

# Field Report on Common Chinese Fish Species' Farming and Welfare

Based on the field visits of 12 farms in Jiangsu, Shanghai, and Guangdong

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Fish Welfare Initiative



ICCAW  
中国农业国际合作促进会  
动物福利国际合作分会

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This field visit was performed through a collaboration between **Fish Welfare Initiative** and the **International Cooperation Committee of Animal Welfare**.

The following report was originally written in Chinese and has been converted to an English version using Google Translate. Please see the **Executive Summary**, written in English, for the main findings.

**Cao Shuiwang, Zhang Pei, Li Kang, Chen Lu**

## I. Abstract

The main purpose of this field visit is to gain a deeper understanding of the farming and welfare status of common fish species in aquaculture in China. During the period from October 18 to November 2, 2022, with the assistance of various parties, we selected a total of 12 aquaculture farms in Guangzhou, Shanghai, Lianyungang City and Yancheng City of Jiangsu Province to conduct field research. The species of fish included grass carp (grass carp), crucian carp (including common crucian carp and golden crucian carp), common carp, catfish, loach (including native loach and Taiwan loach) and California perch. The research methods of this fieldwork mainly used literature research, interview method and participant observation method. We conduct in-depth observation and analysis from the three dimensions of farming environment, specific farming practices and understanding of fish welfare.

Our field visit shows that, from the perspective of fish species, the farming conditions of different species are not the same, and the current status of their farming is also deeply affected by the market. Among them, grass carp is the species with the largest freshwater aquaculture output in China, and its market is relatively broad and stable, and it has a relatively strong representativeness of aquaculture. Although there are currently many large-scale intensive enterprise farms farming grass carp, the main group of grass carp farming is still a large number of small family farms. In the grass carp farms in Guangzhou targeting the mid-to-high-end market, we found that the grass carp farming has been equipped with a professional team for farming, feed ratio, water quality control, fishing and transportation, etc., and the farming operation practice has been standardized and standardized; but in small In most family farms, the farming practice of grass carp still maintains a relatively traditional model. Most of the farmers rely on experience to support their daily specific operations.

During the farming process, there are many fish diseases and relatively high mortality. In addition, silver carp and silver carp, which are usually mixed with grass carp, are used to purify the water quality of aquaculture in the farms investigated this time, and at the same time promote the increase of production and farming income. Similar species also include yellow catfish, dace and herring. The main purpose of farming them is to clean impurities at different water levels in fish ponds, increase income while ensuring the growth environment of other main species. In Lianyungang City, Jiangsu Province, we also found that for carp whose consumption market is unstable, its farming situation is greatly fluctuated by the market. However, crucian carp and catfish are plagued by diseases due to the pollution of local water sources. Loach farming is a major feature of Lianyungang City. Most loach are exported to South Korea and Japan. On the one hand, the farmers must ensure that the loach meets the quality standards for export. resulting in high mortality and morbidity. Finally, California sea bass is a species that has become very popular in the Chinese



market in recent years. In the California perch fry farms investigated in this study, the farms adhere to the principle of "respecting the fish's nature" and carry out professional and refined recirculating aquaculture, which greatly reduces the mortality rate of California perch fry.

This field survey also found that from the perspective of the types of farms, there are obvious differences in the specific farming practices between enterprises and small family farmers. First of all, due to the different market positioning, enterprise-type farms pursue the mid-to-high-end market, and their product quality has higher standards; while small family farmers mainly target the lower-end market, and care more about output, while product quality is higher. Often ranked second. Secondly, at the technical level, enterprise farms are usually equipped with professional technical teams and a large number of professional farming equipment, and have relatively complete management in terms of employee training, farming, water quality treatment, disease prevention, feed research and development, and vaccine injection; and In small family farms, the knowledge of farmers can only be gained through experience, or from a small amount of free training and exchange of farming experience. And in many cases, small family farmers are struggling to balance farming costs and market returns. Finally, in terms of resisting external risks, small family farms are much more vulnerable than enterprise farms. The farming risks of small family farms can usually only be shared among members of the family, while enterprises have more capital and social resources to utilize.

Through this field visit, we also further understand the understanding and thinking of different subjects in the aquaculture industry on fish welfare. We found that markets, including feed and fish medicine markets, as well as consumer demand greatly influence the welfare of the fish itself in aquaculture practice. Facing the instability of the market, most farmers, especially small family farmers, face great farming and investment risks. How to survive has become the primary goal of farmers. Neglect of fish welfare during farming. Secondly, when feed and drug sellers continue to invest a large number of sales personnel with professional backgrounds into the farms for publicity and product technology promotion, on the one hand, it provides more technical support for family farmers, and promotes fish welfare to a certain extent. However, the "profitable" nature of this sales model makes this kind of technical support oriented, so it is difficult to gain the real trust of farmers, so this potential welfare impact is discounted. In the eyes of consumers, the pervasive public opinion that the use of aquatic products is unsafe and irregular also undermines their trust in the product itself. Therefore, the instability of this kind of market consumption behavior further increases the market risk of farming practices, which in turn makes farmers put their own survival first, "protect their own welfare first, and then protect the welfare of fish." It has become the understanding of "welfare" for many farmers.

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## 1. Fieldwork Background

In 2021, China's aquaculture area will decrease by 0.38% compared with 2020, to 7009.38 thousand hectares. Despite this, its aquaculture production increased by 3.26% year-on-year to 53.9441 million tons. Among them, the output of seawater products was 33.8724 million tons, and the output of freshwater products was 33.0305 million tons.<sup>1</sup> China's aquaculture, whether in terms of area or output, is far superior to other countries in the world, leading the development of the global aquaculture industry. As the international community has gradually begun to pay attention to fish welfare in aquaculture in recent years, the fish welfare in aquaculture in China has also received increasing attention from academia and industry. The purpose of our fieldwork is to visit farms of different sizes to better understand the current status of fish welfare in China's aquaculture industry, the understanding of grassroots farmers on the concept of "welfare", and fish welfare. development bottlenecks and challenges.

Our fieldwork revolved around the following questions. The first is the basic information, mainly to understand the general situation of the surveyed farm information, including the farming method, model, variety, area, density, output, output value, etc., as well as the background information of the farmers or employees. The second is to understand and observe the specific farming practices of the farm. This part involves the specific interaction between the farmer and the farmed fish, including preparations before farming, water quality control during the farming process, prevention and treatment of fish diseases, feed Feeding and fishing transportation, etc. Finally, there is external support and cooperation for farming. This part involves understanding the social environment in which farmers live, including the certification status of farming companies, government policies and subsidies, and attitudes towards the involvement of non-profit organizations.

## 2. Methodology

### 2.1. Literature Research

In order to better design this field survey, we first adopted the literature research method to understand the basic situation of aquaculture in China today, so as to help us determine the priority fish species for welfare work. We mainly refer to the "China

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<sup>1</sup> 2022 China Fishery Statistical Yearbook [M]. Beijing: China Agricultural Press, 2022.07: 2-3.

Fishery Statistical Yearbook" in the past five years <sup>2</sup>to sort out the aquaculture area, species and output in China in the past five years. After ranking the species by production, we identified the priority fish species for this survey. Afterwards, we collected relevant data on these priority species, so as to form a basic understanding of their general farming conditions and diseases.

## 2.2. Structured And Semi-Structured Interviews

The main method of this fieldwork is the interview method, including structured and semi-structured methods. In order to better understand farmers, investigators will also adjust the survey outline according to different situations during the field survey. Before setting out to the field, we usually learn about the farm through the Internet and other channels, especially for large farms. During field visit, we usually choose the free time of farmers to conduct formal structured interviews with them in the farm. After the structured interview, the investigator will visit the farm together with the farmer. During the visit, while listening to the relevant introductions of the breeders, the investigators will conduct some semi-structured interviews based on the main content of this field visit, and make supplementary inquiries about some confusions. In addition, after leaving the farm, the investigators also contacted the farmers through WeChat, telephone and other channels to supplement the missing information. In general, structured interviews are the main method of this field visit and the channel for collecting the main field visit data. The questions involved are fixed and preset. The occasion of the semi-structured interview is more flexible and random, and the investigators adjust and supplement the questions according to the actual situation of the farm and the farmers, so as to achieve a better understanding of the "other".

## 2.3. Participatory Observation

In this field survey, in addition to understanding the current status of fish welfare in the aquaculture process through the narratives of farmers and employees, the investigators also used the five senses of the body to be in the farm. The actual farming practices of the farms are investigated and recorded using the traditional observation method. The observation framework includes observing the infrastructure and surrounding environment of the entire farm; observing the water quality of the farm, including water color, sundries, algae, etc.; Observe the disease prevention and control; observe the state of the fish in the farm, especially the fish death, disease, and eating state at the pond mouth. In addition, the investigators also observe the farms and farmers in their daily lives, and perceive their understanding and views on

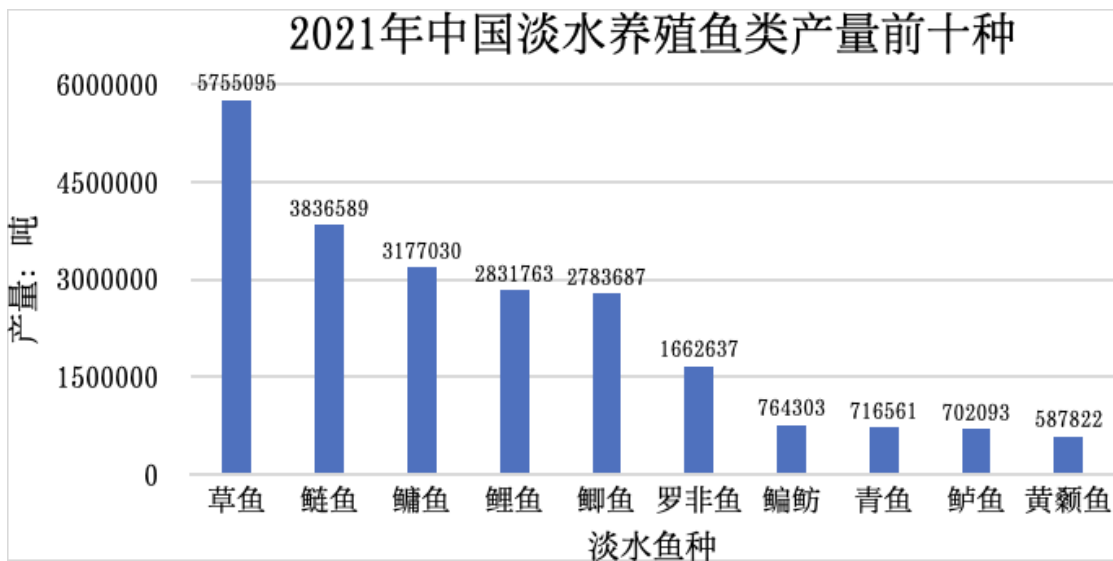
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<sup>2</sup> This yearbook is compiled and released by the Fisheries Administration Bureau of the Ministry of Agriculture and Rural Affairs, the National Aquaculture Technology Extension Center, and the Chinese Fisheries Society.

aquaculture and fish welfare from their conversational tone and expressions.

### 3. Field Briefing

This survey was conducted from October 18 to November 2, 2022. Our investigators went to a total of 12 farms in Guangzhou, Guangdong, Lianyungang, Jiangsu, Yancheng and Shanghai. Among them, there is 1 in Guangzhou, 7 in Lianyungang, 3 in Yancheng (including 1 in Sheyang County and 2 in Binhai County), and 1 in Shanghai. The farm in Guangzhou is a large-scale enterprise farm that mainly raises grass carp (grass carp) intensively. The farms in Lianyungang and Yancheng are mainly small-scale family farming, and there is only one medium-to-large farm that is a cooperation between individuals and enterprises. Finally, the farm located in Pudong, Shanghai is a farm specializing in the domestication of California bass fry.



