Status of Aquaculture of *Penaeus vannamei* in China

Miao Weimin
Freshwater Fisheries Research Centre, CAFS
No. 9 East Shanshui Road, Binghu District, Wuxi city, P.R. China 214081
E-mail: miaowm@ffrc.cn

I. OVERVIEW OF SHRIMP CULTURE INDUSTRY

Historical Development of Shrimp Culture Industry

China is a country with longest history of aquaculture in the world. Comparatively, shrimp culture is a relatively new industry in China. The earliest national production figure of cultured shrimp was 79 metric tons in 1970. It took more than 10 years for the production to reach 10,000 metric tons. The cultured shrimp production reached 10,093 metric tons in 1981.

In 1981-1988, China experienced the first golden period of shrimp culture industry development after the full maturation of mass production hatchery technique for shrimp (*P. chinensis*). The total production of cultured shrimp unbelievably increased to 199,418 metric tons in 1988 from 10,093 metric tons in 1981. However, the good times did not last long. The peak production maintained for 5 years only, ending in 1992 with production of 206,866 metric tons.

The serious outbreak of shrimp diseases badly hit China along with other shrimp producers in Asia. This resulted to the drop of cultured shrimp production to 87,856 mt in 1993, 40% of the highest production in 1991 (219,571 mt). The production continued to drop to 63,872 metric tons in 1994. The industry started to recover very slowly in the next 3 years, and regained its production of more than 100,000 tons in 1997 (102,923 mt). The slow recovery in cultured shrimp production in 1995-1998 was mainly due to modification in the culture system and techniques. Since 1998, China has been into a new era of fast growth in cultured shrimp production. The production has been keeping a very fast growth, from 143,086 mt in 1998 to 760,430 mt in 2003. The rapid growth of production during the last several years was mainly due to the rapid expansion of culture of *Penaeus vannamei,* an exotic shrimp species. Cultured shrimp production in China during 1984-2003 is shown in Figure 1.

It should be noted that the increase of cultured shrimp production was very abrupt in 2003 in China. It appears unbelievable. Two major reasons could be attributed to it in addition to the expansion of shrimp farming in China in 2003. One is due to the unreported freshwater production of *P. vannamei* before 2003. It was estimated that production of cultured *P. vannamei* in freshwater environment reached 160,000 metric tons in China in 2002. This production was not actually included in the total cultured shrimp production of the year. Secondly, it was only in 2003 when brackish and freshwater production of *P. vannamei* was separately reported.

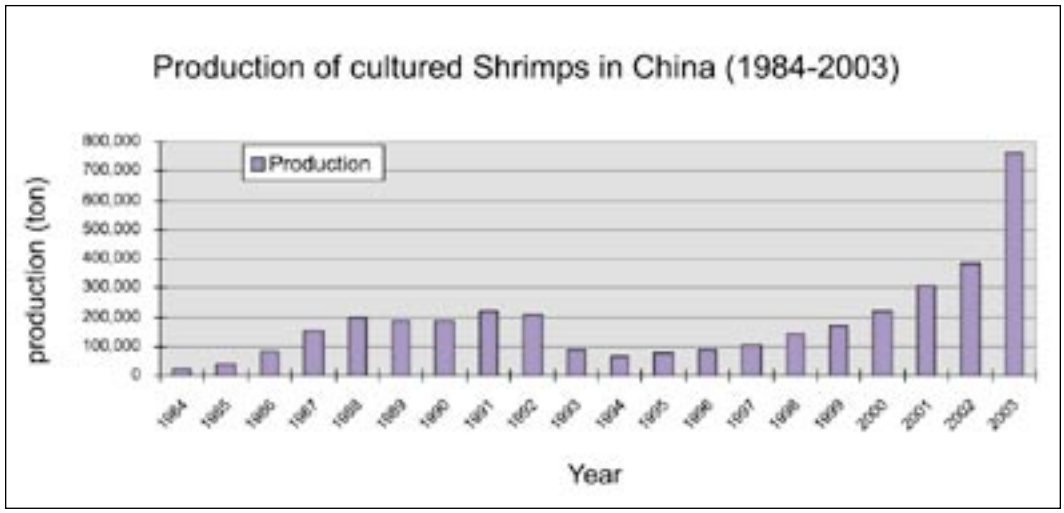

Figure 1. China's cultured shrimp production during 1984-2003

Contribution of Different Shrimp Species to the Total Production

Several species of shrimp species have been cultured in China in the past two decades. Due to the structure of statistic system for aquatic products, production of cultured shrimp species was included in the national statistics by aggregated production of all species until 2003. It was the first time to have separated production figure for four major cultured shrimp species, *P. vannamei*, *P. chinensis*, *P. monodon* and *P. japonicus*. **Figure 2** shows the composition of cultured shrimp production in 2003. It is very clear that *P. vannamei* accounted for nearly 80% in the total production. It dominates the shrimp culture industry in recent years.

