

Date: Saturday 22 April 2000 and following
From: Emanuel (Mike) Polioudakis
To: Persons interested in my research on Thai shrimp farming
Topic: Synopsis of Results of Research on Southern Thai Shrimp Farming;
Some Recommendations

Dear Recipient:

I am an independent anthropologist who did about four years of fieldwork on shrimp farming in Southern Thailand. I have reason to think that you might be interested in the results of my research. This synopsis summarizes my findings and gives some recommendations. I wrote this synopsis without my full papers, so here the dates and numbers are approximate, and I do not cite references. Except for isolating the Contents, I did not set any page breaks, so please beware of widowed and orphaned section headings.

This synopsis will be followed first by an outline of a full report and then by the full report itself, both on email. I try to place shrimp farming in the context of Southern Thai ecology, economy and society. All three are written for a non-technical reader. If you wish the outline and full report, please let me know by email, otherwise I will assume that you do NOT. Please address me just as "Mike" or "Mike Polioudakis."

At present, I work for Professor Claude E. Boyd of the Department of Fisheries and Allied Aquacultures at Auburn University in Alabama (my thanks to him). He is not responsible for my views. My regular mail address is:

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I will accept comments but I probably cannot respond. Please do not assume that I have "taken sides." You may forward this email to anyone. You may cite it if you wish, although I do not know the proper format. Remember that these results are provisional and subject to change.

CONTENTS

Why Concern Yourself With Thai Shrimp Farming

Why Present This Synopsis Now

Research Basis for My Findings

A Brief History of Related Ecological and Economic Topics

GEOGRAPHY OF SOUTHERN THAILAND

CUTTING OF THE FORESTS AND SUBSEQUENT DRAINAGE CHANGE

FISHING

MANGROVES AND OTHER WETLAND FORESTS

TOWNS AND AGRICULTURE

Some Important Facts About Thai Society

Types of Farms and Their Ecological Impacts

EXTENSIVE

SEMI-INTENSIVE

INTENSIVE

A Brief History of Southern Thai Shrimp Farming

EXTENSIVE FARMS AND EARLY COOPERATIVES

INTENSIFICATION, DISEASE AND AFTERMATH

HONEY-COATED DISASTER, HARD REALITY SETS IN

Uncertainty and the Typical Farmer Density Trap

Some Techniques of the Future

Re-circulation of Water

Settling Basins

Specific Pathogen Resistant (SPR) Shrimp

Pro-Biotics

Using Even Less Feed; Using Natural Food to Replace Artificial Food

Low Protein Feed With a Better Amino Acid Profile

Bio-Filters in the Inlet Pond

Not Dumping Bad Ponds or Diseased Ponds

Vaccines; One Pond, One Mother

Synergy; More Small Farmers

Snapshot of Thai Shrimp Farming in 1999

**The Suratthani Shrimp Farmers Association;
The Thai Marine Shrimp Farmers Association**

Good Things About the Industry

The Code(s) of Conduct, and Government Zones

Some More Hard Social Facts

Three Key Recommendations and A Comment

Mostly Negative Recommendations

SPECIAL TAXES
WATER SCHEMES AND PARKS
PRICE STABILIZATION
OTHER ISSUES

Mostly Positive Recommendations

LAND TITLE
OTHER ISSUES

MAIN BODY OF THE TEXT

Why Concern Yourself With Thai Shrimp Farming

Thai shrimp farming is part of a much larger global trend away from caught fish and shell fish toward cultured fish and shell fish, that is to aquaculture. In the future, people will get more of the “fishy” portion of their diet from cultured products than caught products.

Shrimp farming was probably the fastest growing kind of aquaculture over the last twenty years. In part, it grew so quickly because of its occasional very high profits.

However, shrimp farming has some problems. Typically, it has gone through a boom-and-bust cycle. At first, it invades old coastal forest, and/or regions of older agriculture. Then it intensifies its methods and increases the number (density) of shrimp in the ponds, thereby stimulates diseases of the shrimp, and it collapses.

Shrimp farming has been blamed for a variety of bad things, including:

- Destroying the last of the world’s coastal (mangrove) forests
- Undermining the livelihood of local fisher folk and local agriculturists
- Irretrievably polluting near-coastal land and near-coastal waters
- Digging up and abandoning to waste large tracts of the natural landscape or agricultural landscape
- Widening the gap between rich and poor
- Causing dependence on exports
- Causing dependence on cash in the economy

Proponents of shrimp farming deny that it is the prime mover behind these ills, and instead cite its benefits:

- It has allowed agricultural nations to take their place in the world economy
- It has allowed poorly productive land to become highly useful
- It has given an opportunity for people with little land to make much money
- It has provided poor countries with much-needed exports and cash flow
- It has provided jobs for many more people than could otherwise have been sustained on the same plots of land
- Since even small land holders can raise shrimp, shrimp farming has often diminished the gap between the rich and the poor
- Areas of shrimp farming tend to have better roads, schools, and other services
- The boom-and-bust cycle can be much dampened through wise management
- Problems with pollution and disease can be controlled through wise management

Shrimp farming lies in the nexus between world capitalism, the transformation of old agrarian societies, the environmental crisis, the role of private people, the role of private enterprise, the role of NGOs, and the role of government. What happens with shrimp farming may augur the future for other aquaculture and for agribusiness in the Third World.

In the last fifteen years, shrimp farming has consistently been one of the top three industries in Thailand. It contributed greatly to Thailand’s rise as a “Newly Industrialized Country” (NIC) through generating cash that was invested in other areas. It helped avert even greater disaster

when Thailand led the collapse of the Asian economies. We need a clear understanding of Thai shrimp farming and its role in the nation.

Unlike other countries, Thailand has managed to weather the boom-and-bust cycle of shrimp farming. A core group of farmers kept on producing, while other farmers move in and out of production when possible. Now, Thailand consistently produces the highest quality, and the most, “black tiger” shrimp (*Penaeus monodon*) in the world.

The Thai shrimp industry gave birth to one of the only truly viable business organizations in Thailand. What happens to associations of shrimp farmers may indicate the role of private enterprise in the mixed-managed economies of the Third World.

Why Present this Synopsis Now

1. I believe that many people do not wish to read the entire report and/or do not wish to wait for it in order to read the summaries and recommendations.
2. I have recently encountered academic theses, academic reports, government reports, and conference proceedings, which suggest that:
 - A. Contemporary shrimp farmers, unilaterally, excluding other occupations or social groups, ought to be taxed to provide compensation for:
 1. Damage to the ecology, in particular to coastal wetland forests (mangrove forests)
 2. Damage to fisher folk, and to rice farmers and other agriculturists
 - B. Shrimp farmers should be forced to buy clean water from the government. Shrimp farmers should be forced to run their effluents through government treatment facilities. In effect, all shrimp farms, even those which are ecologically sound and well-managed, should be forced to operate in shrimp agro-industrial parks (*nikom kasetakam*).

Shrimp farming has caused some ecological problems. Still, the above proposals are misguided and potentially harmful to Thai shrimp farming, particularly to small-scale shrimp farmers, and to the Thai economy and Thai society. (I discuss one good tax in my Recommendations).

It seems that, to pro-environmentalists and anti-capitalists, shrimp farming has become the current symbol of all that is bad. Yet, for Thailand: the reaction against shrimp farming is out of proportion to the actual costs of shrimp farming; the reaction under-values the benefits of shrimp farming; it does not take into account significant internal reform of shrimp farming by the farmers that is already underway; and it blames shrimp farming for harm that is caused by others. To cripple shrimp farming would hurt the “little guys” far more than it would hurt any “big, bad guys.” Actions against shrimp farming would not help the environment very much unless similar measures were taken against many other groups at the same time (including such “little guys” as fisher folk, rice farmers, rubber growers and fruit growers). Activists should encourage the process of internal reform in shrimp farming before imposing any unusual taxes or government structures on shrimp farming. Activists should not be led by symbolically encoded frustration to

act against the best interests of Thailand.

Even though shrimp farming may have caused some ecological and social problems originally, its long-term profits depend on its maintaining ecological health and good social conditions in the future. Farmers recognize this constraint, even if they do not always know what to do about it as individuals. The best management for shrimp farming is self-regulation that encourages the farmers to use available techniques so that individual benefit coincides with ecological and social benefit.

Research Basis for My Findings

I first lived in Thailand from 1981-1984 to do research for my Ph.D. thesis. I lived for about two-and-one-half years in a coastal Thai Buddhist rice-farming village on the Gulf of Thailand in Nakorn Sri Thammarat Province (“Nakorn”). Besides learning about land-based agriculture, I also learned about natural shrimp farming and about fishing. I learned about Muslim fisher folk from a fishing village immediately “next door.” On a later visit to Thailand I did field work with Muslim fisher folk.

I can understand and speak Bangkok Thai and Southern Thai passably. I can read Thai passably. I can write Thai slowly. My wife is Thai, originally from Nakorn Pathom Province in Central Thailand near Bangkok. She lived with me in the US for eleven years until 1995, when we went to Thailand for this research. She is fluent in English and Thai. She understands the Southern Thai language better than I do although she cannot speak it.

On repeated return visits, I noticed the initial growth and then the contraction of shrimp farming in the South. I spent one summer visiting many shrimp farming sites to prepare for more in-depth research.

For 1995-1996, I obtained a Senior Fulbright Fellowship at the Coastal Resources Institute (CORIN) at The Prince of Songkhla University in Haat Yai to study the social control of shrimp farming in the South. My wife and I bought a pickup truck to do the research. For reasons too complex to explain, I was not permitted to carry out my research. However, on my own I was able to study coastal zone management, thanks largely to materials sent to me by institutions such as the University of Rhode Island.

I was also able to visit Suratthani Province (“Surat”), and, in particular, to become acquainted with the Suratthani Shrimp Farmers Association (*Chom Rom Phuu Liang Kung Suratthani*; the “Surat Chom Rom” or “Surat Association”). There I learned of progressive shrimp farming which was socially and economically beneficial not only to the members of the Surat Chom Rom but to other farmers as well.

I left academia. My wife and I stayed in Surat from March 1997 until August 1999 to study shrimp farming there and in other parts of the South. We drove to farming sites. We spent about every other day interviewing farmers or doing other research activity aimed at shrimp farming. She participated completely in almost all phases of research while we were in Surat. We were entirely self-funded from July 1996 until April 2000 when I returned to the US. That is, we were unemployed and we worked until our funds were depleted.

Besides Surat, we also did research primarily in Nakorn. We visited for long periods the Gulf of

Thailand seaboard from Suratthani to Narathiwat, and the Andaman seaboard from Ranong to Satun. We did very little work around Songkhla Lake or in Pattani because we heard that other researchers were already working there.

We collected fairly good ecological and social histories for a dozen sites. We collected minor ecological histories for half-a-dozen more.

I was a constant attendant at Surat Chom Rom meetings and functions. Members graciously shared considerable time and knowledge with me - and extended my wife and I generous hospitality.

From October 1999 through February 2000 I did library research in Bangkok, mostly at the Asian Institute of Technology (AIT), Chulalongkorn University, Kasetsastr University, and the Department of Fisheries library at Kasetsastr University.

I read both of Thailand's English language newspapers for shrimp-related news, for over a year. I looked at Thai periodicals once in a while. My wife looked at Thai periodicals regularly.

My wife's kin are from Nakorn Pathom Province. We discussed the issues informally with shrimp farmers and other farmers there.

So as to better understand Thai culture (and for fun), I continually watched Thai television and Thai movies, and read Thai books, especially books on religion and social issues.

We stayed in Thailand a long time not just to research shrimp farming but to research other aspects of Thai society, and because three of my wife's very near family members got seriously ill. As a result, despite having lived in the US for eleven years, my wife lost her resident status ("green card"). Since I did not have a job for three years, I am not eligible to serve as her sponsor for her re-immigration to the United States. We have been forced to separate for a year while she stays in Thailand and I try to become eligible. Some questions should really be addressed to her, but she will not be able to answer.

A Brief History of Related Ecological and Economic Topics

GEOGRAPHY OF SOUTHERN THAILAND

Southern Thailand is the political unit that overlays the geographical unit of the Isthmus of Kra, the land bridge which connects Thailand and Burma to Malaysia. Southern Thailand is an inundated mountain range where peaks as high as 2000 meters are sometimes only 50 kilometers from the coast. It is also quite wet, with some areas, such as Ranong Province, receiving as much as three meters of rainfall per year. Whatever happens on the mountains strongly influences the ecology and economy of the coast and the marine near-coast, including rice farming, fishing, and shrimp farming.

Most of the agriculture, especially rice farming, used to be located on a belt between the mountains and the sea. The width of this belt varied, but it was generally from ten to forty kilometers wide. It was wider on the Gulf of Thailand side than on the Andaman Sea side, where often the mountains plunge directly into the ocean. The most productive zones of agriculture were the river plains around the provincial capital towns, such as Surat and Nakorn Sri

Thammarat. Rice was also cultivated in a few large mountain valleys, such as Thung Yai and Thung Song of Nakorn Sri Thammarat province. In a few mountain spots, such as Khiri Wong in Nakorn Sri Thammarat, villagers “farmed” the forest (*wana kaset*) by planting and managing a complex variety of indigenous forest tree species, mostly for fruits, beans, and resins.

Shrimp farming is located in a band about one to two kilometers wide all around Southern Thailand. The band is about 700 kilometers long on the Gulf of Thailand side of the Isthmus, and about 300 kilometers long on the Andaman Ocean side. Some portions are densely and widely cultivated while in some stretches there is no shrimp farming at all.

This band was formerly occupied by old coastal forest or old rice farms. Shrimp farming began in a mild, extensive form, in scattered locations on mud flats, hundreds of years ago. That extensive form expanded in the early 1980s. Then in the middle 1980s, shrimp farming began to intensify its methods and expand its territory. At first it moved into coastal forest, but then it moved out of coastal forest into old rice land. The peak of production came about 1993-1995. At that time water, water quality deteriorated, disease epidemics set in, and many farmers had to quit. Production contracted to fifty percent, or less, of peak land area. However, as a consequence of the problems, reforms in production techniques began that have significantly improved water quality and the ability of shrimp farming to get along with the environment and with society. The actual role of shrimp farming cannot be understood without also understanding the ecological impacts of logging, upland farming, fishing, deterioration of the wetland forests, and urbanization.

CUTTING OF THE FORESTS AND SUBSEQUENT DRAINAGE CHANGES

Since the proliferation of chain saws and large equipment in the 1960s, Thai forests disappeared at an astonishing rate. Perhaps one-half of the original forest cover still stood in 1975; probably not more than ten percent still stands now, and most of what remains is uneconomic to cut. Some of the land was cleared for dwellings, most of it was cleared for mono-crop agriculture such as rubber and fruit trees.

In the South, the government actively promoted the clearing of the forest for rubber orchards and fruit orchards, and (as far as I could tell) was still doing so as late as 1999 despite the ban on logging (see below).

A normal tropical rain forest has at least four layers of vegetation and a layer of litter on the floor. All this material holds rainfall. It sustains the soil and prevents erosion. Water percolates slowly through the forest and down into the coastal area. In the past, when rain fell in the mountains, clear water moved slowly to the coast, caused a rise in streams there and/or minor flooding over a period of several days, and then subsided. Even when no rain fell, even well into the dry season (only two months), naturally stored water in the mountains moved slowly and continually down the mountains into the coastal area. This continual movement of water provided the coastal zone with fresh water, kept wells usable and fresh, and kept sea water from seeping underground too far inland.

Clear cuts of the forest have no vegetation layer, and (rubber and fruit) orchards have only one minor layer of vegetation, often with no litter or grass over the soil. They hold neither soil nor water. From the air, Southern Thailand looks like a dense green tropical forest; but the vegetation is actually rubber plantations and fruit orchards; it is not forest, and it does not act like forest. Drainage patterns changed visibly by the middle 1970s and got progressively worse after that.

By the time of my first field work in 1981-1984, already the creeks (*khlongs*) were much more heavily silted than before. When rain fell in the mountains, the heavily silted water swept down into the coast, caused widespread flooding, and then rapidly disappeared. There was much less constant percolation of water down from the mountains to the coast. Wells that had formerly been good all year had begun to go reddish or saline. Salt water seeped into agricultural land. All this happened well BEFORE shrimp farming expanded.

The coastal zone rice belt had been fairly productive and rice farming there had required little labor. But since the late 1970s, at least half the land formerly planted through controlled immersion (*dam*; “wet” rice) was only planted by broadcast (*waan*). After that, land was continually abandoned for agriculture and given over to raising cows and other marginal activities. Perhaps only a quarter of former wet rice land was still in consistent traditional production by 1985. Farmers, and fisher folk, were easily able to explain all these ecological changes and their results.

In the late 1980s massive flooding occurred, including “rivers” of mud. The worst mud flooding was around Chian Yai in Nakorn Sri Thammarat province. The worst flash flood was at Khiri Wong in Nakorn Sri Thammarat. Several hundred people died in both places.

As a result, the government banned all timber cutting within Thailand. The ban is still in effect. Nevertheless, the forests continued to be cut, settled, and planted in orchards. The cutting only slowed down when effectively available forest ran out about 1995. Even now, forest will be cut if it can be accessed and the timber removed.

Besides forest in the mountains, coastal forest was cut as well (see below).

The changes in the forest and in drainage not only severely damaged rice agriculture, but also severely damaged the near coastal marine ecology, in particular spawning grounds, mangrove forests, and the near coastal waters where local fisher folk try to make a living.

