Advances in Aquaculture and Fisheries Management Vol. 1 (1), pp. 005-010, April, 2013. Available online at www.internationalscholarsjournals.org © International Scholars Journals

Commentary

Publisher's Note: A survey of Aquacultural activities in China

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Accepted 22 March, 2013

INTRODUCTION

China, with one-fifth of the world's population, accounts for two-thirds of the worlds reported aquaculture production. The People's Republic of China is vast. Its territory sprawls over 9.6 million km2. The distance from borders in the east to those in the west measures 5 000 km and from north to south it spans over 5 500 km. China's present population is about 800 million.

Administratively, China consists of three municipalities (Peking, Shanghai and Tientsin) directly under the central authority, 22 provinces and five autonomous regions. China's topography varies widely. Cloud-capped peaks give way to basins of different slopes and sizes. Wide, rolling plateaus alternate with low, broad plains. There are great deserts and wilds in the northwest. Rivers, streams and lakes slice the plains on the middle and lower reaches of the Yangtse River. Some areas are warm the year round; others have long winters and short summers. Most of the land lies in the temperate zone. A combination of high temperatures and adequate rainfall provides favourable farming conditions, especially in the east and south.

China has rich water resources. From the Changpai Mountains in the northeast to the Hengtuan Mountains in the southeast, huge potentials for generating hydraulic power and building water conservancy projects exist. The three major plains - the Northwest, the North China and the lower Yangtse Plain-have a total area of about a million square kilometres. They make up roughly one tenth of China's territory. These plains are the most densely populated part and the region where most cities are located. Today, about 107 million ha (1 600 million mu) are under crops. These are concentrated mostly in the plains which, with thick top soil and suitable climate, constitute the key farming areas. The Yangtse Plain is also a key fishery area with large lakes and a terrain favourable to fish culture.

Recent history and social organization

To understand China's recent progress in agricultural and aquacultural production, it is necessary to keep in mind a little of her history. China's cultural and technological histories are very long. Nevertheless development and modernization were slow in coming. The general large-scale expansion of agriculture and industry, which is now occurring, is relatively recent.

This expansion began with the end of the Revolution and formation of the Socialist People's Republic in 1949. The new government, under Chairman Mao Tse-tung's leadership, instituted a programme of land reform, distributing the holdings of the landlords to peasants. Mutual-aid teams were formed to enable pooling of resources to fight recurrent floods and drought. The central government emphasized control of the major rivers along with general reconstruction. Success of these mutual-aid teams led to the formation of the so-called primary cooperatives in 1955. In these units, regular as well as emergency work was shared. Income was distributed according to the individual's share in the cooperative (land and other means of production).

By 1956, primary cooperatives were changed to advanced cooperatives. All land and machinery holdings were transferred to the cooperative with work assigned according to ability and income. This period coincided with the first Five-Year Plan (1954–68). It stressed development of irrigation. Most of today's reservoirs were constructed then. The cooperatives usually had only a single economy. In coincidence with the Great Leap Forward (1958), cooperatives were welded together to form communes with diverse economies and strengthened financial resources.

It may be debated whether the Great Leap Forward did succeed in its immediate aims. But it is clear that the initiation of the commune system marked the beginning of comprehensive, simultaneous development of all sectors of production. With this came a shift in emphasis toward an agricultural economic base. In 1957, the Yangtse was bridged for road and rail traffic. The first successful artificial spawnings of pond-reared Chinese carps were also made, in Kwangtung, in 1958 - a significant turning point in the expansion of fish culture and production.

By 1961, the main outlines of the new China had taken shape. Considerable progress in agriculture and industry produced improvements in income but along with these came problems of elitism in the professions and Communist Party cadres. This eventually became the stimulus for the Cultural Revolution.

"The Great Proletarian Cultural Revolution" (1966–69) brought important changes in organization. Measures to provide more emphasis on social motivation or "political consciousness" were undertaken. They also gave more participation in decision-making to the worker-farmer, especially within communes and in traditionally professional activities such as medicine, teaching, research and the military. The stress on practical experience and on "learning from the masses" brought a markedly practical orientation to all education and research, including that on fish management and culture. Evolution of China's socialist society is still continuing. Today, land is owned by the commune, a merger of social, political and economic administration and a kind of township. It generally covers an area of 1 000 to 10 000 ha.

Hand tools, small tractors, boats, etc. are usually owned by the unit that financed their purchase, generally the production team. The team, at present, is the basic accounting unit. On the average, a team takes in about 100 workers.

