

A CHINA ENVIRONMENTAL HEALTH PROJECT RESEARCH BRIEF

Aquaculture and Environmental Health in China

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Seafood is already a staple in the Chinese diet, but domestic consumption is projected to rise 40 percent by 2020.¹ Of China's total seafood output, 64 percent comes from aquaculture, making it the only country in the world where aquaculture is greater than wild catch.² Aquaculture—including a wide variety of freshwater and saltwater finfish, shellfish, crustaceans, and aquatic plants—is thus a vibrant industry. Carp is the main cultivated freshwater species, and within the mariculture shellfish are the dominant market. Aquatic plants, such as kelp, account for 27 percent of total aquaculture output. Since 1978, China's aquaculture production has increased 490 percent, making it now the largest in the world, and accounting for 57 percent of global output.³

Local governments promote aquaculture as a poverty alleviating industry and have therefore subsidized production of lucrative species such as tilapia.⁴ China supplies 70 percent of the tilapia imported into the United States and is also its fourth largest supplier of shrimp (shrimp and tilapia are the first and fifth most popular seafood of U.S. consumers).⁵

Because China's waterways are highly polluted, food safety has become a major concern for Chinese aquaculture. Besides municipal and industrial wastewater contamination, mercury emissions from China's coal-fired power plants are another potential source of aquaculture contamination. Statistics on mercury in Chinese fish are scarce, but Chinese coal is believed to be responsible for much of the mercury contamination in waterways and fish in the western United States.

International concern about food safety has cost China's aquaculture dearly, as countries ban species they discovered to be contaminated. Two major cases include the 2005 eel bans in Japan and the 2003 shrimp bans in the European Union—both devastated these important aquaculture sectors in China. Chinese consumers also are increasingly concerned about water pollution, dangerous farming practices, and poor processing in the aquaculture industry that pose serious threats to human health. The rapid development of China's aquaculture

industry is also a major polluter of rivers, lakes, and coastal waters. Moreover this industry's huge demand for fishmeal is driving stock depletion in the oceans.

Environmental Impacts

Raising carnivorous species, such as salmon and shrimp, tends to produce some of the most detrimental environmental impacts because of the amount of antibiotics and waste they produce. However, hardier herbivorous fish that require fewer chemical and organic inputs can also create environmental problems when they are farmed too intensively. In China, the high-density farming of herbivorous fish increasingly faces the same challenges of disease, over medication, and nutrient runoff as the country's concentrated land animal feeding operations (See CAFOs research brief). Some environmental impacts causing concern domestically and internationally include:

- *Eutrophication and Algae Blooms.* Runoff of uneaten food and effluent from fish farms is a growing problem in China. In the past, freshwater fish fed off naturally occurring organic material in ponds; however, as farming has intensified manufactured feed has become necessary, which leads to more uneaten food, effluent and pollutants. For example, shrimp consume only 20 percent of their food on average; the rest washes out to sea, or settles into the soil fouling the ponds.⁶ One study cited by Food and Water Watch estimates that the 155 square miles of shrimp ponds in Thailand produce more phosphorous waste, an organic compound in waste and decomposing feed, than three million people.⁷
- *Antibiotics, Pesticides, and Fungicides.* Many fish farmers are individuals, rather than companies, and they often over apply or misuse antibiotics, pesticides, and fungicides to clear the water of other creatures, reduce parasites, control disease, and boost weight gain on severely overcrowded animals. Antibiotics, either applied directly to the water or that pass through the fish digestion systems, are not biodegradable and persist in the surrounding environment threatening wild fish stocks.⁸
- *Habitat Destruction.* Lucrative fish markets prompted many Chinese rice producers in the early 1990s to switch into intensive aquaculture production. This trend, in conjunction with rapid urbanization, raised concerns about grain security and led the Chinese government in 1994 to establish regulations to enforce a zero net-loss of grain or oilseed farmland (The Basic Farmland Protection Regulation).⁹ Nevertheless, China's aquaculture output continues to rise as more natural bodies of fresh water and more marine coastline are converted fish farms. Diseases and pollution from overcrowded fish farms, particularly shrimp pools, are often pumped out into natural waterways, endangering native species.
- *Depleting Wild Fish Stocks for Feed.* With the exception of shrimp, carnivorous fish species are not as common in China as they are in OECD countries. Shrimp are fed formulated feed pellets made out of grain, fishmeal and fish oil. The huge volume of wild ocean fish that are caught to make these pellets are often captured by local bottom trawlers that can be very damaging to ocean habitats.¹⁰ Food and Water Watch cites that it "takes 2.8 pounds of wild fish to produce one pound of industrially-produced shrimp."¹¹