Very little of the newly cut-and-settled land has clear legal title, whether in the mountains or in the old coastal forests. Numerous villagers managed to grab modest plots of former forest for themselves, but most of the land area was originally taken by a few large-scale land-grabbers who had political, military, police or gangster connections. Some of the large-scale land-grabbers still have large plots of land, but most of them “sold” their land in pieces to small-scale agriculturists. Villagers actively participated in the destruction of all kinds of former forest.

Most of the large-scale land-grabbers and some of the small-scale settlers did manage to bribe their way to a quasi-legal title of the land. Even taking them into account, I doubt that half the newly settled land in Thailand, indeed half the land in the whole country, has clear and deserved legal title. People still buy, sell and rent the land anyway. But people live in fear of losing their land and are highly suspicious about inquiries into ownership. Given the identity of the original large-scale land-grabbers, it can be unhealthy to inquire too strenuously.

FISHING

Problems with Thai fishing have been caused primarily by Thai fishing itself, whether at the level of giant trawlers or at the level of near-coastal “artisanal” fishing (“fisher folk”). Trawling was promoted in Thailand in the 1950s by a joint effort of the Thai and German governments, and caught on quickly. At first, catches increased rapidly, but then declined almost as fast. Trawling

catches too many fish, it damages spawning grounds, and it damages the general near-coastal ecology by “scouring out” the ocean bottom. The first signs of collapse were evident by the early 1970s (about the same time the forests began to deteriorate visibly). The situation has gotten steadily worse since then. Now even boats as small as eight meters long (four fathoms or “*wah*”) have drag nets or push nets but cannot make a living for their owners.

The Department of Fisheries would like to manage the situation but cannot. In particular, it has never enforced, and cannot now enforce, the ban on trawling within three kilometers of the shoreline. No-fishing sanctuaries help, but they are not enough, and they are not rigorously enforced. As a result, the near coastal marine ecology remains severely damaged. All of this happened BEFORE shrimp farming expanded. Fisher folk could easily explain all this themselves (and did so repeatedly to us).

The economic impacts on large-scale boats have not been too severe because those boats have ranged ever farther out to sea, ever farther away from the damaged near-shore ecology. Medium and small sized boats, including especially local small-scale fisheries, have faced consistently declining catches to support an ever-growing population. The decline in catch was partially offset by using nets with smaller and smaller holes; using dynamite, lights and poison; going after a greater variety of species; and by increases in prices; at least until the late 1980s. Since then, fisher folk have protested many times to the government to dramatize their plight. Yet it is hard to see what the government can do now short of radical, and unacceptable, actions such as a ban on most of the currently used gears or eliminating at least half the boats and fishers.

Shrimp farming did hurt some near-coastal fisheries through the release of dirty water, but it hurt them only for a short period of time and not severely. At the peak of production about 1993-1995, sufficient effluents were discharged into near-coastal waters to cause off-flavor in fish and to depress catches mildly (see below for a fuller statement). Since the first contraction of shrimp farming after 1995, probably shrimp farming has had no direct detrimental influence on near-coastal fishing. In some cases it has benefited near-coastal fishing by releasing needed nutrients into the near-coastal ecosystem. The near-coastal ecology would be able to handle nearly all the effluents from shrimp farming even during periods of high production if the near-coastal ecology had not been previously damaged by bad fishing methods.

The cutting of mangroves by shrimp farmers did cause some damage to some near-coastal fishing grounds, particularly in the peak period mentioned above.

MANGROVES AND OTHER WETLAND FORESTS

Mangroves are not the only kind of wetland forest although tidal forests, coastal forests, near-coastal forests, and wetland forests in general have come to be called by that name. Coastal wetlands which are dominated by nipa palm (*ton jaak*), natural and planted, have been very important in Thai economics and coastal ecology. Until they were cut down, the wetlands above the tidal area but near the coast held a variety of hard woods (of which I do not know the scientific names) which were important ecologically and economically (especially for building boats and houses).

Most of the drainage basin of the Chao Phraya River (*Jaaw Phraya*) from about Phitsanulok southwards (about 300 kilometers inland) was once a wetland or near-wetland forest. The province of Nakorn Pathom just west of Bangkok has no coastline (or little) but nevertheless it was a saline water wetland forest until about 300 years ago. Much of the water table in Nakorn

Pathom is only about half a meter below the surface, and a good portion of the underground water is still mildly saline. Much of the water under Bangkok is naturally saline and the land on which Bangkok now stands was once a coastal wetland forest. For a long time, agriculturists and settlers have been cutting down wetlands and wet forest of all kinds.

The forests were replaced largely by mono-crop agriculture: rice growing! Although rice growing has a long romantic history about it, rice mono-culture may not be much better ecologically or economically than the original forest it replaced. Certainly the balance between original forest cover and rice mono-culture should have remained far more on the side of the forest than has happened.

As with the Central Region of Thailand, so with the South, but there a belt of wetland forests between the mountains and the coast was slowly replaced by mono-crop agriculture and towns. I have seen remnants of wetland forest growing in all the major towns of Southern Thailand, as far as twenty kilometers inland from the coast.

Thirty years ago (about 1970), Thailand had about 2.5 million rai of coastal forest (1 rai = 1600 square meters; 1 hectare = 10,000 square meters; 1 hectare = about 6 rai; so about 400,000 hectares). Nobody knows how much coastal forest Thailand had a long time ago, and how rapidly that was cut. Now, Thailand has about 1 million rai (160,000 hectares) of coastal forest left, so about 1.5 million rai (240,000 hectares) was cut in thirty years. Shrimp farmers cut about half-a-million rai (80,000 hectares) of that, or only about one-third. The other one million rai (160,000 hectares) was cut mostly by settlers, but also by other agriculturists, charcoal gatherers, and land speculators.

Much of the portion cut by shrimp farmers was cut as part of government programs and so cannot be blamed on something intrinsic to the nature of shrimp farming. At the time, these government schemes were rightly considered progressive, although now in hindsight we can see that the schemes had serious environmental and economic costs.

The coastal forest in Southern Thailand differs between the Gulf of Thailand side and the Andaman Ocean side. On the Gulf side, except for a few river estuaries, rice farmers had reduced the original coastal forest to a few fragments and/or to a strip about one kilometer wide along some stretches of the coast - well before shrimp farming entered the modern phase. On the Andaman side, the rapid rise of the mountains restricted the development of complex coastal forest in many areas. But the largest coastal forest of all lay in a wide strip on the Andaman side through the provinces of Krabi, Phangga and Ranong, over 100 kilometers long. In some places this belt was over thirty kilometers wide.

It is still not clear how much coastal forest was obtained and cut legally, how much was cut through government programs, how much was obtained and cut quasi-legally, how much was obtained and cut illegally, and how much was just cut illegally. Of the portion that shrimp farmers cut, it is not clear how much falls into any of these categories.

Since about 1994, very few new shrimp farms have been cut in coastal forest, primarily because it is not economically sound to do so; coastal forest land makes bad shrimp ponds (see below). Shrimp farmers largely stopped cutting the coastal forest in Thailand (with one tragic exception, see below). Unfortunately, other people have not.

At the peak of production around 1995, I estimate that about 1.5 million rai (240,000 hectares)

was ever in shrimp farms, registered or otherwise (this figure subject to revision later). So, only a minority of shrimp farms were in the coastal forest.

Of the half-a-million rai (80,000 hectares) that shrimp farmers had cut in the coastal forest, much of it was later abandoned from shrimp farming - but not all. Of the land that was abandoned, I believe that most of it was taken over by settlers, other agriculturists, and land speculators. Some of those people may also have been shrimp farmers previously.

Although some Thai government scientists are trying to find out, at this time nobody knows for sure how much land falls in these categories:

-Coastal forest that was cut for shrimp farms

-Coastal forest that had been cut for shrimp farms and is still in use as shrimp farms

-Coastal forest that had been cut for shrimp farms and then abandoned

-Coastal forest that had been cut for shrimp farms, then abandoned and allowed to revert back to coastal forest

-Coastal forest that had been cut for shrimp farms, then abandoned, and then taken over by other people for other uses

=How much of each land type is in reserved forest

=How much of each land type has a well-founded legal title

=How much of each land type has a poorly-founded legal title

=How much of each land type has no legal title

Most coastal forest and some upland forest were severely degraded well before the expansion of shrimp farming. My wife and I visited almost all the coastal forest in Southern Thailand, and the only forest we saw that was in decent shape was in Phangga Province and a little adjacent to it in Ranong Province. All the rest was degraded, usually below the point where it would have been much use to fisher folk (especially without a healthy near-coastal marine ecology to act along with the forest), and had been degraded for a long time. Most of the damage was done by the villagers themselves, although sometimes the villagers were enticed to it by illegal relations with charcoal concessionaires and land grabbers.

The coastal forest that was cut by shrimp farmers cannot be discounted, but that cutting is only the tail end (and most visible part) of a much longer and more devastating history. The activities of shrimp farmers should be viewed in perspective, wherein it will be clear that they are not the worst actors. Anyone who wants to assess the fate of coastal forests had better think hard about the role of rice farmers, other agriculturists, squatters, small-scale charcoal cutters, and town dwellers as well.

TOWNS AND AGRICULTURE

The population of Thailand grew very rapidly since the 1940s, roughly quadrupling itself to about

sixty million people now. In absolute numbers, the large majority of the additional people stayed on the farm rather than moved into town, so that the amount of available land per person declined considerably. Often now farmers cannot sustain themselves, where they could have fifty years ago. Proportionally more people moved into towns than had lived in towns before, so the towns grew rapidly and rather chaotically. I believe that Thai towns have water treatment facilities, but I have seen little evidence of their effectiveness. The drains from even local towns run black, putrid and bubbly.

Until recently, Thai agriculturists used pesticides and herbicides very heavily. I have seen several cases of blindness caused by their use, and many other cases of cancer that were almost certainly caused by their use.

The wastes from towns and the chemicals from agriculture all drain rapidly into the near-coastal waters in Southern Thailand because of the short distances between the mountains and the sea and because most towns are located on the coast. In 1996, the entire oyster crop of Surat Bay (*Aaw Baan Don*) was lost because of heavy rains and the resultant run-off of chemicals from local factories and orchards - a loss of hundreds of millions of baht (then, 25 baht equaled one dollar) - far more than had ever been lost from any effects of shrimp farming on any economic activity there. I believe that the total damage to the near-coastal ecology (and thus to fisher folk) from urban and non-shrimp agricultural pollution generally far exceeds the damage from shrimp farming.

Some Important Facts About Thai Society

The importance of shrimp farming cannot be understood unless we take into account some social facts.

By 1985, the average land holding per adult on the Gulf Coast seaboard had dwindled to about 7 rai, or a bit over one hectare. The average holding per family was about 15 rai. Of that 15 rai, usually about half was in coconut orchard and half in (former) wet rice land. It is possible for a small family to live on that little land, but it is not possible to do much more. In particular, they cannot endow their children with much of a future.

Thai society is, and always has been, quite conscious of status, wealth and power. Families fight to get those goods, and fight to keep them. The social ladder may be easier to climb in Thailand than in some other countries, but it is not easy. Moreover, since the bubble economy, the gap between rich and poor got wider. Thailand provides free education only through about the sixth grade. The new constitution stipulates through high school but Thailand is far from being able, or willing, to put that provision into effect. Parents know that to succeed in the Thai educational system and to use education for socio-economic advancement, parents must buy admittance to a prestigious school (private or, illegally, public) and then students must buy special tutoring, grades or passes from their teachers.

Thai society is, and always has been, stratified, even at the village level. Some families in the village always had more than they needed, some only just enough, and some not enough. These differences were inherited and perpetuated. Some families among the well-to-do dominated rural politics, and used the poor as "thugs" by which to keep their faction in power. Villages had classes and "rural elites" long before the advent of capitalism, and very long before the rise of shrimp farming.

The Thai government was never intended to manage society, economy or power relations through the rational (Weber) application of laws designed to promote justice. The Western idea of the “rule of law” is neither common outside the West nor dominant even where known outside the West. Rather, Thai government units were operations to guarantee order and to generate revenue for loyal officials, who ran them through patron-and-client bonds. To the Thai, this system was not unusual or offensive. It resulted in a tolerably well-managed country. The recent economic boom did not undermine the system, it actually reinforced and augmented the system until the modern world order made it no longer possible to run a country and/or ecology that way. The Thai have not yet devised an effective substitute and probably will not for several decades.

Although many Thai officials are honest and efficient (and nice people), and the government can be extremely thorough and efficient when it wishes, in practice the Thai civil service is corrupt by Western standards. This corruption is an unavoidable legacy of the historical system and cannot be changed quickly enough to help any programs designed to deal with shrimp farming. As a result of the corruption, program costs are routinely over-estimated. Only about half the money planned for programs is spent on them, and even that amount often goes to shoddy materials, sub-standard performances and public relations charades. Money designated for environmental and/or social rehabilitation is not likely to be used for that purpose and is not likely to have much beneficial effect. Taxes ought not to be collected for these ends unless the spending process is very carefully supervised. To achieve environmental and/or social rehabilitation it is best to spend the money directly through the private sector, directly on targets, directly on NGOs; or to do nothing.

The Thai have difficulty dealing with externalities. (An “externality” is a term from economics which means a problem that someone causes and for which he/she does not have to pay but for which someone else has to pay. For example: loud noise, water pollution, pollution from burning garbage, car exhaust, secondary tobacco smoke, clear cuts of the forest, diseased dogs). The usual Thai method for dealing with externalities is to ignore them; sometimes Thai people literally just turn their faces away. Westerners who first come to Thailand usually have trouble with this aspect of Thai culture.

Thai people do not always manage public (“common” or potentially “free access”) resources such as forests or fishing grounds. Sometimes they just allow free access until the resource is depleted to a kind of degraded equilibrium. When the Thai do manage public resources, they rarely manage them through collective community action, especially collective community action with equal benefit for all. Instead the Thai usually institute a hierarchical system with a “large person” (*phuu yai*) and his/her family in control at the top. Rarely are access to resources, or benefits from resources, equal for all member families; the managers expect more and had better get it. The managers use their disproportionate share to make sure that they stay in control and to further enhance any advantage in wealth or power they have over others. In particular, government has not managed collective resources except in a hierarchical system ruled by a powerful top; the top expects and gets more. Westerners also have trouble with this aspect of Thai culture. (Some near-coastal fishing grounds are managed through families staking out territories in the water, literally. I do not know how egalitarian in general are the results of this practice.)

One reason that the Thai have difficulty with externalities and public goods is that their strategic time scale is fairly short. They tend to be short-term opportunists. Economists say that they “show a high rate of future discount.” Success consists of what happens in the next crop or the next meeting with your superior, not what happens in the next three years. Yet environmental

management requires thinking in terms of decades.

Some Thai are far-sighted. A few far-sighted leaders have served the nation extremely well (the King, and Prime Ministers Prem Tinsunalonga and Chuan Leekpai).

A common Thai saying is “*aaw tua rote*” which means “make sure you get yourself out OK (regardless of other people).” Despite a few outstanding leaders, it would be unwise to think that the average villager or official operates in a long-term time frame, although they surely will try to get out OK.

The Thai are good about making laws but not so good about enforcing them, unless to enforce a law in a particular situation coincides with benefits to the enforcers. The benefits are usually to make money or to please a superior. The Thai are happy to make laws that satisfy international ideologies, and then simply not to enforce the laws. Their behavior toward drugs, prostitution, gambling, and driving are classic cases, easily observed by casual visitors, and another source of wonder to some Westerners. The Thai particularly dislike enforcing laws that might irritate some powerful person. The driver of a Mercedes Benz rarely gets a traffic ticket. The Thai also dislike enforcing laws that inhibit people, especially ordinary people, from making a living - in this case largely for good humanitarian reasons. Perhaps out of a combination of both motives, they also dislike enforcing laws about externalities and about the environment, such as laws about disposing trash, about where to fish, and about what kind of fishing gear to use.

Naturally, there are some things about which the Thai are quite serious, and which have the status of strong social rules rather than weak paper laws. But these strong social rules do not much concern shrimp farming or the environment.

As most police officers can tell you themselves, having laws but not enforcing them, or enforcing laws only selectively, produces some bad results (even when people know the difference between a paper law and a strong social rule). It turns the police into a gang. It encourages hypocrisy in general. It encourages bribery and corruption. It undermines faith in order, in equality, and in the unity of society. It encourages the idea that whatever the police are willing to enforce has a status like law, whether or not what the police wish has been legislated. The Cold War reinforced all these propensities. I am not sure if the Thai think they actually fool foreigners over non-enforcement of laws or if they think that foreigners are willing to go along with the Thai for their own reasons.

Fortunately, the Thai have an abundance of good qualities that usually compensate for the bad ones. I do not discuss the good qualities here because they have already been thoroughly portrayed in the general literature on Thailand.

A few rice farmers were very good at “reading” the land and water, and knew a lot about the natural world. But most rice farmers were rather moderately skilled at farming and moderately knowledgeable about nature. Some farmers were just inept and ignorant about nature. The bad and mediocre farmers tended to copy the good ones, usually without fully understanding why. We cannot assume that all farmers are “at one” with the natural world, comfortable on the land, and highly skilled at farming.

Thai rice farmers could get away with low levels of skill and knowledge precisely because rice farming is a mono-crop. Often, farmers put as much seed on the ground as they could get away with and hoped to get as big a crop as luck could give. They carried over this attitude onto new

ventures, such as farming sugar cane, rubber, oil palm, fruit, pigs, chickens, and shrimp: put in as much as you can and hope to get out a lot.

Shrimp farming requires dealing with externalities (such as “dirty” water and the spread of diseases), and managing collective resources (all water). Shrimp farming seems to call for at least some government management and it has generated some paper legislation. Shrimp farming is a mono-crop. For all those reasons, we should not expect too much success at sound environmental management right away, and we should be skeptical of claims for future success primarily through legal means. The considerable Thai achievements already in handling the problems of shrimp farming should be evaluated against their social propensities.

