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Food Climate Research Network

China briefings
Focus on aquaculture

Photo: Dried starfish, Chaung Chau island, Hong Kong

Tod Mecklem via Flickr

Summary

China is the world's largest producer and consumer of aquatic products. Two key trends are emerging in China's aquaculture production, both of which have environmental implications. One is the shift from production and consumption of herbivorous and/or filter feeding fish towards omnivorous and carnivorous fish. Second is the trend towards intensification characterised by, among other things, the use of more dedicated commercial feedstuffs both for herbivorous and carnivorous species.

In 2010, China accounted for 35% of world fisheries production and more than 60% of world aquaculture production. It is the world's third largest importer of aquatic products and its largest exporter. As in the livestock sector, government policies support scaling up, consolidation and intensification. Major broader policy influences include price deregulation, market liberalisation and land reform. The Chinese property rights regime is a constraint on further growth and 'red line' policies protecting cropland from conversion currently prohibit the construction of new ponds. Two key trends impacting the future of the aquaculture sector are: a shift in production toward more omnivorous and carnivorous fish species, and intensification based on increasing use of dedicated feeds. Environmental and food safety issues relating to chemical use and water pollution are interconnected, and also have implications for the crop and livestock sectors.

CHINA BRIEFINGS
8. FOCUS ON AQUACULTURE

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Written by Huw Pohlner and based on:
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Garnett T. and Wilkes A. (2014). *Appetite for Change: Social, economic and environmental transformations in China's food system. Examination of China 's changing food system, the emerging socio-economic, health, environmental, socio-cultural trends and their shaping drivers; challenges for coming years.* Food Climate Research Network – Oxford Martin School.

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Trends and policies

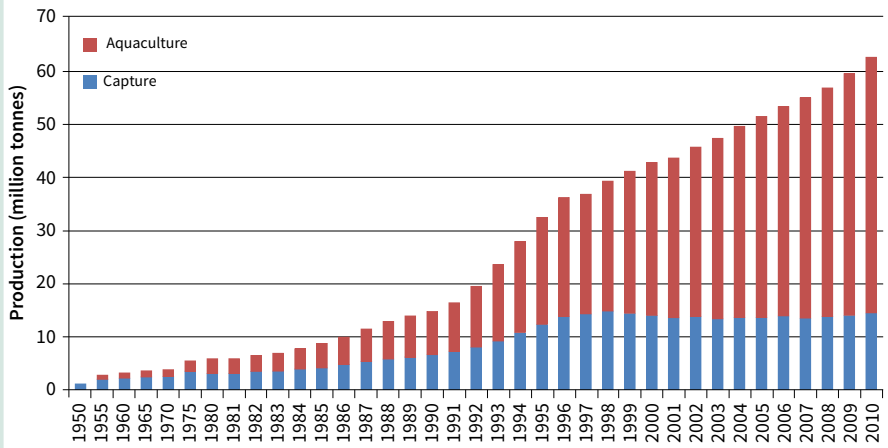
- As with livestock, major policy influences on the aquaculture sector's growth include price deregulation, market liberalisation and land reform.
- The Government is attempting to move away from capture fisheries with zero growth and negative growth policies for inland and inshore waters respectively.
- The basic law for aquaculture is the Fisheries Law, which has driven the sector's development through its strong emphasis on aquaculture.
- Overall, the administrative system for aquaculture is highly complex and fragmentation of responsibilities has negatively affected environmental management and food safety.

Aquaculture production surpassed that of capture fisheries in 1985 and accounted for 71.8% of total Chinese fisheries production in 2011. By 2010, Chinese farmed aquaculture accounted for a quarter of global aquatic food production.

Trends in the aquaculture sector

- Figure 38 shows the dominance of aquaculture in fisheries production since the mid-1980s and the stagnation in absolute growth in capture fisheries since the late 1990s.

Figure 38: Fisheries production (with seaweeds wet weight) from aquaculture and capture during 1950-2010 in China



Source: FAO. (2012). FishStatJ,

For a more detailed discussion, see the original report here.

Productivity of capture fisheries (catch per unit effort) has fallen as stocks have dwindled while aquaculture productivity rose from 1.7 tonnes/ hectare in 1990 to 4 t/hectare in 2000.

- Production is diversified across vertebrate and invertebrate animals and plants, but finfish (particularly carp) contribute more than half of total production.
- The sector is still dominated by small-scale actors but is experiencing greater intensification of production and species diversification.
- In 2010, more than 200 aquatic species were being farmed, with a noticeable trend toward more omnivorous and carnivorous species, reflecting changing demand.

Systems of production and employment

- Since 2000, many former fisherfolk have shifted to aquaculture production as overfishing has reduced the profitability of fishing.
- However, total numbers of fisherfolk and the size of the fishing fleet remain stable (to 2011) despite government efforts to reduce numbers.
- China's current land property rights regime prevents farmers from selling or buying land or ponds; this has likely restricted aquaculture development.
- Aquaculturists' rights are poorly defined, restricting their ability to attract long-term investment and prevent trespass and water pollution from external sources.
- Young people appear unwilling to work in the sector and aquaculture farmers are older on average than other agricultural workers, though wage rises may turn this around in the future.