- *Monoculture and Invasive Species.* A major challenge for aquaculture is the need for fast-growing species that can withstand the conditions of farms. Monoculture of these fast-growing fish can lead to a reduction in genetic diversity and makes farms susceptible to diseases. The quest for fast-growing species also brings in foreign species that can become invasive. Amazonian snails, for example, were imported for food and are responsible for decimating 160,000 hectares of farmland in China, and countless acres of natural habitat.¹² The other disadvantage of this type of farming is the possibility of an epidemic disease that destroys the stock. Before 1993, China was the world's top shrimp producer until an epidemic of white spot decimated the shrimp population.¹³ The market has never fully recovered.

Food Safety Concerns

The Ministry of Health reported in March 2007 that 196 people died of food poisoning in China last year.¹⁴ Unsafe and undercooked aquaculture is an integral component of this total figure. A major challenge to food safety in China is the structure of the aquaculture industry. First, there are many widely scattered players involved in the production of the feed, the fish, and the processing.¹⁵ It is thus highly challenging, and expensive, to standardize and monitor the veterinary care and processing of the fish. Second, there is a strong preference for live and undercooked fish in China, increasing the risks to consumers and highlighting the need for timely monitoring and testing.¹⁶

While the Ministry of Health issues the regulations, food safety rests essentially in the hands of local government enforcers, which in the case of aquaculture often lack the motivation or capacity to monitor strictly. According to Lei Jilin in an interview with *Xinhua*, the local government agencies entrusted with monitoring fish-related food safety are either doing their jobs poorly or not at all.¹⁷ The Shanghai food quality inspections appear to be the most successful, as they are often the first to discover large safety mishaps. Further complicating the food safety issue and eroding consumer trust is the fact that, while investigations are publicly announced, the findings of the investigations of farms and market studies are often not publicized.

One final concern regarding herbivorous fish is the farming practice of using human and animal waste as feed. This practice has proved particularly suspicious with regards to avian influenza around Qinghai Lake where thousands of migratory birds fell ill in 2005 near several large carp farms and feed manufacturing facilities. There is some speculation that poultry litter based fish feed may have played a role in spreading this disease to wild bird populations.¹⁸

High-Profile Aquaculture Related Food Scares of the Last 2 Years:

- April 30, 2007: *The New York Times* reported that melamine scrap, believed to have sickened 14,000 U.S. pets, is commonly used in fish feed in China.¹⁹ Melamine is added to animal feed as a synthetic nitrogen enhancer, making the feed appear to have more protein and increasing its value.
- April 26, 2007: Wal-Mart removed Chinese catfish from U.S. stores due to antibiotic contamination.²⁰ It was the state of Alabama, not the U.S. FDA that discovered the contamination.

- November 2006: 11 out of 15 samples of Mandarin fish from China tested positive for malachite green in Hong Kong.²¹
- November 22, 2006: Carcinogens (chloramphenicol, malachite green and furazolidone) were found in turbot in Shanghai. Turbot sales were subsequently suspended in Shanghai, Beijing, Shenzhen and Taoyuan. Turbot is a species of flatfish with low disease resistance that requires considerable and careful veterinary input. One hundred percent of the Shanghai sample tested positive.
- October 2006: Taiwan banned imports of hairy or mitten crabs from China due to traces of carcinogens.²²
- August 2006: 87 people were diagnosed with meningitis after eating raw or undercooked Amazonian snails in Beijing.²³

Some Positive Steps

With wild catch rapidly decreasing due to over fishing and pollution in China's freshwater and coastal areas, China must increasingly turn to aquaculture to supply its protein base. The trouble with aquaculture is essentially twofold: (1) rudimentary and even dangerous farming practices, and (2) weak or nonexistent food safety monitoring. The effect is environmental degradation and compromised human safety in both domestic and foreign markets.