In terms of the selection of cultured species, the fish species that this field survey focuses on are all freshwater fish. According to the farming ranking of freshwater fish in China, we selected several species with the highest freshwater farming volume. The fish species actually investigated include: grass carp (grass carp), crucian carp (including common crucian carp and golden crucian carp), silver carp (bighead carp), silver carp, carp, catfish, loach (including native loach and Taiwan loach), California perch (freshwater aquaculture), a total of 8 species.

In terms of research objects, this field survey focuses not only on the farmed fish itself, but also on related farming groups, as well as different groups such as introducers, fishery experts and local consumers who lead us into the field.





(where the field point is located <sup>3</sup>)

The backgrounds of the farmers or employees involved in this field survey are also different, and can be roughly divided into several categories:

1. The backgrounds are all farmers, and they are men around 60 years old. This is the case of most family farms. Usually they are husband and wife managing the farm;
2. Farmers who have a technical secondary school degree or above and have been engaged in aquaculture for many years are generally employees of enterprises and farms that cooperate with enterprises;
3. Enterprise-type farms, most of them have a bachelor's degree, and some even have a master's or doctoral degree in aquaculture.

In Guangzhou Fishery Company C, its founder has a doctorate from a certain university. The farm also has a professional and young research and development team, responsible for the cultivation of grass carp (grass carp), feed research and development and other experiments and research work. The team members generally have a bachelor's degree, and some have a postgraduate and doctoral background. However, they are not directly involved in farming, but are actually operated by specialized equipment and employees. However, in Lianyungang City and Yancheng City, Jiangsu Province, the farmers are mostly local villagers. They are generally middle-aged people who have contracted fish ponds on state-owned farms for aquaculture work, and most of them are husband and wife or a family. Although these villagers have not received professional training in aquaculture, many of them have more than 5 years of experience in aquaculture. In addition, the farmers in this area also include some employees of the former state-owned farm, and they also contracted some fish ponds for farming. These employees have a good understanding of the market and farming because they have received knowledge and information from the aquaculture industry for a long time. The Shanghai California perch hatchery

<sup>3</sup>The location areas from south to north are Nansha District of Guangzhou City, Pudong New Area of Shanghai City, Sheyang County and Binhai County of Yancheng City, Jiangsu Province, and Guanyun County of Lianyungang City.

we investigated was established by Dr. E himself with his own investment. Dr. E graduated with a major in aquaculture and is currently studying for a doctorate. With his professional knowledge and research team, he has developed some farming equipment for the farm. In this farm, some work with high technical content is usually guided by Dr. E himself, and most of the specific farming practices are handed over to the employees of the farm. Dr. E said that these employees have received basic farming training. In this field visit, our reporter in Lianyungang and Yancheng City, Jiangsu Province——Manager L, is the main facilitator and referrer of the field visit in this area. Manager L has a professional master's degree in aquaculture and is an "expert" in the farming account. He is currently the product sales manager of an animal protection company. Treatment and other work are closely related to the farmers, providing us with many different perspectives for field research.

Due to the limitations of epidemic control, this field survey only selected farms in three provincial-level administrative regions of China, concentrated in South China and East China, both in coastal areas and without inland provinces. In addition, in terms of the scale of farms, the types of farms investigated are mainly small and medium-sized family farms, and there are fewer large farms. In terms of time, the field interview time for each farm will be controlled within 1-2 hours, and the survey time for large farms is slightly longer. Despite the above limitations, this fieldwork report tries to make a detailed analysis of the farm where the field is located, the current status of aquaculture practices and existing problems, hoping to gain a deeper understanding of the current status of fish welfare in China and the challenges it faces. dilemma.

## 4. Fieldwork Findings

### 3.1. Condition of the Farming Environment

The first subsection of this chapter will mainly analyze the farming environment in different farming places. The environment of the farm is not only affected by its geographical location, water source, climate, and the conditions of the farming facilities that farmers can equip, but is also closely related to its social environment. Coupled with the impact of the epidemic in the past two years, the instability of China's aquaculture industry has become more prominent. The environment of the farming sites in the four places investigated in this survey is different, with some regional characteristics, but there are also some industrial commonalities.

#### 3.1.1. Farm Location and Surrounding Environment

The farms in this field visit are divided into three provincial-level administrative

regions—Guangdong Province, Jiangsu Province, and Shanghai City, spanning South China and East China. The specific location and surrounding environment of the farms in each region are different, and these environments also affect the farming conditions of the farms.



(Guangzhou C Fishery Company, Nansha District, Guangzhou City <sup>4</sup>)

The farm of Guangzhou C Fishery Company is located in Nansha District, Guangzhou, which is the southernmost area of Guangzhou near the port, consisting of many wetlands, rivers <sup>5</sup>and fields. The enterprise is a large-scale enterprise-style farm with a farming area of 6,800 mu. The surrounding environment is dominated by reed wetlands and farmland, with sparse residential areas, no factories or other farms around, and a wetland park nearby, so the ecological environment is relatively high-quality. Because it is located at the southernmost tip of Guangzhou City, its geographical location is also very advantageous-almost in the center of the entire Pearl River Delta, and there is a highway passing through this "island", connecting Guangzhou City, Zhongshan, Foshan, Zhuhai, Dongguan. Some core cities in the Pearl River Delta region, such as Shenzhen and Hong Kong.

The situation is different for the farms in Lianyungang and Yancheng, Jiangsu province. Located on the Huaihe Plain, this area has always been the main production area of China's grain and fisheries, and the land is strictly controlled by the state. Especially in recent years, the downturn in the planting industry has led to a boom in aquaculture, which has stimulated farmers' desire to dig the land and grow "fish". However, manager L, the field introducer, told us that these behaviors have been strictly supervised by the government in recent years. Once the relevant violations of the law are detected by satellites, the government will require them to "return the fishing to farming".

<sup>4</sup> Source Baidu map:

[https://map.baidu.com/search/%E5%8D%97%E6%B2%99%E5%8C%BA/@12619216.589760914,2581312.9299999997,11.38z?querytype=s&da\\_src=shareurl&wd=%E5%8D%97%E6%B2%99%E5%8C%BA&c=257&src=0&pn=0&sug=0&l=13&b=\(12591528,2621242;12632488,2639834\)&from=webmap&biz\\_forward=%7B%22scaler%22:2,%22styles%22:%22pl%22%7D&device\\_ratio=2](https://map.baidu.com/search/%E5%8D%97%E6%B2%99%E5%8C%BA/@12619216.589760914,2581312.9299999997,11.38z?querytype=s&da_src=shareurl&wd=%E5%8D%97%E6%B2%99%E5%8C%BA&c=257&src=0&pn=0&sug=0&l=13&b=(12591528,2621242;12632488,2639834)&from=webmap&biz_forward=%7B%22scaler%22:2,%22styles%22:%22pl%22%7D&device_ratio=2)

<sup>5</sup> River Chung: a Cantonese word meaning river course and river branch.



(Guanyun County, Jiangsu Province <sup>6</sup>)



(Sheyang County, Yancheng City, Jiangsu Province <sup>7</sup>)



<sup>6</sup> Source Baidu map:

[https://map.baidu.com/search/%E7%81%8C%E4%BA%91%E5%8E%BF/@13276406.466496166,4054188.0549999997,11.13z?querytype=s&da\\_src=shareurl&wd=%E7%81%8C%E4%BA%91%E5%8E%BF&c=347&src=0&pn=0&sug=0&l=10&b=\(13168703.745316058,4025496.95699049;13384891.921417087,4114167.8885944285\)&from=webmap&biz\\_forward=%7B%22scaler%22:2,%22styles%22:%22pl%22%7D&device\\_ratio=2](https://map.baidu.com/search/%E7%81%8C%E4%BA%91%E5%8E%BF/@13276406.466496166,4054188.0549999997,11.13z?querytype=s&da_src=shareurl&wd=%E7%81%8C%E4%BA%91%E5%8E%BF&c=347&src=0&pn=0&sug=0&l=10&b=(13168703.745316058,4025496.95699049;13384891.921417087,4114167.8885944285)&from=webmap&biz_forward=%7B%22scaler%22:2,%22styles%22:%22pl%22%7D&device_ratio=2)

<sup>7</sup>Source Baidu map:

[https://map.baidu.com/search/%E5%B0%84%E9%98%B3%E5%8E%BF/@13398205.853547985,3982315.3856985006,9.28z?querytype=s&da\\_src=shareurl&wd=%E5%B0%84%E9%98%B3%E5%8E%BF&c=18&src=0&pn=0&sug=0&l=9&b=\(13022507.256323814,3865299.7670177673;13624481.872084871,4112203.4180135136\)&from=webmap&biz\\_forward=%7B%22scaler%22:2,%22styles%22:%22pl%22%7D&device\\_ratio=2](https://map.baidu.com/search/%E5%B0%84%E9%98%B3%E5%8E%BF/@13398205.853547985,3982315.3856985006,9.28z?querytype=s&da_src=shareurl&wd=%E5%B0%84%E9%98%B3%E5%8E%BF&c=18&src=0&pn=0&sug=0&l=9&b=(13022507.256323814,3865299.7670177673;13624481.872084871,4112203.4180135136)&from=webmap&biz_forward=%7B%22scaler%22:2,%22styles%22:%22pl%22%7D&device_ratio=2)



(Map of Binhai County, Yancheng City, Jiangsu Province <sup>8</sup>)

We surveyed a total of 10 farms in the three county-level administrative districts of these two cities, all of which are located in the lower-level townships of the county and are part of the local state-owned farms. The 10 farmers are all local farmers, and several of them are employees of feed companies and fish medicine companies. They not only work in the company, but also contract the fish ponds of the state-owned farms where they are located for farming. The farms in these three areas also have certain commonalities in terms of environment: First, they are all fish ponds dug on the basis of existing farms, and the terrain is very flat. And because it is a family-style management, many farmers will grow soybeans and vegetables by the fish pond for their own consumption; second, these farms are located on the side of the road, which is convenient for vehicles to enter and exit smoothly during fishing and transportation; third, some farms The environment is affected to varying degrees by surrounding factories, pig farms, cattle farms and other pollution sources. For example, Boss U's farm in Guanyun County was affected by the sewage discharge from the laver farm upstream. At the golden crucian carp farm in Binhai County, Yancheng City, Uncle Z also complained that the wastewater from upstream pig farms and small shed shrimp seeped in and affected the water quality of his fish farming. Uncle Z said that although the government has continued to regulate sewage discharge, after a period of time, some factories began to discharge as usual.

At the last stop of our visit, we saw a different landscape at the California perch fry farm in Pudong District, Shanghai. The farm is located near the mouth of the Yangtze River in Pudong New Area, an area where agricultural products are produced in Shanghai. Greenhouses for vegetables, fish ponds and other terrestrial animal farms. The road leading to the farm is surrounded by rows of windbreaks, and some river outlets are surrounded by reeds. Dr. E said that there are often crabs and water birds here, and the ecological environment is relatively well protected.

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<sup>8</sup> Source Baidu map:

[https://map.baidu.com/search/%E6%BB%A8%E6%B5%B7%E5%8E%BF/@13321383.353588235,4017999.1250000005,10.49z?querytype=s&da\\_src=shareurl&wd=%E6%BB%A8%E6%B5%B7%E5%8E%BF&c=18&src=0&pn=0&sug=0&l=9&b=\(13155295.63669852,3948613.6265279483;13592588.762488136,4127972.135152596\)&from=webmap&biz\\_forward=%7B%22scaler%22:2,%22styles%22:%22pl%22%7D&device\\_ratio=2](https://map.baidu.com/search/%E6%BB%A8%E6%B5%B7%E5%8E%BF/@13321383.353588235,4017999.1250000005,10.49z?querytype=s&da_src=shareurl&wd=%E6%BB%A8%E6%B5%B7%E5%8E%BF&c=18&src=0&pn=0&sug=0&l=9&b=(13155295.63669852,3948613.6265279483;13592588.762488136,4127972.135152596)&from=webmap&biz_forward=%7B%22scaler%22:2,%22styles%22:%22pl%22%7D&device_ratio=2)



(Pudong New Area, Shanghai <sup>9</sup>)



(The windbreak forest on the way to the California perch fry farm, taken in Pudong New District, Shanghai)

The farm that Dr. E rented was originally a fish pond for cultivating vannamei shrimp, which was later converted into a fish fry farm. The place is far away from the industrial area and has a better ecological environment. Because fish fry farming has high requirements on the environment, Dr. E gave full consideration to the surrounding environment when selecting the site. In addition, the farm is located in Pudong, Shanghai, close to Pudong International Airport, which is convenient for the sale and transportation of fry.