The last few points about Thai social life should especially be kept in mind because much of the current discourse on social improvement in Thailand starts with a false romantic myth about Thai society. The term “*chaaw baan*” encompasses both “villagers” and “peasants. It literally means “house people” as opposed to “*chaaw wang*” or “palace people.” The myth:

- The uniquely good Thai character was formed by the “*chaaw baan*”;
- the “*chaaw baan*” originally were all of equal wealth and power;
- the “*chaaw baan*” have an egalitarian ethos;
- the “*chaaw baan*” do not compete but instead cooperate;
- the “*chaaw baan*” can manage collective (public) resources so that everyone benefits equally and the village in general also benefits;
- the “*chaaw baan*” voluntarily follow rules and/or rule-like traditions;
- all the “*chaaw baan*” were highly skilled farmers (or fishermen), who loved the land and forests and waters, and were completely in harmony with nature; and
- this character type and social pattern only broke down under the influence of the West (with a little blame to the Chinese and Japanese), especially under the pernicious influence of Western capitalism and competitive consumerism.

I lived with Thai peasants for years and studied them for years more. I get along with them. This myth embodies a good ideal when it is not used merely to rationalize Thai selfishness. But it is not reality, and ideals are not always a good foundation for practical action.

It becomes especially hard to believe in this myth when we have to specify precisely who the “*chaaw baan*” are and are not, and why.

The consolidation of wealth and power is in constant interplay with the fragmentation of wealth and power. Fragmentation of land through inheritance had been dominant until recently, resulting in the small holdings noted above. However, recently consolidation began to gain ground as some rural families used their larger-than-average land holdings or power as a base by which to gain more land or power. For example, a well-to-do family might cut wood, catch fish, or raise chicken or pigs, on a scale larger than its neighbors, thereby get a cash surplus, send some children to school, and buy out the land of neighbors. Such a family might even serve as the local

tools of urban-based land speculators, gaining a share of the profits and of their neighbors' land. Thus a rural elite began to assert itself in a new way well before the onset of modern shrimp farming. How much the new assertion of the rural elite depended on capitalism as such, rather than on the introduction of new technologies and on social flux, is a question that I cannot address here and which is not crucial to understanding shrimp farming.

Of the typical farming family's 15 rai (3 hectares), half was usually in rice land which could be converted to shrimp ponds while half was in coconut orchards which could not. Not all of the 8 rai of rice land was in one contiguous plot. The average "black tiger" shrimp pond takes about 4.5 rai (0.7 hectares) of land. So, the average family might be able to have one or two ponds. Still, to farmers with just enough land for one or two ponds, shrimp farming was a gift from the heavens. They could jump from raising a couple of cows or growing a subsistence rice crop to making enough money to buy a car and to send their children completely through school. They could find a place in the reinforced socio-economic-political system of the boom economy. They could deal with the bureaucracy. They could deal with the new assertion of local rural elites or even join the rural elite. Shrimp farmers could even expand and diversify their land holdings, and further solidify their new status, by buying the newly cleared land in the mountains. While shrimp farming went well, all this is just what many small farmers did.

Types of Farms and Their Ecological Impacts

The intensity of shrimp farming is generally conceptualized in three stages. Although I do not like this way of looking at shrimp farming practices, it has become entrenched in the literature and it serves a useful purpose of summarization here.

EXTENSIVE farms are the original type. The Thai call them "NATURAL" (*thammachaat*) shrimp farms. They are usually large, at least five hectares in size. They were located on mud flats at the edge of coastal forest and/or near the mouth of waterways so that they could make use of the wild shrimp there. Farmers built a small dike around a mud flat, cut as many trees as they could, scraped out a shallow basin, and enclosed the water at a time when they believed that wild shrimp were moving through. They kept the shrimp from one month to six months, then opened a door in the dike and collected the shrimp as the water flowed out. The usual species were "red-tailed" (*hang daeng*) or "*chae buai*" (I don't know the Western names), both small species somewhat like *P. vannamei* or a bit larger than the "cocktail shrimp" sold in the US. Farmers usually did not add any commercial feed, although they might throw in table scraps and fish parts.

Because working the coastal forest with hand tools was so hard, these farms did not damage the coastal forest very much for the many hundreds of years they were first cultivated. When modern tools and water pumps appeared, the farmers did cut into the coastal forest - even before the cultivation of *P. monodon* ("black tiger" shrimp) and before other kinds of intensification. Nobody knows how much forest they cut.

The next stage is called "SEMI-INTENSIVE" (*kyng thammachaat* or *kyng phatana*). The ponds are usually one to five hectares in size. The farmers dig out a pond with a bottom lower than the surrounding soil level, and enclose it. They try to eliminate all former vegetation from within the pond. They pump water in and out. They stock shrimp which they buy from an external source, and feed the shrimp prepared food. Such stocking results in a considerably higher density of shrimp (the "stocking density") than would be found in the wild. Sometimes they use a simple

form of mild aeration. Shrimp are raised for three to five months (usually three-and-a-half). The preferred species is *P. monodon* for many reasons that I cannot go into here. Shrimp are harvested by opening the pond gate and collecting the shrimp in baskets as water flows out of the pond. Pond water, whether clean or dirty, healthy or diseased, is simply dumped.

At first, semi-intensive ponds were made by dividing up extensive ponds, and by cutting into the adjacent coastal forest. Farmers moved into the coastal forest not because it was better for this type of cultivation but because it was near to the older farms, it was near a ready supply of salt water (the ocean), usually nobody had clear title to it, and often the government encouraged the farmers to do so.

Water released from the pond is called “effluent.” The impact of the effluent on the ecology, and thereby on other activities such as fishing and rice agriculture, depends on the quality (or “dis”-quality) and quantity of both the effluent and the receiving body of water (stream, enclosed bay, open bay, open sea, etc.). The impact also depends on how rapidly the water in the receiving body is flushed out naturally (as by water flow, currents, or tides). The ability of the receiving body to deal with effluent depends on how healthy it has been left after decades of abuse through bad fishing practices, ecological disruption caused by cutting the forests, and/or the effects of pollutants from towns, industry and non-shrimp agriculture.

Extensive farming and semi-intensive farming usually did not have seriously bad effects on the environment, on the social order, or on the ability of other people (fisher folk and rice farmers) to make a living. (In some places semi-intensive farming did have such bad effects, see the excellent papers by J. Honculada Primavera on the Philippines.) When these types of farming expanded and the farmers began to pump water, they did significantly lower the amount of natural shrimp (and of other species) in local waters, at least for a time. The effluents from the ponds were not usually of such bad quality, or of such great quantity, that they adversely effected local ecology and/or fishing unless the effluents were confined to small canals or small enclosed bays, or unless the near-coastal marine ecology was already in very bad shape. In fact, the effluents probably helped local ecology and fishing in many locations by providing organic nutrients.

The presence of many semi-intensive farms in one area did somewhat diminish the ability of other agriculturists to grow other crops around them. A well-built, well-managed pond, from which the effluents are discharged responsibly, and which does not pump fresh ground water for use in the pond, does not pose a threat to other agriculture. It is possible to grow other crops right next to such a pond indefinitely. I have seen several cases. However, most farmers, especially small farmers, did not construct their ponds to such high standards and did not operate them to such high standards. So, nearby fields were sometimes salinated and nearby ground water sometimes depleted. However, because of previous salinization of the coastal zone due to the cutting of the mountain forests, it is quite difficult to decide how much salinization was caused by shrimp farming and how much was caused by general ecological deterioration. I believe that the large majority of salinization was caused by ecological deterioration that came before shrimp farming. More detailed speculation has to await later papers.

Nearly all the farmers who were located in areas where shrimp farming could be done did not want to grow other crops when they found out about shrimp farming, whether their land was already deteriorated or not - they wanted to grow shrimp and get wealthy as fast as they could. The vast majority voluntarily made the switch and effectively said “to hell with contemporary degraded unproductive rice farming.” Newspapers and magazines have always been able to find

the exceptional person who did want to cling to the old way of life, but the journalists have often ignored the much larger group who wanted to change and benefited from the change.

The final stage is called “INTENSIVE” (“DEVELOPED” or “*phatana*” in Thai). The optimum intensive pond is about 0.7 hectares (4.5 rai) in size, and the average pond sticks pretty close to the optimum, because it is hard to control the aeration properly in any pond smaller or much bigger. Farmers must aerate as much as 14 hours per day because the stocking density is many times that of a semi-intensive pond. Stocking density is measured as so many shrimp per square pond area (per square meter, or per rai) regardless of the depth of the pond (which is about 170 cm. in the middle). A typical semi-intensive pond might be stocked at about 5 to 20 post-larval (PL) shrimp per square meter or about 8,000 to 32,000 PL per rai. For intensive ponds, the absolute maximum stocking density that anyone ever admitted to is about 156 PL per square meter or 250,000 PL per rai (we heard of higher); the “usual maximum” is about 94 PL per square meter or 150,000 PL per rai; the “standard minimum” is about 62 PL per square meter or 100,000 PL per rai before the disease epidemics (see below). Artificial feeding is done from the first stocking and continues ever-more intensively until harvest. Chemicals are sometimes used to condition water, prevent disease, and cure disease. As with semi-intensive farming, the shrimp are harvested by opening the pond gate, releasing all the water, and catching the shrimp in baskets. Pond water is simply dumped into the common water source regardless of its health or condition. This is general practice around the world for “black tiger” ponds and should not reflect particularly badly on Thailand.

As shrimp farmers moved towards intensive cultivation they discovered that the soil in mangrove forests made bad shrimp ponds but the soil in old rice fields made much better shrimp ponds. Mangrove forest soil is acidic (sometimes strongly), and it is hard to buffer the pH with such agents as lime and still maintain a stable pond balance. Coastal forest soil is silty and hard to pack. It erodes easily. It allows pond water to seep out, and allows natural acidic water to seep in, especially since the water table around old mangrove forest tends to be high. It causes the water to be cloudy, thus interfering with photosynthesis and oxygenation, fouling the gills of the shrimp, and promoting the growth of bad microbes. Old rice land, in contrast, usually has a higher clay content, or, what is best, clay mixed with sand. It is easy to pack and hold firm. It does not erode very much. It contributes much less silt to the pond. The pond water stays more clear, and a healthier mix of microbes is easier to sustain.

Although intensive farming also can be done so as to allow any kind of agriculture to operate right next to a pond, intensive farming as it is usually actually done limits the ability of nearby agriculturists to do something other than grow shrimp. In effect, it creates shrimp farming zones from which other kinds of agriculture are excluded. Few people in these zones wished to grow anything but shrimp anyway, however.

Although intensive farming can be done so as to produce nearly-harmless effluents, or even beneficial effluents, in much smaller quantities than extensive or semi-intensive farming, intensive farming as it actually has been done too often produced poor-quality effluents that were potentially detrimental to receiving water bodies.

This is why: only about half of the food introduced into the pond is converted to shrimp flesh. The rest is uneaten or is excreted undigested by the shrimp. It collects in the center of the pond, where it rots, creating conditions conducive to the growth of unhealthy microbes. Moreover, the natural balance of the pond is depleted so that it progressively loses its ability to deal with progressively larger amounts of rotting food. A well-managed pond can avoid these problems

and can operate indefinitely. But most ponds are not that well managed and begin to show signs of water deterioration after about two or two-and-a-half months. Farmers used to counter the effects of bad water by draining out some of the water periodically (usually ten centimeters from a total depth of 170, about every two days) and replenishing it with local water (*thai nam*). When many ponds with poor quality water release their contents at the same time, either to exchange water or when harvesting the shrimp, sometimes the local receiving water bodies cannot process the effluent quickly enough.

When shrimp farms were near the coastal forest, they tended to use sea water directly and to release their effluents directly into the sea. When shrimp farming intensified, most farms were located upland, usually at least half a kilometer from the sea, sometimes as far inland as four kilometers. They could only get their water from streams (both natural and previously dug by the government - see below), and they could only release their water into those same streams. The streams were naturally saline in the shrimp farming belt, so that usually the intensive farms did not contribute to the salinization of previously fresh water or land. However, the farms did put a lot of effluent into streams, and the streams could not always accept the effluent. Also, the farms took in the same dirty water that they (or neighbors) had previously sent out, eventually leading to problems with disease. This is a case of “common property” (the water), which calls for some kind of management system; but no traditional management system was in place that the farmers could call upon. Where and when all this caused problems will be mentioned below and discussed further in later work.

Intensive ponds mostly use paddle-wheel aerators, which cause the water to flow in a circle around the pond so as to better distribute the oxygen. This circular motion causes the shrimp feces and undigested food to accumulate in the center of the pond. Depending on the stocking density of the shrimp, the health of the original water, and the rate of feeding, this sludge at the pond center can “go bad.” It becomes a breeding ground for dangerous microbes. In most ponds it would begin to “go bad” after about two to two-and-a-half months. Even when the central sludge is bad, usually the pond as a whole can remain healthy enough to rear the shrimp for a full three-and-a-half month crop. In well run ponds, the central sludge hardly goes bad and the shrimp can be reared for six months or more. When the pond is harvested, the farmer needs to dispose of this central sludge (*khii lain*). At first farmers just used pumps to suck it up and spray it out, sometimes into the nearest stream, sometimes into the nearest empty field.

Early on, farmers and the government recognized that untreated effluents, and this central sludge in particular, were problems. About 1994 (?), the government mandated that all farms over fifty (?) rai (about 9 hectares) in size had to devote ten (?) percent of the size of their grow-out ponds to settling basins for their effluents. A farm that had one hundred rai of grow-out ponds (about 15 hectares or about 20 grow-out ponds) should have a settling basin of ten rai. However, by then most farms of that size were already in place. It would have been hard for them to change their design so as to incorporate such a large settling basin, and farmers were jealous of the land that they would have to lose from production. So, they “got around” the law by asking that the drainage canals which they had already dug be included in the ten percent land area for settling. Taking the area of the drainage canals altogether, it usually just about met the ten percent requirement, and the government was not too picky about any discrepancy, so that farmers really did not have to do anything to meet the legal requirements. Drainage canals do not serve the same purpose as a settlement basin, nor are they cleaned and maintained as a settlement basin would be. This is a typical case of how Thai people avoid enforcing regulations. But the drainage canals probably settled the effluent well enough, especially later when effluent quality improved (see below). I have seen many drainage canals thick with natural vegetation, especially

on the large farms in Surat.

Farmers themselves recognized improper disposal of the central sludge as a problem that directly hurt them, so they treated it differently. The government mandated that all farms, of all size, dig pits in which to store the sludge for at least a year (or longer?) until it was not hazardous. Then the sludge could be used to repair pond walls or roads, or in other ways around the farm. It could NOT be sprayed anywhere in a raw form. The farmers have largely complied. In some cases, farmers have “turned in” other farmers for violations, something nearly unheard of in Thailand. The police actually had to enforce the law often enough to make it work. In particular, the Surat Shrimp Farmers Association (Surat Chom Rom) strongly participated in the enforcement of this law in Suratthani. I saw no violations of this law in Suratthani (I heard of two) although I did see several minor violations elsewhere, especially in Nakorn Sri Thammarat.

The proliferation of intensive farming began to create other differences due to the size of farms. In general, a medium or large sized farm (over fifteen rai or two-and-one-half hectares) is better run than a small sized farm because medium and large sized farms have better control over how they use water. There is also a difference in the pattern of growing. Small and medium sized farms usually grow one crop for about three months, and try to grow two or two-and-one half crops per year. Large sized farms (and some medium sized farms) can grow shrimp for up to six months, up to a large size. Large size shrimp cost more to grow, but the price increases faster than the cost. Large sized shrimp are proportionately more profitable and economically “better” to grow. In ponds where large shrimp are grown, farmers might grow only one, or one-and-a-half, crops per pond per year.

Despite differences due to farm size, in its early stages, shrimp farming countered the effects of rural economic differentiation and promoted greater equality. For a time, even a family with two ponds could afford the necessities of social climbing. This jump start to equality lessened after the first disease epidemics, yet shrimp farming still helps poor rural residents more than other economic alternatives, even when they rent their land out rather than farm it themselves.

A Brief History of Southern Thai Shrimp Farming

EXTENSIVE FARMS AND EARLY COOPERATIVES

Thai shrimp farming did not begin with courageous far-sighted private entrepreneurs modifying imported technology to suit the uniquely Thai situation, as self-told legend has it. The real history began with the collapse of fishing and the need to diversify the coastal economy, instigated by a (for the time) far-sighted government.

By the middle 1970s, the Department of Fisheries (DOF) knew that they had a serious problem with sustaining the livelihood of fisher folk, and that they probably could not do much about it. Instead, they began to encourage shrimp farming and shrimp research. Papers on shrimp in the DOF official journal increased in number each year up until about 1990 and have remained numerous since. Research reports from the field stations have been dominated by shrimp since the middle 1980s.

Plans for shrimp farming cooperatives were begun in the late 1970s, and the cooperatives started about 1980 (the Department of Fisheries is a unit of the “Ministry of Agriculture and Cooperatives,” which has a specific mission to implement cooperatives, and thus acted in

character). The first cooperatives were in the provinces near Bangkok which had heavy coastal forest at the time: Samut Prakan, Samut Songkhram, Samut Sakhon, Chonburi, Phet(cha)huri, and Chantaburi. The government strongly encouraged the cutting of coastal forest, as is evident in shrimp farming manuals of the period. It was there and then that most (but not all) of the half-a-million rai (80,000 hectares) of coastal forest for shrimp farming was cut. Cooperative members usually got 20 to 25 rai (3.5 to five hectares), which was cultivated in one large extensive pond. The government nominally owned the land, but farmers felt that they had use-right ownership; and they even bought, sold and rented the land informally. Many farmers believed that they would get clear legal title to the land under certain conditions, apparently mistakenly.