Development of Safer Feeds and Farming Methods

With aquaculture and demand for fish rising substantially in China, fish farming is intensifying. Feed is a major source of concern and an integral part of intensification. The Chinese government's priority for food security has led it to commit considerable resources to agricultural and fish research that has produced some promising new options for feeds, fish species and farming practices. Such research holds the promise of promoting ecologically safer fish farming practices that also will help protect human health and limit China's use of wild ocean fish as fishmeal. Some new feeds being developed include:

- *Yeast-based feed.* According to World Resources Institute, "Chinese researchers are developing a protein supplement based on yeast that can substitute for more than half the fishmeal in aquaculture feed preparations."²⁴
- *Soy-based feed.* As of 2007, China's aquaculture industry uses 4.5 to 5 million metric tons of soy meal a year.²⁵ Some species, such as tilapia one of China's staple fish, can tolerate 50 percent soy in their diets.²⁶ Other high value fish can tolerate only 10 percent soy; however, even a small reduction in ocean fishmeal dependence will relieve some stress on global oceans.

Another area of research is identifying high-efficiency fish species with higher survival rates and faster growth rates that may reduce the need for chemicals to sustain profitable production.

Integrated polyculture systems, once the norm in China, are a more sustainable solution. One living example is the rice-field carp of Qingtian, Zhejiang. In Qingtian, terraced rice paddies were stocked with carp by naturally flowing river water. However, farmers have intensified carp production with the addition of manufactured fish feed and by erecting concrete barriers to deepen their ponds. The damming of such rivers to create carp pools has led to increasing problems of eutrophication, interrupted water supply to farms and

communities, and diseased fish.²⁷ In order to encourage a return to a more environmentally friendly integrated polyculture system, the government could develop a new certification for organic rice-patty carp, which could help the Qingtian farmers create lucrative markets in the nearby tourist centers of Hangzhou and Suzhou.

Food Monitoring a New Priority

As is true in the case of other environmental and health challenges in China, many superb laws exist, but monitoring and enforcement tend to be weak. During the 2006 turbot scare, it merits mention that the 3 farms highlighted by name in the Chinese news media as responsible, were subsequently fined and ordered to suspend sale for violating bans on antibiotics in fish.²⁸ The coming Olympic Games are playing a positive role in accelerating food safety progress, but there is still much to be done. Some positive trends include:

- March 2007: The Ministry of Health released a draft of a new food safety coordination law to the public via the Internet.²⁹
- March 2007: *The Fresno Bee* reported that Global Food Technologies signed an agreement with the China Seafood Certification Institute to develop a branded food safety program for seafood beginning with one billion pounds of seafood by the end of 2009.³⁰
- November 2006: The Fisheries Bureau of the Ministry of Agriculture announced a nationwide inspection targeting forbidden chemicals in the fish market.³¹

Over the coming months, the China Environment Forum will be producing other aquaculture research briefs and fact sheets focusing on the current political and legal landscape regulating aquaculture in China, international projects, and opportunities for international collaboration. The China Environment Series Issue 9 will also contain a feature article on food safety and aquaculture.

¹ Glitnir Seafood Team "China Industry Report." November 2006. Online at: <<http://www.glitnir.is/English/AboutGlitnir/News/?ItemId=915>>

² Ibid.

³ "Development Plan for Aquaculture Market Study – China." Canadian Embassy Beijing, 2003. Online at; <http://ats.agr.ca/asia/3790_e.htm>

⁴ Bean, Casey. Wu Xinping. "Fishery Products: China's Tilapia Production Situation." USDA FAS GAIN Report CH6029. Approved by Maurice House. Online at <<http://www.fas.usda.gov/gainfiles/200606/146197980.pdf>>

⁵ Ibid.

⁶ "Suspicious Shrimp: the Health Risks of Industrialized Shrimp Production." Food and Water Watch, December 2006. Online at: <<http://www.foodandwaterwatch.org/fish/pubs/suspicious-shrimp>>

⁷ Ibid.

⁸ Ibid.

"Drugs used in the salmon farming industry" David Suzuki Foundation. <<http://www.davidsuzuki.org/Oceans/Aquaculture/Salmon/Drugs.asp>>

⁹ Ding, Chengri. "Farmland Preservation in China." *Land Lines*, Lincoln Institute of Land Policy. July 2004, Volume 16, Number 3. Online at: <<http://www.lincolninst.edu/pubs/PubDetail.aspx?pubid=913>>

¹⁰ Public Broadcasting Service. (2004). *Farming the oceans*. <http://www.pbs.org/emptyoceans/fts/fishmeal>

¹¹ "Suspicious Shrimp: the Health Risks of Industrialized Shrimp Production." Food and Water Watch, December 2006. Online at: <<http://www.foodandwaterwatch.org/fish/pubs/suspicious-shrimp>>