### 3.1.2. Water Source and Water Quality

The water sources of the farms surveyed this time mainly come from the

<sup>9</sup> Map source:  
[https://map.baidu.com/search/%E6%B5%A6%E4%B8%9C%E6%96%B0%E5%8C%BA/@13497128.245586053,3648369.740244436,9.26z?querytype=s&da\\_src=shareurl&wd=%E6%B5%A6%E4%B8%9C%E6%96%B0%E5%8C%BA&c=257&src=0&wd2=%E4%B8%8A%E6%B5%B7%E5%B8%82%E6%B5%A6%E4%B8%9C%E6%96%B0%E5%8C%BA&pn=0&sug=1&l=11&b=\(12556235.427182952,2552725.3866735967;12682197.752338877,2609900.4733264027\)&from=webmap&biz\\_forward=%7B%22scaler%22:2,%22styles%22:%22pl%22:7D&sug\\_forward=b6b5b0ceaab2fb7f400245ee&device\\_ratio=2](https://map.baidu.com/search/%E6%B5%A6%E4%B8%9C%E6%96%B0%E5%8C%BA/@13497128.245586053,3648369.740244436,9.26z?querytype=s&da_src=shareurl&wd=%E6%B5%A6%E4%B8%9C%E6%96%B0%E5%8C%BA&c=257&src=0&wd2=%E4%B8%8A%E6%B5%B7%E5%B8%82%E6%B5%A6%E4%B8%9C%E6%96%B0%E5%8C%BA&pn=0&sug=1&l=11&b=(12556235.427182952,2552725.3866735967;12682197.752338877,2609900.4733264027)&from=webmap&biz_forward=%7B%22scaler%22:2,%22styles%22:%22pl%22:7D&sug_forward=b6b5b0ceaab2fb7f400245ee&device_ratio=2)

downstream water systems or sea estuaries of the three major rivers in China - the Yangtze River, the Yellow River and the Pearl River, and some also come from the drainage channels of reservoirs. Most of the water for the farms is directly taken from the surrounding rivers, and the water quality is uneven. However, even if the water quality is polluted, local farmers can only continue to use it, or improve the water quality by "improving water" to maintain "normal" farming.



(The river gushing in Nansha District, Guangzhou, taken near Guangzhou C Fishery Company)

The staff of Guangzhou C Fishery Company's farm in Guangzhou said that all the water used for farming here comes from the streams of the Pearl River system. The farm is on an "island" with a very dense water network. When you enter this place, you can see not only big river surges, but also some small river surges. The way the farm draws water is to directly introduce the water from the river into the canal and enter the fish pond through the pipeline. Since the place is located at the estuary of the Pearl River, where salt and fresh water meet, the water here has a salinity of 2‰-5‰. The company's publicity column states that "high-quality natural salt and fresh water is most suitable for the growth of fresh grass carp." Dr. F of the company also said that this salinity can make the fish meat more "fresh". There are no residential areas in the river near the farm. There are only patches of wetlands and green forests surrounding the river. However, because of the rainy weather during the visit that day, the river water was dark green.

In Lianyungang and Yancheng City, Jiangsu Province, because they are located in the Huanghuai Plain, the surrounding river network is densely covered, and the waterways are intertwined and complicated. The water for the farms mainly comes from the nearby riverways. Among them, the water sources of the farms in Guanyun County that we investigated come from different water systems such as the Chazhou River, Luoma Lake, Wutou River, and Dawan River. But the farmers in the area say that they don't have many choices about water sources, and they can only choose corresponding fish ponds for farming according to their own economic capacity or the needs of the species they raise. Because in the local area, the better the water source of the farm, the higher the pond rent. When investigating loach farms, we also learned that most of the loach in this area are exported to South Korea. In order to meet the

quality and standards of export products, loach farmers usually choose ponds with better water sources to ensure that the loach can be farmed smoothly. However, most of the loach ponds we saw during our field visit were green and abundant algae could be seen, probably because the survey time coincided with winter cooling and the algae began to die, so some dead algae floated on the upper layer of the water body. Loach farmers also reflect that under the condition of single species and high-density farming (10 million fish/mu), loach ponds in summer often have problems of water quality eutrophication and low dissolved oxygen in water.



(Water condition of Boss L's loach pond)

In addition, the water quality of the farms we surveyed from the Wutou River system is poor. For example, Boss U's farm, which was introduced in the previous section, had its water source polluted by wastewater from a laver factory upstream. According to the farmers, the water quality of the farms from other water systems is not bad, and the subjective opinion is that it is not particularly bad. Manager L explained that the water quality in Guanyun County is better. The main reason is that many water sources in this area come from upstream, and the pollution source is usually only the pollution of residents' wastewater, and other pollution sources are relatively small. However, the farmers in the area also said that even if the water quality of the fish ponds selected for farming is relatively good in the local area, after a period of farming, water quality problems are prone to occur. Generally, nitrite and ammonia nitrogen exceed the standard, and frequent inspections are required. Change the water. The three farms located in Yancheng City are located in the downstream areas of the Zhongshan River, Sheyang River and Waste Yellow River, so the water quality is affected by the wastewater from some upstream factories.

The last is the California perch nursery in Shanghai. Its water source comes from the surrounding rivers and belongs to the lower reaches of the Yangtze River system. Like Nansha in Guangzhou, the water at the estuary is brackish water:

"The water here comes from the river. The water quality of the river is quite good. It is located in the intertidal zone and has a salt content of 3‰."

(Dr. E, November 1, 2022, Pudong District, Shanghai)



It can also be known from the geographical location above that the surrounding environment of the farm is relatively high-quality, and it also has a natural purification effect on the water body. In addition, the location of the farm is a fish fry farm. When choosing the location of the farm, there are relatively strict requirements on the water source environment. The farm has also passed various water purification equipment to control the water quality.

### 3.1.3. farming Mode and Stocking Density

Among the 12 farms surveyed in this survey, some farms adopt recirculating aquaculture farming mode, some farms adopt ecological farming technology, and some farms adopt intensive farming method. Among them, the farms that adopt ecological farming technology and intensive farming methods all carry out polyculture of more than two species. And the farm that adopts the recirculating aquaculture mode is to carry out the cultivation of a single species. In terms of farming density, each farm is also different, but basically they all belong to relatively high-density farming. Among them, among the 12 farms, Guangzhou C Fishery Company has adopted ecological farming technology.



(1+6 polyculture mode <sup>10</sup>)

In reviewing the information on grass carp farming, we found that more than 80% of the grass carp farming in China is the traditional pond farming mode, and the new farming mode only accounts for about 12% <sup>11</sup>. Guangzhou C Fishery Company is a nationwide demonstration farm for healthy and ecological farming. "Green", "healthy" and "ecological" have become symbols of the high quality of its products that the company advertises. Through multi-species and multi-level polyculture, the

<sup>10</sup>Image source: Brochure of Guangzhou C Fishery Company.

<sup>11</sup>National Bulk Freshwater Fish Industry Technology System, "Grass Carp Industry Development Report", 2021.

metabolites of grass carp, the main fish, are used as nutrients for other species. Dr. F of the company believes that this not only improves the stability and efficiency of the pond ecosystem, but also improves the pond's health. Productivity and aquatic product quality.

"The purpose of polyculture is simply to resist disease and regulate water quality. You can read our brochure. The basis of our polyculture in this model is two: to use different physiological habits and make full use of different spaces in the water body; Its biological characteristics (that is, feeding habits)."

(Dr. F, October 18, 2022, Nansha District, Guangzhou)

In Dr. F's narration, the ecological farming technology emphasizes the mixing of different species, including seven species of bighead carp, silver carp, grass carp (mainly raised), crucian carp, yellow catfish, dace and herring. Different species have scientific basis for the use of underwater space, so as to regulate water quality and resist diseases. Compared with most other farms, Guangzhou C Fishery Co. has the most polyculture species, and the farming density of different species has also been scientifically calculated.

"Density is mainly a matter of proportion. It is calculated per mu. This proportion is calculated according to the water environment carrying capacity (technical term) standard. It is based on weight and there is an algorithm."

(Dr. F, October 18, 2022, Nansha District, Guangzhou)

Because Guangzhou C Fishery Company uses cultivated grass carp species with strong disease resistance, their farming density is much higher than other traditional farms, reaching 1500-1800 fish/mu. However, for general farmers, pond intensive farming is their economical choice. Many grass carp farmers will mainly raise grass carp first, and then mix silver carp, carp, crucian carp, shrimp, and even crabs. This is also an insurance method that farmers believe can increase income and guarantee no loss. But sometimes because the impact of some species on the main species is not considered, it leads to the failure of farming. For example, when Boss L in Lianyungang, Jiangsu Province tried to breed Taiwan loach, he also put some grass carp into the pond, which resulted in a large number of grass carp deaths. These farms that choose the pond intensive culture mode generally have a relatively high farming density. For example, the general grass carp farming density is 300-400 fish/mu, and other species of about 300 fish/mu are nested.

In addition, the farming density of loach farming and the circulating water system of California perch fry is also very high. Due to the very advanced technology of recirculating aquaculture, the regulation of water quality can be very precise, so under high-density aquaculture, perch fry can still maintain relatively good growth. However, the high-density cultured loaches we investigated showed a high mortality rate, especially under the high temperature conditions in summer. Boss L, who breeds loach, said frankly that he was worried that the quality of the fish fry purchased from

other places would affect the subsequent production, so he increased the density of the fry (this involves the quality of the fry, which will continue to be analyzed below). But in any case, when most farmers choose the farming density, they will consider the survival rate and farming benefits, but there are still many farmers who will increase the farming density as much as possible in order to pursue the farming benefits.

#### 3.1.4. Climate and Extreme Weather

Among the farms in this field visit, except for Guangzhou C Fishery Company and Shanghai California Bass Hatchery, which have indoor nursery ponds, the fish ponds of other farms are all outdoor open-air ponds. The 12 farms spanned different temperature zones and climate zones. Weather and climate are uncontrollable factors in the farming environment. They not only affect the species cultivated in the farm, but also affect the cycle and batch of their farming.

The C fishery company in Guangzhou is located in a tropical area at 22 degrees north latitude. The climate belongs to the subtropical monsoon climate, which can realize grass carp farming all year round. However, since the farm faces the South China Sea, it is often affected by typhoons in late summer and early autumn. During our visit, the periphery of a typhoon passed the farm lightly, bringing wind and rain. Although the California perch fry farm in Shanghai is also in the subtropical monsoon climate zone, its latitude is higher than that of Guangzhou, and it occasionally snows in winter. Considering that the species of California perch needs to be cultured in water bodies with high water temperature, the company has also covered its outdoor farms with plastic sheds to maintain the temperature of the water body in the pond. Similarly, Shanghai's farms are also vulnerable to typhoons in autumn. This year's typhoon "Fireworks" blew away part of the plastic greenhouses on the farm, causing some economic losses to the farmers.



(Plastic shed blown by the typhoon in the California perch outdoor fish fry farm)

Lianyungang and Yancheng, which belong to the Huanghuai Plain and are located in the north of Jiangsu Province, both belong to the warm temperate zone and have a

temperate monsoon climate. The temperature in the two places will drop below zero in winter. "Hibernate" treatment, that is, to stop or reduce the feeding of fish ponds, so the time that fish farming can be carried out in this area is relatively short every year. Moreover, in autumn, the area may still be affected by typhoons from the Pacific Ocean, causing stress reactions in fish, as Uncle L, who raises grass carp in the area, said:

"This year, our fish pond was affected by a typhoon. When the fish weighed 2-3 catties, a typhoon came. When the typhoon passed, the fish were still fine, but after that, the fish began to show stress. Halfway through A large number of deaths began. Of course, it was also due to physical reasons, and with the addition of typhoons, they became ill and died."