More than 20 million people (1.5% of China's population) depend directly or indirectly on the aquatic sector for their livelihoods.

Processing

- In 2011, five coastal provinces accounted for 85% of total processed aquatic production, with Shandong dominating.
- 35% of total aquatic production was used as raw processing material, lower than the global average for the proportion of production that is processed before consumption.
- By-products from processing are a considerable resource and are mostly used to produce fishmeal rather than for the manufacture of higher-value products such as oils, peptides and other active ingredients.

Processors are mostly small-scale and only about 10% of the 10,000 plants operating in 2013 were approved to produce for export.

Inputs to production

The main inputs to production are:

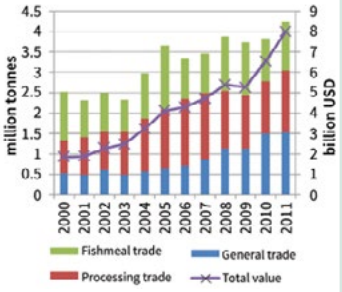
- Genetic resources: the sector has been the focus of substantial breeding efforts and government reports state that the penetration of improved varieties reached 55% by 2010;
- Land: policies to protect crop land from conversion to other uses have included a prohibition on new pond construction, prompting to some extent a renewed interest in integrated production systems such as 'rice-crab' farming;
- Feed production: Growth in aquaculture has largely been achieved through a shift towards more intensive production systems reliant on feedstuffs; and,
- Feed components: The balance between fish- and plant-based inputs to feed production in China is unclear, but use of fishmeal has levelled off recently as prices have risen, spurring efforts to find replacements and import sources. Commercial feed is still less prevalent than farm-produced feeds – the latter account for 55%-60% of aquaculture production.

Feed accounts for 60%–80% of total costs for intensive systems, and production of commercial aquafeed in China increased 17-fold between 1991 and 2008.

Trade

- Most fish produced in China is consumed domestically.
- The volume of imports is greater than exports, but the value of exports is much greater than imports, reflecting the role of value-adding processing in China.
- Imports have increased substantially in recent years, with the most rapid growth being in general trade (whole fish and ornamental fish) (Figure 41).
- The rate of imports is currently growing faster than that of exports and some commentators suggest China's comparative advantage in processing may be diminishing.
- Chinese companies are starting to purchase overseas fishmeal companies to secure future feed supplies.

Figure 41: Import value of fisheries products by value (US$ billion) and volume (million tonnes), by different categories



Source: Ma G. (2008). Aquatic products import and export trade analysis and prospect in 2007. Agriculture Outlook, (5): 31–35; Fisheries Bureau of the Ministry of Agriculture. (various years). China Fisheries Statistical Yearbook. Beijing: China Agriculture Press; Mu Y. (2007). Aquatic products export exceeded 9 billion CNY, total trade value hit a record high: 2006 national aquatic products import and export trade analysis. China Fisheries, (3): 8–10; Xiao F. (2002). Aquatic products import and export developed steady in 2001. China Fisheries, (3): 19–21; Xiao F. (2003). 2002 aquatic products import and export trade situation analysis. China Fisheries, (4): 16–19; Yu S. (2012). National fisheries products export and import trade status analysis. China Fisheries, (3): 36–37.

For a more detailed discussion, see the original report here.

In 2010, China accounted for 12% of global fisheries exports by value; fishery exports accounted for 29.3% of total Chinese agricultural product export value.

In 2011, China was the third-largest fisheries products importer in the world, with an import value of US$ 7.6 billion.

Consumption and markets

- Actual per capita intakes vary widely between coastal and inland regions, between rural and urban areas, and by socio-economic status.
- There is a strong preference for live purchases so production tends to be located close to consumption and distributed by individual vendors.
- In wealthier regions, supermarkets are making inroads with frozen products, despite prices being as much as 50% higher than in wet markets.

China consumes 40% of the global catch of aquatic products and estimates suggest per capita consumption is well above the global average.

20%–35% of aquatic products are eaten outside the home.

Environmental issues in the aquaculture and fisheries sector

- Some fisheries waters are seriously polluted, partly through the practices of the sector itself but more substantially as a result of other agricultural and industrial activities.
- Aquaculture accounts for about 5% of all agricultural pollution discharges, the vast majority of which are generated by the livestock and crop farming sectors.
- Greenhouse gas emissions in aquaculture are largely from fossil fuel burning, and are smaller than those from capture fisheries.
- Capture fisheries have contributed to declining marine and inland fish resources for decades and policies such as fishing vessel number control, artificial propagation and release of juveniles have been enacted with limited success.

In 2011, the direct economic loss from pollution incidents in fisheries areas was more than US$ 60.7 million.

