 1995; Das, 1995). Also, much more is known about the content and declared objectives of national laws and regulations than about what actually happens concerning their implementation.

National legislation designed to regulate shrimp aquaculture received the most attention. Nearly every country producing farmed shrimp seems to be in the process of designing regulations to protect aquaculture from pollution from other sources such as industry, agriculture and urban sewage. Many also have general legislation concerning environmental protection and natural resource use, that, if applied, could contribute to control the pollution and other damage generated by shrimp aquaculture. India, for instance, at the federal level, has several laws of this type such as: the Water (Pollution, Control and Prevention) Act of 1974 (as amended), the Environmental (Protection) Act of 1986 and the related Coastal Zone Regulation of 1991, the Forest Conservation Act of 1980 (as amended), as well as the normal revenue law which prohibits obstruction of rivers, natural water flow channels by any authority or person (Das, 1995).[34] The emphasis in national

[34] An analysis of the institutional constraints to the application of these laws in general for India can be found in Khator, 1991.

legal codes has generally been on technical standards concerning discharges of pollutants (Barg, 1992; van Houtte, 1994).

As was seen in section IV, in several countries there is legislation requiring that mangroves and croplands be conserved and that local communities retain access to the sea. Villagers in Tamil Nadu protested against installed shrimp farms [35] which prevented their traditional access to the sea. They obtained a ruling from the Supreme Court requesting scientists from the National Environmental Engineering Research Institute (NEERI) to report on the situation. Following this scientists' report, the Supreme Court issued an order prohibiting the further conversion of agricultural land or salt pans into prawn farms in the three Indian states of Tamil Nadu, Andhra Pradesh and Pondicherry (**Multinational Monitor**, 1995; Khor, 1995). Several countries have legal stipulations that commercial shrimp aquaculturists above a minimum size obtain government licences, and that ponds be located within certain distances from high or low tidal levels. A few countries such as Malaysia, Sri Lanka and Indonesia require that environmental impact assessments be carried out before official permission to construct is granted, but there is little information about the quality of these assessments or about the extent they influence investment and management decisions (NACA, 1994a; FAO-NACA, 1994a and 1994f).

There seems to be little analysis of how well laws regulating shrimp farming are implemented or how appropriate they are for different social and ecological contexts within each country. One finds frequent mention of conflicting jurisdictions by different state agencies, of contradictory objectives, of inadequate implementation mechanisms and of lack of adequate monitoring. In several countries, such as Malaysia and India, state governments have wide powers over the exploitation of natural resources leading to many unresolved legal conflicts between federal and state authorities. A few of these conflicts were mentioned in section IV. There appear to have been few critical analyses concerning the consequences of laws regulating aquaculture on local communities and different social groups within them.

Property rights in general and especially land-and-water tenure systems are key institutions determining the incidence of benefits and damages arising from shrimp farming. Property rights imply the customary and legal rules that govern access to and use of a resource, and the rights to future streams of benefits arising from it, among individuals, social groups, corporate entities, the state and other collectivities. A common problem, as was seen earlier, is that customary rights to aquatic resources are often in conflict with newly imposed ones. In any case, property relations vary widely from one situation to another. For example, in Thailand, most (80 per cent) shrimp farms belong to independent operators owning and cultivating an average of 0.16 to 1.6 hectares pond surface (Lin, 1995). In India and Bangladesh, on the other hand, large private or corporate farms predominate in many areas. These commercial enterprises may include several hundred hectares that are alienated from customary, communal or private uses. Furthermore, even the

[35] The grassroots organization Land for the Tiller (LAFTI), the social organizations PREPARE and Orissa Krushak, the Tamil Nadu Gram Swaraj Movement and the Research Foundation for Science and Ecology launched, in March 1995, a national campaign, the People's Alliance against the Shrimp Industry (Khor, 1995).

legal rights of private owners are often overridden with the help of state intervention.