(Uncle L, October 30, 2022, Lianyungang City, Jiangsu Province)

In addition, due to the global impact of the "La Nina" phenomenon in 2022, the farms we surveyed were all affected by persistent high-temperature weather in summer, especially in areas near 30 degrees north latitude, under the continuous support of subtropical high pressure, there have been many high-temperature weather exceeding 40 degrees Celsius, and the duration is longer than usual. Boss L, who raised loach this year, said that the difficulty of raising loach this year is related to the high temperature weather:

"This year's weather is very hot, reaching 40 degrees. It's so hot that the fish don't eat feed. The high temperature weather also makes loaches have a high incidence of disease and many deaths. Many fish ponds in the news have started to put ice cubes to cool the fish <sup>12</sup>. Did you see that?"

(Boss L, October 24, 2022, Lianyungang City, Jiangsu Province)

High-temperature weather usually deteriorates the quality of aquaculture water, which not only causes the fish of many farmers to not eat and lack of oxygen to float, but also reduces the resistance of fish, making them prone to disease and death. In autumn and winter, most parts of China will experience a sharp drop in temperature and cold waves. Algae in the water will die in large numbers, which will affect the water quality. Manager L, who has a professional background in aquaculture, joked that fish are like people, and they will "catch a cold like people" when they encounter this kind of cooling. Since most of the surveyed farms are outdoor ponds, conditions such as weather and water temperature cannot be controlled, so for each batch of fish raised, the farmers usually can only rely on "luck", or often use the Chinese farmers' "dependence on the sky to eat". "This sentence is on the lips, and these explanations have become farmers' self-adaptation to this extreme weather. However, the negative impact of these extreme weather and global warming on China's aquaculture industry was felt particularly strongly in this survey.

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<sup>12</sup>See China News Report: "Too Hot! The temperature in a fish pond in Hunan has been as high as 45 degrees for many days, and the boss has no choice but to buy ice to cool the fish." Source: <https://www.163.com/dy/article/HEA6QVQ20552ZOAF.html>



### 3.1.5. Source, Quality and Cost of Feed and Pharmaceuticals

Feed and medicine have always been the bulk of farmers' expenses. Among the 12 farms in this field survey, 7 farms indicated that their feed and medicines were obtained from the local aquaculture technical service center, which is called a pharmacy or a feed store by the locals. Some of the remaining 5 farms belong to enterprises, some have cooperative relations with enterprises, or the farmers are internal employees of enterprises. There are three main sources of feed and medicine for these farms: first, purchased by the enterprise itself, usually the brand selected after continuous comparison; second, from the enterprise where the employees of the enterprise work, and the farmers who are both employees and farmers You can enjoy discounted prices for feed and medicine purchases; third, from enterprise research and development, this kind of enterprise will let other factories process the feed formula it researches. In contrast, farms that are related to enterprises can handle feed and medicine issues by themselves or a team, while for individual farmers, especially rural family farmers without professional knowledge background, technology and financial guarantee, They usually can only rely on technicians from feed companies or animal protection companies to help them choose appropriate feed and medicine, or rely on farming experience to make judgments.



(Fish medicine and feed store in the street where the field site is located)

In the field visits in Lianyungang and Yancheng, pharmacies and feed stores are all over the streets. Farmers are particularly concerned about the price and quality of feed, because in their opinion, good feed means low feed-to-meat ratio, high output, and the price is within an affordable range. But when asked how to judge the quality, these family farmers in Jiangsu Province basically think that the quality of the feed can only be judged by the harvest of fish, so for the sake of insurance, the farmers usually choose the feed of a big brand. However, in the past two years, due to international factors such as the Russian-Ukrainian war and the impact of the domestic epidemic, the raw materials for bulk goods have continued to rise, and the price of feed has also skyrocketed. Bring a big impact. In order to control the cost and price of feed, some

feed manufacturers can only selectively reduce the content of some ingredients to ensure that the price can be accepted by farmers. But because of this, in our survey, many farmers said that the quality of the feed this year is different, especially in terms of protein, which is often insufficient.

In comparison, enterprises or their employees' farms will get more guarantees in terms of feed and medicine. In our survey, farmers who have relationships with aquatic animal protection companies, such as Mr. Z, Mr. M, and Mr. S, as employees of an aquatic animal protection company, can get discounts from the company when purchasing feed and medicine. But in terms of quality, even enterprises, in the same feed market environment, joked that these are experiences bought with money.

In terms of the source of medicines, the farms we investigated all used Chinese standard medicines, including antibiotics. In comparison, for fertilizers and water, biological preparations for water improvement, Chinese patent medicine mixing powder, antibiotics and other drugs, farmers with animal protection company backgrounds get discounts from the company, and the professional knowledge of themselves and their colleagues also helps them compare. Understand the choice and use of medicines. However, for ordinary family farmers, most of them can only rely on the after-sales service of pharmacies to obtain some product information.

"If the fish is sick, go to the pharmacy in the town to sell it. There is a professional veterinarian (Mr. S) who prescribes the medicine. Farm X is a public institution in the county, and the (product salesperson) will check the growth of the fish. They are all Chinese patent medicines, protecting the liver. Courageous."

(Boss L, October 24, 2022, Lianyungang City, Jiangsu Province)

But sometimes, when faced with the high-priced medicines recommended by these "technical staff" in pharmacies, farmers still have very conflicting emotions: on the one hand, they want to treat sick fish in time; but on the other hand, they are worried. Pharmacies will recommend unnecessary medicines, which will lead to an increase in farming costs.

### 3.1.6. Epidemic, Market and Other Factors

2022 is the third year of the new crown epidemic in China. Under the government's strict epidemic prevention policy, the epidemic has also profoundly affected the operation of farms, especially the road blockade caused by some policies, which directly caused many fish to be unsalable in fish ponds. Farmers also had to continue feeding. In addition, unclear market factors lead to fluctuating fish prices, and farmers can only judge the time for fish to be released from the pond based on industry information. Of course, the knowledge background of farmers also profoundly affects how they care for the fish they raise. However, under the general social situation of economic downturn, Chinese consumers have also experienced

consumption downgrades, and consumers' consumption habits have further shaped the quality of aquaculture products.

The first is the epidemic, which undoubtedly has a great impact on the entire society. In Lianyungang, Jiangsu Province, Boss U's carp pond was affected by the epidemic in Lianyungang City at the beginning of this year, so he did not have time to disinfect the fish pond, so he had to start feeding seedlings immediately before the end of the seedling release period. As a result, not only did fish diseases frequently occur in the farm, but it also cost him more money in improving the bottom and water treatment, resulting in a loss in farming and increasing the cost of farming. In Binhai County, Yancheng City, Uncle Z also failed to sell all the crucian carp in the pond mouth due to the bad market conditions caused by the epidemic. As a result, he could only mix this year's fry to continue farming. In addition, because he did not disinfect the fish pond by sun drying, Uncle Z said that the number of deaths in the fish pond this year has increased significantly compared to last year.

Another consequence of the epidemic is the unclear and heterogeneous market information. This market atmosphere has also caused extreme anxiety among farmers.

"A lot of my current knowledge is information and resource learning on mobile phones. Just watching videos and explanations can't help much. We have a team here, and everyone's farming is more professional. Compared with others, the overall social situation is still economical. Uncertainty, consumption It is also uncertain, consumption habits and product needs are also uncertain, farmers are actually anxious every day. For fish farming, consumers also have a great influence on us, especially the impact of the epidemic is even greater, and everyone is quite anxious. Those of us are in a good situation, but the working class is more difficult. It's not that we don't have farming technology, funds and teams, but in this social situation, there is a lot of pressure to measure various relationships."

(Ms. Z, October 24, 2022, Lianyungang City, Jiangsu Province)

Although the farms under the cooperation of enterprises have the help of enterprises, most of the market information can only be understood and judged by farmers through different channels. In this uncertain environment, on the one hand, farmers are worried about the drop in fish prices, and on the other hand, they are also thinking about choosing the best time to sell the fish in the fish pond. In the market of different fish species, farmers said that this year's carp market is the most unstable compared with other species, and many carp farmers have suffered losses. Faced with such an environment, some farmers also plan to end their farming work.

"I may not raise fish next year, and I dare not raise it anymore. In the past two years, fish farming has lost money due to the epidemic, and the funds cannot keep up. Feed factories could owe money in the past, but now they don't. Next year, if the price of feed continues to rise, it will be very difficult for us. , was eliminated. I want to go back to my hometown and find a way to survive. I lost 500,000 to 600,000 yuan in two years, and the market price is sold at a loss. We are going to be eliminated, and losing weight next year will be even more serious, so This year the carp storage ponds will be

sold."

(Boss U, October 30, 2022, Lianyungang City, Jiangsu Province)

From Boss U's sharing, we have seen the vulnerability of individual farmers, especially those of some family farmers who have reached old age, and are even more powerless and helpless in the face of these uncertainties. For these relatively disadvantaged farming groups, many of them can only hope that the government can regulate the market, hoping that the government can improve the surrounding farming environment as much as possible and renovate poultry farms. But in our survey, many farmers also reflected the government's inability to govern in this process. In addition, Manager L also admitted that the local farming industry does have relatively large management difficulties. Because the local farming problems are complicated and there are many farmers, it is difficult for the science popularization and technical guidance work of many grassroots aquatic technology guidance stations to cover all farmers. However, due to the product requirements and standards brought about by export, some farmers have to strengthen their own standardized operations on water quality, feed and medicine use in the farming process. For example, loach farmers said:

"The fish here (loach) cannot be sold if they are sick, because they are exported to South Korea, in the Ganyu District. They have to be tested before they can be given to them. Before buying, the vendors will come to test and meet the standards before they can be sold."

(Uncle M, October 29, 2022, Lianyungang City, Jiangsu Province)

Ganyu District, Lianyungang City, Jiangsu Province is close to Rizhao Port in Shandong Province, and there are a large number of enterprises engaged in fish export near the port. The consumption of loach in South Korea and Japan is very large. Because of the limited farming in their own countries, they need to import a large amount of loach from abroad to meet the needs of the local market, so China has become their importer of loach. Export enterprises in Rizhao Port purchase a large amount of loach from loach farmers in Lianyungang every year for export. As Uncle M described, these companies have to conduct a series of quality inspections on the loach before purchasing the loach from the farm, and only purchase it after meeting the import standards of Korea or Japan. Pay attention to the treatment of water quality, and the use of feed and medicine, which also shows the regulating function of the market in this process.

### 3.2. The Situation of Farming Practice

In this section, we will focus on analyzing the practical operation of the investigated farmers in the process of fish farming, including pond mouth treatment, farming mode and stocking density, regulation of farming water quality, feed feeding, and fish disease prevention. The different aspects of fish farming, including fish farming



and treatment, harvesting and transportation, are involved in a series of processes, especially the interaction between the farmer and the fish.

### 3.2.1. Pond Mouth Treatment Before farming

In this survey, except for Guangzhou C Fishery Company and California Bass Fishery Farm, which use small storage ponds when raising fry, the 12 fish farms mainly use pond farming. Manager L said that some fish ponds will also be covered with plastic film, such as ponds for cultivating loach. But regardless of whether it is covered with plastic film or not, farmers will first treat the pond mouth before each round of farming. The 12 farms are different in the treatment of the pond mouth. The outdoor pond mouth treatment process is generally to sun the pond first, then disinfect, and use tea bran, quicklime or bleaching powder as disinfection materials. The treatment method for small indoor cisterns is: first wash with a high-pressure water gun, and then disinfect. For example, the California perch nursery in Shanghai uses 84 disinfectant.

In terms of the frequency of pond mouth treatment, most fish ponds are once a year, generally according to the farming cycle. For example, in the fry farm of California perch, the reservoir will be cleaned and disinfected after each batch of fry farming.