Soon after the cooperatives in Central Thailand were established, large cooperatives were started in Suratthani and Nakorn Sri Thammarat provinces in Southern Thailand, under similar conditions. There, too, large tracts of coastal forest were cut with government sanction.

At first the cooperatives were successful, and farmer satisfaction was quite high, even judged in light of the mandatory approval that Thai peasants have to give to all government programs. But soon the farmers found that they could make more money by cheating in various ways, and the cooperatives began to fail financially as collective units even if the farmers did quite well as individuals.

When neighbors who were not in the cooperatives saw the financial success of members, they emulated it as best they could according to how much land they had. Many of these people illegally encroached on coastal forest; at the time the government appeared to do little about that. Many of the neighbors became “auxiliary” members (*samachik som-thop*) who agreed in principle with the cooperatives to share access to water inlet and outlet; to buy fuel, feed and shrimp from the cooperatives; and to sell the shrimp through the cooperatives. They also learned to cheat successfully. Since many of them did not have access to coastal forest and had to convert their old rice fields to shrimp ponds, they were among the first to discover the advantages of old rice land over coastal forest land.

About the time that the cooperatives began to have official trouble, intensification began, in the middle 1980s. This process revived the cooperatives for a while, but they soon ran into the same problems with cheating, and soon declined again. Intensification further pressured the cooperatives in that more neighbors, those who had even small plots of land, could begin to raise shrimp, and gained access to cooperative resources to do so. Since then the cooperatives have lingered on as legal entities, with few active members, but with many outstanding debts.

Thai shrimp farming cooperatives have not done much worse than cooperatives for other types of agriculture. Problems with cooperatives are not intrinsic to shrimp farming but to the Thai way of life and to how Thai cooperatives are managed.

INTENSIFICATION, DISEASE AND AFTERMATH

Coastal forest that is readily available and suitable for shrimp farming quickly ran out sometime in the late 1980s or early 1990s. Even before then, new shrimp farms had been more often located on old rice land than in coastal forest. After about 1992, the very large majority of new shrimp farms were located in old rice land. By the middle 1990s, I estimate that at least two-thirds of operating shrimp farms were located on land that was not originally coastal forest. (These figures badly need direct verification but it was very difficult for my wife and I to do so

for any but a small region.)

About the time that this phase of intensification was well underway, shrimp growing in the area around Bangkok collapsed. The reason why is not clear. People hostile to shrimp farming say it was because the farmers fouled their own water and caused disease to break out massively, as in Taiwan. Shrimp farmers point to the rapidly expanding polluting factories in the same region, which also cut down large tracts of coastal forest. Both versions are true.

Even before the collapse around Bangkok, intensification in the South had begun. It became very rapid after the collapse as shrimp farmers moved to the South from the Central region and brought new ideas and capital with them. A few pioneering and far-sighted business firms, such as Aqua-Star near the Ranote-Hua Sai area, played an important independent role in disseminating ideas, methods and ideals; but I cannot go into their role here.

Even before the collapse around Bangkok, and early in the period of intensification in the South, there was evidence of various diseases in intensive ponds, including infection by the dangerous bacterial family *Vibrio*. Pond production had already begun a noticeable decline from previous yields, and, more importantly, the yield became uncertain (unpredictable, see below). These early disease problems and this decline should not be confused with the later problems caused by disease outbreaks (see below). The farmers say that the water had “gone bad in general” (*nam sia thua pai*) rather than in one specific pond, and readily admit that they caused it themselves, primarily through overstocking.

The first massive disease outbreak was the Yellow-Head Virus around 1994-1995. Although the disease has a nearly 100% mortality, it seemed to disappear nearly as fast as it had come. It was gone within about a year from most areas of the South except the southern part of Nakorn Sri Thammarat, where it is endemic to this day. Yellow Head tends to strike at about one month after the pond has been stocked. At that time, the farmer has invested in the cost of preparing the pond and in buying the shrimp, but the farmer has not yet invested too much in the greatest cost of rearing shrimp: food. Farmers who faced only moderate losses after one month were able to shut down for a crop and then later re-start. One reason Yellow Head disappeared so fast is that most small farmers stopped growing for at least one crop after the first incidence of the disease, and so the disease lost its foothold. Also, Yellow Head does not seem to persist among natural stock, especially among non-shrimp crustaceans such as crabs.

That first virus stimulated the shrimp growers in Surat to solidify their communication with each other, to strengthen their association, and to begin testing for disease.

Unfortunately, it also stimulated the massive use of chemicals for a short period of time, such as chlorine to sterilize the growing water, and antibiotics such as oxytetracycline to kill the virus. Prophylactic use of chemicals, and over-use of chemicals, had been a problem since the first disease symptoms before Yellow-Head virus, but became a serious problem after that.

About 1996 the second viral epidemic struck: white spot syndrome virus (WSSV), or, as it is known in the South, “Red-Body White Spot” disease (*tua daeng jut khaw* or sometimes just “red body” *tua daeng* or just “white spot” *jut khaw*). It is only slightly less virulent than Yellow Head, causing about 90% mortality. This virus came and stayed. As late as December 1999, there were still outbreaks with as much as 70% of ponds infected in some areas of Surat. This virus clearly did become endemic among local wild stocks, particularly among non-shrimp crustaceans such as crabs, who serve as carriers (perhaps because it does not seem to cause a high

mortality among wild stocks, even wild shrimp).

Unlike the Yellow-Head virus, White Spot virus caused a long-term shut-down of the small farmers, and many of the medium sized farmers. As many as 80% of ponds in some areas were idle for over two years. It had this effect not just because it became endemic in wild stocks but also due to the rhythm of its incidence. Unlike Yellow Head, white spot tends to strike at about two or two-and-a-half months after stocking, just when the farmer has invested a lot of money for food in the crop but before the time at which the crop can be harvested for any profit. After one such heavy loss, many farmers had to try again right away to recoup their losses, and then got hit again. After losing their shirts for two crops in a row, many farmers had nothing left and had to shut down. Because WSSV can cause such heavy losses, farmers actually fear this virus more than Yellow Head.

The outbreak of this virus also evoked responses by the growers, in many ways undoing the bad effects of earlier disease problems and undoing the bad effects of increasing intensification:

Farmers who had enough land turned some of their grow-out ponds into inlet treatment ponds, or inlet “resting” ponds in Thai (*boh phak nam khaw*, or usually just *boh phak*). Farmers kept enough water in the inlet pond for several growing ponds if possible. They treated this inlet pond water with some kind of disinfectant, not to sterilize it against disease organisms but to eliminate the carriers of the disease organisms. Then they let the water sit for at least ten days so that the natural microbe balance would restore itself, before pumping it for use in grow-out ponds.

Many farmers stopped using chemicals in grow-out ponds to prevent disease. Sometimes before filling the pond they would spray the soil only with mild chlorine (or iodine) mixtures to minimize disease organisms and carriers.

Many farmers used chemicals in grow-out ponds only to treat diseases rather than to prevent diseases. They tried to use a chemical specific to the disease, to use only as much as needed, but no more.

They stopped exchanging water because they did not want to take the chance of introducing diseased outside water into an otherwise healthy pond.

Since they could not exchange water, the water quality tended to deteriorate more quickly than it had in the past. To counter this tendency, they reduced the initial stocking density, the density at which they first put in young shrimp. In general, the initial stocking density dropped to about 70% of pre-disease incidence (44 per square meter or 70,000 per rai). Rarely did people go above the old “standard” of 62 per square meter (100,000 per rai), which became the new maximum.

Also to avoid water quality problems, they began to be very careful about how much they fed the shrimp. They tried to find out how many shrimp survived in the pond and feed only as much as those shrimp would need for their age and body size.

Before releasing water from ponds, they called each other on their ubiquitous hand-held mobile phones to warn each other not to pump in water. Thus effluent was discharged as far as possible into a large receiving body (a bay or the sea) and not allowed to concentrate in streams or near shore. Even small farmers had hand-held mobile phones and were aware of when their neighbors, large or small, were about to release water.

All of these measures significantly improved the quality of effluent and reduced its volume.

During the time of peak intensive production from about 1992 to 1995, effluents from intensive farming probably did adversely affect water quality in at least three places: off the coast of Sichon in Nakorn Sri Thammarat Province; off the coast of Paak Phanang-Hua Sai-Ranote in Nakorn Sri Thammarat and Songkhla Provinces; and in Pattani Bay in Pattani Province. Intensive farming caused changes in the water off the coast of Suratthani Province but probably did not lead to any decline in fishing catches. Intensive farming probably did adversely affect water quality and artisanal fishing near some provincial harbor towns that formerly had been ringed with coastal forest (such as in Trang and Krabi provinces) but the adverse effects probably did not extend much beyond the bays of those towns. Intensive shrimp farming probably did adversely affect artisanal fishing off the degraded coastal forests of Trang province.

Even in these cases, it is not clear that shrimp farming effluent alone would have caused damage if the coastal ecology had not already been ruined by over-fishing, by illegal fishing methods, by the cutting of the mountain forests, and by other sources of pollution.

Since the viral epidemics, production has never been as intense or as widespread as during 1992-1995; the quality of effluents has been much better; and the quantity of effluents has decreased because fewer ponds are in production and because the quantity of effluent from the ponds left in production has been much reduced. Consequently, since about 1996, even intensive farming probably has not further adversely affected water quality. In many places the bad effects went away; and in some places the effluents probably helped the local near-coastal marine ecology by introducing needed organic nutrients to counteract the effects of bad fishing and forest removal. Shrimp farming has almost certainly helped large-scale oyster raising at Ban Don Bay in Surat, a major industry there.

Unfortunately, in a few places recovery has not taken place due to the severely damaged near-coastal marine ecology, because careless shrimp farming has not abated, and because the abandoned shrimp farms were taken over by squatters and other people who continued to stress water quality. The Paak Phanang-Hua Sai-Ranote area and Pattani Bay are the two clearest examples.

Then a bacterial plague set in beginning about 1997 - *Vibrio*. Already the shrimp industry in the Philippines and Indonesia had been ruined by *Vibrio* bacteria - the same family that causes cholera, dysentery and other serious diseases. Shrimp farming in those countries has never recovered. The Thai farmers were fortunate in that their modifications of technique in response to the viruses prepared them in advance to minimize the onset and virulence of the bacteria. Many farmers could avoid the bacteria, and others could raise a crop up to harvest despite minor infections.

By 1998, a clear pattern of disease had set in, to which the farmers adjusted as best they could: White Spot Syndrome Virus tended to hit the crops raised when water was cold and of low salinity, such as around the rainy season from October to January; *Vibrio* tended to hit the crops raised when water was warm and highly saline, such as during the hot season around March and April.

(I am not a biologist so the following opinion should be taken with a grain of salt. Because it is more virulent during the rainy cold season when water is less saline, I believe that WSSV originated in cold, mildly saline marine water. It has been in Japanese kuruma shrimp for many

years. Possibly it moved into Southeast Asian stocks from more northern seas long ago but only became a problem when intense shrimp farming allowed it to proliferate among the “stressed” cultured shrimp, and when the release of large amounts of virus-laden effluents during harvest allowed the virus to become endemic among wild stock.)

By about 1997, approximately 30% of ponds that had once been operated were still in operation, 30% were sporadically in operation, and the remaining 40% percent were usually out of operation. Most of the ponds that were out of operation belonged to the smallest land holders because they were the ones least able to take preventive measures and least able to take the risk of any additional failures.

Endemic diseases also promoted a process of consolidation. Most people who had two ponds or less had to shut down. However, if one family member can get other family members to allow him the use of their nearby ponds, or if one person can rent the nearby ponds of several villagers, then the consolidator can use some of the former growing ponds for inlet water treatment and can implement the other anti-disease measures. This began to happen more frequently after 1996 although it is still not so widespread as to characterize shrimp farming in areas with many small farms. This practice consolidates wealth and power in the hands of some people who are able to organize other people; such organizers usually already had a base of wealth and power. Groups of kin who were already well off or well-led were able to organize to stay well off.

It is important to stress that this consolidation is NOT a case of rich urban shrimp capitalists taking up the land of the rural poor. Most of the large farms owned by urban people were established before the disease epidemics on land that had not before been used to farm shrimp. Well-to-do urban people rarely bought out small-scale shrimp farmers. Small-scale shrimp farmers sometimes sold to each other, but more often they have obstinately held on to their land in the hope of getting in an occasional successful crop. Consolidation here is a continuation of the primacy of the local “elite” (now turned rural capitalists) over others.

Even at that, many small-scale shrimp farmers have been able to get in that occasional successful crop themselves, or rent otherwise, and thereby gain an income far higher than they would have gotten through rice farming or raising cows.

HONEY COATED DISASTER; HARD REALITY SETS IN

Then in 1997 came (what I consider to be) the worst event in the history of Thai shrimp farming. Before describing this event, it is necessary to explain what happens to empty ponds.

People who have written about the boom-and-bust cycle in shrimp farming often bewail the many abandoned ponds. They especially complain that the ponds have not been replanted in mangroves - whether or not that was the original vegetation cover is not entirely clear. My wife and I had a different experience. During the time that many ponds apparently lay idle, we saw two important things.

First, the ponds were not really idle. Most of them filled up with water, and then, after a year or two, filled up with fish. (Ponds which had been very badly managed did have “rancid” soil which can take two years to clean out and support a normal aquatic life - but rarely the five or ten years claimed by some critics who probably have never endured three meters a year of tropical rainfall). Some ponds were even stocked with fish, or were converted to fish ponds. Some reverted back to extensive shrimp ponds. Local children had fun playing in the ponds, and neighbors had no

scruples about fishing in the ponds as long as the ponds were not a commercial venture. We ate many good fish and natural shrimp out of those ponds. The ponds provided a lot more food and income than the previous land uses had. They were probably a lot closer to the original coastal wetland ecology than were even old rice fields. They were certainly a lot closer to the original ecology than the burned-over maginalized cow land that the old rice fields had become. The ponds served as a buffer against flooding better than the old rice fields had done, and encouraged a greater diversity of flora and fauna than the old rice fields or the old cow fields from which most of the ponds had come.

Especially, second, if the ponds were near mangrove or nipa, the mangrove or nipa regenerated spontaneously in the ponds. Most abandoned ponds “go green” within a year and regeneration of mangrove and nipa usually began within two years. The mangrove or nipa did not have to be planted. Sometimes mangrove has to be guarded against villagers who cut it for charcoal or who root it out so as to catch the fish more easily.

We are not saying that all abandoned ponds are valuable or that all will revert back to coastal forest on their own. In the first year, abandoned ponds are certainly ugly. Ponds in sand only erode and fill in. But we do think that critics ought to study the original local ecology and local use of land carefully before making any blanket judgments.

In some places, what had been degraded coastal forest and dead rice lands was becoming a mixture of reviving coastal forest, old shrimp ponds with new lives as described above, viable shrimp ponds, and still-viable old rice land. This mixture was an ecologically and socially sound use of the coastal zone that needed little outside management to make it better. If nothing had happened, my wife and I were ready to write happily about a new economy-ecology that was evolving.

Now back to disaster. In 1997, the Thai economy collapsed and the Thai government floated the currency (the baht). The baht eventually settled down to about sixty percent of its original value (from 25 to the dollar to about 40 to the dollar). Since Thai shrimp are usually sold on the international market for a price that finally figures out in dollars, the effective price of Thai shrimp just about doubled. However, there was a time lag between the floating of the baht and the full increase in the prices of imported feed ingredients, equipment and other materials. So, for a period of about eight months in 1997 to 1998, the profits on shrimp temporarily exploded. (If the “normal” profit is about 20% percent, and the price doubles without costs going up, then the new rate of profit is 120%.)

In late 1997 and early 1998, not a pond was idle in all of Southern Thailand. Small farmers who previously had whined about the lack of credit and about discrimination against the “little guy” suddenly found the money to go back into production - usually borrowed from family members hoping to get in on a quick killing. Renters from local rich families and from the towns were beating the bushes to cut over-priced deals. Places which previously had endemic disease problems and had only ten percent of their ponds in operation suddenly had ninety five percent in operation.

My wife and I watched with great sadness as old ponds that had reverted back to mangrove or nipa, or to other coastal forest, or which had become natural fish ponds, were scraped out and quickly converted to muddy holes in which to dump a crop of shrimp. The healthy work of years of abandonment was undone in a few months of frenzied greed. Something deep in the character of rural “innocent” Thai society had reared its ugly head.

What happened next was exactly what one would expect if 50% of the land in a delicate agribusiness was taken over by amateurs out to make a quick baht, who were not proficient with the latest techniques and did not care anyway. Diseases stormed back with a vengeance. Some places got one crop in. Few places got two crops in. The boom collapsed as fast as it had begun. Unfortunately, it left in its wake denuded ponds which had once been returning to the natural landscape, and virulent endemic disease organisms to plague even the best and most conscientious of long-term professional farmers. The whole cycle of ecological and social recovery had been set back by five years. Hopefully, with the stable new economy, the recovery will resume, and my wife and I eventually will be able to research that viable new coastal ecology-economy.