In most coastal areas where commercial shrimp farming has recently been expanding, the rights to land and water are not clear. Traditional rules specifying the rights of diverse social groups in the use of these resources were often well established by custom and sanctioned by political authorities. With the expansion of commodity production, however, the state has usually supported the imposition of property régimes encoded in national legislation that extinguish or subordinate the rights of customary self-provisioning users of land, water and forests that are appropriated for commercial production systems such as shrimp farming. Frequently, land and water resources that were customarily managed as common property by local user groups were legally decreed to be public property owned by the state. The state in turn sold or leased them to private entrepreneurs or investors. The shrimp pond owner, lessee or concession holder was then able to exclude customary users who seldom had legal rights to compensation for their loss. Moreover, the shrimp producers were seldom held responsible in practice for damage they caused to others through pollution, salinization, mangrove destruction and the like. Even in the few countries where national laws theoretically permitted redress by damaged parties, legal costs, social barriers, threats of reprisals and other obstacles simply appeared too formidable for peasants and fisherfolks to consider demanding compensation, or the restoration of their customary rights.

The inherent bias against customary users of coastal land and aquatic resources is reflected in FAO's definition of aquaculture. This includes the statement "(Fish) farming also implies individual or corporate ownership of the **stock** being cultivated" (van Houtte, 1994:12). This neglects both the complexity of the concept of "ownership" and the fact that in many common property régimes "farming" has proved to be rather effective and efficient in meeting local livelihood needs. An individual or a corporation cannot very easily own a fish or shrimp that swims in communal waters, as unlike cattle on communal land it is not feasible to brand them. Dispersal of eggs in communal waters is a common practice in fish breeding that does not imply either individual or corporate rights to ownership, although communal ownership is possible to the extent outsiders are excluded. Moreover, this FAO definition presents other difficulties from a strictly legal point of view (van Houtte, 1994; New and Crispoldi-Hotta, 1992).

Thailand provides a good example of the regulatory legislative approach. It has recently adopted legislation that has laudable intentions but that will be very difficult to enforce. Its provisions include requirements that all shrimp farms must register with the government, and those above eight hectares need government approval before construction. Farms are required to have reservoirs for water replenishment which occupy at least 30 per cent of their total area and should use sediment ponds that contain molluscs or seaweed.[36] Also, farms should dispose of sediments on land and not release them into public waterways (Rosenberry, 1994b). This legislation falls far short of the recommendations of the NACA country report for Thailand that called for

[36] Molluscs and seaweeds consume and break down organic sediments (Chandrkrachang, Chinadit, Chandayot and Supasiri, 1991).

limiting production to 200,000 metric tons from 80,000 hectares of farms (both of these limits had already been exceeded in 1994) (NACA, 1994b:16). All of the measures that were adopted, however, address serious problems that could negatively affect the profitability of the shrimp industry in the immediate future. Nonetheless, obtaining compliance will be far from easy as some short-term profits of individual producers would have to be sacrificed in order to improve the profitability of the industry as a whole. Moreover, there would have to be standards for other sectors of the industry.

If the requirement of prior government approval for shrimp farm construction could be interpreted to mean that there would have to be critical social and environmental impact assessments and that the industry would have either to foreclose its exploitation or to bear the costs of its social and environmental damages — that are now borne by other social groups — this new legislation in Thailand could be an important step. It is, however, unlikely that the government of Thailand alone has the clout to impose such equitable policies.

There are frequent references in the literature to the need for comprehensive land- and water-use planning of a country's coastal and wetland areas (FAO-NACA, 1994a-h; NACA, 1994a-b). Zoning is often mentioned as a suitable instrument for implementing such plans. Zoning could be supported by economic incentives and penalties such as taxes designed to reward those who comply and penalize those who do not.[37] This discourse implies national plans, presumably designed by well meaning technocrats in collaboration with national political leaders. There seems to be little recognition that experience elsewhere and with other issues suggests that zoning and land use planning have been most effective where they have been designed and carried out with the broad organized participation of the local groups most affected. Of course, there also would have to be a supportive national policy and an institutional framework that recognizes the rights of customary national resource users, and of unborn generations, to sustainable livelihoods and a productive clean environment.