Although it is common sense for farmers to clear ponds, farmers may accidentally fail to clean their ponds. These accidents are related to the epidemic. For example, Uncle Z's crucian carp pond mentioned above has no clear pond this year:

"There is no clear pond in the 75 mu this year, because the fish has not been sold out. Tea seed cakes are used for the clear pond, once a year. Because there is no clear pond in that fish pond, the current situation of the pond is not very good."

(Uncle Z, October 28, 2022, Yancheng City, Jiangsu Province)

The self-consciousness of clear ponds involves the knowledge background of farmers and the professionalism of farming. Uncle Z originally thought that there would be nothing wrong with the fish pond if it was not clear. During the farming process, it is necessary to invest a lot of money to buy medicines for water quality treatment, which also leads to water quality problems, causing a large number of fish to die during the farming process.

### 3.2.2. Fish farming and Delivery Methods

Among the 12 farms we investigated, there are three main sources of fish fry: one is to cultivate fry by oneself throughout the whole process; the other is to buy small fry (fish flowers) or fish eggs, and cultivate them in fish ponds to compare After the large fry, the fish will be raised again; the third is to directly purchase the fry that can be directly released from other places. In terms of fry quality, the quality of fry directly

released from other places presents the most unstable state. However, the survival rate of fry cultivated by many qualified farms can basically reach 90%-95%.

One, cultivate yourself. This method is usually only adopted by enterprise-type farms with relatively strong capital and technology. In our field visit, Guangzhou C fishery company, Jiangsu Lianyungang teacher Z's cooperation with S company's grass carp farm, and Shanghai California perch nursery have the conditions to carry out this method of fry farming. For example, Guangzhou C Fishery Company develops and breeds disease-resistant grass carp fry by itself. But for most farms, it is impossible to cultivate their own fry, and it is very uneconomical. Therefore, many farmers can only buy fry from other fish farms, or even buy fry through introductions or online, but The quality of fry often varies. For example, Boss L said frankly this year that the loach seedlings he bought this year had relatively big problems:

"The fish fries from the Northeast are also the wild fish they catch, which is very unstable. The survival rate of wild loach fry this year is less than 30%, and the survival rate in previous years was as high as 70-80%. In fact, a three-acre pond this year only has 5,000 If it is good, it can receive 9,000 catties per 3 mu, and 10,000 per 3 mu is considered very good. About 67,000 of the 1 million fish survived, only a 7% survival rate."

(Boss L, October 24, 2022, Lianyungang City, Jiangsu Province)

"The fish fry in Hubei are sometimes 70-80%, sometimes only 10%-20%. This year's survival rate is 60%-70%."

(Boss T, October 27, 2022, Yancheng City, Jiangsu Province)

The quality of fish fry is related to the survival rate of the farming process, but the quality of fish fry purchased by farmers in the market for direct feeding mostly varies. Especially loach fry, many of the loach fry sold are directly caught in the wild. It can be known from the death of Boss L's loach fry that the quality of this fry is extremely unstable. Therefore, in order to ensure the survival rate of farming, some farms also choose to buy small fish flowers themselves, and then put them in their own fry ponds to cultivate them as "fry stocks", so as to ensure the quality of fry when they are released.

"I used to deliver fish by myself, and I would also bring fry back. I didn't understand it. I heard others said it was good, so I thought I could go to the seedling farm. Now I raise seedlings by myself. The fish flowers come from Shandong, Hunan, and Hubei. The fish flowers come from Shandong, Hunan, and Hubei. There is no way to see whether it is good or bad, and then put it in fish ponds for farming, it will be relatively stable. The survival rate is about 95%."

(Uncle L, October 30, 2022, Lianyungang City, Jiangsu Province)

These cultivated fish fry are generally divided into different specifications. For example, Guangzhou C Fishery Company and Shanghai California Bass Fish Farm have

three-level farming ponds. When the fish fry grow from the previous size to the next size, both farms will adjust These fry were exchanged for ponding. The way they change ponds or put fish fry is usually more complicated, and they will try their best to be careful and careful in treating fry. They also designed tools such as nets and sieves to minimize physical damage to fish. But what cannot be ignored is that the employees who pull the net are all workers, and they may not be fully able to grasp it. They admit that although the workers have done their best to put the fry into the pond and transfer them to the pond, these operations will inevitably cause some scratches or stress reactions to the fish itself. However, what we can see is that these farming companies are still working hard to reduce the damage to the fish itself, and at the same time reduce the loss in the farming process. During our surveys of other farms, we have not seen these tools. Many farmers said that after they purchased the fry, they would soak the bag containing the fry in the pool for a period of time when releasing the fry. After the fry had fully adapted to the water temperature and environment, they would untie the plastic bag and release the fry. Of course, if it is a self-cultivated fry, it will be placed in a bucket and soaked in the pond to adapt to the water temperature, and then slowly wait for it to swim to a new farming pond.



(Pull nets at Shanghai California bass hatchery)

### 3.2.3. farming and Feeding

In the farms we surveyed, different species, feed types, equipment, and different stages of fish growth will affect the way farmers choose to feed. We found three main different feeding methods, including intelligent feeding, ordinary feeding machine feeding, and artificial feeding. Among them, Guangzhou C Fishery Company has adopted an intelligent feeding machine. According to Dr. F's introduction, the intelligent feeding machine can achieve precise feeding. During the field visit, we also saw workers using ordinary feeding machines for feeding.



(Intelligent feeding system of Guangzhou C Fishery Company Group)

Pellets are generally fed through an ordinary feeding machine, because the pellets are relatively heavy and will slowly sink into the water, so these feeds can be eaten by fish species in the lower water body. The fish fry in the loach and the reservoir are all fed by the way that the farming workers spread the material by hand. We have also seen that a small number of farms use VC machines to feed feed consisting of extruded materials. Because the venture capital can make the feed float above, so that fish species that like to eat the upper layer of food can get enough food, such as flowers and silver carp.



(Puffed material and granular material, taken in Lianyungang City, Jiangsu Province)





(Feeding situation of ordinary feeder, taken at Uncle L's grass carp farm)

In terms of the amount of feeding, large enterprises will have stricter standards, and even use artificial intelligence instruments for feeding. For example, the intelligent feeding system of Guangzhou C Fishery Company can be controlled according to remote data. Manager T introduced that this intelligent feeding tower machine can make the fish feed more evenly spread. However, for farmers in many small farms, the amount of feed is often determined by personal farming experience.

"We only have feed (feeding), and the amount of feed is recommended by the feed company. It mainly depends on the size of the fish, water temperature, appetite and digestion. (Fish) have not eaten recently, and their liver is not good, so they will not swim to the fish. Eat on top. So, adjust the dosage every day."

(Ms. M, October 28, 2022, Yancheng City, Jiangsu Province)



(Uncle L and his wife and manager L are carefully checking the eating situation of grass carp)

But even with the so-called recommended feeding amount and feed ratio, many family farmers will not simply follow the instructions for feeding, but will squat beside them to observe the fish eating situation while feeding. Manager L said that because the amount of feed is not only related to the size of the fish, but also related to the water temperature and the health status of the fish, the farmers will carefully check



their food consumption every time they feed. However, during our field visits, we also found that many farmers will continue to feed the fish more feed in order to make the fish grow faster and heavier. Although they know that overfeeding often causes a lot of gastrointestinal burden on the fish and affects the water quality, these farmers still insist on feeding as much as possible in order to let the fish grow fat and go on the market as soon as possible. Before feeding, these farmers will use a mixer to mix some drugs that increase the resistance of the fish. According to their words, "help the fish digest", so as to ensure that the excess feed will not cause too much harm to the fish. Stomach burden.

#### 3.2.4. Aquaculture Water Regulation

The field time this time coincides with autumn in the northern hemisphere. We encountered cloudy and rainy weather during our survey in Guangzhou, but mostly sunny days in our surveys in Jiangsu Province and Shanghai. Therefore, we can see that the conditions of the current aquaculture water bodies are different. The condition of the water body of the farm is also related to the source water body, whether the farmers have regularly checked and treated the water quality, and the weather. In enterprise-type farms, the water quality is tested regularly by the staff, and they will use some professional testing equipment, but for most small family farms, farmers usually do not buy these equipment, plus Farmers themselves also lack professional knowledge. They generally seek the help of technicians in charge of after-sales service of fish medicines for water quality testing. Generally, the frequency of testing is not particularly stable, roughly once a week or two.



(Technicians are initially checking the water quality)

Generally speaking, in the 12 farms investigated, the main reasons for the problems in the aquaculture water include: 1. Exceeding the standard of the two main

substances of nitrite and ammonia nitrogen, which are related to fish feed and feces; 2. Summer At high temperatures, the dissolved oxygen in water decreases.

In terms of water quality control, we also found that different farms have different treatment methods, including using silver carp and other species to purify water quality, improving water with biological agents, and improving water with chemical agents. Among the 12 farms we surveyed, except for the loach farms where a single species is raised, the ponds of other farms will mix two kinds of fish, silver carp and silver carp, to purify the water. The California perch fry farm in Shanghai has an 80-acre outdoor storage pond. Only white silver carp is stocked, and no additional feed is fed. The water is purified before being used in the outdoor farming pond. In addition, the water quality of the local water source itself is good, and the water quality of this farm is the highest quality among the farms investigated this time.



(Water quality of fish farming ponds of Guangzhou C Fishery Company)



(The reservoir of the California perch farm, turquoise and clear water)

In Lianyungang and Yancheng, Jiangsu, the water quality of most farms is not as good as that in Guangzhou and Shanghai. The method they use to adjust water quality is generally called water improvement. The ways to improve water include fertilizing

water, replenishing bacteria, detoxifying and improving the bottom. Among them, fertilizing water and supplementing bacteria refer to supplementing beneficial bacteria in the aquaculture water body, detoxification is to remove harmful substances in the aquaculture water body, and bottom improvement is to "improve" the silt formed by long-term aquaculture. The frequency of water improvement in these two farms is generally determined according to the quality of the water source itself and the weather conditions. Generally, it is mainly to add biological and chemical agents. In simple terms, biological agents transform the water body through the propagation of beneficial bacteria, that is, "fertilizing water" and "replenishing bacteria" as farmers say. The conditions require high water temperature, and the speed of improving water will be relatively slow. They are often used in Spring and summer; and chemical preparations will use some chemicals, the speed of water change is relatively fast, and it is often used in autumn and winter. Especially in loach farms, without the water purification function provided by polyculture species, farmers can only optimize the farming water body by repeatedly splashing biological or chemical agents. In addition, because the water source of most farms belongs to the downstream river water, and flows through many farmlands and farms, the water source and soil are often polluted by chemical fertilizers and pesticides, and fish ponds are no exception, so in some places with serious pollution, to ensure the health of the water body, farmers need to add more preparations to continuously "detoxify" the water body, which undoubtedly increases the cost of the farmers. Boss T of the catfish farm in Sheyang County has a deep understanding:

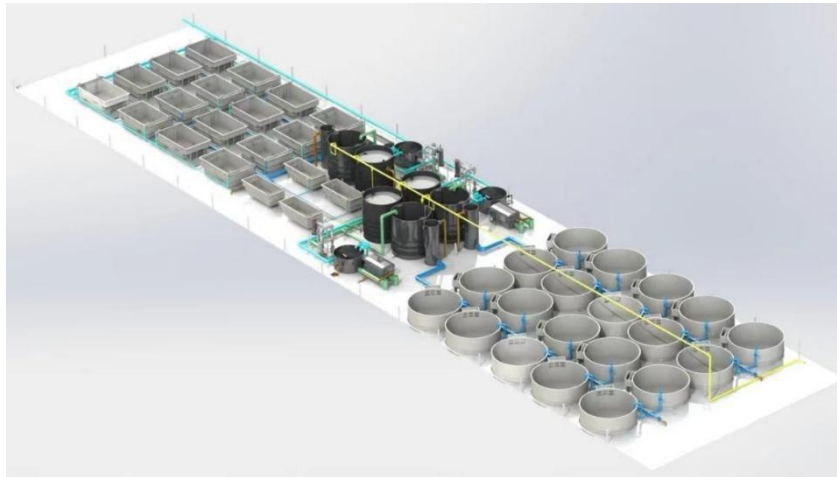
"It is to adjust the water frequently, including fertilizing water, replenishing bacteria, detoxifying, and changing the bottom. The water quality is tested here, which is the after-sales service of those who sell feed and medicine, and the test is done every half a month. But the water adjustment is to adjust the water once a week. , one adjustment costs 1,000 yuan, how high do you think the cost is. The pH value here is around 9.0."