It is extremely important NOT to blame this episode on shrimp farming as such. It would be easy to make of this episode one of those stories common in the social science literature in which uncanny events on the world market have unforeseen catastrophic local results. But that would be only partly true and not the key point anyway. The root causes of this disaster were simply: (1) human greed; (2) the willingness of all people, but notably villagers, to destroy the environment to make a quick baht; and (3) the inability of the government to protect the environment. Ordinary villagers and other Thai people ALREADY had the attitudes that the international economy and modern technology allowed them to express. They had developed those attitudes in the old, traditional society. Anyone who misunderstands this lesson will choose the wrong future course.

Uncertainty and The Typical Farmer Density Trap

No doubt some readers already have thought that many of the problems of shrimp farming could be avoided if only the farmers would crowd the ponds less, if only the farmers would stock at a lower initial density.

This is true. It is even more true when one considers the price of shrimp according to the cost of raising shrimp. The price of shrimp goes up faster than the size of shrimp and therefore faster than the cost of raising shrimp. It takes longer, and costs more, to raise large shrimp, but the price of large shrimp more than compensates for the additional costs. For example, it takes about three months to raise shrimp that reach a size of 50 to the kilogram. The price of those shrimp might be 170 baht per kilogram while the cost of raising them might be 130 baht per kilogram. This is the typical crop nowadays, especially on small and medium sized farms. In contrast, it takes about four to five months to raise shrimp that reach a size of 35 to the kilogram. The price of those shrimp might be 280 baht per kilogram while the cost of raising them might be 160 baht per kilogram. Fewer large shrimp can be raised in the same pond than small shrimp, but not that much fewer. It is well worthwhile to grow fewer shrimp to a larger size. Many large farms try to raise shrimp in this way now.

There are strategic (economic) reasons why the farmers do not switch from small shrimp to large shrimp even when they know they should. It is not a question of ignorance, stupidity or being stubborn, but of being caught in a trap. To explain requires presenting more technical material than in other sections.

People often confuse two sources of shrimp mortality. The first source is the death caused by a major disease, such as WSSV. This rate of death is so high that most farmers essentially discount

it. They can only hope that they can get something out of the pond.

The other source is “normal” mortality that ensues after the shrimp have been stocked. The large majority of this mortality occurs within the first month, so for convenience I will call it “first month mortality” (FMM) or, as the Thai preferred, “first month survival” or FMS (*atras tua rote*). FMM went up with intensification (FMS went down), thereby setting off a spiral that trapped many farmers into high stocking and high mortality.

Unfortunately, it is almost impossible to tell the rate of FMM (or FMS) until the shrimp get large enough to catch and count, after at least six weeks, long after the death has occurred and the farmer would have needed to make adjustments. Really, the farmer cannot be sure of FMM (FMS) until he/she harvests the crop. So farmers need some assurance of the rate of FMM (FMS) to know how much to stock initially and how much to feed subsequently.

In the early days of semi-intensive farms, post larval (PL) shrimp for stocking were often about a month old (about PL 30 to PL 40) and fairly large in size. The Thai call them “finger shrimp” (*kung ngiw*) to describe the difference between then and now. “Finger shrimp” had a high rate of survival but were fairly expensive. Farmers found that the hatcheries would supply ever younger PL for a price that fell even more quickly than the size. Eventually, the standard age for PL stabilized at 10 to 18 days, with the usual range about PL 12 to PL 16. In effect, the hatcheries pushed off onto the farmers the normally high mortality which occurs from PL 12 to PL 35. The farmers accepted the shift because the mortality was not too high and the mortality was fairly predictable. Before the water went generally bad, FMM was about 20% to 40% (80% to 60% FMS), even when stocking with PL 15; but it was consistently and predictably in that range. Farmers made up for any increased mortality (decreased FMS) by buying more PL initially and stocking more heavily to begin with. It was worth it then.

After the water went generally bad, FMM got higher (FMS got lower), and, even worse, it got unpredictable. “Normal” or “average” mortality (FMM) went up to about 40% (FMS of 60%). Unfortunately, the mortality commonly ranged unpredictably from 30% to 80% (70% to 20% FMS). This variation represents perhaps the “first standard deviation” in the mortality probability curve. FMM could go from 20% to 90% (20% to 90% FMS). This variation is perhaps the “second standard deviation” in the mortality probability curve.

If a farmer has high FMM (low FMS) without knowing it, after the end of six weeks he is staring at a rancid pit into which he has poured his livelihood uselessly. It is as bad as a viral disease without necessarily having had a virus or any other KNOWN cause of the mortality. Thai farmers have a phrase just for high FMM, “the shrimp didn’t catch” (*kung mai tit*). They fear and hate this possibility.

So, what to do? Either the Thai farmers can take the chance of an occasional high FMM (low FMS) and write off that crop, or they can stock the pond heavily to try to compensate for an unpredictable high FMM. If they stock the pond heavily and get high FMM (low FMS), they can get by. They might even get fairly large shrimp (40 per kilogram) after three months because the pond water stayed so healthy. If they stock the pond heavily and get “normal” FMM (40%, or 60% FMS) then they can raise the shrimp up to three-and-a-half months when the water in a particular pond goes bad, and still do fairly well with shrimp about 50 per kilogram size. If they get low FMM (high FMS) then they can raise the over-crowded shrimp for three months to a size of 60 per kilogram, and still do all right because there were so many shrimp in the pond. Moreover, they can raise two or two-and-a-half crops per year. If the first crop does poorly,

perhaps the other(s) will do well. If the first crop does well then they do not have to worry about the others as much and can still attempt them.

Notice that stocking high to compensate for unpredictable FMM (low FMS) creates a mentality, and it creates the conditions that perpetuate the possibility of a high FMM (low FMS). The farmers do not wish to stock at a low rate or to raise the crop for a long time. They have had bad experiences with low stocking rates when they get a high FMM (low FMS). They have had few good experiences with raising shrimp for a long time, and have had many bad experiences when they try to raise a “normal” or low FMM pond for any longer than three months. Farmers do not expect to be able to raise shrimp for a long time (much more than three months). If farmers do not anticipate growing for a long time, they should put in a lot of shrimp. If farmers put in a lot of shrimp, then they cannot grow for a long time, and they will have troubles if they try.

Putting a lot of shrimp in the pond tends to make the water and soil in that pond worse. Any pond which has been used in this manner will probably give bad results if the farmers try to raise shrimp in it for a long time, even if the shrimp are not at a high density. Putting a lot of shrimp in a pond and growing them for a short time eventually leads to conditions where that is all the farmer can do, at least until the pond has rested and gotten healthy. But that is all the farmers want to do because that is how they avoid “shrimp not catching” (high FMM, low FMS) and a disaster.

To get by most of the time is better than to do well half the time and suffer disaster the other half. This is rational. It fits in well with the rice-growing mono-crop mentality. It is a common mindset among peasants. But here it is also a trap.

(Now, farmers and hatcheries cannot go back to the time when hatcheries absorbed the high and unpredictable mortality from PL 12 to PL 30, for reasons too tedious to explain here.)

Mr. Chatchai Chainakane, a medium sized farmer and an officer in the Surat Chom Rom, waged a one-man crusade in his sub-district (*tambon*), to try to get farmers to switch from (1) high initial stocking density, short growing period, small size, low profits to (2) low initial stocking density, long growing period, large size, large profits. He saw the problem of profits clearly. He analyzed the situation in full numerical detail. He prepared demonstrations that any farmer in his right mind could understand. He was backed in full by the Chom Rom. But Mr. Chatchai largely failed. He did not fail because the other farmers could not understand but because they were afraid. My wife and I also tried to get farmers to switch. That is how we found out that the problem is not ignorance, stupidity or stubbornness but uncertainty.

Until something is done about the uncertainty, or until many farmers are encouraged so switch and sustained in the new strategy for a few crops, no permanent change can occur.

If the farmers can be persuaded to switch, then the water will get cleaner, the farmers will make more money, and they will make money more consistently, all at the same time.

Some Techniques of the Future

Even after the latest disease epidemics, the same shrimp farmers who had survived before largely still survived. Most of them realized that shrimp farming in the future would have to be different, to be even more controlled and environmentally responsible. In particular, the following changes

were begun. I omit some changes that I do not think will be of lasting value, even if the changes were widespread.

Re-circulation of water

It is dangerous to take in new water. The less new water the better. Many farms which could afford to do so were re-circulating a portion of the water from their grow-out ponds back into other grow-out ponds for re-use or back into the inlet treatment pond for conditioning first. Unfortunately, water from diseased ponds is still often released into the environment rather than treated and re-circulated, but steps to deal with diseased water can be taken in the future once the practice of re-circulation is established. The re-circulation of water will radically reduce the quantity of effluent, and strongly improve the quality of all water.

Settling Basins

The biggest problem with effluents now is what scientists call “total suspended solids,” or silt and clusters of plankton that float in the water. These can be removed by allowing the pond effluent to sit in the settlement basins that were supposed to have been constructed according to the law. Settlement basins can work well with water re-circulation because they can be used to harvest the shrimp from a pond without allowing the water to escape outside the system. After the solids have settled out, water from the settling basin can be moved to the inlet water pond. Even without a permanent, devoted settling basin, grow-out ponds which are temporarily out of production can be used as make-shift settling basins in a kind of rotation. Not as much land has to be lost as would be needed for permanent settling basins capable of handling the output of many ponds at a time. In any case, if farmers are to avoid the worst problem with effluents, and make the best use of re-circulation, they will have to develop some sort of settlement system better than the drainage canals they use now.

Specific Pathogen Resistant (SPR) Shrimp

It is possible to breed shrimp which are completely free of particular pathogens such as the WSSV. Such organisms are called “specific pathogen free” or “SPF” organisms. However, if shrimp are bred that way and never exposed to disease viruses or properly immunized against disease viruses, then it is likely that the shrimp will succumb quickly if they are later exposed under the crowded conditions common in grow-out ponds. Since it is highly likely that shrimp will be exposed in grow-out ponds, the use of SPF shrimp may not be the best solution.

(I am not saying that hatcheries need not take great care to insure that the shrimp delivered to farmers are free of viruses. Hatcheries must take greater care in the future than they have in the past, farmers must force them to do so, and farmers must be willing to pay the price of such care.)

Among others, Dr. Boonsirm of Mahidol University in Bangkok is developing shrimp that are resistant to the major disease pathogens. Organisms that are resistant to particular pathogens are called “Specific Pathogen Resistant” or “SPR” organisms. Such SPR shrimp would have a more predictable survival rate, and would facilitate the switch to a lower stocking density and to re-circulation of water. Some farmers have supported these efforts financially.

Pro-Biotics

The use of “pro-biotics” is the use of beneficial organisms, usually microbes (*juu-lin-see*), for the

cultivation of other organisms, such as chickens, pigs, cattle and shrimp. The use of pro-biotics in shrimp farming is not really a future technique since they began to proliferate in 1995. I like the idea of using one component within nature to help another, so I was excited about the first proliferation of pro-biotics. Nearly every farmer in Surat, with all size holdings, used pro-biotics of some kind in most grow-out ponds, at least for some time during grow-out.

Unfortunately, pro-biotics were not nearly as effective as I had hoped. I had hoped that pro-biotics would be effective in several ways: (1) stimulating healthy pond water; (2) helping shrimp to digest food; (3) converting “bad” chemicals, such as nitrites and ammonia, into “good” chemicals; (4) degrading the central sludge more rapidly and into safer by-products; and (5) protecting against bacterial diseases, primarily by competing with the bad bacteria so as to keep their numbers down (“competitive exclusion”). It turned out that pro-biotics were only really effective at number (4), converting the central sludge. After initial heavy use and experimenting, farmers settled down to using products that were specific to going after the central sludge. Most farmers used the products only during the later half of grow-out when the central sludge becomes a real problem.

Pro-biotics still can contribute to pond health in many ways, but more research needs to be done on pond micro-ecology and on the type of microbes that are specifically suited to local conditions.

Using Even Less Feed; Using Natural Food to Replace Artificial Feed

For reasons too cultural to go into here but which have roots in the rice-growing mono-crop mentality, most farmers: (1) over-feed their shrimp, contributing to problems of water quality; (2) believe that it is necessary to feed young shrimp from the time of first introduction so that the shrimp would not eat each other (shrimp are cannibalistic); and (3) believe that it is necessary to feed young shrimp from the time of first introduction so that the young shrimp can get used to processed food. Over-feeding is counter-productive and wastes money, and both excuses for early feeding are false.

Shrimp always eat natural food that is available in the pond, even when they are given artificial feed. How much natural food they eat, and how much artificial feed, depends on how much natural food is available and on how much artificial feed they are given. The food conversion ratio (FCR) is the ratio of how many kilograms of feed it takes to make one kilogram of shrimp. Any ratio above 2.2 is not good while any ratio below 1.8 is good indeed. Most farmers use a small feed sampling tray (*yoh*) to check if the shrimp are eating all the artificial feed, or if the shrimp need more feed.

Unfortunately, the sampling-tray method almost certainly leads most farmers to believe that the shrimp have eaten all the artificial feed when they have not. Since the farmers are strongly inclined to over-feed anyway, they interpret results from the tray so as to allow them to do that. The combination of inaccurate technique and bad interpretation leads to marked over feeding, waste of feed, and water quality problems. In contrast, many farmers in the Surat Chom Rom (Shrimp Farmers' Association) have become more astute about interpreting the feeding tray and more reticent about adding feed. The Chom Rom farmers know that the shrimp will not starve or eat each other if the farmers wait two or three more days to increase feed. The shrimp can rely on natural food in the pond. Most farmers have poor FCRs higher than 2.2, puny shrimp, and poor profits. Yet Chom Rom farmers who are careful about feeding have FCRs of 1.5 to 1.9, bigger crops, healthier shrimp, and higher profits. Farmers need to develop better guidelines about

checking feeding and about feeding rates, and should feed less in general.

It is true that shrimp will eat each other if they are big enough, hungry enough, if the density of shrimp in the pond is high enough so that shrimp cannot run away from each other, and if some shrimp are weak while others are strong. However, these conditions rarely occur until several weeks into the growing period, and even then only if the shrimp are stocked too densely. It is not a practical problem in a well-managed pond.

Just-stocked young shrimp can hardly eat processed feed. For the first few weeks they live very largely on the plankton and other micro-organisms in the pond. Added feed just collects on the bottom to rot, spoil the water, and waste money. Shrimp should not be fed artificially until about three weeks after they are stocked. Exactly artificial feeding should begin depends on the availability of natural food in the pond. Shrimp will learn to eat artificial feed whenever they first encounter it, even a month after first stocking. They do not need to be taught early.

Enlightened farmers and researchers think of the whole assemblage of natural organisms in the pond as self-sustaining, and realize that shrimp can eat many of these natural organisms. Shrimp can eat organisms that float in the water (plankton, etc.), crawl on the bottom (other small crustaceans), and even some that live in the mud (worms). It is called the “(natural) food chain” (*luuk soh ahaan [thammachaat]*) in Thai. Since about 1998, a few farmers and researchers have promoted using the “natural food chain” in the pond as a substitute for artificial feed, at least during the first month or so of grow-out. In Surat (and perhaps elsewhere near Bangkok) farmers have also tried to encourage the growth of the “natural food chain.” The outcome so far has been quite encouraging, resulting in less artificial feed needed (a better FCR), and in cleaner ponds. I thank Dr. Surasak Dilokkiat (D.V.M.) for explaining the role of natural food and the natural food chain to me, and for his role in pioneering these techniques in Surat.

Low Protein Feed With a Better Amino Acid Profile

The following is my own amateur analysis (although I have been influenced by the work of Dr. George Chamberlain). Shrimp feed in Thailand has a protein content of 35% to 40%, mandated by law so as to protect shrimp farmers from unscrupulous feed companies who might otherwise have produced bad quality feed. However, that level of protein is probably more than what the shrimp need for growth alone. The additional protein is simply used for energy rather than for growth, or is not digested at all and is excreted as nitrogen compounds in the pond water. Nitrogen compounds are usually the biggest source of water problems. So the high level of protein in feed contributes directly to water quality problems and disease, especially when the shrimp are over-fed and feeding begins too early.

Probably the biggest reason for the high protein content is to make sure that the shrimp get all their essential amino acids, even if they get the essential amino acids out-of-proportion and get some amino acids that are not essential. It is possible to formulate food that has exactly the right amino acid content (has the exact “amino acid profile”) for shrimp, but that food would be expensive. Yet a food with a better “amino acid profile” would reduce the amount of feed needed, reduce feeding costs, and reduce other costs associated with water quality. Farmers need to work with feed companies to find a better balance between a correct amino acid profile and feed costs. They need to find a feed that might cost a bit more but is lower in protein, more effective for growth, and whose use lowers other costs, so that it is more cost-effective in total. Finding this new balanced feed is particularly important for small farmers who cannot, or will not, be careful about how they feed.

Bio-Filters in the Inlet Pond

A bio-filter is an organism that filters water by taking out some of the bad components or by converting them into good components. Green mussels have been used successfully to filter shrimp pond effluents. The oyster industry in Surat Bay is part of a giant unplanned (but now recognized) bio-filter in which shrimp ponds and oyster beds help each other.

Deliberate bio-filters have not caught on because they are difficult to set up and manage, not always cost-effective, and because they take space away from grow-out. However, one practice has caught on which is an inadvertent bio-filter: the stocking of water inlet treatment ponds with fish. The farmers and the employees put fish in the ponds so that they can have a greater variety of cheap fish in their diet. Indeed, it is hard to keep fish out of the ponds. My wife and I ate many good meals caught from water inlet settling ponds.

Where farmers have to treat inlet water with chemicals (chiefly chlorine), of course the inlet pond cannot support fish very well. The proliferation of fish in the ponds shows the reduction in the use of chemicals. Farmers should be encouraged to stock fish or to let fish grow in the ponds.