The issue of centralization versus decentralization of coastal area planning and controls is to a large extent a false dilemma. Many problems can best be dealt with locally by the people most concerned, but effectively dealing with problems associated with commodities that enter national and international trade implies the need for a broader enabling public policy and institutional framework. Numerous problems, such as quality standards, the legal system, tax, environmental and labour codes and the like require national and international norms. The rule of thumb should be to provide as much scope as possible for local level popular participation[38]. Where local power structures are dominated by small élite groups, popular participation will only be feasible if the basic rights of the hitherto powerless are protected by a state that is somehow accountable to even its poorest citizens.

[37] Zoning, even if effective and participatory, is insufficient as there should be social and environmental impact assessments at each step in carrying out coastal area plans.

[38] According to a working definition of UNRISD, participation is: "the organized efforts to increase control over resources and regulative institutions in given social situations, on the part of groups and movements of those hitherto excluded from such control" (Pearce and Stiefel, 1979:8).

Economic incentives and disincentives

A serious problem with the regulatory legislative approach is that laws can often be easily disregarded by powerful social actors that they were designed to regulate. Moreover, in most places local communities, and especially vulnerable social groups in such communities, do not have an active participatory role in formulating and implementing public policies. These groups are largely ignored in environmental impact assessments, in determining the construction, location and densities of shrimp ponds, in regulating shrimp farm activities or in having rights to adequate compensation for degraded environments and lost access to natural resources. There seem to be no provisions ensuring that communities benefit through local taxes on shrimp farm assets or profits. As was seen in earlier sections of this report, this leaves local communities without possibilities or incentives to co-operate in designing and enforcing regulations aimed at making shrimp farming more environmentally and socially friendly. At the same time, the shrimp industry is usually sufficiently powerful politically to shape rules and laws to suit its own perceived interests, and to evade them if they do not. In this it usually, but not always, has the co-operation of large landowners and other members of local élites. As was seen in section IV, both local élites and commercial shrimp farmers frequently evade regulations designed to diminish the industry's environmental damages.

This has led many analysts to argue that, to the greatest extent possible, the command and control approach should be replaced by one of economic incentives and disincentives. A combination of well designed taxes, penalties, credits, trade and price policies, support services and infrastructure could contribute to promoting aquaculture that is more environmentally and socially sustainable. Such policy measures, however, require at least as exacting institutional and policy contexts as does effective regulation. They can be easily perverted towards other ends if they are not guided by a very skilfully designed enabling framework and if they do not enjoy solid political support as well as wide participation of diverse social actors at all levels. In addition, successful implementation of both the regulatory and incentive approaches require highly competent and corruption-resistant public officials.

As was seen earlier, most governments and financial agencies provided economic incentives, such as cheap credits, export promotion, import privileges, tax breaks and easy access to natural resources, to stimulate the shrimp farm industry's expansion, but not to internalize its negative externalities. The literature reviewed did not mention concrete examples of where the economic incentive approach had been used successfully to minimize social and environmental externalities of shrimp farming (FAO/NACA, 1994h).

There seems to be little probability that the polluter pays principle will be widely applied in the near future. This is especially the case where the pollution involves the loss of livelihoods by politically powerless groups such as poor peasants or fisherfolk, or unborn generations. Prevention and

compensation are both costly, which means that someone has to sacrifice short-term gains.[39]

The difficulties in implementing such legislation can be readily appreciated. For example, in 1994 shrimp producers in Thailand were already protesting taxes on imported feed and other necessary inputs. They argued that unless these taxes were eliminated, or unless they received rebates, Thailand could no longer compete with producers in other countries, such as India or Bangladesh, where costs were lower. As a result, they said, Thailand would soon lose its place as the world's largest shrimp exporter. Frozen shrimp exports in 1992 were one of the country's most valuable earners of foreign exchange, rivalling rice which had been the leading agricultural export crop for many years (**Fish Farming International**, 1994c). This example illustrates the fierce opposition generated among commercial shrimp producers by any general application of the polluter pays principle, or other regulations that would be costly. It also illustrates the need for international co-operation in order for minimum social and environmental standards to be accepted by an industry operating in a highly competitive world market. Failure to accept such norms, however, may mean that the industry cannot be socially and environmentally sustainable within a few years.