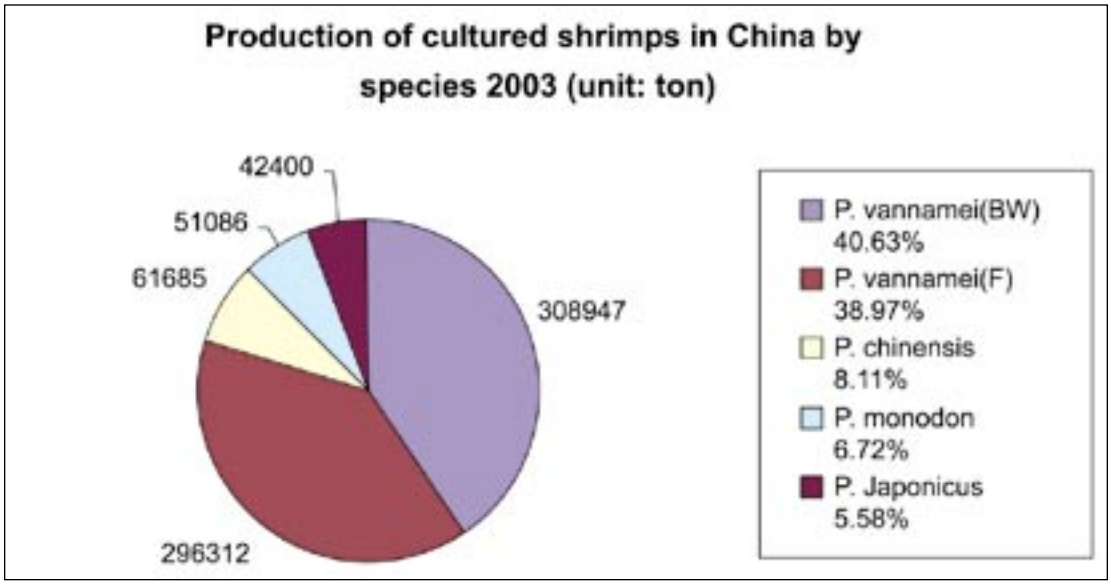

Figure 2. Species contribution to China's cultured shrimp production in 2003

Value of Cultured Shrimp in China

Shrimps are among the species with highest commercial value in all cultured species in China. Statistic data is only available for the aggregated figure of all cultured shrimp species. Total value of all cultured shrimp species in China during 1984-2002 is shown in **Figure 3**. It should be noted that fluctuation of the total value of cultured shrimps was the result of production change, change in exchange rate of US$ vs. CY yuan and market price. In 2002, the cultured shrimp production increased by nearly 100% compared with 1988, but the total value only increased by little more than 50%.