Farms which are large enough should be encouraged to have a dual system of inlet ponds if possible. A small inlet pond can be used to treat water with chemicals. After the chemicals have been eliminated, the water can be put into a larger storage pond which has fish and other organisms. Water can go directly from the second, "natural" inlet pond to the grow-out ponds. On a large farm, such a dual system should take no more land than a single pond system, and should be more efficient because chemical use can be concentrated in a small area. Some farms have already evolved such a dual system, primarily to save money.

Not Dumping Bad Ponds or Diseased Ponds

Just as farmers learned not to pump the central sludge, they must learn not to dump the water from ponds in which the water has gone bad or in which the shrimp are diseased. To do so only causes problems that eventually come back to haunt the farmer him/herself. If the farmer wishes to harvest the pond by opening the gate and letting the water flow out, he/she can use a settling basin or another unused grow-out pond to trap the diseased water and hold it until it is suitable. If the farmer has no other place to store the water, he/she can harvest the shrimp with a seine (net) and let the water stand in the pond until it is better. These methods are known and have been tried, but they are not popular. It is a classic case of an externality. People know that simply dumping the water causes problems, but, in the short run, the problems are mostly for other people and only indirectly for the farmer who dumps the pond. The proper methods are inconvenient, or require additional land to use, or do not lead to as complete a harvest as just opening the gate and letting the water run out. No farmer wishes to make the sacrifice if other farmers do not have to do it also. Probably the farmers will have to be compelled until the idea catches on and the methods become standard.

Vaccines; One Pond, One Mother

So far, vaccines against shrimp pathogens (viral and bacterial) have not been very effective. The immune system of shrimp differs from the human immune system in that shrimp seem not to "remember" pathogens and/or vaccines for a long time as humans do. A vaccine does not "last" nearly as long in shrimp as it normally does in humans nor is it as effective while it does last.

Even adding doses at frequent intervals does not seem very effective in preventing disease, and the effectiveness seems to diminish as the shrimp get older and conditions in the pond become more stressful. Moreover, adding vaccines continuously is cumbersome and rather expensive. Dr. Tim Flegel at Mahidol University has done considerable research in shrimp immune systems, but more research is needed in their immune systems and in vaccination. Under Thai growing conditions, the vaccination of SPR shrimp seems to be a better plan than attempting to grow-out SPF shrimp in isolation.

I have noticed that shrimp which are exposed to vaccines earlier seem to respond better to the vaccination process. For reasons that are too detailed to go into here, I believe that the best success (perhaps the only cost-effective success) can be achieved if shrimp are exposed to vaccines from the time they are eggs. Successful vaccination probably needs to begin in the hatchery and continue until grow-out is complete.

To make a good vaccine, the procedure has to “kill” or deactivate the internal RNA or DNA of the virus even while it leaves the external protein coat of the virus as much in the original condition as possible. It is the RNA or DNA that make the shrimp sick, but the immune system actually responds to the external protein coat of pathogens rather than to the internal RNA or DNA. Present procedures for making shrimp vaccines denature (twist and distort) the external protein coat of pathogens so much that the immune system of the shrimp does not recognize the protein coat and the vaccine is not effective. Most immune systems probably do not even “see” DNA or RNA. So the presence of recognizable pieces of DNA or RNA in a vaccine (by PCR) says nothing about the effectiveness of the vaccine. Unfortunately, procedures which do not denature the protein coat (such as are used in making vaccines for humans) are too expensive for use in making shrimp vaccines, especially if the vaccines have to be administered in large doses at frequent intervals. Research is needed to develop inexpensive techniques to de-activate the internal RNA or DNA without denaturing the external protein coat.

At appropriate stocking densities, it should be possible to stock an entire grow-out pond with the PL shrimp from one brood mother. By using the PL shrimp from only one brood mother for one pond, hatcheries can more easily make sure that the mother was not herself infected with any diseases and that all the eggs have been properly washed and vaccinated. Farmers can better understand the disease process in case disease should occur, and can better learn how to fight diseases. To get all the PL shrimp for one pond from one brood mother might raise the price of PL shrimp a little bit. Farmers should buy only from hatcheries or dealers who can trace the parentage of their PL shrimp (who keep adequate records), and who can guarantee that the PL shrimp all come from one brood mother.

Reliable vaccines and homogenous PL shrimp with health histories are both important as indicators of the probable survival rate during grow-out. When a farmer knows the probable “first month survival” rate (FMS and FMM) with greater certainty, he/she has more control over the initial stocking density and the feeding rate, and thereby over the eventual water quality of the pond and the effluents.

Synergy; More Small Farmers

Clearly, many of these innovations work together. For example, how well natural food can be used depends on the stocking density. A high stocking density not only depletes the natural food quickly but also fouls the water and inhibits the growth of further natural food. A low stocking density leads to slower depletion and preserves the water conditions that allow the natural food to

replenish itself. Shrimp can be grown longer, to a larger size and a better price, for no more money. Thus a lower stocking density can save more money than immediately apparent if used in conjunction with natural food, and the saving in food can make up for any perceived loss due to having fewer shrimp in the harvest. Farmers need to experiment to find the appropriate stocking density so as to use natural food to the most cost-effective advantage.

Some of these techniques are best used on medium or large farms, and, in that sense, the diseases and the innovations have favored large farmers over small farmers. Yet most of the techniques can be practiced by small farmers, and some of the techniques, such as minimal feeding, low stocking density, and the use of natural food, should be practiced especially by small farmers. The techniques which make the “first month mortality” (“first month survival” rate) more predictable are particularly important for small farmers because they can allow the farmers to switch without fear to a strategy of lower stocking density, longer growing period, large shrimp, and large profits. Some of the techniques, such as not dumping a bad pond, must be followed by farmers of any size even if the farmer suffers a temporary loss. Even a fellow with one pond can profitably grow shrimp in an environmentally beneficial manner over the long run.

Shrimp farms should be divided into four categories according to the ability they have to control the flow and quality of water, and thus how well they can assimilate these techniques:

1. **Truly small farms less than 1.5 hectares (about eight rai) in size.** Recall that the optimum size for a *P. monodon* grow-out pond is about 4.5 rai (0.7 hectares). It is possible for truly small farms to have an inlet water treatment pond (and even to re-circulate water), but it is not reasonable. Farmers would have to have grow-out ponds of less than optimal size, and would thus have problems in water quality management which might be worse than the benefits gained from a water inlet treatment pond. Farmers would not do it even if it were theoretically possible anyway. So, they have to depend on treating water in the grow-out pond.
2. **Small Farms from 1.5 hectares (eight rai) to about five hectares (30 rai).** Such farms can have a water inlet treatment pond, and might use vacant grow-out ponds as temporary settling basins for effluent during harvest. Very likely they cannot re-circulate water.
3. **Medium sized farms from five hectares (30 rai) to 15 hectares (90 rai).** Such farms can have a water inlet treatment pond, can adapt ponds and waterways as settling basins, and can re-circulate their water to some extent. If they must treat inlet water with chlorine or other disinfectants, they might need two water inlet ponds. How much they can re-circulate their water depends on local conditions and on current economics.
4. **Large sized farms over 15 hectares (90 rai).** Such farms can have an inlet water treatment pond system, can have dedicated settling basins, and can re-circulate a majority of their water.

Each step up in size involves a loss from some area that could have been devoted to grow-out ponds (and thus directly to profit) into area that is devoted to water treatment (and thus only indirectly to profit). Such loss is a dis-incentive to increased size and thus to consolidation by kin groups or renters. It is also a legitimate source of concern by large farmers if they have to devote much more of their land and capital to management than other farmers. If the additional water treatment practices implied with increasing size are actually cost effective and environmentally desirable (I truly think that they are both), then it might be the task of government and foundations to make that clear to small farmers either through demonstration farms of various

sizes and/or through detailed accounting case histories of real farms.

Snapshot of Thai Shrimp Farming in 1999

Since my wife and I first started working on Thai shrimp farming, there have been two viral epidemics and one bacterial plague, and all three scourges resulted in collapses and revivals; there has been a movement out of coastal forest; there has been a mass upsurge in activity due to the floating of the baht, followed by a resultant re-cutting of coastal forest, then followed by a severe retraction. It is not easy to characterize Thai shrimp farming. There is no state about which to give relevant statistics. Nevertheless, some baseline is needed from which to make suggestions.

Usually Thai farms are divided into three categories of small, medium and large. It is easy to combine the first two groups above to get the three usual categories. The line of division varies according to who does the dividing and for what reasons.

Note that Thai farms are quite small by world standards and that Thailand still has many small farmers. In other parts of the world, an average farm might be several hundred hectares in size, and a few dozen farmers might control the entire national industry.

These ratios all vary from place to place:

- how many farms of what size type;
- how many farms on old rice land or on old coastal forest;
- how many farms are still in operation, or sometimes in operation, or have been abandoned; and
- how many farms are run by the owners or rented out.

It would be useful to know all this because it bears on how well the farms in any area will be run and on how they impact local environment and society. Unfortunately, we do not know. I will first make some guesses and describe some variation. (Why these ratios vary from place has to do with ecological and social history, which will be featured in the final report.)

(Some of these questions could be settled by investigation of satellite imagery. Contact me for further details if you wish.)

When all farms were functioning about 1994-1995, I guess that about one third of the land area was located in old coastal forest and the rest on old rice land or other agricultural land.

Since the decline after 1995, I guess that about 20% of the land area of all currently functioning farms is still in old coastal forest. I think most of these remaining farms have legal or quasi-legal title, and so have a right to remain there. Most of the farms are on the Andaman Sea side of Southern Thailand. Clear cases of this residual are also located in the Don Sak, Chaya and Phun Phin districts of Suratthani Province, and in Khanom district of Nakorn Sri Thammarat province. If we count nipa plots as coastal forest (I do), then the Paak Phanang district of Nakorn Sri Thammarat still has many farms limping along in coastal forest.

If 20% of the land area of currently functioning farms is located on old coastal forest, then 80% is

located on old rice land or other old agricultural land.

People commonly say that “80% of Thai shrimp farms are small farms.” I am not sure where “they” got that figure except perhaps from early Department of Fisheries statistics. In 1995 at the peak of production, perhaps 80% of all farmers had farms of fifteen rai (two-and-half hectares) or less. But 80% of the land was not in the hands of small farmers.

We need to distinguish between the number of farms (or farmers) in a particular size category and the amount of land held by the farms in a size category. Just because medium farms are bigger than small farms, a certain number of medium size farms would control more land than the same number of small size farms. It would take fewer medium size farms to control the same amount of land as a certain number of small size farms. The same is true of the relation of large farms to medium and small farms. How much land was held by which size category, and how many farms were in each size category in any given locality, depends on the average size farm in a particular size category in a particular locality – too detailed to go into here.

At the peak of production, about 60% of the land was in the hands of small farmers, 20% in middle sized farms, and 20% in large sized farms. More of it would have been in large sized farms in the Kanjanadit district of Suratthani, more of it would have been in the hands of small farmers in the Hua Sai-Ranote strip in Nakorn Sri Thammarat and Songkhla provinces.

Since production has declined, of those farms that are still functioning, I guess that about one third of the land is held by each size of farm. In the Kanjanadit district of Suratthani province, more would be held by large and medium sized farms, so that no more than 25% of land was still held and operated by small farmers in that district. In the Phun Phin district of Suratthani province until recently, at least 70% of land was still held and operated by small-to-medium sized farmers! In the Paak Phanang-Hua Sai-Ranote strip of Nakorn and Songkhla provinces, small farms predominate. In other areas of Nakorn Sri Thammarat, medium sized farms hold perhaps half the land, especially medium sized farms consolidated by kins-people or renters. Along the Andaman coast, medium sized and small farms predominate, except near some of the coastal towns, where medium and large sized farms are more apparent.

Even though the amount of land held by continuously functioning farms is about evenly distributed among the farm types, the total amount of land actually held (both functioning and non-functioning) is still held predominantly by small farmers. Small farmers have not relinquished the land, but merely do not farm it regularly. Small farmers will attempt a crop from time to time, depending on the condition of the water, the condition of their finances, and the price of shrimp. So some land which looks not to be in use, and some land which is currently in use, actually goes in and out of production.

Rather than work the land themselves, small farmers who cannot stay continuously in production actually prefer to rent out the land (people constantly asked my wife and I if we wished to rent). Renters usually try to get at least three or four contiguous ponds (but usually not more unless they rent on a very large scale). So, of the land that is currently in production, and of the land that is not in production, both types move in and out of the hands of renters. We could not determine how much of the land was in which state because the changes were too rapid, and our people-power too little. This knowledge is important because short-term renters tend to use the most abusive growing practices while long-term renters often use quite good growing practices.

Rather than the typical boom-and-total-bust cycle that developed elsewhere, Thailand has

developed its own dampened cyclical pattern. When water quality is good, prices good, and farmers can get credit, the total land put back in operation climbs up to about sixty to seventy percent of the old peak total (excluding what has been permanently abandoned from old coastal forest). When water is bad, disease rampant, prices low, and credit hard to get, perhaps only thirty percent of the potentially viable land is in production. When conditions are good, a lot of people jump in. The newcomers tend to be “amateurs,” who create bad conditions and a subsequent decline. When conditions are bad, then the amateurs drop out first, leaving the good raisers still in the game, and conditions soon improve. Then the cycle begins again. Over the long run, only people who have sufficient expertise and resources will consistently remain, and the cycle will probably dampen down. But it will probably never entirely smooth out. Therefore, it is hard to speak of an overall average amount of viable land in production.

In any case, in Thailand, farm sizes and owner types are quite mixed. Many small farmers are still in the game and will remain in the game. The ability of farmers, and the desire of farmers, to maintain good water, good effluents, and clean conditions, varies considerably. Any plan must take this variability into account.

The Suratthani Shrimp Farmers Association; The Thai Marine Shrimp Farmers Association

For cultural reasons, because of the traditional Thai system of government, because of historical relations between the Thai and the resident Chinese, and because of influence from the Cold War, business associations in Thailand have usually been pathetic at best.

The single greatest success that I have ever seen is the Suratthani (Province) Shrimp Farmers Association (*Chom Rom Phuu Liang Kung Suratthani*), the “Surat Chom Rom.” They would be an outstanding success even in the United States.

This association is over ten years old, has a core dedicated membership of about thirty people, an associated membership of about fifty more, and a greater membership of a couple hundred. Their leadership has been superb. The association meets every two weeks to discuss techniques of raising, the ecology, disease problems, the condition of hatcheries and young shrimp, shrimp prices, and any other issues of relevance to raising shrimp. They publish a newsletter and various educational documents. Their meetings are open to all, including non-members. They hold an annual shrimp fair every year, which may be the largest and most important such event in Asia. They frequently host visitors from all over Thailand and from other countries, including a long-term American anthropologist. They give tours of their farms. The guiding members are divided between large farm owners and medium sized farm owners, yet one of the most influential guiding members is a small farmer. Small farmers routinely attend the fair and the seminars, and the Association has made active efforts to reach out to the small farmers through local meetings. The Association pioneered in the analysis of effects from feeding, stocking density, natural foods, the use of chemicals, the treatment of disease, the use of inlet ponds, and techniques of water recirculation. Nearly all their recommendations favor the environment, reduced effluents, better water quality, and the appropriate low use of chemicals (sales people have a hard time with them). They have tried to educate small farmers out of the cycle of high stocking density-short rearing time-small profits. The Association bought their own equipment for the screening of viruses in shrimp (PCR) and made the service open to the public for a nominal charge - well before the government even considered such an action. They replanted coastal forest in a few strategic areas. They contributed to shrimp disease research, to research on specific pathogen free

shrimp, and to the re-stocking of wild brood stock. Each year they present an award to three people who have contributed to the shrimp industry, especially to shrimp research.

They do not avoid government, but, unlike other business associations, they have not sought government patronage or to work under a government umbrella. They are almost unique in cherishing private enterprise. No government officials sit on their committees. Government officials make up only a minority of the people who give papers at the annual fair, and even those presenters are usually government researchers in universities. They have given their achievement award to government officials, but they have given it far more often to private people. They have worked with the government on projects to increase wild brood stock through stocking of donated raised shrimp, on monitoring pollution in Suratthani Bay (*Aaw Ban Don*), on zoning plans, on adjusting the electricity rates for shrimp farmers, and on the Code of Conduct (see below).

One other Provincial Association is strong enough to deserve mention, that in Chantaburi Province. Associations exist in nearly all other Provinces where shrimp is grown (about twenty in all) but they are not very strong. To knit together the Associations and make them stronger, and to represent Thai shrimp farmers collectively both to the Thai government and to other nations, the Suratthani Association pioneered in the formation of the Thai Marine Shrimp Farmers Association (*Phuu Liang Kung Thalay Thai*), a league of the Provincial Associations. That league now conducts official business for farmers at the national and international levels.

Recently the Suratthani Association and the Thai Marine Shrimp Farmers Association worked with representatives from the European Union to start a model farm that will demonstrate techniques which farms of all sizes can use. This was done as part of an initiative by the EU to work through private enterprise directly.

I stress the positive aspects of these associations, and the joint effort with the EU, because I believe that healthy farmers' associations are necessary if Thai capitalism is to find the right balance between private action, government oversight, profit, and protection of the environment. Thai shrimp farming offers an unusual and valuable opportunity wherein the pursuit of long-term profits actually coincides with protection of the environment. Although some farmers have worked for the environment out of a genuine concern for nature and for social welfare, most shrimp farmers helped the environment precisely because they wish to protect their profits; they are not ashamed of this, nor should they be. Final success can only come through integrated private efforts and enlightened government cooperation. Members of the Surat Chom Rom often told me all this explicitly themselves.

