



## A Harbinger of the Problems Confronting China's Economy and Environment: the great Chinese shrimp disaster of 1993

LEE FEIGON\*

*Within the space of about 5 years, China developed an aquaculture industry that accounted for more than 50% of the world's farm-raised shrimp, producing billions of dollars in exports. Then day-after-day in 1993, peasants all along the coast of China awoke to find their shrimp floating dead in the water. The Chinese shrimp industry collapsed, completely disrupting world seafood markets. The greed, poor planning, the passion to evade shifting governmental regulations, and massive ecological neglect that brought about this disaster indicate some of the problems underlying 'the Chinese economic miracle'. When set against the great scheme of the Chinese economy, this is a little story, but it is one that says much about the fragile economic and ecological underpinnings of China's growth. The outlines of the story are very simple. It begins like many tales heard in recent years about the Chinese economic miracle.*

China's cultured shrimp industry once seemed a wonder story. In a short period of time, China came to account for more than 50% of the world's farm-raised shrimp, producing billions of dollars in exports. 'With a total production of over 200,000 tonnes of cultured shrimp and more than 50 thousand million artificially reared shrimp larvae produced annually, the Chinese shrimp farming industry led the world for six successive years.'<sup>1</sup> In 1993 this lucrative business was wiped out, practically overnight, causing major dislocations to a world shrimp market that had come to depend on Chinese sources.

### Background to the story

Fish farming is an old industry in Asia. Many writers have commented about the ecological efficiency of traditional Chinese fish ponds. The ponds were often constructed in conjunction with the raising of mulberry trees, the trees serving as an embankment for the ponds, the ponds providing water and fertilizer for the trees.

\* Lee Feigon is a Professor of East Asian Studies and History at Colby College. He is currently also an adjunct Professor in the Kellogg Graduate School of Management at Northwestern University as well as a Research Associate at the University of Chicago.

1. Wang Qingyin, Cai Shengli and Li Jian, 'The shrimp farming industry in China', *World Aquaculture*, (March 1997), pp. 23-24.

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Salt-water fish farming was carried out in tidal inlets, especially in Liaoning, Shandong, and Hebei. Farmers screened in the shrimp and milkfish fry that collected in coastal ponds, relying on tidal action to bring fresh water and nutrients to the crop, occasionally adding supplemental feed to encourage faster growth.

The big change in this industry occurred in the 1930s, when a Japanese researcher succeeded in spawning shrimp and raising them in ponds. The species used by the Japanese wasn't very productive, and Japan is not the best place for shrimp ponds. Thirty years later, scientists in France, China, Taiwan, and the United States improved on the Japanese techniques, utilizing new and more productive shrimp species. By the mid-1970s, large extensive farms in Ecuador, and smaller, more intensive farms in Taiwan began to create 'shrimp millionaires' overnight.<sup>2</sup>

It was the Taiwanese who really changed the shrimp industry. In the 1980s, Taiwanese scientists made a breakthrough in artificial propagation that greatly increased the supply of shrimp juveniles.<sup>3</sup> Growers along the West Coast of Taiwan gradually extended the water depth in the ponds, developed new and better kinds of feed, and introduced pumping to bring fresh water in and out of the ponds. In effect, they brought to these outdoor ponds the same techniques used in tropical fish aquariums. The old ponds had produced between 10 and 100 kg of shrimp per hecter. The new intensive ponds yielded as much as 10,000 kg per hecter.<sup>4</sup>

This started a world-wide boom in shrimp production. By 1990, cultured shrimp had become 19% of the total shrimp produced, and almost all the frozen shrimp sold in supermarkets in the US. The availability of pond-raised shrimp encouraged increased consumption, especially in the US and Japan, the two countries that together still account for about 80% of worldwide shrimp usage. As consumption grew, the Taiwanese kept building ponds.