Tractors, trucks, larger boats and heavy equipment are generally held by production brigades. These are a more diversified grouping of 10 or so teams.

Much of the housing is individually owned and inheritable. Personal acquisitions such as bicycles and radios are also owned personally. Gradually, however, basic accounting is being passed from the production teams to higher levels. An upward movement of ownership of the means of production is also occurring. In a number of communes the ownership of individual houses has already been transferred to the commune.

Status of freshwater fisheries and aquaculture

China also has a very long history of freshwater fisheries and aquaculture. A Chinese named Fan Li started breeding and raising fish (common carp) in Wushi, Kiangsu Province, eastern China, more than 2 400 years ago. In the year 473 B.C. Fan Li wrote a book, "Fish Breeding", which is the first known document on fish culture.

Today China has about 20 million ha (300 million mu) of freshwater areas. One third, or about 6.7 million ha (100 million mu), can be used for fish culture. Of this area, about 60 percent is fish ponds (lowland and upland), irrigation ponds and village ponds, while 40 percent is lakes and reservoirs.

The major freshwater fish-producing areas are located in the Heilung drainage system and the lowland reaches of the Yellow-Yangtse and Pearl Rivers. The Yangtse, with its many large and small lakes, is the most important, and includes the provinces with the highest production, Kiangsu and Hupei (Solecki, 1966). Owing to the many canals and lakes the Yangtse Delta is known as the "water net area" of China. Its focus is the city of Wushi, China's Venice.

The next most important production area is in the Pearl River Basin. Like the eastern Yangtse Basin, the lowland areas of the Pearl have long been traditional fish culture regions owing to plentiful water and extensive natural spawning areas for the Chinese "family fish" or major carps.

While four cyprinid species dominate the freshwater fish production, there are over 500 species occurring in the fresh waters of China of which at least 200 are suitable for table use. The species to which reference will most often be made in this report are as follows:

Four majors (family fish, or Chinese carps):		
	Grass carp	Ctenopharyngodon idella
	Black carp	Mylopharyngodon piceus
	Silver carp	Hypophthalmichthys molitrix
	Bighead carp	Aristichthys nobilis
Other species commonly used in mixed culture with the above:		
	Mud carp	Cirrhinus molitorella
	Common carp	Cyprinus carpio
	Golden carp	Carassius auratus
	Wuchan fish	Megalobrama amblycephala
	Tilapia	Tilapia mossambica
Favoured predatory species include:		
	Mandarin fish	Siniperca chautsi
	Snakehead	Ophiocephalus argus

Freshwater fish culture in China can be divided into two kinds: (i) pond culture, and (ii) lake and reservoir culture. In lakes and reservoirs, culture primarily consists of stocking fish raised in nearby ponds, while in pond culture the fish are also provided with supplementary food both directly, and indirectly through fertilization of the water.

Pond culture is carried out by two types of communes: (i) fishery communes, and (ii) agricultural communes with fishery as sideline occupation. Fishery communes usually adopt “all-round production”, i.e., integration through use of fish, pigs and vegetables in the production process. Agricultural communes, with fish culture as a sideline occupation, adopt a comprehensive development of grain, fish, livestock and other crops.

There are three forms of lake and reservoir fishery management: (i) state-owned, (ii) brigade or commune, and (iii) brigade and commune together. Usually, however, reservoirs are under commune management. In the biggest reservoirs, the State does the fish stocking while production brigades organize the commune members to catch fish.

At all levels - from national down to the provincial, county and commune - Chinese agricultural policy is repeatedly presented in the form of Chairman Mao's sayings. Every citizen is aware of these sayings and the policies.

The major ones include:

i. “Take agriculture as the foundation and industry as the leading factor”
ii. “Water conservancy or irrigation is the lifeblood of agriculture”
iii. “In water conservancy, take the direction of undertaking small-size projects”
iv. “Take grain as the key link and ensure all-round development of agriculture, industry, animal husbandry, forestry, sideline occupations and fisheries”

The Mission found that freshwater fishery, especially pond culture, has always been taken as an integral part of the farming system. Grain and fish promote each other and they have developed together.

In freshwater fisheries, stress is laid on fish culture and the simultaneous development of culture and catching.

Fish fry and fingerling production form the base for fish culture. In the people's communes, fish fry and fingerling stations have been set up and run by the communes themselves.

China's 2005 reported harvest was 32.4 million tonnes, more than 10 times that of the second-ranked nation, India, which reported 2.8 million tonnes.[2]

China's 2005 reported catch of wild fish, caught in rivers, lakes, and the sea, was 17.1 million tonnes. This means that aquaculture accounts for nearly two-thirds of China's reported total output.