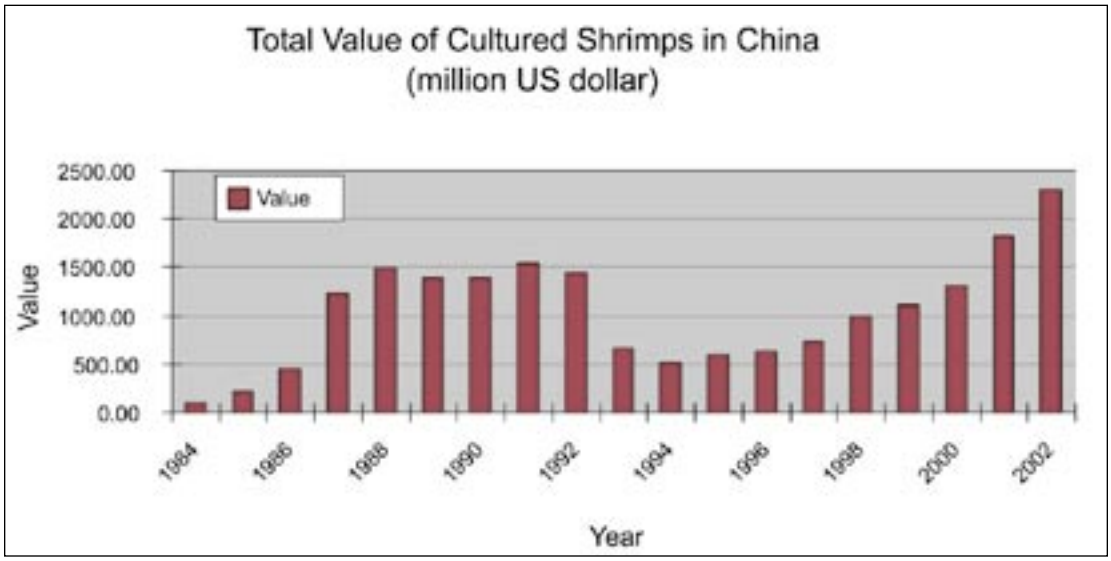

Figure 3. Total value of cultured shrimp in China in 1984-2002

Contribution of Shrimp Culture to Overall Aquaculture Sector

Figure 4 shows the contribution of shrimp culture industry to overall aquaculture sector in China in 1984-2002. In terms of production quantity, the shrimp culture industry takes a very small share in the total aquaculture sector in China. The highest was in 1988 when cultured shrimp production accounted for 2.85 % in the total aquaculture production. When the product value is considered, the role of shrimp culture industry becomes much more important in the whole aquaculture sector. The largest contribution was also in 1988 when cultured shrimp production value accounted for 17.72% of the total aquaculture output value.

Looking at the trend of contribution of shrimp culture industry to whole aquaculture sector in China, it shows that the contribution of shrimp culture Industry in China in 2002 decreased by 60.38% (by volume) and 63.17% (by value) compared with that in 1988 despite of the 92.63% increase in production quantity. Such contrast is mainly due to the expansion of other culture species other than shrimps, which were seriously cumbered by the disease problem. However, the trend in recent years is very promising. It indicates a steady increase, although the question of sustainability remains. What's important is how to sustain such trend.