But there are limits to development that disregards environmental consequences. In late 1987, disaster struck Taiwan. The ponds had been built so close together that the shrimp were crowded, stressed, and highly susceptible to disease. 'Soon the farmers were pumping each other's effluent. Farmers didn't know what to do with the sludge that built-up on the bottom of their ponds, so they piled it on the pond banks, creating an ideal home for pathogens and toxins.'<sup>5</sup> With the intake for one pond near the out-take of another, the water in which the shrimp lived quickly grew dirty, polluted, and contaminated. The growing demand for shrimp production led farmers to use increasingly dubious shrimp larvae (baby shrimp), some contaminated with disease. A virus spread quickly up and down the Taiwan coast. In a matter of weeks, one farmer after another awoke in the morning to find shrimp floating dead in the water. By 1988, the Taiwanese shrimp industry had collapsed. In 1 year, production dropped from roughly 100,000 metric tons to 20,000 tons.<sup>6</sup>

2. Bob Rosenberry, 'A brief history of shrimp farming', *World Shrimp Farming* (San Diego, 1997), pp. 181-182.

3. Imre Csavas, 'Shrimp farming development in Asia', *Shrimp '88: Conference Proceedings* (Kuala Lumpur: Infofish, 1988), pp. 74-76. Also I-Chiu Liao, 'History, present status and prospects of prawn culture in Taiwan', *Shrimp '88*, pp. 195-213.

4. Imre Csavas, 'Shrimp farming development in Asia', pp. 74-75. See also: Pinij Kungvankij and Hassanai Kongkao, 'Culture system selection', *Shrimp '88*, pp. 123-160.

5. Bob Rosenberry, 'A brief history of shrimp farming', p. 184.

6. *Ibid.*

The industry in Taiwan never recovered. Farmers who had invested in shrimp production because of the promise of huge profits refused to risk another crop failure and abandoned shrimp production turning instead to tilapia and milk fish or simply rice. Those who did persist were frustrated by continued virus problems. 'Taiwanese entrepreneurs carried their technology to other parts of Asia, like the Philippines, Indonesia and Thailand, and to several spots in the western hemisphere, including Brazil, the Dominican Republic and Texas, in the United States',<sup>7</sup> but the biggest beneficiary of the collapse of the Taiwan shrimp industry was China.

### The development of the Chinese shrimp farming industry

Shrimp farming is exactly the kind of activity that the Chinese government encouraged. It is a small rural industry requiring little capital, and in the 1980s and early 1990s, virtually all the expansion in the Chinese economy came from small rural industries.

China has all the preconditions necessary for a successful shrimp aquaculture operation—abundant coastal land, reasonable construction costs, freezing and processing plants, low priced feed, an off-shore shrimp fishery that can supply brood stock for the hatcheries, cheap energy to pump water and oxygen in and out of the ponds, and, finally, a domestic or export market on which to sell the shrimp.<sup>8</sup> Moreover in China shrimp farms could be constructed without the obvious environmental damage that countries like Thailand have undergone by clearing mangrove swamps for shrimp ponds. Few if any Chinese shrimp ponds needed to be built in mangrove areas, because virtually none existed in China.<sup>9</sup>

China also did not have other problems that many countries trying to build a shrimp farming industry had to face. In many areas, the expense of purchasing coastal land has been a major impediment to the development of shrimp farming operations.<sup>10</sup> In places like Bangladesh, individual farmers have resisted the conversion of cheap rice land into shrimp ponds, seeing it as the destruction of their livelihood,<sup>11</sup> but because basic necessities like rice remained heavily controlled well into the late 1980s and early 1990s, Chinese farmers didn't mind converting rice land into supposedly more lucrative shrimp ponds, especially when the land they

7. *Ibid.*

8. Alec Forbes, 'Managing production costs—shrimp in Asia', *Proceedings of Aquaculture International Congress* (4–7 September 1990), p. 2. China had many inherent advantages over the rest of Asia that might have led Chinese production to increase far more rapidly than the rest of Asia, especially given the huge area being devoted to the construction of new ponds in China. Because of the way rice prices were controlled, feed was cheap in China. During most of the Deng years, the Chinese government forced Chinese energy producers to sell their energy at prices that were approximately one-third that of the international market. This meant that energy used in processing the shrimp and running the pumps that brought fresh water in and out of the ponds should also have been relatively inexpensive. According to one study of shrimp processing costs, in Indonesia energy costs were 10 cents a KWH, in Thailand 8 cents KWH, in Hong Kong 9 cents a KWH, in Taiwan 9 cents a KWH, in India 8 cents a KWH, and in China only 6 cents a KWH. See Kee-chai Chong, 'Improving profitability of shrimp aquaculture', *Shrimp '92* (Hong Kong: InfoFish, 1992), p. 92.