[39] Furthermore, it is often questionable who should pay for the pollution — how much should be the obligation of the farm producer, the marketing firm or the consumer? The applicability of the polluter pays principle is not straightforward. Who actually pays the bill depends largely on the relative bargaining power of the various social actors.

Environmental impact assessments

As mentioned above, several countries now require environmental impact assessments before permission is granted to install commercial shrimp farms. This raises four rather fundamental issues:

- The first is the conceptual framework of the assessments. What constitutes environmental degradation and how is it linked with shrimp farming?
- The second is the social content of these assessments. Are they merely concerned with degradation of the natural environment or are the social impacts for different population strata also included?
- The third is the quality of the assessments. How relevant are they technically and analytically? If they include social issues, are the social actors most affected actively involved (obviously, unborn generations cannot participate) in carrying them out?
- Finally, what influence do such assessments have over what actually happens? What effect in practice do the assessments have on investments, the location of ponds and infrastructure, management practices and on compensation for those who are prejudiced?

The first question is discussed in some of the environmental literature (Dasgupta, 1982; Ehrlich and Ehrlich, 1992; Wilson, 1988), but is hardly touched upon in the publications on shrimp farming. Some regard mangrove destruction, biodiversity loss or pollution of water and croplands as decisive *a priori* indicators of environmental degradation. Others assume that such processes are reversible and treat them as if they could be evaluated in terms of financial benefits and costs. Almost none of the publications discuss the more fundamental empirical, ethical and philosophical issues behind these judgements.

The second question concerning the inclusion of social issues in environmental impact assessments also seems to be neglected in most recent publications concerning shrimp farming. While considerable attention is given in the literature to the importance of environmental impact assessments when undertaking investments in commercial shrimp farms, there is little recognition of the need to include social issues in such analyses. An exception was an article a decade ago by the Director of ICLARM. He raised many of the social issues treated in the present paper and argued for social feasibility assessments of all aquacultural projects, contending that the concept of social feasibility should include all aspects of aquaculture that are not strictly technical and financial (Smith and Pestaño-Smith, 1985). His challenge to the then newly emerging farmed shrimp industry, and to social scientists observing it, seems to have been largely ignored, however, as social issues are seldom given much priority in later publications by national and international agencies dealing with shrimp aquaculture. Even when the negative social consequences for local people are recognized, this does not seem to influence the content of programmes designed to promote shrimp farm expansion (Christy et al., 1988). The

present paper, however, suggests that social and environmental issues are inextricably intertwined.[40]

The third issue of the quality of environmental impact assessments deserves considerably more attention than it has apparently received. The guidelines reported in the literature appear rather formal and bureaucratic. Environmental and social impact assessments, however, should involve a great deal of critical analysis based on sound data from the natural and social sciences. They have to be adapted to each unique environmental and social context and to recognize explicitly the many uncertainties involved. To the maximum extent possible, the social actors who are involved or affected should be active participants in carrying out these studies and in related planning and implementation processes. This requires inter-agency co-ordination at all levels as aquaculture cuts across numerous government agencies (Dickson, 1992:129).

The issue of the practical effects of environmental impact assessments is perhaps the most important of all. There is little information available about how the findings of environmental impact assessments influence either public policies or those of others. This requires further research. Environmental impact assessments that remain in bureaucratic or academic files are not likely to influence the behaviour of the state or of other social actors.

Benefit-cost analysis

Proposals for benefit-cost analyses in purely monetary terms dominate the literature. They are not very convincing, as they seem to ignore political realities. Moreover, they imply that placing market values on livelihoods of the poor, who are largely outside the market economy, and on the environment, such as the destruction of mangroves or the disappearance of plant and animal species, is a meaningful exercise. Monetary benefit-cost analyses offer technocratic solutions to what are essentially political issues. In reality, if actual market values are used or inferred, the results of economic benefit-cost analyses will almost inevitably advance the interests of the powerful in the present world system to the disadvantage of the people depending more on local resources and environments and who have little influence over markets, such as poor peasants or unborn generations. If shadow prices are used to reflect the analyst's views of the real importance of these groups' interests, however, this is merely another way of expressing particular value judgements in pseudo-scientific terms (Barraclough and Ghimire, 1995).