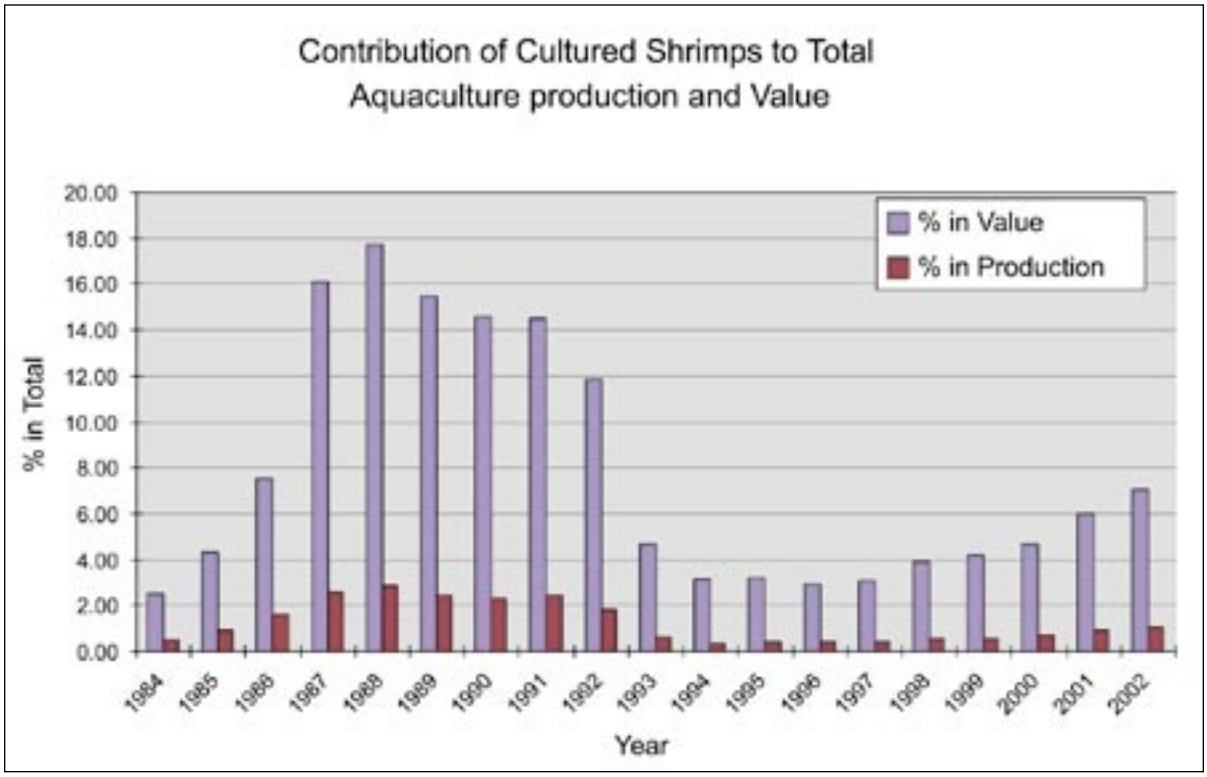

Figure 4. Contribution of shrimp culture to overall aquaculture sector in China

Shrimp Export

Shrimp has been one of the most important export aquatic products in China. However, there is no disaggregated exporting data available for specific commodity from different sources (wild catch vs. aquaculture) due to the structure of national statistic system. The export quantity and value of shrimp from all sources in China during 1984-2003 are shown in **Figure 5** and **Figure 6**.

Considering the contribution of shrimps to the overall aquatic products export from China, it accounted for only 6.45% of the total production in 2002. However, the export value of shrimp accounted for 13.25%. It was the second most important export commodity of aquatic products after river eel in 2002.

Although there is no available statistical data on the composition of exported shrimps, cultured shrimp could take the major share in the shrimp export because the total wild catch of shrimp was only 95,218.mt in 2003. It accounted for about 11 % of the total shrimp production in the same year.