9. D. J. Macintosh, 'Environmental issues in shrimp farming', *Shrimp '92*, pp. 118–127.

10. Depending on the kind of system and the expense of the land, it averages something like one third of capital costs and about one fourth of total capital and operational costs. See Pini Kungvankij and Hassanai Kongkeo, 'Culture system selection', pp. 125–132.

11. Imre Csavas, 'Shrimp development in Asia', pp. 68–70.

were using for this purpose was marginal coastal land, much of it reclaimed by the construction of coastal dikes during the Mao era. It was individual farmers in the south who first expanded most aggressively into the construction of shrimp ponds.

The initial shrimp pond development in China was gradual. It began to speed up after 1985, when the government rescinded controls over the procurement and marketing of shrimp, opening an increasingly profitable domestic and foreign market to the growers.<sup>12</sup> About the same time the Deng regime made a disastrous attempt at reforming the grain payment system. While supposedly paying the peasants higher prices, the government kept the cost at which rice was sold to urban consumers low. Government buyers often had a hard time coming up with the money to pay the peasants and so began to give them IOUs instead of cash. Rather than accept IOUs for their rice crops, an increasing number of individual peasants and local governments began to expand into the construction of shrimp ponds.

The increasingly rapid construction of shrimp ponds turned into a mad dash in the late 1980s. The 1987 crash of the Taiwanese shrimp industry sent shrimp prices through the roof and encouraged Overseas Chinese companies to come to China to help expand the shrimp industry. About the same time, an increasingly hard-line government reintroduced central controls over rice prices, paying the peasants amounts that taking into account inflation were lower than those paid in 1980.<sup>13</sup> Government policies at the time also made it difficult for local communities to buy the fertilizer (needed for good rice yields) at reasonable prices, and so it became increasingly difficult and expensive for many farmers to get good rice yields, even if they were satisfied with the iffy government payments for their rice.

The dash became a stampede when local governments realized that the construction of shrimp ponds would give them access to badly needed foreign currency and goods. In 1979, in its eagerness to encourage aquaculture, the government had stipulated that foreign exchange earned from shrimp exports (and most other kinds of agricultural commodities) did not have to be turned over to the state, as was the case with most other exports. The machinery and equipment needed for shrimp culture and processing were also exempted from all import taxes. In the late 1980s and early 1990s, when the central authorities tightened access to foreign currency in order to restrict the import of the expensive foreign goods and commodities they feared were draining the economy, rural coastal areas, the focus of the coastal development strategy associated with the ousted reform leader Zhao Ziyang, found their capital constricted and access to foreign exchange denied. But since the Chinese government still allowed agricultural industries like aquaculture to import needed supplies, local governments could build aquacultural industries and then use them to launder Chinese *renminbi* and obtain foreign currency (and hence desired foreign goods) without going through the central authorities.

By building aquacultural projects, Chinese companies could import tariff-free cars, trucks, machinery, and other items needed in local areas. They were even allowed to bring in foreign investment to build freezing plants for aquaculture

12. Jia Jiānsān, 'Present status of China's prawn industry: a review', unpublished manuscript (PRC: Bureau of Aquatic Products, 1986), p. 8.

13. Barry Naughton, *Growing Out of the Plan: Chinese Economic Reform, 1978-1993* (New York: Cambridge University Press, 1995), p. 297.

