

An improved culture model for vannamei shrimp in South China

By Peng Zhidong, Dong Qiufen, Zhang Song and Yang Yong

Smaller ponds for intensive culture are proposed but there are also reservations on the application of the new model.

China has a long history in marine shrimp culture spanning more than 50 years. Today, the Chinese shrimp industry has caught the world's eyes, for its large production volume. Shrimp is an important commodity for export, as well as for the emerging domestic market for the more than 1.34 billion population.

Guangdong, Hainan, Guangxi, Fujian, Zhejiang and Jiangsu are the main marine shrimp culture provinces, each with their own culture conditions. In 2011, China's production of both freshwater and marine shrimp reached 1.56 million tonnes, of which 895,000 tonnes were marine shrimp (China Aquatic Products Processing and Marketing Association). In turn, more than 70% comprised the white leg shrimp, *Penaeus vannamei*. There are various culture systems for vannamei shrimp ranging from high elevation culture ponds, where systems are intensive at 200 post larvae (PL)/m², semi intensive 70 PL/m², polyculture with ovate pompano, milkfish, tilapia, common mullet and in inland areas in low saline ponds with stocking density from 60 PL/m² to 110 PL/m².

Similarly to most shrimp producing countries in Asia, China's shrimp production has been hampered by natural disasters (typhoons, floods etc), adverse environmental conditions (high and cold temperatures), diseases (white spot syndrome virus and early mortality syndrome) as well as increasing costs such as higher pond rents and labour costs. However, Chinese shrimp farmers continue to find solutions. Some farmers learn to culture shrimp following traditions, superstition and Feng Shui whilst others merely continue as they realise that they cannot control natural disasters but must live with them. Others seek new technologies and new culture models.

A new model

Recently, a new shrimp culture model in Donghai island of Zhanjiang, Guangdong is generating a lot of interest. This is an improved model from the traditional high-elevation culture ponds with smaller ponds, separate water supply and drainage systems. It was developed by the technical service team of Guangzhou Hinter Biotechnology Co., Ltd and associated feed mills. Hinter is the largest aquafeed premix supplier in

Table 1. A comparison between two models for vannamei shrimp culture.

Item	Traditional high-elevation pond	New model
Size	Large. 7~10 mu* (0.47-0.67 ha)	Small. 3~5 mu (0.2-0.33 ha)
Central waste discharge	Difficult	Easy
Management	Difficult	Easy
Water quality	Unstable. Easy to change but difficult to control	Relatively stable. The separate small ponds with separate supply and drainage system can allow for more water exchange.
Success rate	Low at about 20%	High at about 85%
Profit levels	Low	High
* 1 mu ≈ 0.0667 ha ≈ 666.7 m ² 1 ha = 15 mu		

Table 2. Comparison of culture parameters of the two models.

Parameters	Traditional high-elevation pond	New model
Density (PL/mu)	120,000 (180 PL/m ²)	300,000 (450 PL/m ²)
Survival rate (%)	60	80
Growth (pcs/kg at 75 days)	80	100
Price (RMB/kg)*	26 (USD 4.10/kg)	24 (USD 3.78/kg)
Production (kg/mu)	900 (13,500 kg/ha)	2,400 (36,000 kg/ha)
FCR	1.0~1.3	1.0~1.3
Production Cost (RMB/kg)	16 (USD 2.52/kg)	16 (USD 2.52/kg)
Input (RMB/mu)	14,400 (USD 34,020/ha)	38,400 (USD 90,720/ha)
Profit (RMB/mu)	9,000 (USD 21,263/ha)	19,200 (USD 45,360/ha)
* Farm gate price was collected in Zhanjiang on 7/9/2011; 1 RMB = USD 0.1575		

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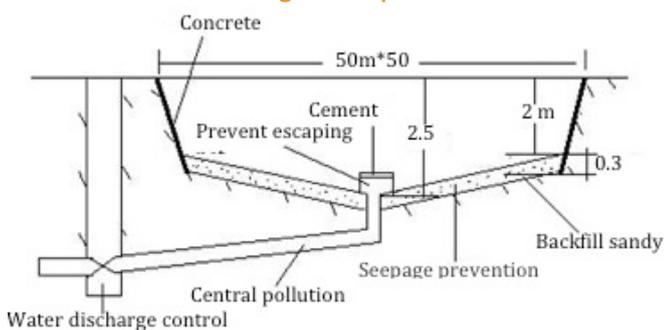
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Picture 1. Construction design for the ponds



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The higher cost for construction of new ponds or for modifications of an existing farm is compensated by high density, high survival rate and high production. Table 1 shows the differences between the traditional high-elevation culture pond and the new model. The culture parameters of these two models are listed in Table 2.

