

Hybrid snakehead fish farming in China

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

Farming of the fish has expanded but with a dependence on local live fish markets. Prices fluctuate with supply and industry looks forward to steady prices with fillet export and better marketing.

The snakehead fish from China is considered as an exotic predator and invasive fish to the US aquaculture industry. Since the first appearance of several snakeheads in a pond in Crofton in Maryland in June 2002, they have been frequently sighted in the US. On the contrary, snakeheads are highly valued as a food fish in China and some other Asian countries.

China is a country with a long history in traditional herbal medicine, and for centuries, the snakehead fish is listed for its pharmacological properties in promoting muscle growth, hematopoiesis and some other physiological activities of the human body. Added to this, the fish is tasty. This and its high flesh yield make the snakeheads an important commercial fish of high market value in Chinese aquaculture.

The snakehead fish is widely distributed in China, with the exception of the highland areas. There are more than seven snakehead fish species reported in China, but only three of them, *Channa maculate*, *C. asiatica* and *C. argus* are farmed. *C. maculate* and *C. asiatica* are mainly distributed in south China and *C. argus* are found mostly in the central and northern provinces. Lower supplies from overfishing of the snakehead some 30 years ago resulted in higher prices. This also encouraged its intensive farming. With a developing snakehead fish farming industry, a hybrid species which is a cross between female *C. asiatica* (♀) and male *C. argus* (♂) was developed successfully in Shunde, Guangdong in 1994.

Expansion in farming

After nearly 10 years of promotion and good farming practices, the hybrid snakehead fish have overcome its negative 'ghost fish' image and has become more popular in China. Currently, more than 90% of hybrid snakehead farming areas are in the south. Recently, hybrid snakeheads were introduced to the central and north of China. With the expanding China's domestic market, snakehead fish production is increasing with a total annual production of more than 350,000 tonnes, comprising 170,000 tonnes in Guangdong, 100,000 tonnes in Zhejiang, 35,000 tonnes in Shandong and 12,000 tonnes in Guangxi and other provinces. This interest in snakehead farming coupled with good marketing strategies have spurred the development of supporting industries, such as seed stock and formulated feed.

Seed

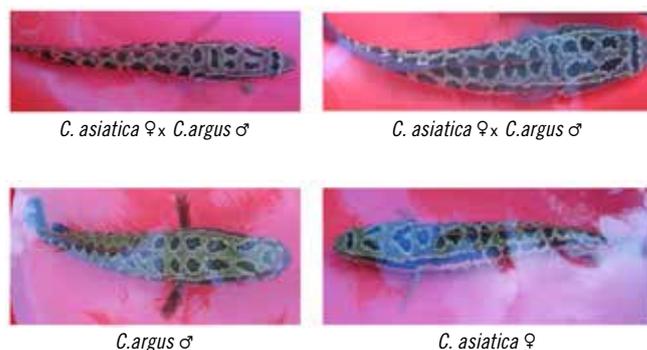
Since the 1980s, wild caught snakehead fish fingerlings were stocked intensively in ponds and cages in Shunde, Guangdong. In 1987, the first batch of *C. asiatica* from Hong Kong was introduced to Shunde and showed good growth performance. Within a 6-month culture period, this Hong Kong stock gained an average weight of 1 kg, which was twice that of the local variety. To overcome the problem of inbreeding, in 1994 scientists carried out work on hybridisation of the snakehead. Finally the hybrid snakehead (female *C. asiatica* ♀ x male *C. argus* ♂) performed best with fast growth, less reliance on trash fish as feed and stronger adaptation capacity to changing weather conditions in China.

Now, there is an ongoing work in Shunde to develop another hybrid snakehead fish from male *C. asiatica* (♂) and female *C. argus* (♀). However, this new hybrid species does not perform better than the 1994 hybrid, it requires more sophisticated breeding technology to produce better growth traits.

Guangdong leads in hatchery production

As the winter is cold in most areas of China, Guangdong is the most suitable province for hatchery production of seed stock. But even in Guangdong, the lowest temperature can be as low as 10°C, when the snakehead just hides in the soil without feeding. There are more than 100 private sector hatcheries and nurseries for hybrid snakehead fry production in Guangdong province, and the yearly output is more than 1 billion fry. The market for fry is the intensive farms in Guangdong. Some fish seed traders sell the fry to some other provinces in east and north China. In 2007, the Fisheries Research Institute of Academy of Agricultural Sciences of Hangzhou, Zhejiang province successfully developed a hybrid snakehead fish hatchery similar to that in Guangdong. This solved the problem of transporting seed stock from Guangdong to Zhejiang province which is more than 1,000 km away.

Figure 1: Commercial snakehead hybrids



Farming trends

With global warming, the hybrid snakehead fish fry are now available from April to July, but rainy weather conditions can significantly influence fish farming activity. Farmers also stock snakehead fish ponds according to market demands, a good price this year will lead to more fish output some six months later.