Chinese Urea Imports 1981-95

'000 metric tonnes

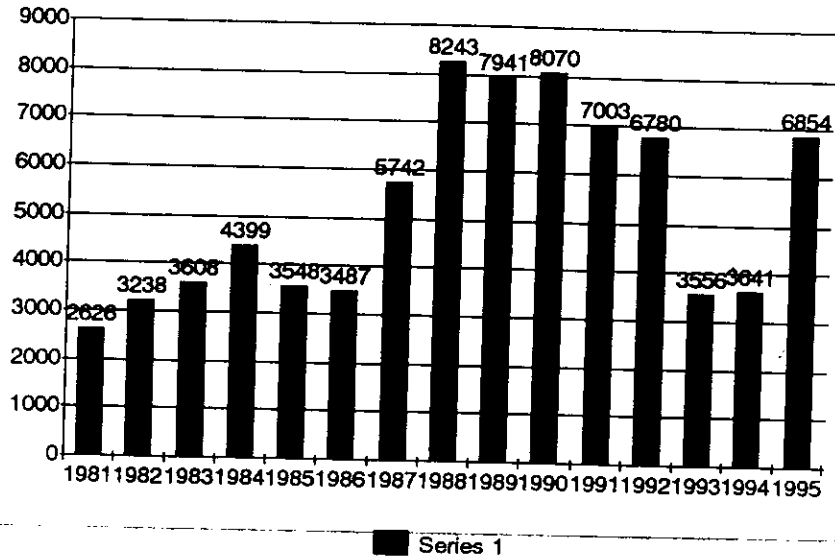


Figure 1. Fertecon: Chinese urea imports 1981-1985. These industry publication figures were supplied to me by Carmel Kelleher.

projects. One example of the access to foreign goods provided by aquaculture was the case of fertilizer. In the autumn of 1987, the year of the Taiwan shrimp crash, the government, after a disastrous experiment in the free trade in fertilizer, re-centralized the fertilizer trade.<sup>14</sup> As already noted, in the resulting confusion many rural areas found their access to agricultural fertilizer restricted; hence their ability to produce the rice and other commodities on which they depended was greatly reduced. Aquacultural development, however, was a governmental priority. Fertilizers for aquaculture were more easily obtainable, and these could then be used in the rice paddies as well.

During the late 1980s and early 1990s, the import of urea, the chemical which is used for fertilizing shrimp ponds soared (see Figure 1). Urea is typically put on the bottom before water is let into the pond to create an algae bloom that will provide a cheap source of supplemental feed for the shrimp. Urea helps create plant growth that filters the water in the ponds.<sup>15</sup>

Urea, a petroleum by-product, is also a good source of nitrogen fertilizer for rice and other crops. Areas that built shrimp ponds could get import allocation for urea. They could then divert the urea to the nearby rice fields. One foreigner working as

14. Scott Rozelle, 'Gradual reform and institutional development: the keys to success of China's agricultural reforms', in John McMilland and Barry Naughton, eds, *Reforming Asian Socialism: The Growth of Market Institutions* (Ann Arbor: The University of Michigan Press, 1996), pp. 205-207.

15. For a good discussion of the need for fertilizing shrimp ponds see James W. Avault, Jr., 'The benefits of fertilizing ponds—some fundamentals review', *Aquaculture Magazine* 24(2), (March/April 1998), pp. 69-74.

an aquaculture advisor, helping the Chinese build shrimp ponds, has noted that his operation, the largest and most important in all of China was told it 'could have anything we wanted in the way of imports', but in spite of the fact that large quantities of urea were being imported into the country for aquaculture use while he was in China, his unit never got any urea or any other badly needed inorganic fertilizer at all and had to fertilize with buffalo and cow manure due to the shortage of chemical or inorganic fertilizers.<sup>16</sup>

### The result

Many of the ponds were not only deprived of items like urea necessary for their long-term growth and preservation, but, in spite of the environmental disaster that had recently occurred in Taiwan, the Chinese built their ponds with even more abandon, and on stricter budgets, than their neighbors across the straits had done. As in Taiwan, the intake from one pond was often placed next to the out-take from the neighboring pond. The resulting pollution and poor oxygenation stressed the shrimp and made them susceptible to disease. It made it difficult, if not impossible, to stop any disease that had started from spreading rapidly up and down the coast.

Because there was little consideration of the long-term economic and/or ecological viability of the ponds, the Chinese completely ignored warnings that they needed better feed and larvae in order to ensure the viability of their ponds. In a 1986 paper assessing the Chinese shrimp industry, it was noted that 'the development of a compound prawn feed industry is likely to be an urgent task for the Chinese aquaculturists'.<sup>17</sup> Four years later, the Chinese were still talking about constructing such an industry.<sup>18</sup> It never happened. Even when manufactured feed could be obtained, most farmers eschewed the expensive calibrated pellets, instead feeding the shrimp rice, grain off-products, duck egg custard, and ground up trash fish and clams. This caused 'water pollution and anaerobic decomposition of the substrate'.<sup>19</sup> Viruses in the ground-up rice and grain were easily transmitted into the shrimp. Run-offs from industrial pollution, erosion, and chemical spraying further stressed the shrimp.