(Boss T, October 27, 2022, Yancheng City, Jiangsu Province)



(Algae Biologicals)

The last way to treat water is to use a "circulating water system", which is a very complex infrastructure. In this facility, tap water is continuously filtered through different levels of procedures and circulated to achieve water quality that meets fish fry farming standards. This equipment is generally used in the farming of fry, such as the California perch hatchery investigated in Shanghai. Dr. E introduced that he and his research team spent a lot of time, energy and materials on inventing and optimizing this equipment. It can be said that an important cost of the California perch hatchery is the "circulating water system":



(Source water treatment system: picture provided by Dr. E)

"The water in the first-level farming pond is tap water (continuously recycled), which needs to be continuously purified and reused through the 'circulating water system'."

(Dr. E, November 1, 2022, Pudong District, Shanghai)

In this visit, we also noticed the wastewater treatment of the farms. Among the 12 farms we investigated, we found that one of them—the California perch nursery farm in Shanghai—has treated wastewater, and the rest of the farms' aquaculture water will be directly discharged into the river after use. The area where the California perch nursery farm in Shanghai is located is a farming base, which is a demonstration site for ecological farming in Shanghai. Therefore, the municipal government has relatively strict requirements on the treatment of wastewater. In addition, the California perch nursery farm is just one of the many fish farms in the base, and the base will centralize the wastewater from all the farms, then treat it, and finally discharge it into the sea. However, other farms we surveyed did not see this kind of tail water treatment process and equipment, and farmers often directly discharge sewage into adjacent ditches. In addition, during the field visit, we also found that some farmers habitually discard the dead fish in the fish ponds directly around the fish ponds, which also increases the hidden danger of virus infection in the fish ponds.





(A wastewater ditch from aquaculture in Lianyungang City, Jiangsu Province)

### 3.2.5. Disease Prevention and Treatment

During the field visit, Dr. F, who studies fish farming, introduced that the sources of pathogens in aquatic animals mainly include viruses, bacteria, fungi and parasites. There are roughly two types of fish diseases in the farms we surveyed: bacterial and viral diseases. However, the causes of fish diseases are complex. In the communication with farmers, we found that the reasons for fish diseases are as follows: Among them, the internal reasons include the weak physique of the fry and the diseases carried by the fish itself; the external reasons include high temperature, high density, Too much food, poor water quality, stress response and negligent care by farmers. However, these causes also have common features, among which, the unsuitable external farming environment and the practice of overfeeding by farmers are the most common causes of diseases. Among the 12 farms surveyed, the farmers of each farm said that their fish would have a certain amount of disease. Among them, there are 8 farms with high incidence this year, all of which are in Jiangsu Province. Accompanied by the death of a large number of fish. The following is our specific analysis of fish diseases and deaths in farms this time.

First of all, the internal reason is that the body of the fry is weak, which is the most frequent attribution of the farmers to the death. Whether it is enterprise farming or family farming, farmers often attribute it to the problem of weak resistance in the fry stage.

"The link of fish disease is mainly in the fry stage, because the body is weak."

(Dr. F, October 18, 2022, Nansha District, Guangzhou)

Of course, the diseases of different fish species are also different. In addition to the weak constitution, some diseases are especially present and highly common in some fish species, such as crucian carp and California perch.

"Crucian carp is more difficult to raise, mainly because of the high incidence of disease, but the risk is high. If you raise it, you can make money. The main reason is



sporozoites, which are carried by the crucian carp itself."

(Ms. M, October 28, 2022, Yancheng City, Jiangsu Province)

"Bass has three viral diseases that are terrible, rhabdovirus (common in bass and mandarin fish); frog genus iridescent virus; hepatosplenomegaly iridescent virus, iridescent virus is more serious this year."

(Dr. E, November 1, 2022, Pudong District, Shanghai)

Next comes external causes. In addition to the reasons of the fish itself, some external factors that induce fish diseases, such as temperature changes brought about by seasonal changes, are also important reasons for the occurrence of fish diseases. Farmers said that the high incidence of fish diseases is usually at the turn of seasons, just like people are usually prone to colds when the seasons change.

"This year's high temperature weather itself will worry about many fish diseases, but the situation is good, mainly because they will 'catch a cold' when the seasons change, just like people."

(Dr. E, November 1, 2022, Pudong District, Shanghai)

In summer, the generally high temperature in China can easily lead to fish disease and death. Especially this year, most parts of China have experienced continuous high temperature, and the disease and death conditions of most farms are much more serious than in previous years. Especially in loach farming ponds, because the ponds are relatively shallow, if the temperature is too high in summer, the water temperature will be too high immediately. In addition, the farming density of loach is higher than that of other species, and the situation of disease and death is also the most common in the survey.

"It is not easy to raise fish this year. There are many fish diseases, the farming density is relatively high, the temperature is high, and there are too many feeds. So much is definitely not good, and it will lead to enteritis, rotten fish gills, and bad liver and gallbladder. In addition, wild Loach is not as good as Taiwan loach, it eats a lot and grows slowly, so it will not be raised next year."

(Boss L, October 24, 2022, Lianyungang City, Jiangsu Province)

In addition, there are also some artificial practical reasons for external reasons. Dr. F mentioned that the process of pulling the net will also cause damage, which will cause the fish to have a stress response and skin scratches, which will lead to illness and death. This situation often exists in farms that need to transfer ponds.

"The second disease link is from the fish species area to the adult fish area. During the process of pulling the net, it is easy to injure the fish body and cause some diseases."

(Dr. F, October 18, 2022, Nansha District, Guangzhou)

Diseases are accompanied by death. The main reasons for the fish's midway death

are the extreme weather mentioned above, such as the impact of typhoons, and this year, a large number of diseases appeared in Mr. S's carp pond at the end of the farming period. Negligence occurred in operation. However, most farmers do not simply attribute the cause of the disease to a certain factor. For example, Boss U and Teacher S analyzed the causes of diseases in their fish ponds in various ways:

"This year the incidence rate is very high, and it is difficult to cure, especially crucian carp, crucian carp's big red liver, hemorrhagic disease. Carp herpes virus, the incidence of fish here is too common. It used to be seasonal, but now it is common. The cause of the disease is still here The water quality is not good enough, especially in summer with high temperature and low dissolved oxygen, but it is very complicated and can only be prevented."

(Boss U, October 30, 2022, Lianyungang City, Jiangsu Province)

"It's not easy to raise carp this year. There are too many fish diseases. It's hard to explain in one word. It's hard to explain in a few days in class. There are too many reasons for fish diseases, such as environment, water, feed, man-made, internal and external factors. It is very difficult. Crucian carp disease, The time period is very important, and negligence in management can also lead to diseases. The current diseases are caused by eating, and so are people. The liver is not good, the disease of wealth, overnutrition, the liver and intestines are overloaded, and enteritis. In addition, the quality of the feed is not good, the chef What kind of feed is given, if you can't eat the feed, you will have diarrhea from the feed. Food safety issues, feed problems are very prominent."

(Ms. S, October 26, 2022, Lianyungang City, Jiangsu Province)

When Mr. S analyzed the high incidence of fish diseases, he also laughed at himself as a local fishery expert, and it was difficult to explain clearly. However, he emphasized an important reason, which is also the widespread aquaculture in this area (Lianyungang City, Jiangsu Province) The problem is that when farmers consider cost and profit, they overfeed them in order to increase production, resulting in a high incidence of fish intestinal diseases, and some farmers have certain drug abuse practices.

Faced with more and more complex and more frequent fish diseases, the farmers we surveyed think that all they can do is to prevent them. "Prevention is more important than cure" is a saying we often hear from farmers. In terms of disease prevention, we found that the farms met usually have several practices: vaccination, farming anti-virus fish species, creating a good water environment, controlling the amount of food eaten by fish, and taking internal medicines to enhance immunity.

In terms of vaccines, most places in the Chinese market currently only have grass carp vaccines. Among the five grass carp farms we surveyed, the grass carp in the farm that Mr. Z cooperates with Company S has been vaccinated, but Mr. Z also said that although the vaccine can be Prevent some basic diseases, but there is no guarantee that all fry can be injected with vaccines. And cultivating virus-resistant fish species is



"The first point is, don't feed too much feed, and don't let the fish eat vigorously (eat freely); the second is to take good care of your health, protect your liver and gallbladder."

(Boss T, October 27, 2022, Yancheng City, Jiangsu Province)

Finally, the prevention of diseases depends on the regular care and observation of the breeders. It is necessary to prevent the occurrence of fish diseases through daily feeding, observation of fish ponds, and relying on one's own experience and knowledge. However, not all farmers have this technology. Once a fish disease occurs, many small family farms will call the fishery experts in the town or the after-sales technicians of the medicine to come to the fish pond for professional guidance. During our field visit, Mr. S had some problems in his fish pond, and the breeder he worked with called him to check for fish diseases.



(Ms. S is checking the fish disease through biopsy)

In terms of the treatment of fish diseases, although there are different treatment methods, the usual methods are two ways: disinfecting the water body and taking medicines internally. The farmers we surveyed generally carry out regular inspection and treatment of the water body, and take some drugs internally to the fish to achieve the therapeutic effect.

Of course, we also found out during our visit that for some farmers, choosing to give up and not treat may be one of their ways of dealing with fish diseases. Because the fish is about to be sold, farmers do not want to increase the cost of treatment, and prefer to let a small number of fish die of illness, leaving healthy fish and selling them out of the pond in the near future.

### 3.2.6. Use of Farming Equipment

farming equipment is an external support to help improve the farming environment, and the conditions of the pond mouths of the farms we surveyed are different. Among the 12 farms, except for the farms that only raise loach without using any farming equipment, the rest of the farms are equipped with aeration machines and feeding machines, but the number is uneven.



(loach pond is not equipped with any equipment)

Aerators are turbine-type machines and not all farms were using them at the time of our survey. According to Manager L, this is mainly because it depends on the dissolved oxygen in the water and the state of the fish. Generally, the machine is used in summer. Due to the high temperature in summer, once it encounters high temperature weather, the dissolved oxygen in the water will be greatly reduced, and the farmers will turn on the aerator and let it work continuously for a very long time.





(Aeration machine being used in a farm, taken in Lianyungang City, Jiangsu Province)

In terms of the quantity distribution of aerators, Mr. S's experience is to recommend an aerator for 5 mu, but not all farms have this condition, especially in family farms.

In terms of feeding machines, we found that there are three types of equipment used by farmers: wind feeding machines, ordinary feeding machines and smart tower feeding machines. The first two machines are more traditional feeding machines, used in small family farms, while the latter machine is a relatively intelligent machine, which only exists in large enterprise farms like Guangzhou C Fishery Company. middle. In addition, large enterprise farms are also equipped with a variety of equipment such as oxygen cylinders for increasing oxygen in the nursery workshops. For example, in California perch nursery farms, different farming spaces are equipped with different farming equipment, which is also the result of the survey. Among the farms with the most equipment and the most complex:

Table 1. Shanghai California perch nursery equipment

type	equipment
Circulating water system reservoir	1. Fish pond, 2. Microfiltration machine, 3. Pump pool, 4. Circulation pump, 5. Ultraviolet sterilizer, 6. Fixed bed biological filter, 7. Moving bed biological filter, 8. MHO medium pressure aerator, 9. Air energy heat pump (high temperature), 10. Fan (plastic sheet tumbling), 11. Liquid oxygen tank . 12. 70 anemophilus hatching barrels (biological bait cultivation)
round cement pond	1. Greenhouse, 2. Water wheel (aerator), 3. Fan (aerator)
Outdoor farming pond	waterwheel



(A corner of the circulating water system of the Shanghai California perch farm)

Generally speaking, the amount of equipment at the pond mouth actually determines the rent. Small family farms generally cannot afford such high equipment costs and can only be equipped with basic aerators and feeding machines. And large enterprises have more resources to develop and manufacture their own equipment and machines for fish farming.