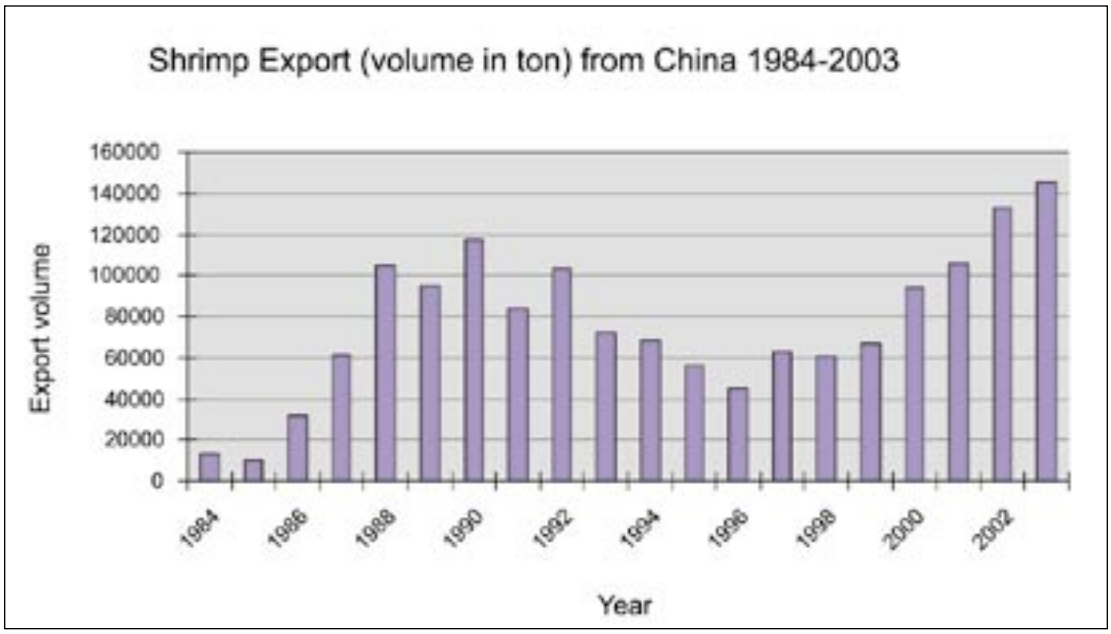

Figure 5. Quantity of exported shrimp from China

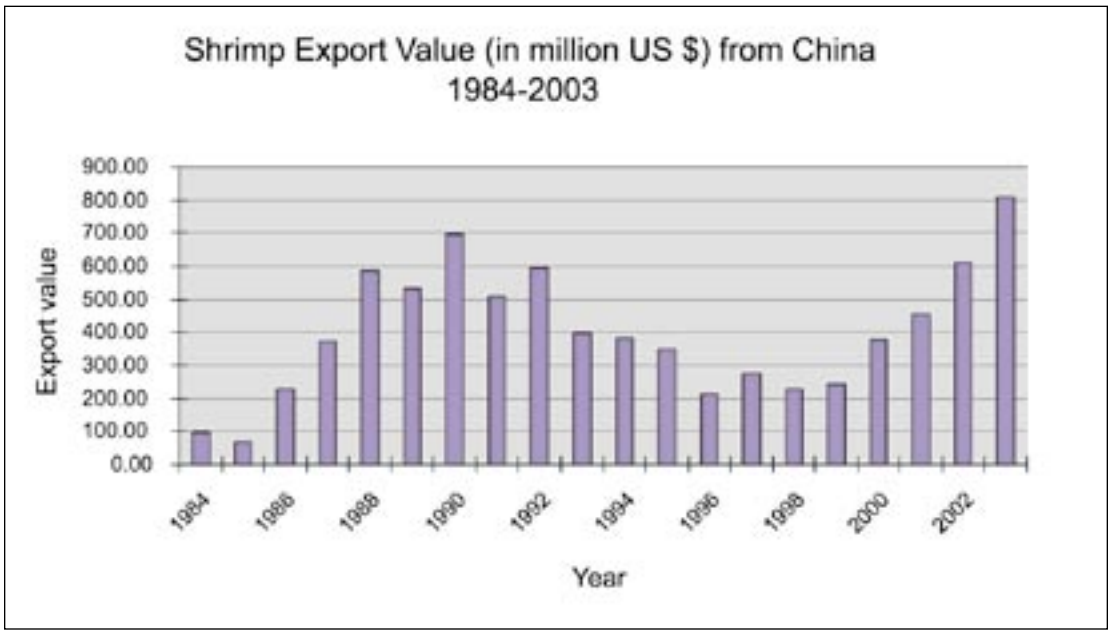

Figure 6. Total value of exported shrimp from China

Problems in the Industry

China is presently facing several major problems existing in the shrimp culture. The first is disease problem, especially White Spot Syndrome Virus disease, which seriously impacted the traditionally cultured species, *P. monodon* and *P. chinensis*. Although tremendous efforts (both financial and human resource inputs) have been invested in tackling the problem in China, there have been no established systematic measures that can effectively prevent and control the outbreak of the disease. The disease associated with *P. vannamei* (especially Taura Virus disease) is also an unpredictable factor determining the suc-

cess or failure of the farmer. *Vibrio* spp is another significant disease in the late period of *P. vannamei* culture.

The quality of shrimp fry is another problem significantly affecting the performance of the industry. Due to the very limited breeding techniques of the hatchery operators and repeated use of broodstock, the deterioration of shrimp fry quality is common. Thus, these result to slow growth rate, prolonged culture period and susceptibility to diseases.

Discharges of untreated effluents from shrimp farming can create serious environmental problems in the near future and could hit back at the shrimp culture industry. Presently, few farmers treat the effluents from their shrimp ponds before discharging to the natural environment. This could be a serious threat to the sustainability of the industry if no effective action is taken soon.

Another problem is market of shrimp products. In the international market, shrimp export industry is facing strong pressure from non-tariff trade barrier (technical barrier) set by an anti-dumping action adopted by importing countries. In domestic market, seasonal market and fast expansion of the production affected the economic returns of the shrimp farmers due to unreasonably low price, sometimes far below US$ 2.0/kg.