This new farming model pays particular attention to water quality which is the main criteria for the high production and high profit margins. Some key features of the model are discussed below.

Smaller size pond

These small sized ponds translate to more dams, roads and less available farming area, which lead to higher costs. A reconstruction of the traditional high-elevation ponds into smaller ponds (Picture 1) costs about RMB 10,000/mu (USD 23,625/ha) with ten labourers working on 1.5 mu per day. To construct these new small ponds from a new area will cost around RMB 30,000 mu (USD 70,875/ha). The advantage of having the small independent ponds is that they are easier to manage.

Pre-treatment of water

Seawater will be drawn during neap tides and passed through a sand filter and stored in the storage tank which occupies 20% of the total farm area. The water will be pumped into a tank containing sand to be filtered again before it goes into the different ponds through separate pipelines. A silk screen with 60~80 mesh placed at the end of a pipeline will stop the entry of harmful organisms.

Some 3-4 days prior to stocking, the aerators will be running in the culture ponds filled with water to a depth of 0.8 m. During this time, the necessary disinfection of the water will be carried out. Before stocking post larvae, the water quality should be as follows: pH 7.8~8.6, dissolved oxygen (DO) > 4 ppm, total alkalinity > 100 ppm, ammonia nitrogen < 0.5 ppm, nitrite < 0.15 ppm, hydrogen sulphide (H_2S) < 0.1 ppm, Secchi disc transparency 25~50 cm.

Fresh water conditions

Based on our experience in Guangdong, we know that vannamei shrimp is fast growing and is resistant to some saline pathogens when cultured in freshwater. Thus, it is recommended to decrease salinity gradually from 24 ‰ to 4 ‰ by addition of freshwater. Some 15 days before harvest, seawater should be added to increase the salinity to about 12‰ so the shrimp will have the taste as shrimp cultured throughout in saline ponds. As it may not be easy to get a supply of freshwater from a river in some areas, the utilisation of underground water is proposed.

Aeration

An important requirement is good water quality which in turn also requires adequate DO from an efficient aeration model. There are many types and brands of aerators in the Chinese market but we recommend the water-car type (local name), which is already very popular. There are several brand names for this type of aerator. When running, this aeration system will circulate water and bring the waste feed and faeces to the central area, which is 20~30% of the pond area.

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Cleaning the sand filter



Water supply with independent pipes



In the new model small culture ponds ranging from 3 to 5 mu (0.2-0.33 ha) are used

Post larvae and feeds

In the new model, specific pathogen free (SPF) vannamei shrimp post larvae perform better than any other local or domestic vannamei post larvae. An untiring and careful management of the post larvae is also important for a successful new culture model.

A good quality shrimp feed with high crude protein such as at 40% is important. It is also important to keep to the recommended total daily feeding volume but a change in feeding frequency at 8 times/day instead of the commonly used frequency of 3 times/day is suggested.

Pond bottom management

This is extremely important to ensure a consistently good environment for the shrimp. This is detailed in Table 3.