### 3.2.7. Fishing and Transportation

Fishing and transportation are the last stages of farming in farms. The subdivided fishing operations include: preparation before fishing, operations during fishing, and finally fish truck loading and transportation operations. In the 12 farms we investigated, the pre-harvest operations include three methods: product inspection, food withdrawal and water removal.

Among them, the farm of Guangzhou C Fishery Company and the two farms of Lianyungang that breed loach have both tested the products. Guangzhou C Fishery Company not only has a grass carp farming base, but as a fishery-based enterprise, its business also includes sales. You can also see their stores in some vegetable markets in Guangzhou. Testing can ensure the quality of the products that can pass the market smoothly. Security inspection; as for the loach farm in Lianyungang, as we mentioned above, the loach there needs to be exported to South Korea and Japan, so pre-harvest inspection is an indispensable part.

The other is to stop eating. The farmers of most of the farms surveyed said that they need to stop feeding before fishing, and usually stop feeding 1-2 days before selling. The purpose of stopping feeding is mainly to prevent water pollution caused by excrement during transportation. And loach, because of its own characteristics, generally does not need to stop eating. For this reason, Mr. S, who has rich experience in loach farming, added:

"The loach here is all exported to South Korea. In Ganyu District (Lianyungang City),

Koreans like to use beef and loach to make soup, while there are snacks made of loach in Japan. There is no such processing in China, they are all live. Fish transported to Japan and South Korea for trade is a relatively small product. There is no need to stop feeding when fishing for loach, and there is no need to waterproof when transporting, and it can be transported wet."

(Ms. S, October 26, 2022, Lianyungang City, Jiangsu Province)

The last thing is to draw water, which is a common operation in Guangdong farms. Dr. F, the farm of C Fishery Company in Guangzhou, said that the farmed adult fish need to be "dragged" before they are sold. Hanging water is an operation often used in Guangdong aquaculture, the purpose is to make the fish more firm. In the promotional brochure of Guangzhou C Fishery Company, it is written:

"Strictly follow high standards to carry water, large carp carry water for 30-45 days, small carp carry water for 21-30 days, let every fish of Guangzhou C Fishery Company The internal organs of fresh grass carp account for  $\leq 8\%$ , showing the characteristics of slender body, no muddy smell, and garlic petals. <sup>13</sup>"

Dr. F, who is in charge of farming, explained:

"Dropping water is what we have been doing. The purpose of this operation is to improve the meat quality of the fish, that is, to lose weight. We need to put these fish in a special hanging water fish pond. There is only one kind of grass carp in the fish pond. The requirements for water quality will be relatively high, and the flow rate will be relatively fast, so we will not feed them. This is different in the farming model, it is a single species of fish. And the farming density will be much higher, normally 3000 catties Per mu, it's okay, but it's increased by five to six times when watering, that's 15,000 to 20,000 jin/mu."

(Dr. F, October 18, 2022, Nansha District, Guangzhou)

It can be seen that the fish are not fed during the water lifting process, so it is equivalent to losing weight to the fish, and the farming mode, density and environment will all change. Of course, this hanging water was "invented" for the needs of the local market. For example, the farms in Jiangsu Province do not have this kind of practice. After drawing water or stopping feeding, adult fish need to be caught.

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<sup>13</sup> Excerpted from the brochure of Guangzhou C Fishery Company



(Fishing time, taken in Lianyungang City, Jiangsu Province <sup>14</sup>)

When fishing, farms usually choose sunny days, lower the water level after choosing a fish pond, and gradually pull the net. These operations generally employ specialized fishing workers who bring their own equipment, including pulling nets. In addition to the fish species of loach, when fishing for other fish species, the farms will sprinkle some medicines on the fish ponds for disinfection, so as to prevent the fish injured by the net from being infected with germs and dying. Medicines are disinfectants of different types, such as iodine, vitamin C, sulfur dioxide, etc.

"When pulling the net, sprinkle some iodine and sulfur dioxide to reduce the loss of the net when the fish are stressed."

(Ms. S, October 26, 2022, Lianyungang City, Jiangsu Province)

"Disinfectants are sprayed before fishing, and after pulling the nets, mainly because they are afraid of being infected and dying after the skin is damaged."

(Boss U, October 30, 2022, Lianyungang City, Jiangsu Province)

For the preparation of fishing equipment, compared with ordinary family farms, enterprise farms, such as Guangzhou C Fishery Company and Shanghai California Bass Hatchery, have specially designed fishing nets and fish screens that minimize damage to fish bodies.

In the fish market where the fish is caught and listed, the workers of the fishing team generally put the adult fish into a basket by grabbing by hand, and then transfer the fish in the basket to the fish cart. Many farmers emphasized that this process requires workers to work fast, otherwise it will cause surface injuries and lack of oxygen to the fish. These fish carts are generally prepared by the purchaser, while qualified farms like enterprises are equipped with their own designed fish carts. For example, the finished fish of Guangzhou C Fishery Company we investigated are

<sup>14</sup>Image courtesy of Manager L.



loaded by their own fish carts. In order to ensure freshness, the farm will prepare oxygen for the fish and deliver it to the direct sales store within 2 hours.

"The fish sold are transported by our special car of Guangzhou C Fishery Company. There are buckets and oxygenation equipment in this car. If it is kept fresh, it is to let these live fish reach the vegetable market within two hours, or directly Therefore, when we transport live fish, we can only choose the nearest place, otherwise, it will be stale for too long."

(Dr. F, October 18, 2022, Nansha District, Guangzhou)

But for most family farms, they usually sell the fish directly to middlemen for sale, so the treatment and operation of middlemen directly affect the welfare of the fish being transported. Most fish from farms are sold in areas close to the place of production. For example, the farmed fish from Lianyungang and Yancheng in northern Jiangsu will be sold to the neighboring southern Jiangsu and Shanghai, while those from Guangzhou C Fishery Company will Sales to other cities in the Pearl River Delta, such as Guangzhou, Foshan, Dongguan, Shenzhen or Hong Kong. These transportations will not be too long, and for some special fish species, such as loach, which will be sold to South Korea and Japan, as mentioned above, they will be transported in a car container by wet transportation. For example, carp is generally only eaten in Shandong, Henan, Liaoning, and Hebei provinces, so most of the buyers come from these places. And fish fry farms like California perch will send the fry to the farms that raise perch all over China.



(Fish boxes containing fish, taken in Lianyungang City, Jiangsu Province)



### 3.3. Understanding Fish Welfare

In the last section of this chapter, we will discuss the understanding of “fish welfare” by different subjects encountered in the survey, such as fish farmers, fishery experts, feed and pharmaceutical promoters.

When it comes to "animal welfare", most of the public think of the welfare of pets, and a small number of the public are relatively aware of the welfare of farm animals, such as the welfare of terrestrial animals such as cattle, pigs, and chickens. However, the concept of "fish welfare" is very unfamiliar to many members of the public, and the discussion of "fish welfare" in China is currently limited to a very small range of academic research. With the rapid development of the aquaculture industry in recent years, fish have become hundreds of millions of aquatic animals and the objects of intensive farming, and their living environment is becoming more and more worrying. "Fish welfare" is derived from "animal welfare". Relevant researchers and international organizations believe that fish, like terrestrial animals, can also perceive pain, and they also need to be included in the category of animal welfare to receive the same welfare care as terrestrial animals.<sup>15</sup> Because most of the field respondents in this field survey have not heard much about fish welfare, we tried to use words that Chinese farmers can understand when interviewing, such as "how to raise fish well?", "how to Doing is good for the fish to be raised" or "how to raise the fish or be good for the fish?" to try to understand the concerns of different farmers on the fish itself. For some farmers who have a background in fish farming knowledge, we will use the concept of "fish welfare" to directly inquire about their views and opinions.

The first is the understanding of "well-raised fish". For most farmers, especially those in family farms, fish farming is their hard-earned harvest for a year. Well-raised fish means the usual farming process smooth, high yield and sold at a high price. To put it simply, there is no or less disease in the farming process, high yield and high selling price.

"I think raising good fish means selling them at a good price. No matter how good the fish is raised, it's not good if you don't have a good price."

(Brother X, October 25, 2020, Lianyungang City, Jiangsu Province)

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<sup>15</sup> Tore S. Kristiansen and Marc BM Bracke, "A Brief look into the Origins of Fish Welfare Science", in *The Welfare of Fish*, edited by Tore.S. Kristiansen.



(Farmers usually live next to fish ponds, taken in Yancheng, Jiangsu)

As a whole livelihood and life, farmers have to live on the edge of fish ponds and take care of fish. Being with the fish you raise, care and tending becomes a major part of their lives. Therefore, the importance of livelihood is as important as "keeping good fish". Because being good for fish is also an expectation of raising fish well, an expectation of hard work in "living". Therefore, in the eyes of many farmers, if there is no good price and market, even if it is "good" that they recognize, it is just a "bad" effort for nothing.

Secondly, in order to achieve the goal of "raising good fish", all the farmers we surveyed expressed their concern for such factors as feed nutrition, water quality, and disease prevention and control during the farming process. In particular, farmers with relevant aquaculture knowledge will understand "raising good fish" from a professional standpoint and respecting biological nature. For example, Dr. E, who has a doctoral background in aquaculture, pays special attention to disease prevention in his views on raising California perch and feed two considerations:

"(Raise good fish) First, the prevention of viruses, especially in the farming period, the water quality must be good, and the density should not be too high. Second, the feed must be good, because it (California perch) is born with diabetes and cannot digest starch."

(Dr. E, November 1, 2022, Pudong District, Shanghai)

Disease and feed are indeed the most important parts for farmers. One is related to death and loss, and the other is related to input and output. If these two elements are not handled properly, the farming results will be in vain. Therefore, although the farmers in some farms know that the environment of their farms and the condition of the pond mouth are not the best quality, they will try their best to create some conditions for raising fish: such as improving water quality by improving water quality; buying good feed, to ensure that the fish get enough nutrition, or to constantly summarize their own farming experience. For example, Boss L felt that he did not

breed loach very well this year. He concluded that,

"Cultivation is all about taking risks. Hey, the most important thing is to plant well. For example, our species this year is very bad. I bought seedlings domesticated from wild loach in the Northeast. Good seedlings are disease-free, uniform, and relatively strong. Second, reasonable stocking density. For example, novices may stock more sparsely, and veterans may stock more intensively. The last is high-quality feed, and now we can only buy brand names. For example, the price of feed is high this year, and the raw materials are high. The quality can't be guaranteed either. Raising wild loach is much more laborious than Taiwan loach, and requires more management, so we need to take care of them more and often observe the fish pond."

(Boss L, October 24, 2022, Lianyungang City, Jiangsu Province)

Although the result of farming may not be ideal, this year's loach has not been raised well, and the "harvest" that Boss L expected has not been obtained, but from the statement of Boss L, we can still know that he has constantly summed up his farming experience and hopes to be able to Breed the loach well.

Therefore, although what farmers think of "raising good fish" is more likely to be the result of "raising good fish"-the increase in income, it is undeniable that in this process, most of the The practical operation of farmers is still trying to provide fish with a good growth environment and adequate care. However, we also found that although some farmers hope to "raise good fish" to obtain good returns, they still face many difficulties and corresponding contradictions in actual operation, such as whether to over-feed to obtain a higher growth rate? At the same time, how to deal with the burden of liver, gallbladder and stomach of fish caused by overfeeding? But if you don't overfeed as much as possible, can input and output be balanced? Can you have enough income to provide a good life for your family? These contradictions are usually the result of multiple considerations by farmers based on their own situation. Regrettably, our survey experience in Jiangsu Province is that in the face of these multiple considerations, many farmers still choose the production of aquaculture, and do not care too much about the quality of the fish. Of course, this has something to do with the current consumer market in China , the analysis will continue below.