Policy Issue on the Import and Culture of Exotic Shrimps

Since the late 1970s, the Chinese government has been putting high importance to the establishment of the legal system and regulations to regulate various aquaculture related activities. The major laws and regulations concerning with import and culture of exotic shrimp include “Fisheries Law,” “Law on quarantine of imported and exported animal and plant,” “Regulation on management of feed and feed additives,” “Regulation on management of veterinarian drugs,” and “Regulation on management of broodstock and seed for aquaculture.” A “Technical Code for Shrimp Culture to produce healthy food” was issued by the Ministry of Agriculture in 2001. The Chinese government generally encourages introduction of exotic species for aquaculture purpose but stresses high importance to prevent introduction and spreading of new disease pathogens. It is required to conduct ecological risk evaluation before introduction of exotic species. The introduction of exotic species needs to be approved by concerned ministry or provincial authority. The introduction process must strictly follow the officially designated quarantine procedure though authorized government agency.

Traditionally, China used to be ruled by man rather than law, and presently China is now in transitional process from former planned economy to market-oriented economy. The Chinese government is pushing very hard to establish and implement various laws and regulation on various social activities and relationships. However, it takes a long time for the people to change their traditional mind. The implementation and enforcement of aquaculture related laws and regulations are in different status. Some laws and regulations are rather strictly complied while some are not so. For instance, the import of broodstock and seed for aquaculture purpose generally follows the related laws and regulations. However, the cross boundary movement of life aquatic animals (including broodstock and seed) within the country is not always following the concerned laws and regulations. China is currently establishing license system for aquaculture. It will have better control over the aquaculture environment.

II. CULTURE OF *PENAEUS VANNAMEI*

History of Introduction

Penaeus vannamei is the major exotic shrimp species cultured in China now. It was first introduced to China from Hawaii by Oceanography Research Institute of Chinese Academy of Science in 1988. The first successful trial on artificial propagation of the shrimp was conducted in 1992. The first hatchery produced post larvae were obtained in 1994 in small scale. The culture of the species was first conducted in brackish water. The desalinized shrimp fry was introduced to freshwater environment for culture sometime in 2001 due to the serious virus disease outbreak in brackish water. The culture of the species in freshwater started to expand rapidly in China after it was proven to be more successful than in brackish environment.

Source of Broodstock

Despite the rapid expansion in culture area and growth in production, China has not established its capability to produce its own broodstock for the culture of *P. vannamei*. At the moment, broodstock of *P. vannamei* is basically dependent on overseas supply although few hatcheries started to establish their own broodstock. Most hatcheries import broodstock of *P. vannamei* from Taiwan Province, which are believed to be 2nd or 3rd generation from the SPF population introduced from Hawaii. Some hatcheries directly import broodstock from Hawaii.

Number of Hatcheries

China is a vast country and *P. vannamei* culture is fast expanding industry, therefore, it is not possible to have an accurate estimate on the total number of *P. vannamei* hatcheries that are currently operating. The rough estimate is at least more than one thousand. *P. vannamei* hatcheries are more concentrated in Guangdong, Hainan and Fujian Province along the south-east coast of China though *P. vannamei* hatcheries have been established in 14 provinces/autonomous region/ central government directed municipality.

Total Production of Fry

Production of *P. vannamei* fry was not included in the fisheries statistic data until 2003 in China. The total production of *P. vannamei* fry reached 112.634 billion in China 2003. Three provinces along the south-east coast of China (Guangdong, Hainan and Fujian) contributed 69.06% of national *P. vannamei* fry production although 14 provinces/autonomous region/municipality directly under central government reported production figure.

Growout Culture

Within a rather short period, growout culture of *P. vannamei* has spread extensively in China due to its advantages in culture. Basically, *P. vannamei* is now cultured in two different environments, freshwater and brackish water in China. Out of the total 33 provinces/autonomous region/Central government directed municipality in the mainland China, 24 report production of *P. vannamei* from freshwater (inland waters) in 2003, while 11 coastal provinces/autonomous regions/Central government directed municipalities reported production from brackish environment. It was on the first year that production of cultured *P. vannamei* was included in the official statistics data separately.

There is no statistical data available for the pond area used for culture of *P. vannamei*. It can only be estimated from the total production. The rough estimate of the total area of freshwater pond for *P. vannamei* culture may be around 60,000-80,000 ha. and total area of brackish pond used for the same purpose may be around 40,000-60,000 ha.

Marketable size *P. vannamei* used to be 50-80 pieces/kg when the culture first started in China. Recently, there is a significant decline in the growth of cultured shrimp. In order to market the shrimp with more or less the same culture period, the marketable size is much smaller now. It is normally 60-100 pieces/kg now.