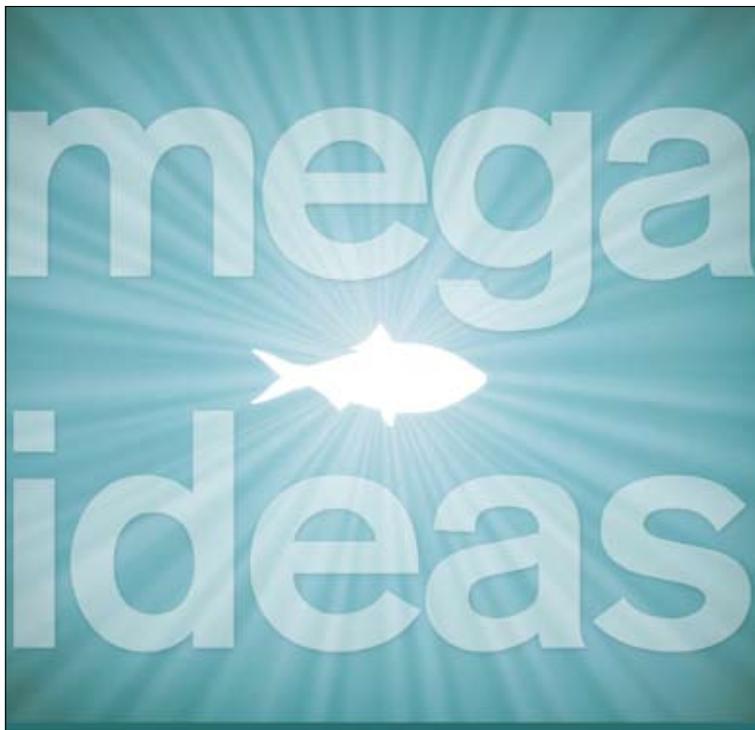
Production experiences

Farmer Wu from Zhanjiang De Hai Industry has started to use this new model. In June 2009, he invested RMB 600,000 (USD 94,500) to

Table 3. Pond bottom management in the new model.

	1~30 days	31~60 days	61~90 days	>90 days
Waste-discharge (Discharge the waste after feeding)	-	3 times/day	3 times/day	4 times/day
Waste removal (removal in the 20% central area)	-	once every 5~7 days	once every 3~5 days	once every 1~3 days
Water exchange	-	once every 7 days, with 10~20 cm each time	once every 3 days, with 15~25 cm each time	once every 2 days, with 20~30 cm each time

reconstruct his two ponds with an area of 9 mu each into six ponds with an area of 2.5 mu each. The profits in the same year were RMB 800,000 (USD 126,000) with two successful crops. In 2010, he was



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The waste is discharged from the middle of the pond

successful with three crops with 250,000 kg shrimp from the six small ponds and the net profit was RMB 1,500,000 (USD 236,250). The cost analysis for Wu's farm is given in Table 4.

Table 4. Cost analysis of the shrimp culture at Zhanjiang De Hai Industry.

Pond condition			
Area/Depth	2 ponds with 2.5 mu each. Water depth was 1.8 m. 10 water-car aerators		
Culture cycle	15th April, 2011 ~ 30th June, 2011. 75 days in total.		
Post larvae	1,600,000 PL with 1 cm body length. RMB 12.8/1000PL (USD 2.02/1000PL)		
Output			
Average size	Production	Ex-farm price	Sales volume
80 pcs/kg	19,000kg	RMB 30.4/kg (USD 4.8/kg)	RMB 577,600 (USD 90,972)
Farming analysis			
1. Good quality feed for tiger shrimp with FCR 1.2.			
2. Feed cost 1.2 X RMB8/kg = RMB 9.6/kg. The total input was about RMB 16/kg, the net profit was about RMB 14.4/kg. (Inputs include feed, RMB 9.6/kg; post larvae, RMB 1/kg; labour RMB 0.8/kg; electricity RMB 1.8/kg; animal health treatments, RMB 1/kg; pond rent and others RMB 1.8/kg)			
3. Shrimp size could reach 80 pcs/kg in 75 days with a high survival rate at around 95%.			
4. High production with 3,800 kg/mu (5.7kg/m ² or 57,000 kg/ha)			
5. Net profit: RMB 14.4/kg*3,800 kg/mu =RMB 54,720/mu (USD 129,276ha), total net profit for 5 mu was RMB 273,600 (USD 43,092).			

In 2009, some farmers obtained high production with 3,500 kg/mu (5.25 kg/m²). In 2011 the highest production record was 5,000 kg/mu (7.5 kg/m²) and the average production was 3,000 kg/mu (4.5 kg/m²). More and more farmers are trying this new model, but the high investment is a deterrent.

However, this farming model is not without problems. With such high stocking density, farmers have to be on the lookout for signs of slower growth and some diseases especially when the shrimp reach a size of 100 pcs/kg. The system cannot withstand typhoons and has not been proven efficient in inland freshwater soil bottom ponds. Furthermore, the use of underground water is not environment-friendly. New technologies, such as biofloc should be investigated to control water quality and improve on this new model concept.

Peng Zhidong Dong Qiufen Dr Zhang Song Dr Yang Yong

Peng Zhidong, Dong Qiufen, Dr Zhang Song and Dr Yang Yong are experts in aquaculture nutrition and health from Guangzhou Hinter Biotechnology Co.,Ltd. Email: qiufendong@gmail.com (Dong Qiufen).

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