I regret that I cannot thank everyone in the Chom Rom by name in this paper. I will do that in later papers. I have not forgotten.

Good Things About the Industry

Since (I hope) I have been honest about the problems caused by shrimp farming, I wish to take some space to point out some of the benefits of the industry.

Thai shrimp farming may have been forced to reform its environmental practices by the disease epidemics, but at least it has reformed, and it is well along in the development of techniques even if it is not as far along in the adoption of techniques. Many medium and large sized farms release effluents that are barely harmful to the environment, if at all. The largest problem in the future is

to extend the practices of reform to the small sized farmers.

Compared to other types of agriculture, a shrimp farmer can make many times the profit on the same size land. On one hectare of land a farmer can raise about two cows per year which can bring at most 10,000 baht profit per year. On the same land, with one successful crop, a farmer can make 200,000 baht (or more) profit per year. (Here I do consider the risks from disease so as to figure “average” profit because disease incidence does not fall on small farms in such a way as to make that calculation meaningful. However, even with disease, a careful small farmer who saves his profit can average one successful crop per year and many tens times more profit per year than with any other type of agriculture).

As mentioned above, that additional profit can mean the difference between success or failure in Thai society. People who were formerly consigned to perpetual marginality now find that their children have a future.

People with larger plots of land might make proportionately less profit per unit of land but they make a steadier profit.

Fifteen rai (about two-and-a-half hectares) of rice land could support one family at subsistence level and give no additional people any wages. The same land will support perhaps two shrimp ponds. Each pond should have one caretaker, although sometimes one person looks after two ponds, or two people look after three ponds. The caretakers work about forty hours per week, although their work is broken up into irregular periods and might include getting up at night to check aerators, etc. For this work, a caretaker is paid from 3500 to 5000 baht per month, is usually supplied with rice as well, and sometimes is supplied with all food. He or she also receives a portion of the profits. He or she usually has a place to stay, the quality of which varies with the farm.

In comparison, the average factory worker usually gets 2500 to 3500 baht per month, works at least 40 hours per week (often more, often six days per week), and receives no food, lodging or share of the profits.

Shrimp farming is a large net employer of Thai rural people who would otherwise have no jobs and no land. A 50 hectare (300 rai) farm employs at least 30 people, provides them with food, provides them with shelter, and often provides them with garden space as well. No other form of agriculture comes even close to providing that level of employment.

Often husband and wife employees work together, the couple tending three or four ponds cooperatively. Sometimes their children stay with them. That never happens in factories.

A well run shrimp farm, as are most medium and large sized farms now, is much cleaner than a factory. People work out of doors where they are not confined with pollutants.

Most farmers now are careful about chemicals. Chemicals tend to go into the ponds rather than being broadcast into the environment as with other agriculture. Compared to other kinds of agribusiness, and to many family farms, shrimp farm workers probably have much less exposure to chemicals.

For cultural and social reasons too complex to go into here, Thai men have never taken well to factory work. But they do get along better on shrimp farms because they can mix work and non-

work, and can adjust their working hours. In general, rural people like the style of work on a shrimp farm much better than in factories.

For cultural and social reasons too complex to go into here, many of the workers on shrimp farms in Southern Thailand are not from the South but from the Northeast (Isan). However, they are not foreign (that is, Burmese). Their wages stay within the domestic economy.

On a small farm, workers often stay in the owner's house, although they also sleep in small huts out by the ponds.

The housing on medium and large sized farms looks like cramped concrete bungalows to Western eyes - but to rural Asian eyes it looks good. In terms of living space and toilet facilities, the housing exceeds what most agricultural workers get, and far exceeds what these people would get in the slum in which they would otherwise live. Shrimp farm workers are satisfied with their housing. I myself have stayed in worse.

Most of the shrimp feed is manufactured in Thailand, and most of the components come from Thailand (as far as I could tell), although shrimp feed does contain soy beans and some other components that must be imported. At least half the equipment used on shrimp farms comes from Thailand.

Like other Thai, shrimp farmers like to show off with imported goods. However, they have largely spent their profits domestically (even if sometimes only on sex and liquor). The first thing that most farmers bought was a pickup truck, which these days has a fairly high domestic content. The highest priority for farmers of all sizes who have stayed in production is education for their children, and they have spent a lot on it.

It is true that shrimp is a luxury food, and thus it is not a staple of the economy or diet, and it is not part of the core of the economy (following Sraffa). Also, the Thai used to prefer other kinds of shrimp to "black tiger" shrimp. However, the Thai do eat a fair amount of shrimp, more than the average American, so that shrimp is not really a luxury food in Thailand as it is in America or Europe. And the Thai are coming to eat more and more black tiger shrimp as it pervades the domestic market at costs below alternative species.

However, just because shrimp is a luxury food on the international market, it brings in much needed foreign exchange, and it does so largely with Thai materials. It is usually the biggest generator of net international revenue for Thailand. Medium and large-scale shrimp farm owners tend to be Thai-Chinese business people who invest their profits domestically in other enterprises. Nobody has ever calculated the role that shrimp farming played in sustaining recent economic development, the role it continued to play during the economic problems, and the role it has played in the recovery.

Nobody has calculated the net accelerator and multiplier effects that shrimp farming has on the economy.

In some places, such as with the shell fish beds of Baan Don Bay (*Aaw Baan Don*) in Surat, shrimp farm effluents have actually improved the local near-coastal ecology.

The Code(s) of Conduct, and Government Zones

Many industries regulate themselves. They often do so through a “Code of Conduct,” a charter of “does” and “don’ts,” which usually includes provisions for inspection and for certification of compliance. The best codes involve inspection by an outside (“third”) party who is neutral. Government can serve as the outside inspector, but usually it does not.

The Global Aquaculture Alliance (GAA) is an association of aquaculture producers who aim to help each other to regulate the industry and also to improve conditions for themselves. In 1998 the GAA contacted the Thai government and the Suratthani Association about making a Code of Conduct for shrimp farming, leading eventually to certification and eco-labeling. The Thai government, through the Department of Fisheries (*Krom Pramong*) responded enthusiastically and seemed to take over leadership in the process.

Without interfering with the Thai Government Code of Conduct process, the GAA continued to move forward on its own Code for Thailand and for other regions.

In 1998, the Department of Land Improvement (*Krom Phatana Thii Din*) within the Ministry of the Interior (*Krasuang Mahathai*) began to implement a plan to confine marine shrimp farming within zones. The Suratthani Chom Rom and the Thai Marine Shrimp Farmers helped to correct some of the errors of the plan.

In 1999, the Department of Fisheries (*Krom Pramong*) within the Ministry of Agriculture and Cooperatives (*Krasuang Kaset lae Sahakon*) began its own zoning program. I know little of the details.

As far as I could tell, the two government agencies did not consult with each other on their respective zoning plans. Unfortunately, such lack of communication, and apparent competition, is common between units of the Thai government for historical reasons discussed above. I do not know how either zoning plan will affect the proposed Code of Conduct of the Department of Fisheries.

Some More Hard Social Facts

Thailand’s population quadrupled in the last sixty years. Fortunately, the rate of growth has declined sharply, and the actual growth might stop in about twenty years. Unfortunately, as a populous nation with a degraded tropical ecosystem, Thailand is caught in a bind. If planners do not regenerate Thailand’s ecosystem, the people in general will not be able to live up to the standard they deserve, some people will suffer hardship, and future development will be impeded always. On the other hand, if planners take land and waters out of use to allow the ecosystem to regenerate, even more people will have to suffer significant hardship for at least a couple of decades. In either case, nobody wants to be in the group that suffers. Families will fight to make sure they get what they (think they) need and to make sure they are not in the excluded group.

In a generation, Thailand will have about seventy million people living in an area about the size of Texas, in a degraded former tropical forest. There is no more free land to claim or to convert to agriculture. Thai forests have been cut down. Thai waters have been fished out. The only valuable ore that Thailand has is tin, and the bottom fell out of the tin market long ago. Rubber tappers can barely feed their families, and the market will not improve. Some, but not enough, of the depleted Thai resources were converted into domestic capital (human and material).

If nothing is done, the most likely case, hopefully, few Thai people will starve. Thailand will continue to progress, although much more slowly than the Thai had hoped. The condition of the average Thai might get slowly better, although the condition of some people will get much worse, and the gap between rich and poor will widen. More ex-fisher folk and ex-farmers will find themselves in the urban slums.

Suppose that the Thai people all collectively decided to live at the same material standard of living, together altruistically to share Thailand's remaining wealth. Suppose that there were enough resources in that case so that everyone "just got by." (Certainly there are no more resources remaining than that, and there are probably less.) Even then, unless large tracts of forest and waters were specifically set aside for recovery, the forests and waters would not recover, and Thailand would face a perpetual future as a green and blue desert.

Assume that both nature and society would be better off and more productive in the long run if some of the forests and waters were set aside so that the forests and waters in general were allowed to recover and were kept healthy - probably a true assumption. Assume that the recovered forests and waters could support the expected population AND allow enough extra so as to work toward ecologically sound economic progress. The problem is how to get there from here. Even if everybody tried to share the remaining wealth after setting aside the needed forests and water, and most people "just got by," still almost certainly at least some other people would have to suffer significant hardship until recovery was achieved (even if communities governed the forests and waters). Given the present deterioration of nature and the current population level, there is an unavoidable period of adjustment, and of suffering by at least some people, needed for the recovery of the forests and waters. (I deliberately omit the horrible alternative of drastically expanding Thailand's awful drug and prostitution industries.)

However, in practice, Thailand's real choice is yet harder. The vast majority of people do not wish to "just get by" with a moderately full belly. They want a decent dwelling, clean water, a variety of food, a motor vehicle, reliable roads and electricity and telephones, and the ability to send their children all the way through a school that gives them a chance at a future. I am not talking about the bloated, glitzy fantasies of the dead bubble economy, which some Thai have wisely abandoned following the King's recent advice. I am talking about reasonable desires in the modern world, which do not contradict the King's advice. It is not reasonable to expect people to remain as docile pets in villages living out someone else's notion of the good life.

In 1995, it might have been possible to dream about absorbing enough people into newly created environmentally sound factories so as to take the pressure off the land and coasts, allow the forests and waters to recover, and implement ecologically sound agribusiness. Since the economic disaster, it is quite unlikely that those factories will be built.

It is not possible to set aside enough land and forests to achieve recovery AND to satisfy the reasonable need of the Thai people for modern lives, at the same time.

If reformers definitely want the forests and waters to recover, and reformers set aside enough forest and waters to achieve recovery, and the Thai people pursue the reasonable goals of a modern life at the same time, then, compared to the situation of "just getting by," even more Thai people will suffer even more real hardship for an even longer time.

Worse still, most Thai people really do not share the dream of ecological recovery. Even if they

can imagine that an ecological recovery might make things better for nature and for society-as-a-whole in the long run, they certainly do not believe that an ecological recovery will really be allowed to happen or that any recovery would be shared equally enough. They are not willing to take the chance that the awful burden of an interim hardship period would fall on themselves and their families, and they will avoid any such burden for themselves and their families any way they can.

Thai people are quite realistic about their own needs and about the competition in their own society (even if publicly they have to say something else). Ordinary people, including villagers and fisher folk, will try to achieve a good modern life for their children now even if they perpetuate ecological and social disturbance to do so. Most ordinary Thai people will try to achieve a decent life even if some of their neighbors cannot achieve it, even at the expense of some of their neighbors, and certainly without too much regard for the ecology. Thailand is not unusual in these respects.

Then the questions are: How to save the forests and waters anyway? How much of the forests and waters can be saved anyway? What is the trade-off between ecological recovery, human progress, human suffering, equality, and inequality? Who suffers, and how much? Who gains, and how much? What do the Thai people really want in the long run? How do they get there from here?

Some of the people who otherwise would have been unemployed will find jobs in shrimp farming. If shrimp farming is done properly, it can help some people find a reasonable modern life without those people doing too much harm to nature or to their neighbors. It can take some of the pressure off, and maybe even allow some forests and waters to recover more than they would have otherwise. That is not much. But it is a little.

Three Key Recommendations and A Comment

There are three interconnected recommendations that I hold above all others.

1. Draw a visible line around the area in which shrimp farming is allowed. Within that zone, if any actors (the government, NGOs, foundations, etc.) cannot do anything to positively help the shrimp farmers, to which the shrimp farmers agree in advance, then do nothing. Leave the farmers alone. Let them work out their own solutions to the balance between profit and the environment. This recommendation is much like the government plans to create shrimp farming zones, for which reason I support those plans, especially the provision by which the zones are clearly marked.
2. Draw a visible line around the coastal forest that the government wishes to preserve and/or revive, and allow NO activity whatsoever in that coastal forest zone. Remove all shrimp farming and all other residents from that zone. Fully compensate those residents who have reasonable legal title (see below), and disregard the rest. Perhaps allow some fisher folk to work OUTSIDE of the zone in OTHER coastal forest, including some OTHER coastal forest that they manage. But exclude even them from the core zone itself. Then we can quit worrying about the link between shrimp farming and the coastal forest.
3. Actually enforce the law which bans trawling within 3000 meters of the coastline. Put up clear marker buoys within line-of-sight of each other so that nobody makes mistakes. Put down

what the Thai call “artificial coral reefs” (*pakaa rang thiam*) in a blanket along all the coast within the 3000 meter zone, and renew them every five years. “Artificial coral reefs” are usually large hunks of concrete with jagged pieces of metal sticking out of them, which tear up trawling nets. Trawler owners hate them, and have sometimes used violence to stop local fisher folk from deploying them. Yet government studies show that they work. They are cheap to make, and to deploy, and they work. If the government cannot enforce the law directly, then let simple technology enforce the law indirectly. (I actually favor a stricter version of enforcement in addition to marker buoys and “artificial coral reefs,” which would require all boats to have continually functioning locational transponders, but I cannot go into that here.)

Now the comment. Despite any problems, shrimp farming is a valuable component of the Thai rural economy and society, especially for small farmers. The technical means now exist for farmers of all sizes to raise shrimp so as not to hurt the ecology (or even to help it) and so as to help society while making a profit for themselves. Anyone who truly wishes to help rural people in Thailand should concentrate on finding ways for shrimp farmers to be able to consistently use the best methods.

What follows are some general recommendations. The GAA (see Boyd 1999), and the DOF (see the standard manual by Limsuwan et al. 1999) have already given specific guidelines on how to manage shrimp ponds so as not to hurt the ecology or society. I will not repeat them here (except for a couple of points that I consider important).

I truly do NOT mean to disparage the government in what follows. Everyone should cooperate with the government as much as possible. The government has done good things, and good people dedicate their lives to government service. The government will have a role, especially in zoning and with its Code. But the government so far has not been able to keep up with the rapid changes in shrimp farming, and I do not think its present plans are sufficient. Besides, Thai shrimp farming provides an unusual opportunity to work with an effective private sector. This opportunity should be stressed. Any use of resources should err on the side of the private sector rather than on the side of government.

Mostly Negative Recommendations

The history of Thailand has shown clearly that we cannot rely only on the good will of the “villagers,” or business people, or cooperative organizations, or even the government, to save the environment or to insure social justice. The Thai are not unique in this “failing” and should not be criticized too harshly for it. Yet we must be realistic about it. We have to make the realization of social benefit coincide with the striving for personal benefit.

SPECIAL TAXES

Using sophisticated methods borrowed from economics, it is possible to evaluate the costs and benefits that an industry has economically, ecologically and socially. If the benefits exceed the costs in all three aspects, then the industry should be left alone. If the industry is not making a net economic gain then usually it disappears, so that case need not be considered. If the industry is making an economic profit but produces social and/or environmental net losses, then the industry can be taxed to make up the deficit, and the tax can be used to pay back the social and/or economic losers. This is one method for dealing with externalities. However, if the social and/or environmental losses exceed the economic profits, so that the industry has to pay out as taxes

more than it takes in as profits, then the industry will be taxed to death. Assessors must be careful. Still, overall, this method is an important technique that has a rightful place among the tools of management. Various industries, and government programs, should get used to being evaluated this way.

Shrimp farming can be evaluated. If it creates net social and/or environmental costs, then it can be taxed to provide compensation to the victims. For example, small fisher folk might be paid for damage to fishing grounds, or mangrove replanted. Since shrimp farming is supposed to make a large profit, it is not likely to succumb to appropriate taxation. Ideally, the method is correct, and this all sounds like a good idea. It is not. In this simple form, it is a very bad idea.

If the method is applied at all, it must be applied properly.

The method should be applied thoroughly by taking into account the accelerator and multiplier effects from the industry, that is the effects of the industry on the economy as a whole. None of the studies I have seen have done that.

(Accelerator and multiplier effects are how much an industry stimulates the whole economy through how much it orders for its production, how well it uses resources, and how much more activity it induces by paying out wages and investing profits. The accelerator and multiplier assess the productivity and popularity of an industry, and the place of the industry in the whole system of production.)

The method should not be applied to only one industry unilaterally but to all industries at the same time, especially when many industries have an impact on the same ecology and the same society. If shrimp farming is to be assessed for its total costs and benefits, then all relevant industries should be so assessed at the same time. If shrimp farming has to pay any compensation, then all industries with deficits should pay compensation. I suspect that many other industries would come out with far worse assessments than shrimp farming. I would love to see assessments of fishing, including small-scale fishing; of all agribusiness including rice farming, tapioca growing, sugar growing, oil palm growing, rubber tapping and fruit growing; and of government projects.

It is extremely unlikely that this kind of comprehensive assessment will ever be done. If it is not done, then shrimp farming cannot be held accountable by itself. Not only would it be unfair to act on shrimp farming unilaterally, but it goes against the very economic methods which drive such assessments - it is methodologically unsound and yields incorrect assessments.