The total production of cultured *P. vannamei* reached 605,159 mt. Out of which, 296,312 mt was from freshwater environment and 308,947 tons were from brackish environment. The production distribution of cultured *P. vannamei* is shown in Figures 7 and 8 (next page). It is very obvious that Guangdong province is the largest contributor to the production of cultured *P. vannamei* in China. It contributed about 40% of the cultured *P. vannamei* production in China in 2003. It was followed by Jiangsu province in freshwater culture and by Haina province in brackish water culture.

Contribution to Domestic Shrimp supply and Shrimp Export

It is not possible to exactly evaluate the contribution of cultured *P. vannamei* in domestic market and export. However, a rough estimate can be made according to the total export volume and species composition of the production.

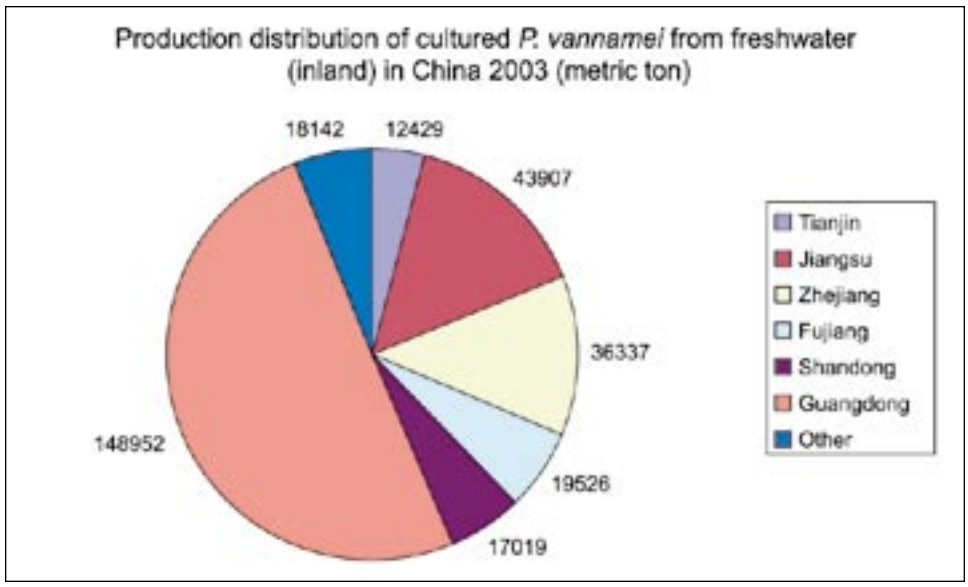

Figure 7. Production distribution of freshwater cultured *P. vannamei* in China

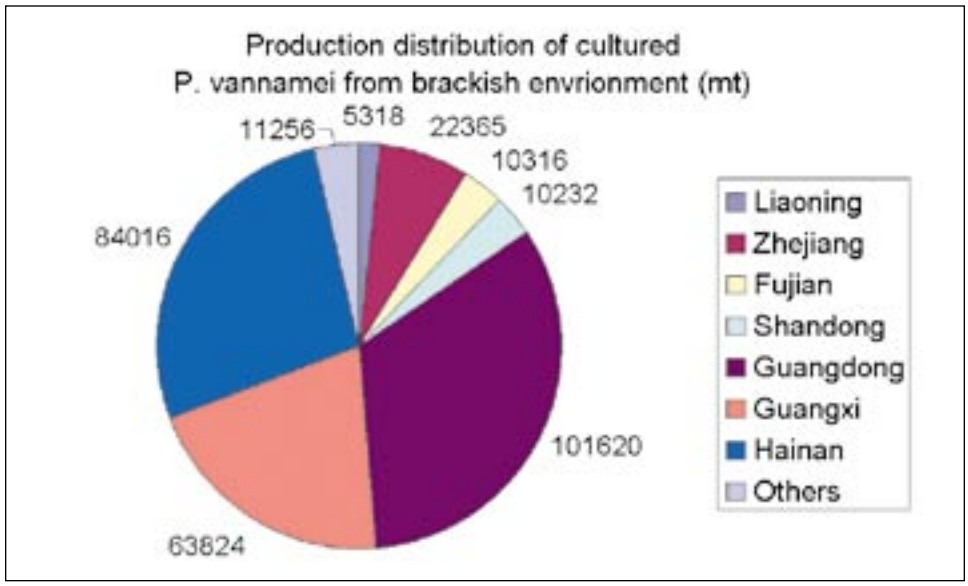

Figure 8. Production distribution of *P. vannamei* cultured in brackish water in China