Hybrid snakehead fish is usually farmed intensively in ponds and fed with extruded feeds. As the availability of water is limited and its usage is restricted, farmers farm the fish without any water exchange or limited water exchange. In such situations, farmers have mastered the technology to maintain good water quality with minimal water exchange - a result of years of farming experience. To control and maintain water quality, they stock some carps, such as bighead carp and common carp together with snakehead fish. In such polyculture

systems, the stocking density for bighead carp and common carp is about 0.2 fish/m² and 0.4 fish/m² respectively, and that for snakehead is 13-20 fish/m². The snakehead is an air breather and can live without water for more than 7 days, if the skin is moist enough. Aerators are used in the ponds to provide oxygen for the carps.

The seasons in China allow for three different harvests. The first crop of hybrid fish involves stocking fingerlings before May, and harvesting from September the same year with a farming period of not more than 6 months. The harvest size is usually from 500 g to 750 g. In this first crop, the weather in Guangdong is cold and survival rate is low, and stocking density is higher than other two crops at about 20 fish/m² (1500 fish/kg).

However, from March to May, it is still cold and rainy in Guangdong and a different culture management is deployed. The second crop of fish is stocked about 2 months after the first crop and fish is harvested from November to April the following year after a farming period of 7 to 12 months. The harvest size is more than 700 g. Here the production is larger when the stocking density 15 fish/m², as after May the weather is hot and stable with high fish survival rate. Fish also grow slowly over the winter season with no feed intake.

The third crop is stocked after June and harvested in June the following year. The farming cycle is 10 to 15 months and harvest size is about 800g. The stocking density is about 13 fish/m². The risks to diseases are high because of the frequent weather changes from winter to spring and then to summer during the farming period. The advantage is the better chance of selling fish with a good price in June, when usually there are not enough of commercial size fish in the market.

Table 1 Snakehead fish farming in China in 2011

Parameters	Snakehead	Silver carp	Crucian carp
Culture area (m ²)	2735		
Pond depth (m)	2.5		
Size of juvenile fish (fish/kg)	1500	30	95
Stocking density (fish/m ²)	20	0.28	0.73
Feed conversion ratio (FCR)	1.09	-	-
Feed frequency (times/day)	2 to 3	-	-
Feed rate (%BW)	3 to 5	-	-
Culture duration (days)	190		
Body weight at harvest (g/fish)	700	1150	210
Survival rate (%)	70%	87%	46%
Yield (kg)	26,732	650	195
Price (USD/kg)	1.08	0.64	0.52
Gross income (USD)	58,836		
Production cost (USD)	44,190		
Net income (USD)	14,646		
Unit production (kg/m ²)	9.77	0.28	0.07
Unit profit (USD/m ²)	5.36		
B/C (%)	33.14%		

Note:

1. Fish prices were collected on 2 December 2011. The exchange rate of USD and CNY was 1:6.37
2. Snakehead fish price on 15 August 2013 was 7.8 CNY/500g (2.55 USD/kg), the exchange rate of USD and CNY was 1: 6.11.

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Harvesting

Feed

In the past, the snakehead fish was fed trash fish in China. However, since 2000, as extruded feeds for other fish species become available, farmers in the south showed some interest in using extruded feeds. They have already found it disadvantageous to feed the fish with trash fish which was more labour intensive. Feed conversion ratio (FCR) was high and with bad water quality, the frequency of diseases was higher and survival rate lower. Cost of production was higher with lower profit margins. Several feed mills then promoted the use of extruded feeds for *C. asiatica* to feed the hybrid fish, but could not achieve good culture results, resulting in the loss of confidence in some farmers in the use of extruded feeds.

Extruded feeds

Guangzhou Haiwei Feed Co., Ltd and Shunde Baian Feed Co., Ltd are two of the early producers of extruded feeds specific for the snakehead fish. With nutritional improvements to the feed and more promotional efforts by the feed mills, farmers gradually accepted extruded feeds. In 2002, the extruded feed market for snakehead fish was just about 200 tonnes, but reached 3,000 tonnes in 2003, 20,000 tonnes in 2005, 70,000 tonnes in 2009 and 220,000 tonnes in 2012. Except for some farming of *C. argus*, using trash fish in the north of China, most farmers now prefer to use extruded feed.

Currently in Guangdong and Guangxi, there are more than 30 fish feed companies producing feeds for the snakehead fish. This resulted in an oversupply and fierce competition among producers. The feed price varies from USD 1.51/kg (39% crude protein) to USD 1.64/kg (44% crude protein). Feed performance and FCR vary with brands. In the past few years, with the price of fishmeal increasing, some small fish feed producers are likely to incorporate other animal sources of protein, such as poultry meal and blood meal, ultimately reducing the quality of the feeds. But the larger feed companies have upheld their reputation for quality with fishmeal added at more than 30% in the formulation. The feed of Guangzhou Haiwei Feed Co., Ltd of Guangdong Haid Group has an FCR of 0.9-1.2 and that of other feed brands range from a high FCR of 1.4 to the lowest at 1.0.