Most of the damage was done in the past, especially to coastal forests. Many of the shrimp farmers in operation today did not cause that damage. Many of them have never farmed in coastal forest. It is not methodologically correct, and it would start a bad precedent, to make one group of people pay for the damage caused by another group of people, even if they are all in the same industry. That is like making the small fisher folk pay now for the damage caused by medium sized trawlers all through the past just because they are all fishers.

Of course, if the people who did cause the damage can be correctly identified, then they should be made to pay, regardless of the industry, and regardless of whether or not those particular people are still in the industry. Let the people who actually cut the forest pay for it; let the old trawler owners who made a killing and got out pay for what they did.

It is likely that an assessment of the shrimp industry based only on its CURRENT effects would not come out negative, that is, it might not be doing any harm and would not have to pay.

Of course, if shrimp farming has to be assessed based on both past and present effects and has to pay on that basis, then other industries should be assessed that way as well and pay as well.

Shrimp farming might have made a sustained high profit in the glory days before the disease epidemics, but the profit now is only occasionally high and hardly reliable even on large farms. Currently available figures on profit are based on past conditions, are not reliable, and cannot be used as the basis for assessment. On average, current profit is probably not much more than other industries. Thus taxing the present industry (for damage done mostly in the past) might kill it, and thereby end the source of compensation.

To be precise, an industry will be “taxed to death” not when the taxes exceed the profits, but well before that, when the taxes make that industry less profitable than alternatives. At that point, people who can move their investment elsewhere do so, and the industry withers (when people in the industry suffer an “opportunity cost” from not investing elsewhere, and can do something about it). Assessors need to make sure that they assess any taxes with this limitation in mind.

Moreover, the taxes are liable to impact different size farmers differently. Small farmers who face this kind of a tax have less ability to move their capital elsewhere and so might suffer more than medium or large size farmers. Big farmers will get out and small farmers will have to carry the burden. If the method is extended to other industries as it should be, then assessors need to keep in mind that rice farmers can only move their capital by selling their land. Fisher folk can only sell their boats.

If Thai shrimp farming has to pay an environmental and social tax, but shrimp farming in other countries does not, then Thai shrimp will cost comparatively more. Since costs in Thailand are already higher than in most other countries, any significant unilateral tax on Thai shrimp could severely contract Thai shrimp farming. Then, there would be no industry to pay any more taxes. If planners are serious about assessing environmental and social taxes, then taxation should come about as the result of an international agreement using comparable standards and applying them multi-nationally.

Whenever the Thai face a large tax, rather than pay the full tax, they are far more likely to bribe officials so as to be assessed less. The combination of the bribe and the lower assessment will be less than the full tax or farmers would not go to the trouble. Of course, none of the bribery money will go to social or environmental rehabilitation; and the amount of tax money actually available for social and environmental recovery will be much less in the end than planners would have estimated in the beginning.

Yet the biggest reason not to assess environmental and social taxes is that the revenues will never be used to make the environment or society better anyway. Most of the revenues will just disappear while only a small part will be used for public displays. The widespread stealing in the shrimp cooperatives, and government corruption in other areas (for examples the Hopewell Project and the new international airport), should have taught a hard lesson. There is no point in debilitating an industry merely to further corrupt villagers, politicians and officials without doing any social or environmental good.

WATER SCHEMES AND PARKS

Do not force shrimp farmers to re-cycle their water through government treatment plants. I do not trust the government to run such plants effectively, and the fees would almost certainly exceed the real costs. Let farmers who want clean water clean it themselves, and learn to cooperate to do so.

Do not force shrimp farmers into any sort of planned agribusiness parks. Such schemes have already failed in Malaysia and Indonesia. They have already failed in Thailand when they were called “cooperatives.” At the schemes I saw at Paak Phanang in Nakorn Sri Thammarat province, water problems were almost sure to develop, and most of the plots were taken not by local small-scale farmers but by business people from the town. Let people sort out their own land, rental and water arrangements.

PRICE STABILIZATION

After the collapse of the boom economy, and especially after strategic manipulation of the market by some buyers (into which I cannot go here), the price of shrimp fluctuated a lot for about two years. The Thai government has attempted to stabilize the price of other agricultural commodities, such as rubber, sugar and rice. Following on that example, many shrimp farmers called on the government to regulate the shrimp market and stabilize prices at a level which would allow them to make a consistent profit.

Without going into details, based on the government record with other commodities, shrimp farmers should NOT request the Thai government to stabilize prices. Price stabilization in other markets has been a failure. For the most part, middle-men buyers and processors have gotten the benefits of price supports at the same time that small farmers have become “enslaved” through debts. In several cases, notably with rubber, corrupt officials have sold off stocks in government warehouses. Almost certainly the same things would happen with shrimp.

It would be good if prices would stabilize at a level high enough to insure that a serious grower would make a profit every year while not high enough to encourage amateur growers to enter the market frivolously. This is a price slightly lower than what many farmers would like, but it is a price that wise shrimp farmers recognize as better in the long run than a high price. Shrimp farmers suggested the following price levels, for these reasons, to me themselves. Price is usually figured per kilogram for shrimp of a particular number-per-kilogram (their “size”). Prices of about 160-200 baht per kilogram for shrimp of 50-per-kilogram, and 180-240 baht per kilogram for shrimp of 40-per-kilogram, would be about right. The Surat Chom Rom has offered its own suggested prices similar to these.

Good as this situation might be, farmers should not obtain it through government actions directly to stabilize prices. The best things the government could do are to encourage a better marketing situation and to promote Thai shrimp worldwide, both of which it has done to some extent.

OTHER ISSUES

Foundations interested in helping the ecology or society in Thailand should NOT contribute primarily to schemes run by the government. In particular, they should not contribute to mangrove reforestation schemes unless ALL the land ownership questions have been settled. Indeed, given the ability of the forest to revive itself, money spent on reforestation might better be spent on other projects such as on decent housing and clean water.

Foundations should not contribute to parks run by the government, with the possible exception of the scheme at Khung Khaen Bay.

Foundations should not contribute to “model” farms run by the government. Any such projects in the planning stage should be aborted and the money used otherwise. All such projects that I know about are too expensive and add nothing to the existing stock of knowledge. The farmers already know what to do. It is not about knowledge, it is about convincing farmers, especially small and medium sized farmers, that it is economically rational to act properly. Farmers do not pay attention to the government, they pay attention to other farmers. If foundations wish to support such education, they should contribute to model farms run by the farmer associations, such as the EU has done.

Shrimp farmers should never dig wells to use fresh water to mix with pond water, although they can dig wells for drinking and bathing as do other farms.

Shrimp infected with diseases that might be transmitted to humans, such as all *Vibrio*, should never be harvested. The diseased shrimp should die in the pond or should be killed in the pond, and the pond water stored until all the dangerous disease organisms are gone. This practice may be financially difficult for the farmers but it is absolutely necessary to insure quality and reputation. It must be made mandatory in the Code(s) of Conduct (see below).

Diseased water, or obviously dirty water, even if it does not contain disease organisms that can be transmitted to humans (shrimp viruses cannot be transmitted to humans), should never be dumped directly out of a pond. The shrimp should be harvested with a net and the water allowed to recondition, as described above. This provision must be made mandatory in the Code(s) of Conduct (see below).

Shrimp feed is made from fish meal (mashed fish), soy beans, grains, and other components. Shrimp feed already contains a low proportion of fish meal and a high proportion of soy beans and grains. It probably takes less than one kilogram of fish meal to make one kilogram of shrimp. This conversion ratio would be even better if feeding were done more efficiently, as described above. The issue is important because fish is a basic source of protein to people in the Third World, and fish protein is used more effectively if it is consumed directly by poor people than if it is diverted into shrimp feed and consumed only indirectly as a luxury food by rich people. So, the fish meal content of all shrimp feeds should be published (if not the whole formula, which is usually a trade secret). If the feed companies will not publish the fish meal content, then the farmers should analyze the feed and publish the results themselves. Farmers should use the feed with the lowest fish meal content that still has the most cost-effective amino acid profile. The industry should demonstrate that it is a net animal protein producer and not a net animal protein loser, that is the industry should show that it takes less than one kilogram of fish meal to produce one kilogram of shrimp.

(Shrimp farming could be a net animal protein loser and still benefit [otherwise] poor people more than it cost them because of the jobs and salaries that shrimp farming provided. The salaries would allow the people to buy good quality food. Also, the fish that goes into fish meal tends to be fish that people, even poor people, do not eat anyway [so called “trash fish”]. But these arguments are not strong and I would not like to depend on them without much more data. It is better to just make proper feed and use it appropriately.

In contrast, it is possible to argue that NO food that could possibly be used by humans should go into shrimp feed, even if shrimp farming is a net animal protein producer, because shrimp is a luxury [at least in the West]. However, this argument is the same as saying that no resources should be diverted into luxuries at all. This argument has some merit, especially in a religiously austere sense, but it would make the world a much duller place if carried out fully.)

Mostly Positive Recommendations

Obey the laws that already exist. Respect the rule of law.

Implement the “Future Methods” as quickly as possible.

LAND TITLE

The single most important thing that could be done to allow economic, ecological and social progress in Thailand is to settle land ownership. I do not mean land reform, such as the equitable distribution of land, which is a separate issue. I mean establishing clear title to all land, regardless of who owns how much. Issues of equity might be tackled later.

Land title reform consists of two aspects: (1) Simplify the Thai land title system; and (2) Make sure that every single square meter of land (or near-coastal forest) has clear ownership under one of the titles.

First, simplify the Thai land-holding system. It is so ridiculously complicated that I cannot even describe it here. In the past, the system might have had a rationale in allowing multiple use and in protecting the use rights of small-scale settlers, but I think it never served those purposes well and it certainly does not serve them now. As far as I can tell, the main reasons to maintain the system are to provide a way for officials to collect bribes, to allow officials to avoid enforcing some laws, and to allow rich/powerful people to continue to steal.

Permit only four kinds of land ownership/control:

- (1) government owned land with no access;
- (2) government owned land with limited access (of which I would allow very little);
- (3) community controlled lands and waters, so-called “community forests” and “community fisheries,” allowed ONLY with a strong provision that the communities strictly control their population; and
- (4) privately owned land in which the owners have complete rights of transfer.

Either convert land which has limited rights of transfer to fully owned land with complete rights of transfer, or take it back as government land and compensate the former residents.

In particular, eliminate land which is nominally owned by the Crown but on which people have various use rights. Either give to the current residents this land outright to have and to sell, or turn it into one of the other land types. If long-term legitimate residents need to be compensated before eviction, then pay them fairly. Simply remove more recent squatters.

Eliminate nearly all multi-use land areas. Either make them no-access government lands, make them community forests or fisheries, or, in rare cases, let them out on long-term contracts with strict provisions for care. The Thai simply are not very good at multi-use. Peasants tend to think that multi-use means they have use-rights in perpetuity to the land without taking care of it. Short-term contracts are taken as a license to despoil.

Draw visible lines around government and community land (or near-coastal forests) so that people can make no mistakes.

Second, ALL the land should be owned either by the government, by a community collectively (community forests and fisheries), or by private individuals and businesses. The status of all government lands should be made clear once-and-for-all. The rights of access to government lands should be made clear once-and-for-all. Most importantly, any land that is not owned by government or controlled by communities should be owned privately.

I strongly suggest that boundaries to no-access land, limited-access land, and community land, all be marked by permanent concrete pillars at least one meter square in size which can be seen by satellite. Enough of these markers should be erected so that they are within human sight of each other, that is they should be erected about every kilometer apart. That way, nobody can claim any misunderstandings. I am not being facetious or far-fetched. This is a low-cost, low-tech, high-certainty way of protecting land. Give an irrevocable long-term jail sentence for tampering with a marker.

I know that granting full titles of private ownership now will allow large-scale land grabbers of the past to get away with their crimes. However, for the most part, those people already have made their profits; and it is the people who bought from them, the small farmers, who now fear losing their land. Forget about the big guys. They will not be punished anyway. Uncertainty of ownership only allows the big guys to go on stealing, and it perpetuates corruption. Give the little guys clear title so that they can live in security. Under present circumstances, with title reform, small-scale land holders will benefit far more in total than large-scale landholders, that is society-as-a-whole will benefit more, even if justice will not be strictly served.

(I do NOT recommend that anybody who squatted on a piece of land in the last fifteen years be given title. I think many of those people have to vacate their land so that the forests and waters can be allowed to recover. I am sorry for them. Some of them are my friends or the children of my friends. Prime Minister Chuan acted correctly in reversing the “Green Palace” (*Wang Khiaw*) decision of Prime Minister Chawalit to validate illegal squatting. After people are removed, title reform is needed so that the land will not be re-stolen and so that the land really can be revived.)

Any foundation which wishes to invest in reforestation or social reform should consider investing in land title reform first. It should fund research to determine just how much forest should be excluded from human use, and where that forest should be located. It should fund research as to how much forest can sustain multi-use (if any - I am highly skeptical), and where that forest should be located. It should fund research into economically and ecologically viable community forests with self-limiting human populations, and where they should be located. It should fund surveying to establish land boundaries and titles - the data is available on aerial photographs taken thirty years ago and on satellite images. It should fund the erection of marker pillars. It should fund marker buoys and artificial coral reefs. All these are relatively low-cost projects that will yield the highest benefits in the long run, and, without which, other reforms (such as

reforestation) are not likely to do well.

OTHER ISSUES

In a paper given at the NACA conference on aquaculture in Bangkok in February 2000, Anantha K. Duraipapp and Adis Israngkura from the Thai Development Research Institute evaluated the role of various taxes in leading the shrimp industry to desired reforms and away from the coastal forest. They pointed out that only moderate taxes were needed to meet the desired objectives. I agree with them that a tax on shrimp farms in old coastal forest would hasten the final exodus of all shrimp farms from that kind of land. This tax is a good idea, and should be implemented. However, it is the only tax that should be levied, for reasons discussed above (I admire both these fellows and regret any difference of opinion I might have with them). In other cases (such as shrimp farms on old rice land), the disease epidemics act economically like a tax and force the same kinds of reforms that taxes would encourage, without allowing for the inevitable corruption inherent in taxes. It might seem unfair to tax only farmers who are in former coastal forest, but: (1) those farmers probably acquired that land very cheaply and have thus gained their benefits already; or (2) regardless of what kind of title they have now, those farmers probably acquired that land quasi-legally to begin with. To make a tax on shrimp farmers seem more fair, we could tax all other people who carry on business of any kind in old coastal forest as well. To levy such a tax, the boundaries of old coastal forest need to be clearly established and maintained.

Even without land title reform, zoning of shrimp farming is probably inevitable, and probably a good idea. The plan by the Department of Land Improvement (*Krom Phatana Thii Din*) has some flaws, but it is not a bad plan altogether, and the flaws have been corrected somewhat by the Surat Chom Rom and the Thai Marine Shrimp Farmers. The Land Department plan has zones that are usually clearly marked by natural boundaries (often waterways) or have been clearly marked by man-made structures (such as raised roads or railroads). It is a kind of de-facto title settlement. Zoning should be supported, and farmers helped to adjust to zoning.

A Code of Conduct for shrimp farming has to be established. It has to require outside-party inspection and certification in the long run if the public is to trust it and if the shrimp farmers are to behave according to it. In the end, probably a respected NGO will have to supervise the outside-party inspection. Inspection by the Thai government alone, or by associations of shrimp farmers alone, or by a hired agency alone, probably is not enough. Therefore I encourage the development of a Code of Conduct by the GAA (or similar group) aimed at eventual outside-party inspection, even if the Thai government develops its own Code.

The provisions of the Code have to be adjusted according to farm size. Small farms just do not have the same control over water quality as medium or large sized farms (which does not mean that small farms necessarily have bad water quality). However, farms of all sizes now have enough control to make sure that their water is clean. Pick from the methods discussed in this paper those that are appropriate. Foundations should consider investing in educating small farmers and in organizing them to cooperate with the Code of Conduct.

Fund the shrimp farming associations in ways that do not undermine their need to support themselves and to stay independent. The Surat Chom Rom and the Thai Marine Shrimp Farmers have already proven that they can be trusted and that they do good work (I only have experience with those two groups so I cannot speak for other organizations but I do not rule them out). Ask them what they want. Basically, common extension service techniques should be applied.

One model farm funded by the EU is not enough. Model farms should not cost a lot of money to set up and operate. By definition, a model farm must make a profit over the long run (two years) or it cannot serve as a model and should shut down. Thai farmers will pay attention only to farms run under realistic conditions, using ponds of realistic size (not miniatures), and which make a clear profit. Model farms can be of various sizes, or can have sections which show techniques applicable to various size farms. One model farm in most major districts of most shrimp producing provinces (perhaps thirty farms in all) is not too much.

Shrimp farmers need access to literature, the very large majority of which is now unavailable to them. Most of that literature is in libraries in Bangkok such as at the DOF main library or at the major universities, or it is in a few DOF centers such as at Songkhla. For example, very few shrimp farmers are aware of the literature evaluating their industry, calling for special taxes, or calling for special water management. Very few shrimp farmers get to see the government reports. The best literature, and the most important literature, should be copied, or scanned, and made available at each shrimp farming association office. Some literature may need to be translated into Thai. The collections should include the papers given at the important meetings on shrimp farming held every year in Thailand.

The Thai have a high rate of basic literacy, but films and videos are even more effective at getting a message across. Videos and CD-Roms of appropriate techniques should be made, and made available with viewing equipment, at the shrimp farmers' association offices. The Surat Chom Rom already has made one short video.