The same 1986 paper noted above cited the need to have new and better sources of larvae, yet this was also not accomplished in time, and little effort was made to screen the post-larvae for disease. A large hatchery industry was developed, much of it with Taiwanese help, which an outside observer described as 'fairly well organized' and producing 'adequate supplies for the farms'.<sup>20</sup> But the peasants were not trained well in how to handle these fragile young shrimp:

The post larvae in China are usually seeded into ponds at too early a stage in their development. There is no concept of nursery ponds, and most farms seed post larvae

16. Alec Forbes, Letter of 11 February 1998. In a 1990 article, Forbes notes that few places in China use inorganic fertilizer in aquaculture. Alex Forbes, 'The shrimp industry in the People's Republic of China', *Aquaculture Magazine* 16(1), (January/February 1990), p. 46.

17. Jia Jiansan, 'Present status of China's prawn industry: a review', pp. 7-8.

18. Alex Forbes, 'The shrimp industry in the People's Republic of China', p. 47.

19. *Ibid.*, p. 47.

20. *Ibid.*

with a minimum of acclimatization. As a result fatalities are high, and as a consequence the farmer overstocks his ponds hoping to compensate for these losses; thus this sad cycle perpetuates itself. The post larvae are stocked into ponds for about 10 days before any water is exchanged.<sup>21</sup>

Moreover, the farmers had no one to 'turn to in case of disease' because there was nothing like an extension system that dispensed aquaculture advice.<sup>22</sup>

Because the local and regional governments were building these projects to justify imports and bring in foreign investment, they needed to show results. The best way to do this was to use phony statistics, and there is evidence that they began to do this as early as 1987. Alec Forbes, an aquaculture expert hired by the Chinese as director of Rising Dragon Shrimp Farm, a Sino-US joint venture, noted that in his discussions with producers and officials, he had been told that 12,000 metric tons of shrimp had been produced in 1987 in Guangdong province, a figure confirmed by his own personal observations. Yet when the official figures were published, it was claimed that 85,000 tons had been produced that year and that 100,000 tons were to be produced by 1990.<sup>23</sup>

After exaggerating so wildly in the first years of the shrimp boom, it would have been impossible for them to keep compounding the problem in subsequent years, especially as foreign observers and central government officials began to look more closely at these figures. In fact, even though a considerable number of new ponds were dug in China during the late 1980s and into the 1990s, official figures show that after 1988, production appeared to decline in the following 2 years. By 1990, the official figures show that the level of cultured shrimp production had actually decreased to less than was shown in the apparently wildly exaggerated 1987 figures.

Obviously this was a situation that put great pressure on farmers to stock ponds at unhealthy levels and to keep building new ponds to increase production figures. Production did apparently leap to an all-time high in 1991, before declining again in 1992, the year before disaster actually struck the ponds (see Figure 2).

One indication of the unnaturalness of these figures is seen by the fact that while Chinese production lurched up and down, production in the rest of the eastern hemisphere rose steadily, even though few other areas were building new ponds as aggressively as the Chinese (see Figure 3).