¹² "Meningitis infects 87 who ate un-cooked snails." *News-Medical.Net*, August 24, 2006. Online at: <<http://www.news-medical.net/?id=19589>>

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- ¹³ "Suspicious Shrimp: the Health Risks of Industrialized Shrimp Production." Food and Water Watch, December 2006. Online at: <<http://www.foodandwaterwatch.org/fish/pubs/suspicious-shrimp>>
- ¹⁴ "Coordination of food safety inspection strengthened." *Xinhua News Agency*, Edited by Luan Shanglin. March 15, 2007. Online at: <http://news.xinhuanet.com/english/2007-03/15/content_5853176.htm>
- ¹⁵ Bean, Casey. Wu Xinping. "Fishery Products: China's Tilapia Production Situation." USDA FAS GAIN Report CH6029. Approved by Maurice House. Online at <<http://www.fas.usda.gov/gainfiles/200606/146197980.pdf>>
- ¹⁶ Ibid.
- ¹⁷ "Cancer-causing fish slip through food safety supervision net." *Xinhua News Agency on People's Daily*, November 22, 2006. Online at: <http://english.people.com.cn/200611/22/eng20061122_324106.html>
- ¹⁸ Feare, C. J. "Fish Farming and the Risk of Spread of Avian Influenza." *Wild Wings Bird Management*, March 2006. Online at: <http://www.birdlife.org/action/science/species/avian_flu/pdfs/fish_farming_review.pdf>
- ¹⁹ Barboza, David. Barrionuevo, Alexei. "Filler in Animal Feed Is Open Secret in China." *New York Times*, April 30, 2007. Online at: <<http://www.nytimes.com/2007/04/30/business/worldbusiness/30food.html?pagewanted=1&ei=5087%0A&em&en=4cc809464be57336&ex=1178251200>>
- ²⁰ Nohlgren, Stephen. "Wal-Mart removes Chinese catfish nationwide after Alabama bans sales." *St. Petersburg Times*, April 26, 2007. Online at: <http://www.columbusdispatch.com/dispatch/content/national_world/stories/2007/04/26/catfish.html>
- ²¹ "Mandarin Fish Found To Contain Malachite Green Dye In Hong Kong." *China CSR*, November 28, 2006. Online at: <<http://www.chinacsr.com/2006/11/28/882-mandarin-fish-found-to-contain-malachite-green-dye-in-hong-kong/>>
- ²² Huang, Annie. "Chinese hairy crab imports banned after tests find excess carcinogens." *Taiwan Journal*, October 27, 2006. Online at: <<http://taiwanjournal.nat.gov.tw/ct.asp?CtNode=122&xItem=23422>>
- ²³ "Meningitis infects 87 who ate un-cooked snails." *News-Medical.Net*, August 24, 2006. Online at: <<http://www.news-medical.net/?id=19589>>
- ²⁴ "Farming Fish: The Aquaculture Boom." World Resources Institute, 1994 statistics. Online at: <<http://www.mindfully.org/Food/WRI-Aquaculture-Boom.htm>>
- ²⁵ "US soymeal producers target Asian aquaculture industry." *Fish Farmer Magazine*, March 5, 2007. Online at: <http://www.fishfarmer-magazine.com/news/fullstory.php/aid/940/US_soymeal_producers_target_Asian_aquaculture_industry_.html>
- ²⁶ Ibid.
- ²⁷ Edwards, Peter. "Recent developments in Chinese inland aquaculture." Network of Aquaculture Centers in Asia-Pacific, February 23, 2007. Online at <<http://www.enaca.org/modules/news/article.php?storyid=903>>
- ²⁸ "Fish farms punished over use of banned medicines." *NewsSGD*, November 11, 2006. Online at: <<http://www.newsgd.com/culture/culturenews/200611280002.htm>>
- ²⁹ "Coordination of food safety inspection strengthened." *Xinhua News Agency*, Edited by Luan Shanglin. March 15, 2007. Online at: <http://news.xinhuanet.com/english/2007-03/15/content_5853176.htm>
- ³⁰ Pollock, Dennis. "Food program goes global." *The Fresno Bee*, March 30, 2007. Online at: <<http://www.fresnobee.com/270/story/38677.html>>
- ³¹ Xie Chuanjiao. Wu Jiao. "Food safety tops the menu." *China Daily*, November 28, 2006. Online at: <http://www.chinadaily.com.cn/china/2006-11/28/content_744323.htm>