In spite of their many limitations, cost and benefit analyses can be useful instruments to advance a broader political debate, especially when they

[40] Normative debates about the fundamental criteria for making the shrimp industry "sustainable" should consider questions such as the following: (1) How much pollution is acceptable to whom? (2) Whose former activities can be displaced, and by how much, to leave space and resources for the new industry? (3) How many jobs and livelihoods can the industry provide? (4) What institutions and policies (governmental and non-governmental) are required to induce the industry to become socially and environmentally sustainable? (5) How can all concerned actors be involved in addressing such questions and having their claims taken into account?

involve the local people who might be prejudiced. For example, at the request of the Supreme Court of India, the National Environmental and Engineering Research Institute prepared a report in 1995 on the impacts of shrimp aquaculture. According to this report, it has been estimated that for Andhra Pradesh the industry's annual earnings of 15 billion Rs. caused damages worth Rs. 63 billion. For Tamil Nadu Rs. 2.8 billion earnings were outweighed by Rs. 4.3 billion in costs (Khor, 1995). Of course, all these estimates can be disputed on technical grounds, but in the process of debating these estimates underlying political issues often become clearer to participants.

The implicit assumptions by many environmental economists promoting benefit-cost analyses in monetary terms as a decisive tool for evaluating the claims of different social groups competing for the same natural resources seem to be that both ecosystems and social systems are mere subsystems of the economy. Many ecologists, historians and social scientists would argue that the reverse is more realistic. They view society as being a subsystem of an essentially closed global ecosystem and the economy being a mere subsystem of the broader society.

◆ Implications

If the experiences in China and in Taiwan Province of China are reliable guides, the rapid expansion of intensive commercial shrimp farming in its present form in coastal areas of a given country can only be sustained for a couple of decades at most before diseases associated with self-pollution cause drastic decreases in production. Even assuming that new technologies are developed to overcome these problems, the industry's longer term social and ecological sustainability appears to be something of a contradiction of terms. The social disruption and exclusion of significant populations caused by the industry's expansion imply that repressive political systems would be necessary in order for new areas to be continually brought into production. In addition, the longer term negative environmental impacts would eventually generate strong opposition among other powerful interest groups, such as those investing in tourism, commercial agriculture and urbanization. Of course, the farmed shrimp industry is not unique in these respects. It is doubtful whether "development", as practised in the recent past, is sustainable indefinitely anywhere on a global scale, but shrimp aquaculture brings out many of its difficulties in a dramatic way.

Institutional, environmental and policy contexts differ to some extent in each locality and each country. It is not feasible to prescribe policies or institutional reforms to be applied everywhere in a mechanical fashion. A general rule is that governments should be made representative and accountable, basic human rights respected and property rights should be equitable, clear and secure. Low income customary natural resource users should as a minimum be compensated somehow for their losses, although this is very difficult when they are deprived of their livelihoods and autonomy. The interests of others who are negatively affected by externalities arising from shrimp farming (including future generations) should be taken fully into account. Given the many limitations of compensation schemes — because of incommensurabilities in values and of political instability, it would usually be more practical and correct to prevent

the polluters from causing the damage in the first place, through regulatory means and economic incentives, than to attempt compensation for those who are harmed. But it is not realistic to expect the shrimp industry to follow such criteria unless they are applicable more generally to other sectors, and at global as well as national and local levels.

Unfortunately, these injunctions can be little more than pious wishes without broader reforms in socio-economic and political relations locally, nationally and internationally. This is not the place to discuss what such broader reforms should include, or how they might be brought about. Perhaps, pressures on the shrimp farming industry to clean up its act by becoming more environmentally and socially concerned could make a modest contribution in this direction. High income purchasers should, in any case, have to pay the real price of their consumption.