### Disease eliminates the Chinese shrimp farming industry

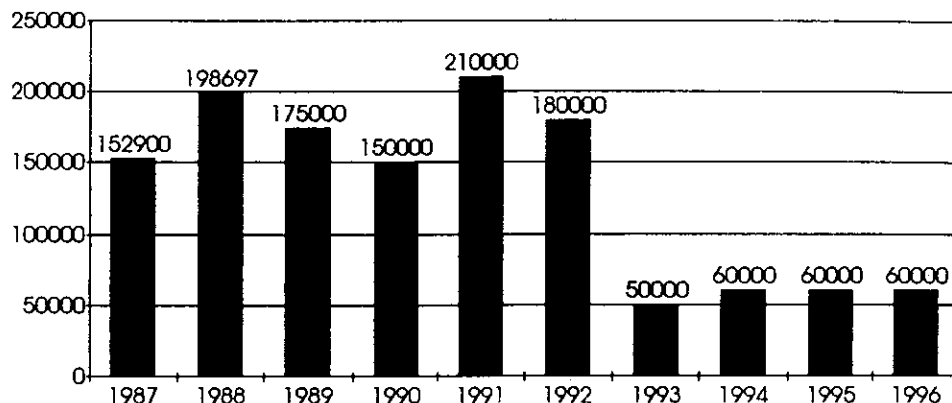
In mid-summer 1993, one after another shrimp pond manager in the southern province of Guangdong awoke to see an entire pond's shrimp floating dead in the water. A few weeks later, the outbreak spread into Fujian and then up the coast. Before the year was over, Chinese farmers had lost between 80 and 90% of their total crop. As word of the outbreak spread, farmers liquidated their crops before

21. *Ibid.*, pp. 46-47.

22. *Ibid.*, p. 48.

23. Alec Forbes, 'Marine shrimp culture in the People's Republic of China: one man's experience', *World Aquaculture* (December 1988), p. 12. See also Alec Forbes, 'The shrimp industry in the People's Republic of China', p. 48.

## CULTURED SHRIMP PRODUCTION CHINA - MT HOS O



**Figure 2.** Cultured shrimp production. These figures were compiled for me by Paul McCarthy, Vice-President of Development at Central Seaway, Co., Inc., a shrimp importer. He took them from successive issues of Bob Rosenberry's *World Shrimp Farming* (San Diego). The most recent Chinese published figures are similar, though somewhat higher. They also show Chinese production rising from 1987 through to 1989, falling somewhat in 1990 and then staying pretty steady through 1992. These figures can be accessed at the China Fishery Home Page ([www.lib.noaa.gov/china/chinafp.htm](http://www.lib.noaa.gov/china/chinafp.htm)) and have been compiled by the Information Center, Chinese Academy of Fishery Science.

they could be destroyed. What shrimp was salvaged was mostly the less expensive small sizes. Overnight China changed from a shrimp exporting country into a shrimp importing one.

Coincidentally, or perhaps not, the shrimp pond meltdown occurred just when there was a major transformation of the Chinese economy, and shrimp ponds were no longer needed by local officials wishing to evade government restraints (and just when local officials may have had to account to foreign investors and the central government for their phony statistics). In 1992, Deng Xiaoping made his famous southern tour, which signaled to the country that the constrictive policy was over and southern and coastal areas could resume development. By loosening the economic restrictions on the coastal economy, Deng opened up economic arenas other than shrimp farming for their capital. Coastal areas could now get direct access to foreign capital and goods and did not need to rely on the subterfuge of shrimp pond construction as a way of obtaining foreign exchange and goods.

Furthermore, in 1993, the government, concerned about declining grain yields, began to force farmers to produce their quotas. With quotas in place, farmers were forced to turn rice land that had been turned into the production of shrimp back into rice production.

As a result of these factors, shrimp farming never recovered from this blow. Neither Chinese industry nor the Chinese government ever garnered resources to uncover the source of the disease problem. Some areas that tried to restart shrimp farming discovered that the pathogens were so entrenched in the soil that the