China exported 145,511.8 mt of shrimp products in 2003. Considering that some of the exported commodities were peeled or processed in many ways, it can be converted into about 20 metric tons of fresh harvest. This accounted for about 23% of the total shrimp production (including wild catch). Therefore, more than three quarters of shrimp production were consumed by domestic market. Considering that *P. vannamei* accounted for about 63% of the total shrimp production in China in 2003, in terms of supply, its contribution to the domestic market is tremendous. It also created a significant impact on the market price. Its market price dropped to US $ 3-4/kg in 2002 from earlier US$ 6-7/kg. Such price was maintained more or less the same since then. But, it did not cause much impact on the market price of other shrimp species as the production of those species has been maintained more or less the same.

It is very hard to assess the contribution of cultured *P. vannamei* to the shrimp export either by quantity or value as the exported shrimp only accounted for small proportion of the total shrimp production. The contribution may be very significant, especially cultured *P. vannamei* from brackish environment.

Labor and Employment Generated

In addition to the contribution to domestic shrimp supply and shrimp export, *P. vannamei* culture also brings about significant social benefit in terms of job opportunity. Although there is no such statistical data, it can be estimated that *P. vannamei* culture industry employs about 150,000 labors where about 10,000 are in hatchery operation and about 140,000 in growout culture.

R&D Activities on *Penaeus vannamei*

Large scale culture of *P. vannamei* has been carried out in China for 5-6 years. Therefore, scientific research and technology development activities carried out so far are rather limited. Existing activities are mainly focused on the following aspects:

- Mass production hatchery technique;
- Virus disease fast detecting methods: it is mainly for the purpose to determine whether shrimp post larvae carry virus. Fast detecting kit has already been put into practical use;
- Culture environment manipulation through different agents, such as beneficial microorganism, immune promoting agent such as Chinese herb extracts, vitamin complex and polysaccharide etc;
- Multi cropping and intensive farming system and related management scheme for high yield;

Very limited efforts have been made to improve the quality seed of *P. vannamei*, China has not yet established its own *P. vannamei* SPF or SPR population at the moment.

Disease Outbreak and Management

There was a serious outbreak of diseases in brackish water culture of *P. vannamei* in 2001, which was later identified as Taura virus disease. It caused tremendous loss to the farmers. Since then, there has been no report of serious outbreak of the disease in large area. However, disease problem has been always the number one threat to farmers. Comparatively, disease problem is more serious in brackish water than in freshwater.

At the moment, there is no promising method in preventing and controlling of disease problems. It virtually depends on the quality of shrimp postlarvae. The farmers try to minimize the chance of disease outbreak mainly through improvement of culture condition and applying various disease preventing agents.

REFERENCE

DOF, MOA, 2004. 2003 China Fisheries Statistic Yearbook. Beijing

Guo Zhijie, Gao Hongnian & Wu Wanfu et al., 2004. China Seafood imports and Exports 2003. China Society of Fisheries, Beijing

FAO, 2004, Fishstat Plus "Aquaculture production: Quantities 1950-2002". FAO, Rome

FAO, 2004, Fishstat Plus "Aquaculture production: Values 1950-2002". FAO, Rome

FAO, 2004, Fishstat Plus "Commodities production and trade 1950-2002". FAO, Rome

Ma Jinjin,et al.,2004. Review on culture technique of desalinized *P. vannamei*. Irrigation Fisheries. Vol. 24 (4): 30-32

Chen Changfu, et al, 2004. Influence of immuno-polysaccharide on resistance to *Vibrio harveyi* of *Penaeus vannamei* by oral administration. Journal of Anhui Agricultural University, 31(4): 402-405

Ge Xianping, 2003. Status and development trend of freshwater prawn/shrimp and crab culture in China. Scientific Fish Farming, Add. Issue, p 1-5

Zhao Fazhen, 2003. Status and development trend of shrimp culture in China. Scientific Fish Farming, Add. Issue, p 6-8