- The introduction of alien species has caused disease problems in aquaculture, and may have contributed to the extinction of some native species.
- Two key trends are emerging in China's aquaculture production, both of which have environmental implications:
    - The shift from production and consumption of herbivorous and/or filter feeding fish towards omnivorous and carnivorous fish; and,
    - The trend towards intensification characterised by, among other things, the use of more dedicated commercial feedstuffs both for herbivorous and carnivorous species.
- The environmental implications of these trends hinge upon their 'efficiency'. There is much discussion about the need to improve the 'efficiency' of China's aquaculture sector but the word can be used in different ways:
    - **Efficiency defined in terms of trophic levels:** Most of China's aquaculture is based on the rearing of herbivorous fish or filter feeders, which consume plants or nutrients from the water directly. Carnivorous species need to consume other animals as a part of their diet and feed conversion efficiency will be lower, since plants are first consumed by the feed fish before being consumed by the farmed fish.
    - **Efficiency defined in terms of the feed conversion efficiency of the feeds themselves:** Commercial aqua feeds are optimally formulated to meet the nutritional requirements of the fish. Often the digestibility of farm-produced feeds is poor. The consequence is that use of commercial feeds leads to a greater volume of edible fish output relative to feed input, and less water pollution.
    - **Efficiency defined in terms of resource use:** Resources here include: the use of specially produced feedstuffs (based on fishmeal and/or oilseed cake); land, and energy/fossil fuels.
        - Feeds: In contrast to the statement above, farm-produced feeds based on agricultural byproducts might be considered to be more resource-efficient than systems based on the use of commercial feeds manufactured from dedicated grains or from fishmeal, even if the feed conversion efficiency of the former is lower. However, even on-farm feed production tends to rely on bought-in commercially produced ingredients such as oilseeds and maize so the proportion of fish reared on 'inedible' by-products is in fact relatively low.
        - Land: Extensive systems may use more land than intensive systems and so more land is required for a given level of production. On the other hand, the land used in these systems may not be suitable for other forms of cultivation, particularly where water sources are brackish. Moreover, in contrast to systems utilising commercial feedstuffs, where soy may be a component of those feeds, these extensive systems do not rely indirectly on land elsewhere for feed production.
        - Energy: Energy use in extensive systems is lower than in intensive production.

- **Efficiency defined in terms of total outputs from the system:** Where a species is fed commercial feeds, its feed conversion ratio may appear relatively high, compared with systems where no feeds are used at all. However, the true feed conversion ratio resulting from the use of commercial feeds may be better than appearances suggest since polyculture – the cultivation of other species at the same time – can be practiced in these high input systems.

- Two observations emerge most clearly from this discussion of efficiency: first, that ideas about the desired future direction of China 's aquaculture sector very much depends on one's definition of efficiency and how the boundary of the aquaculture system is defined; and, second, that life cycle analyses that examine the environmental impacts and issues resulting from China's very diverse systems of aquaculture are urgently needed.
- Environmental issues relating to crop, livestock and fish production are inherently linked, as livestock and fisheries sectors both rely on imported raw feed materials, with by-products from each sector being used to provide feed for the other.

Food safety

- Food safety problems in aquaculture include water pollution, chemical residues, the presence of parasites and microorganisms, and poor hygiene during processing and transport.
- These issues have led to export bans in the past (e.g. Chinese shrimp bans in the EU in 2002 and eel bans in Japan in 2003), prompting the establishment in 2004 of the China Entry-Exit Inspection and Quarantine registration system.
- As regulations and standards have been strengthened, smaller players have exited the sector.
- Aquatic food safety concerns are increasingly a major issue within China too, driven by consumer concerns and the increased availability of information in this area.
- Organisational reforms in 2013 targeted administrative complexity that was contributing to coordination problems and vulnerability to food safety abuse.
- Scaling up and industrialisation in the sector have increased the use of medicines and chemicals and exacerbated water quality issues.
- The increase in frozen fish sales introduces food safety risks associated with inadequate cold storage infrastructure; only 23% of aquatic products were transported in frozen form in 2010, and 40% chilled. Improvements in cold chain infrastructure have potential to reduce losses and waste, improve food safety and reduce live fish transport.

The number of certified processors remains small but grew by 70% between 2006 and 2010.

Policy implications

1. Any future reforms to land property rights in China will likely have an impact on the pace of change in the aquaculture sector, and potentially on its environmental impacts.

2. Policies to support the sustainability of aquaculture in China should be based on life cycle analyses that trace the environmental impacts of each of China's diverse aquaculture systems back through their respective supply chains.

3. Efforts to reduce the current degree of geographical and systemic separation between the livestock, fisheries and crop sectors may aid nutrient recycling and overall efficiency within the broader food system.

4. As with other sectors, consolidation and scaling up has been encouraged by government policy, but studies show that some intensive systems consume ten times more energy than pond culture per kilogram of fish produced and generate food safety issues, creating a policy dilemma.

5. Efforts to build aquatic product traceability systems have not yet resulted in a fully functional system; this is a policy development area to watch.

6. An ageing workforce threatens the future of the aquaculture sector; policy intervention may be required.

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