CULTURED SHRIMP SUPPLY

Eastern Hemisphere

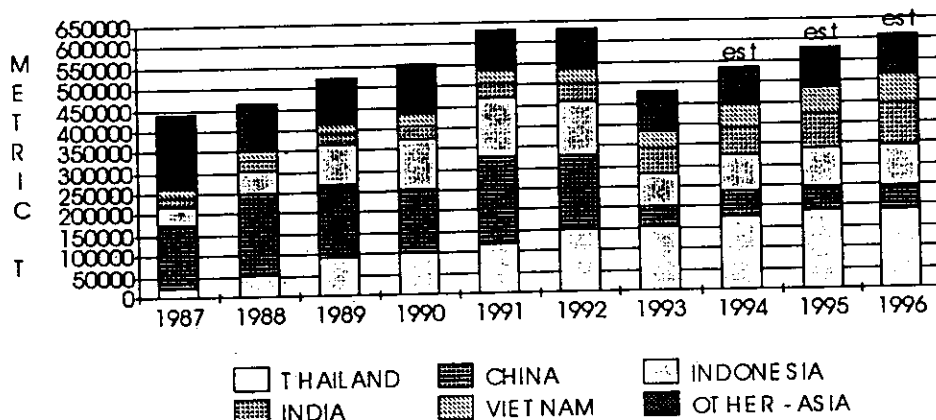


Figure 3. Cultured shrimp supply. These figures were also compiled for me by Paul McCarthy, Vice-President of Development at Central Seaway, Co., Inc., a shrimp importer. He took them from successive issues of Bob Rosenberry's *World Shrimp Farming* (San Diego).

diseases flared up again in the new crop. As of 1998, the Chinese shrimp farming industry was still operating at only a tiny fraction of its earlier capacity. Basically, after 1993, the disappearance of the non-economic reasons that had led to the construction of so many shrimp ponds, left few with much interest in rebuilding the industry. This was quite unlike what happened in Thailand and Ecuador, two large shrimp producing countries that also experienced major disease outbreaks in their shrimp ponds and quickly developed ways to combat such diseases (as did a number of other countries).<sup>24</sup>

Conclusion

In the long run, the Chinese shrimp disaster is simply the continuation of a trend that has been unfolding in China for centuries. The often poorly considered expansion of modern industry and technology and China's ever expanding population has, time after time, resulted in the transformation of fragile marginal land into economically dubious and environmentally unsound projects.

The Chinese shrimp disaster, of course, also illustrates the skepticism that needs to be used in assessing the statistics of the Chinese economy. Economic activity in China is too often a shell game meant to void government regulations. Entrepreneurs spend too much of their time struggling to outwit the government, rather than considering the possible long-term efficacy of their actions or of their potential consequences to the environment.

The Chinese shrimp disaster of 1993 was just a blip on the horizon compared to

24. See, for instance, D. J. Macintosh and M. J. Phillips, 'Environmental issues in shrimp farming', p. 129.

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some of China's bigger scandals. In the last decade, Chinese grain purchasing policies have roiled international agricultural markets and the exposure of illicit Chinese trading has caused copper futures to plummet around the globe. But this little blip totally disrupted world shrimp consumption for more than a year and forced consumers to pay billions of dollars more for their meals.

The unwise and ill-considered construction of so many shrimp ponds in China may also have damaged the already fragile and often badly shattered ecology of the Chinese coast. Even under the best of circumstances, shrimp farming can have deleterious effects on the environment. 'Shrimp excrement and partially eaten fishmeal ... [get] flushed into the surrounding environment, depleting wetlands of oxygen and poisoning the groundwater.' Some observers claim that 'three to five years of intensive shrimp aquaculture is all it takes to turn a once high productive ecosystem into a dead zone ... Highly saline "mud deserts" are left where there were once sea-grass beds, coral reefs, and other marine habitat'.<sup>25</sup>

Although the effect of the Chinese shrimp disaster has yet to be assessed, vast quantities of organic and inorganic compounds have been pushed into the oceans. Waterways and water patterns have been disrupted. Salt has been added to rice fields that will take years to wash out. Imported shrimp larvae was used and then escaped and mixed with domestic shrimp.

Short-term economic results are already obvious. Off-shore fisheries have been disrupted as fishermen are pushed to deplete diminishing fisheries to keep factories built for aquaculture active. Chinese factories built for aquaculture have even turned to buying catches from the Russian deep-sea fleets just to stay in business and keep people employed. Cod and pollack caught in the Arctic Circle are now shipped to China for processing before being sold to Europe and the United States, hastening the exhaustion of the vast sea beds off Alaska.

During its short shrimp boom, Chinese consumers grew fond of eating shrimp. In many urban areas, it has become customary to present a big block of shrimp as a New Year gift. Now that its cultured shrimp industry has collapsed, China has had to use badly needed foreign currency to buy its shrimp.

It is tempting to close by saying that the great shrimp disaster is a parable for the economy as a whole. Time will tell.

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25. Tracy Baxter, 'The hidden life of shrimp', *Sierra*, (July/August 1998), p. 57.