Pressures on the industry to move in this direction could come from several sources. One could be from industrialists and investors who become increasingly concerned about the industry's longer term social and environmental sustainability. The scientific community could become an important pressure group to the extent some of its members become aware of the ecological damages the industry's expansion implies. Another could be from other industries coveting the same natural resources, such as tourism, commercial agro-exporters and urban developers who can compete politically and economically on more or less equal terms with shrimp producers. Also, one should not neglect pressures for reform emanating from far-sighted civil servants and political leaders within national states and international organizations.[41] Environmental groups as well as human rights and consumer organizations are already becoming increasingly concerned and putting pressures for reforms on both governments and the industry itself. The organized pressures from hitherto powerless social actors who are negatively affected, such as peasants, fisherfolk, villagers and landless labourers, are already increasing and such initiatives should be widely supported and protected by all who are socially and environmentally concerned.

Policy and institutional reforms are required at all levels. The possibilities of bringing about such reforms will largely depend upon the effective participation of the key social actors and of alliances of concerned parties in both producing and consuming countries.

[41] For example, Dr. Alagarswamy, Director of the (Indian) Central Institute of Brackish Water Aquaculture for the Sustainable Development of Shrimp Farming, states that shrimp aquaculture should confront the six following principles of sustainable development: social acceptability; equity; economic viability; technical appropriateness; environmental soundness and conservation of resources (Alagarswamy, 1995:14).

APPENDIX: FILLING A RESEARCH GAP

Like many young dynamic industries, shrimp aquaculture raises a host of problems. The industry itself, together with allied institutions, can be expected to advance rapidly towards finding partial solutions to many of the technical, financial, marketing and administrative problems that it is confronting, as it has been doing rather successfully during the past few decades. The present research suggests, however, that the industry is not likely to solve, or even devote substantial resources towards finding solutions to, many of the broader social and environmental problems associated with its continued growth. These involve power relations in the whole society, livelihood and health issues for local residents, concerns about the future health of the planet's natural environment, as well as the longer term economic sustainability of the industry. These issues have to be confronted by critical research primarily supported by public institutions and NGOs.[42] Until now, at least, these problems have received insufficient attention.

The first priority indicated by this literature review is to initiate selected case studies of the social and environmental implications of commercial shrimp farm expansion and of the means for controlling it in developing countries. This research should begin at the local level by examining several affected areas in each case study country, and then move on to examine institutional linkages, constraints and opportunities at sub-national, national and international levels. It should analyse the effects of public policies and economic constraints and consider possible alternatives at all levels.

Case studies should be selected to represent what are considered to be typical combinations of social and related environmental processes, policies and institutions that are associated with commercial shrimp farm expansion. Different ecological systems, social contexts and shrimp farming intensities should enter the selection process. Case studies should initially be carried out in three or four Asian countries. They should also include one or two countries each in Africa and Latin America where commercial shrimp aquaculture is established or planned.

Researchers should seek to understand better the social and environmental implications of export shrimp farming for diverse social groups and in different ecological settings. Each case should be examined within its broader historical and social context.[43] Particular attention should be given to identifying vulnerable social groups and to drawing out a careful analysis of their responses as well as those of the various social actors who are influential in policies and institutions affecting coastal natural resource management. The analyses should emphasize the implications at local levels of policies and programmes that have been promoting the shrimp industry and the ones that have in the past and could in the near future be considered

[42] For example, Skladany argues: "The concerted involvement of a relatively neutral international organization(s) which can assert a more socially defined mode of aquaculture development may be required, so that the benefits of such activities are available to a wider society..." (Skladany, 1992:35).

[43] Case studies that do not carefully relate outcomes to interacting social and natural systems of processes and structures tend to be merely anecdotes.

and implemented for regulating it. The studies should also focus on understanding the multiple impacts the industry has on diverse natural ecosystems. The many dimensions of the social and environmental impacts of the shrimp industry, as well as their institutional and policy implications, require an interdisciplinary approach involving a collaboration among research partners with diverse specializations.

In summary, the case studies should deal with the political economy of shrimp farming and environmental degradation in specific ecological, social and political contexts. After gaining a better understanding of these dynamics in various specific local, national and regional contexts, it should be feasible to make tentative generalizations on the basis of comparative analyses of the case studies and other information generated during the research effort. These conclusions would be useful for administrators, planners and political leaders, educators and non-governmental organizations. The research could contribute to efforts to prevent the expansion of the industry in unsuitable social and environmental settings and to mitigate the adverse social and environmental impacts of existing and projected installations.

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