The principal aquaculture-producing regions are close to urban markets in middle and lower Yangtze valley and the Zhu Jiang delta.

Aquaculture began about 3500 BC in China with the farming of the common carp. These carp were grown in ponds on silk farms, and were feed silkworm nymphs and faeces.[4] Carp are native to China. They are good to eat, and they are easy to farm since they are prolific breeders, do not eat their young, and grow fast. The original idea that carp could be cultured most likely arose when they were washed into ponds and paddy fields during monsoons. This would lead naturally to the idea of stocking ponds.[5]

In 475 BC, the Chinese politician Fan Li wrote the earliest known treatise on fish farming, Yang Yu Ching (Treatise on fish breeding). The original document is in the British Museum.

The common carp was the number one fish of aquaculture in antiquity, and today, world wide, is still extensively cultured.

During the Tang dynasty (618–907 AD), the farming of common carp was banned because the Chinese word for common carp (鯉) sounded like the emperor's family name, Li (李). Anything that sounded like the emperor's name could not be kept or killed.[6]

The ban had a productive outcome, because it resulted in the development of polyculture, growing multiple species in the same ponds. Different species feed on different foods and occupy different niches in the ponds. In this way, the Chinese were able to simultaneously breed four different species of carp, the mud carp, which are bottom feeders, silver carp and bighead carp, which are midwater feeders, and grass carp which are top feeders.[4][7] Another development during the Tang dynasty was a fortunate genetic mutation of the domesticated carp, which led to the development of goldfish.

From 1368 AD, the Ming Dynasty encouraged fish farmers to supply the live fish trade, which dominates Chinese fish sales to this day.[8]From 1500 AD, methods of collecting carp fry from rivers and then rearing them in ponds were developed."[5]

Recent history

The major carp species used traditionally in Chinese aquaculture are the black, grass, silver and bighead carp.[10] In the 1950s, the Pearl River Fishery Research Institute of the Chinese Academy of Fishery Sciences (CAFS) made a technological breakthrough in the inducedbreeding of these carps, induced by injecting fish pituitary hormones.[10]

In the past, fish culture in China has been a family business, with traditional techniques passed from generation to generation.[11] However, in the late 1960s the Chinese government began a move to the modern induced breeding technologies, which has resulted in a rapid expansion of freshwater aquaculture in China.[11][12]

From 1978, China's economic policies moved from central planning towards a market economy, opening new markets for aquaculture products. The effect of this, together with further technological advances, has been to move Chinese aquaculture towards industrial scale levels of production.[11] In the 1980s, many species other than carp, such as other species of fish, crustaceans, molluscs and seaweeds, have been brought into production. However, in the late 1990s, CAFS scientists developed a new variant of the common carp called the Jian carp. This succulent fish grows rapidly and has a high feed conversion rate. Over 50% of the total aquaculture production of carp in China has now converted to Jian carp.[10][13] By 2004, the induced breeding of carps had been so effective that the carp industry amounted to 46 percent of the total aquaculture output.[11]

Statistics

Since 2002, China has been the world largest exporter of fish and fish products. In 2005, exports, including aquatic plants, were valued at US$7.7 billion, with Japan, the United States and the Republic of Korea as the main markets. In 2005, China was sixth largest importer of fish and fish products in the world, with imports totalling US$4.0 billion.[2]

In 2003, the global per capita consumption of fish was estimated at 16.5 kg, with Chinese consumption, based on her reported returns, at 25.8 kg.[2]

The common carp is still the number one fish of aquaculture. The annual tonnage of common carp, not to mention the other cyprinids, produced in China exceeds the weight of all other fish, such as trout and salmon, produced by aquaculture worldwide.

Since the 1970s, the reform policies have resulted considerable development of China's aquaculture, both marine and inland. The total used for aquaculture went from 2.86 million hectares in 1979 to 5.68 million hectares in 1996. Over the same time span, production increased from 1.23 million tonnes to 15.31 million tonnes.[14]

In 2005, worldwide aquaculture production including aquatic plants was worth US$78.4 billion. Of this, the Chinese production was worth US$ 39.8 billion. In the same year there were about 12 million fish farmers worldwide. Of these, China reported 4.5 million employed full-time in aquaculture.[2]