In addition, with better quality seed stock, good farming management and extruded feeds, the current rate for skeletal malformations in the snakehead fish is very low in China, sometimes even completely absent. Previously, this has been attributed to poor quality fingerlings, farm mismanagement and unbalanced feed nutrition. With several years of experience in developing feed for the snakehead fish, Guangzhou Hiner Biotechnology Co., Ltd is proud to have played a role in promoting snakehead fish farming with extruded feed. The company has the Hiner A701 premix for snakehead fish which can reduce fish malformation, increase growth and resistance to diseases. The Hiner aquaculture nutrition and farming service team has helped many feed mills and fish farmers.

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Feeding the fish with extruded feed

Marketing

Guangdong is the largest producer of snakehead fish with more than 1,300 ha of farming area. More than 80% of the production is sent to Shanghai, Zhejiang, Hubei and some other northern provinces. The Chinese prefer to consume live fish and as the snakehead is an air breather, the fish is easily transported over more than 2,000 km without affecting survival rate. The price of the live snakehead fish is 30% higher than chilled fish.

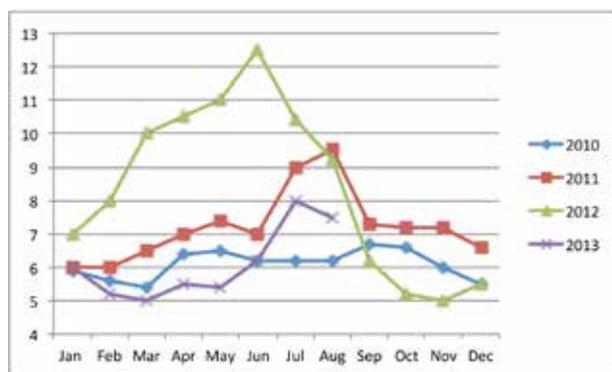
Usually both farmers and fish traders can easily profit from snakehead fish farming, although it is still a high risk industry because of price fluctuations. The profit margin at the farm level is around 33% (Table 1) and at the retail levels, margins can be 10 to

30%. Since profits have been very high in the past, it has attracted many newcomers investing in snakehead fish farming. This resulted in an oversupply and reduction in prices. Fish prices were very low with a large production in 2010 but rose in 2011 and hit the highest point in 2012 but dropped down again in early 2013 (Figure 2).

As the fish is produced for the local market only, little has been done to control the quantity of snakehead fish farming. In China, there is no accurate data to show farmers how to control farming quantity.

The fish farming quantity shows a significant negative correlation with fish prices of previous years. In 2010, fish price was low and the output declined in early 2011 by 20% and this prompted a higher price

Figure 2: Snakehead fish prices in Guangdong from 2010 to 2013



Note: In 2012, from January to August, the average weight of snakehead was 0.65-0.9 kg/fish and from September to December, the average weight of snakehead was 0.55-0.9 kg/fish (Adapted from www.fishfirst.cn)

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in 2011. When the total fish quantity increased by 25% in late 2011, prices dropped at the end of 2012. Following this trend, it is predicted that fish output should decrease by about 40% in 2013, and the price in late 2013 will be better than 2012.

Outlook

The snakehead fish has become an important food fish in China but there are some urgent issues which require attention.

Seedstock

There are many private sector hatcheries and nurseries for hybrid snakehead fish, but all these lack a standard management protocol. The high profits of hybrid seed production have encouraged some low quality fingerlings, because some producers just care about quantity rather than quality. The good news is that some reputable groups have started breeding programs such as BaiRong Fish Seedling and Nanhai Keda Hengsheng. These larger groups have good reputation with good management system, technology and other available resources.

Diseases

With changing climatic conditions and limited water supply, the fish easily succumb to diseases. Putrid skin disease is common and farmers need to be able to anticipate and prevent this from affecting fish survival and prices. There are many animal health companies with chemicals and treatments to maintain good water quality and to treat diseases. Most of them also provide technical services to farmers.

Food safety

With strict legal regulations, banned medicines are seldom used in aquaculture. However, it is still necessary to raise farmers' awareness on the environmental impact and to keep to a sustainable aquaculture protocol and produce safe fish.

Marketing

As fish prices fluctuate every year, the industry needs a fish trade association as well as a marketing system to ensure its profitability. More assistance and guidance from the government are sought in fish marketing communication and to ensure that there is no oversupply. The meat yield for the snakehead is high at 63% which is 3 to 5% higher than tilapia and channel catfish and thus has a potential for the export of fillet. This will add to China's seafood exports which are now mainly focused on the tilapia and shrimp. In Zhejiang province, some leather producers are trying to use the fish skin to produce commercial products, such as handbag and handicrafts.

When some of these problems are resolved, the snakehead fish industry is expected to develop positively. In addition, the success in snakehead fish farming and experiences from China are good examples for the development of the same industry in other Southeast Asian countries. The Hinter international service team is sharing their knowhow on snakehead fish farming in Vietnam, Myanmar, Cambodia and other countries.



Hybrid snakehead fry



From left, **Dong Qiufen**, **Peng Zhidong**, **Mei Gaoshang**, **Dr Zhang Song** and **Dr Yang Yong** are experts in aquaculture nutrition and health from Guangzhou Hinter Biotechnology Co. Ltd. Hinter mainly delivers total practical solutions for aquafeed mills to help them produce high quality aquafeed. Email: qiufendong@gmail.com (Dong Qiufen).