Top 10 species grown in China in 2005	
Species	**Tonnes** [2]
Japanese kelp	4 314 000
Grass carp	3 857 000
Pacific cupped oyster	3 826 000
Silver carp	3 525 000
Japanese carpet shell	2 857 000
Common carp	2 475 000
Wakame	2 395 000
Bighead carp	2 182 000
Crucian carp	2 083 000
Yesso scallop	1 036 000

Production, area and yield: 2003 [15]			
	Total production (tons)	**Area used (ha)**	**Yield (kg/ha)**
Overall total	30,275,795	7,103,648	4,260
Marine culture	12,533,061	1,532,152	8,180
Inland culture	17,742,734	5,571,496	3,180
Pond	12,515,093	2,398,740	5,220
Lake	1,051,930	936,262	1,120
Reservoirs	1,841,245	1,660,027	1,110
Rivers	738,459	382,170	1,930
Rice paddies	1,023,611	1,558,042	660
Other	572,396	194,297	2,950

Inland aquaculture

In 1979, inland aquaculture occupied 237.8 million hectares and produced 813,000 tonnes. In 1996, they occupied 485.8 million hectares and produced 10.938 million tonnes. In that year, 17 provinces produced 100,000 tonnes from inland aquaculture.[14]

Pond culture is the most common method of inland aquaculture (73.9% in 1996). These ponds are mostly found around the Pearl River basin and along the Yangtze River. They cover seven provinces: Anhui, Guangdong, Hubei, Hunan, Jiangsu, Jiangxi and Shandong. The government has also supported developments in rural areas to get rid of poverty. The sector is significant from a nutrition point of view, because it brings seafood to areas inland away from the sea where consumption of seafood has traditionally been low.[14] Even the arid Xinjiang produced 58,835 tons of fish in 2000, 85% of it from aquaculture.[16]

In recent times, China has extended its skills in culturing pond system to open waters such as lakes, rivers, reservoirs and channels, by incorporating cages, nets and pens.[14]

Fish farming in paddy fields is also developing. In 1996, paddy fish farming occupied 12.05 million hectares producing 376,800 tonnes. A further 16 million hectares of paddy fields are available for development.[14]

Species introduced from other parts of the world are also being farmed, such as rainbow trout, tilapia, paddle fish, toad catfish, silver salmon, river perch, roach and Collossoma brachypomum.[14]

Besides fish and crustaceans, turtles (primarily, the Chinese Soft-shelled Turtle Pelodiscus sinensis) have been extensively farmed as well since the 1980s and 1990s. Based on a 2002 survey of 684 turtle farms, researchers estimated that these farms had the total herd of more than 300 million animals; they sold over 128 million turtles each year, with the total weight of about 93,000 tons, worth around US$750 million. Since these data are based on less than half of all turtle farms registered with the appropriate regulating agencies (i.e., 684 out of 1,499), it was estimated that the overall herds and production amounts are at least twice as high.[17]

Marine Aquaculture

Using current culture technologies, much farmed cultivation of marine plants and animals can be applied within the 10 metre isobath in marine environments. There are about 1.33 million hectares of marine cultivable areas in China, including shallow seas, mudflats and bays. Before 1980, less than nine percent of these areas were cultivated, and species were mainly confined to kelp, laver (Porphyra) and mussels.[14]

Between 1989 and 1996, areas of cultivated shallow sea were increased from 25,200 to 114,200 hectares, areas of mudflat from 266,800 to 533,100 hectares, and areas of bay from 131,300 to 174,800 hectares. The 1979 production was 415,900 tonnes on 117,000 hectares, and the 1996 production was 4.38 million tonnes on 822,000 hectares.[14]

Since the 1980s, the government has encouraged the introduction of different marine species, including the large shrimp or prawn Penaeus chinensis, as well as scallop, mussel, sea bream, abalone, grouper, tilapia and the mud mangrove crab Scylla serrata.[14]

In 1989, production of farmed shrimp was 186,000 tonnes, and China was the largest producer in the world. In 1993 viral disease struck, and by 1996 production declined to 89,000 tonnes. This was attributed to inadequate management such as overfeeding and high stock densities.[14]

In 2001, the fisheries scientists Reg Watson and Daniel Pauly expressed concerns in a letter to Nature, that China was over reporting its catch from wild fisheries in the 1990s.[18][19] They said that made it appear that the global catch since 1988 was increasing annually by 300,000 tonnes, whereas it was really shrinking annually by 350,000 tonnes. Watson and Pauly suggested this may be related to China policies where state entities that monitor the economy are also tasked with increasing output. Also, until recently, the promotion of Chinese officials was based on production increases from their own areas.[20][21]

China disputes this claim. The official Xinhua News Agency quoted Yang Jian, director general of the Agriculture Ministry's Bureau of Fisheries, as saying that China's figures were "basically correct".[22] However, the FAO accepts there are issues about the reliability of China's statistical returns, and currently treats data from China, including the aquaculture data, apart from the rest of the world.[23][24]

References

1. FAO: Fishery and Aquaculture Profile for China
2. Fact sheet: Aquaculture in China and Asia
3. FAO report: China responsible for two-thirds of world aquaculture production – FishUpdate.com
4. Parker R (2000) *Aquaculture science* Page 6. Delmar Thomson Learning.
5. History of aquaculture Retrieved 2 August 2009.
6. Nash CE and Novotny AJ (1995) *Production of aquatic animals* Page 22, Elsevier Science Ltd. ISBN 0-444- 81950-9.
7. FAO (1983) *Freshwater aquaculture development in China* Page 19, Fisheries technical paper 215, Rome. ISBN 92-5-101113-3.
8. *Fisheries of Americas* Retrieved 2 August 2009.
9. Ruǎn Jīnshān; Li Xiùzhū; Lín Kèbīng; Luō Dōnglián; Zhōu Chén; Cài Qīnghǎi (阮金山;李秀珠;林克冰;罗冬莲;周宸;蔡清海), 安海湾南岸滩涂养殖贝类死亡原因调查分析 (Analysis of the causes of death of farmed shellfish on the mudflats in the southern part of Anhai Bay), 《福建水产》 (*Fujian Aquaculture*), 2005-04
10. CAFS research achievement *CAFS*. Accessed 26 July 2011.
11. National Aquaculture Sector Overview: China. Retrieved 2 August 2009.
12. Chaudhuri H and Singh SB (1985) Induced breeding of Asiatic carp FAO: Project report: AC193/E. Rome.
13. Jian, Zhu; Jianxin, Wang; Yongsheng, Gong and Jiaxin, Chen (2005) "Carp Genetic Resources of China" pp. 26–38. In: David J Penman, Modadugu V Gupta and Madan M Dey (Eds.) *Carp genetic resources for aquaculture in Asia*, WorldFish Center, Technical report: **65**(1727). ISBN 978-983-2346-35-7.
14. Central Library (1996) Aquaculture Industry
15. People's Republic of China: 1999 - 2003 Aquaculture Production - Pacific Rim Fisheries Program
16. Guo Yan, FISHERIES DEVELOPMENT IN XINJIANG, CHINA
17. Shi, Haitao; Parham, James F; Fan, Zhiyong; Hong, Meiling; Yin, Feng (2008-01- 01),"Evidence for the massive scale of turtle farming in China", *Oryx* (Cambridge University Press) **42**: 147–150, doi:10.1017/S0030605308000562, retrieved 2009-12-26
Also athttp://sites.google.com/site/jfparham/2008Shi.pdf
18. Watson, Reg and Pauly, Daniel (2001) *Systematic distortions in world Fisheries catch trends* Letter to *Nature*, 414: 534.
19. Pearson, Helen (2001) *China caught out as model shows net fall in fish* Nature 414, 477. doi 10.1038/35107216
20. Heilprin, John (2001) Chinese Misreporting Masks Dramatic Decline In Ocean Fish Catches *Associated Press*, 29 November 2001.
21. Reville, William (2002) Something fishy about the figures *The Irish Times*, 14 Mar 2002

22. China disputes claim it over reports fish catch *Associate Press*, 17 December 2002.

23. FAO (2006) The State of World Fisheries and Aquaculture (SOPHIA), Page 5.

24. Fishery statistics: Reliability and policy implications

Further reading

- Tapiador DD, Henderson HF, Delmendo MN and Tsutsui H (1979) Freshwater fisheries and aquaculture in China FAO: Fisheries Technical Paper 168, Rome. ISBN 92-5-100328-9.
- Weimin Miao W and Xinhua Yuan X (2007) "The Carp Farming Industry in China - An Overview" In Leung P, Cheng-Sheng Lee C and O'Bryen PJ (Eds.) (2007) Species and System Selection for Sustainable Aquaculture Blackwell Publishing. ISBN 978-0-8138-2691-2.
- Zhijie G, Yingliang X, Xiangguo Z, Yong W, Daobo A and Sugiyama S (2008) Review of fishery information and data collection systems in China FAO Fisheries Circular No. 1029, p. 46. Rome. ISBN 978-92-5-105979-1.