During our visit, we also encountered some fish experts or farming technicians who had little understanding of fish welfare, and they were rather ambivalent when talking about "fish welfare". These conflicting emotions are also related to the lack of discussion and research on animal welfare in the overall social environment. Many people will be confused. Does fish welfare think about fish from the perspective of human beings, or fish from the perspective of fish? Many fish experts are also confused, how to scientifically evaluate the welfare of fish? It is precisely because these issues have not formed an atmosphere for discussion at the entire social level, especially in a social environment where "anthropocentrism" prevails, it is even more difficult to form such a discussion. In addition, our scientific research has not yet

formed a systematic study on fish welfare, and there are no complete indicators that can be used to evaluate the welfare needs of different fish species. When there is increasing demand, and farmers also need high output and high efficiency to make profits, some farming technicians will inevitably feel contradictory considering the potential cost pressure that may be brought about by related farming ethics. For example, Manager L, who is engaged in the sales of aquatic animal protection products and knows the aquaculture in this area like the back of his hand, also expressed his confusion about "raising good fish" and "fish welfare":

"The fish welfare we talk about now may still be an unrealistic rhetoric. In reality, it is difficult to achieve, because everyone wants to raise fish well, but it is difficult for everyone to do well, especially for ordinary farmers. I clearly know that if I give more feed, it will cause liver disease, and if I don't grow heavier, I will lose money when I harvest."

(Manager L, October 30, 2022, Lianyungang City, Jiangsu Province)



(Landscape of a loach pond in Lianyungang City)

From Manager L's narration, we can roughly feel the concerns and contradictions from the front-line technicians, because these are some problems that he has actually experienced in his daily work and has to face. Farmers all hope to raise good fish and get good income, but how to use limited resources to raise good fish itself has stumped a group of people.

For consumers, food quality and safety have always been their great concern, and many consumers do not have enough trust in farmed aquatic products. These concerns about food safety have affected the sales of products and the benefits of farmers themselves, which in turn has affected the stability of the consumer market. To some extent, it can be said that it has brought demand for the improvement of fish welfare, but at the same time it has also really brought a lot of pressure to farmers. Bring greater farming risks and challenges. Therefore, in fact, local farmers and people, as well as the fish being farmed, are facing different difficulties in this social

environment. On the one hand, many farmers are constantly obtaining more resources from land and fish. On the other hand, due to the limited knowledge, technology and funds, especially small family farmers without any support, they face practical difficulties. Focus on multiple difficulties. Coupled with the instability of the consumer market, in the face of these difficulties, it has become the understanding and practice of many farmers to protect their own welfare and then the welfare of fish.

## 5. Summary and Thinking of Field Visit

### 5.1. Fieldwork Summary

Our field survey spanned Guangdong, Jiangsu and Shanghai, and visited 12 farms in total. In terms of analysis, we focus on three parts: the farming environment of the farm, the specific farming practices, and the understanding of fish welfare by different subjects such as farmers, fish experts, and markets. However, the situation, problems and difficulties of each farm are actually different. We hope to use this subsection to compare and summarize the fish species and farm types we surveyed.

#### 5.1.1. Comparison of farming Conditions of Different Species

Among the farms we surveyed, except for the ponds in China's native loach ponds, grass carp fry ponds and California perch ponds, all fish ponds have more than one species, which means that other ponds are polyculture Case. Below we have compared and analyzed some of the more prominent varieties based on the survey.

First of all, grass carp has always ranked first in China's freshwater aquaculture production. Because of stable consumption and perfect farming technology, not only the requirements in the market make grass carp have different levels of consumption. As far as the farm is concerned, it is more pursuing high-quality grass carp, so it is constantly updating and improving its farming technology. It not only has a dedicated research team, but also has anti-virus fish species in the laboratory. Due to the long history of grass carp farming, the relevant vaccines for grass carp have also developed relatively quickly. Many farms have begun to vaccinate grass carp, and most of the farms are doing well. For example, the 5 farms we surveyed The condition of grass carp in the farms is relatively good, but there are also some farms where the farming cycle is prolonged due to the epidemic, which increases the risk of grass carp dying midway.

Secondly, in the farms we surveyed, silver carp is a common polyculture species, and the stocking density is relatively low, and it is more used to regulate water quality. There are also farmers who use the space of the upper water body of the pond to



increase the total output and income according to their habit of living in the upper layer of the water body. In addition, we have also seen that the yellow catfish, dace and herring released by a small number of farms are not only to increase income, but also to further purify the water quality and play a role in ensuring the growth environment of the main species.

Although the yield of loach does not rank among the top 10 in China's freshwater farmed fish species production, but because its individual weight is smaller than that of other freshwater fish, its farming quantity is the largest. In the loach farms we investigated in Lianyungang, the farming density is very high, and the mortality rate is also the highest, especially in the loach juvenile stage. In addition, loach has a relatively high disease incidence in summer, and in addition to the low water depth of farming, it usually has much less space for activities than other species. However, under the requirements of the international market, in order to meet the quality requirements of products exported to South Korea and Japan, loach farmers will use drugs carefully in farming practices to avoid product returns that do not meet export standards. Finally, in terms of transportation, the "wet transportation" method of loach is also different from other species, which may be related to the physiological structure of loach, but more attention should be paid to the welfare issues.

Carp is a species with a limited market in our survey and is only popular with consumers in Shandong. Because of the consumer market, the price of carp in the market is relatively unstable compared to other species. Especially under the influence of the epidemic, many farmers said that they have lost interest in carp farming and lacked interest and confidence in carp farming. Coincidentally, the two carp farms we investigated both had fish disease problems, which were largely related to the poor water quality of the farms and the lack of farming techniques of the farmers. Stability also makes carp often face the situation that they cannot get out of the pond, and continuing to stay in the pond will intensify the challenges to the farming environment and farming technology.

And another species with a better market——California perch has grown rapidly in China in recent years. This is similar to the fact that California perch has good meat quality, is favored by consumers, has a high market price, and is oriented towards urban consumers. middle and upper income families. Because it prefers warmer waters, most California perch farms are only distributed in southern China. The Shanghai California perch farm we surveyed is a fry farm, so its farming environment and practical operation are the most scientific and "respectful of fish" among the farms we surveyed, and it has a complete circulating water system and farming technology. In terms of farming density, the farm is also constantly seeking a balance, because a higher density can easily cause disease problems; in terms of feed, the farm also chooses high-quality feed and domesticates them one by one to eat compound feed. It can be said that the farm has perfected its farming environment to the greatest extent so that California perch can grow healthily.

Through this field visit, we also found that among many species, crucian carp is the most susceptible fish species. Farmers said that crucian carp itself is prone to disease,

and the farming cycle is relatively long. It usually takes about two years of continuous farming by farmers, so they need extra patience and care. In addition, catfish, a similar fish species, also has a relatively long growth cycle. Farmers say that it takes 2-3 years to reach the state of adult fish. The ponds we investigated this time mainly raise crucian carp and catfish, and there are many diseases and deaths. Coupled with the poor water quality in the ponds of the surveyed farms, farmers have a higher frequency of water transfer and medication. The reason why farmers choose to breed is also because once the farming goes well, the output value is still relatively high.

### 5.1.2. Comparison of Different Types of Farms

The thinking in this section is based on different types of farms. According to the degree of resources, we divide the types of farms in the order of high and low: pure enterprise type, farms contracted by enterprise employees, and farming in cooperation with aquatic animal protection companies Farms, small family farms. Among them, the first three are related to aquaculture enterprises or aquatic animal protection enterprises, and have more financial and technical support, while the last one, the resource support channels of small family farms are usually only the farmers themselves. Our analysis mainly divides them into two types: enterprise type and small family farming.

The first is market positioning and product quality. The positioning of enterprise-type farms is relatively in favor of the mid-to-high-end market, and they pursue higher quality in terms of quality. For example, Guangzhou C Fishery Company pursues high-quality fresh grass carp, and California sea bass nursery pursues high-quality Fish fry; while other types of farms usually choose species with good economic benefits for farming, and the most important consideration is market demand. Especially for small family farmers, what species to breed is generally the result of comprehensive consideration based on their own understanding of the farming market. Even, some farmers may choose "good money" varieties in order to quickly improve their quality of life-"what makes money and is easy to raise, and what to raise". The choice of individual farmers is actually highly unstable and variable, and the quality of their farmed products is not uniform and cannot be guaranteed, which in turn affects their ability to resist external risks.

Secondly, at the technical level, enterprise-type farms have trained their employees, and the farmers themselves are employees of related enterprises. A channel for exchanging farming experience and learning. However, for small family farmers, generally they have not received professional training on relevant aquaculture technology, and have no relevant learning background. Usually, they can only rely on the accumulation of years of farming experience, or rely on fish farming experts and after-sales service to obtain Guidance and help. In addition, in terms of fish fry cultivation technology and quality, because enterprise farms have relatively complete

technology for fry cultivation, they can do more control on the quality of fish fry, while small family farmers do not have relevant technology and capital for fry cultivation, so it is necessary to purchase fry from outside, so it is difficult to guarantee the stability of fry quality.

From the perspective of water quality and diseases, although the water treatment methods of the farms we surveyed are similar, water quality must be tested and treated, as well as disease prevention and treatment, but because small family farmers usually lack equipment and corresponding knowledge. For water quality testing and disease prevention, we can only understand the water quality and disease situation through our own experience or the help of after-sales service technicians. Enterprise-type farms generally have their own professional instruments and even laboratories. The water quality and disease detection in the farming process are more intensive and strict, and the operation practices are more standardized and standardized.

In terms of feed feeding, enterprise farms have their own teams to research and develop farming feeds, and obtain relatively scientific data support through repeated experiments, so as to manufacture their own approved feeds. For other types of farms, they can only guarantee the quality of feed by purchasing and relying on big brand feed. Of course, as our visit shows, farmers can only know whether the feed is good or bad after they practice it themselves, and the price of feed produced by feed mills continues to rise, and its quality is also uneven, which causes great difficulties for farmers to choose, and also increased the risk of farming.

In addition, in terms of farming equipment, enterprises have more capital, technology and manpower to invent and create intelligent operations. On the one hand, it can make farming practices more standardized, and on the other hand, it can also save farming costs. But for small family farmers, due to the lack of advanced farming technology and farming equipment, taking care of and observing the situation of fish ponds and fish has become their daily life. We found that many farmers now also rely on the Internet, mobile phone information, etc. to increase their farming knowledge. But at the same time, due to insufficient equipment and technology, small family farmers also have problems such as untimely water quality testing and inaccurate disease judgment, which further increases the risk of fish disease.

Finally, in terms of resisting external risks, enterprise-type farms undoubtedly have more funds and social resources to use. Professional technicians can deal with disease resistance, and there are also special departments responsible for expanding funds and market chains. In addition, enterprise farms also have more ways to purchase feed and medicine. However, small family farms are relatively vulnerable to external risks. In order to reduce the cost and risk in the farming process as much as possible, the farmers have to spend a lot of time and energy thinking about the breed, method, price of feed and medicine, market conditions and so on.

In general, our survey found that enterprise farms can provide a better living environment for farmed fish in many aspects, while small family farmers have invested more personal emotion, care and care. Of course, these Paying does not necessarily

mean that the living environment of fish can be better, because it still involves a lot of professional farming knowledge and technology. But no matter what type of farm it is, the ultimate purpose of its farming is "profit". The environment in which fish live is inseparable from this ultimate purpose of farming, and the main body of its thinking is human beings—the farmers themselves. Therefore, how to achieve a win-win situation between fish welfare and human interests may be the key point to effectively improve fish welfare in the future.

## 5.2. Thinking: Fish Welfare under Multiple Actors

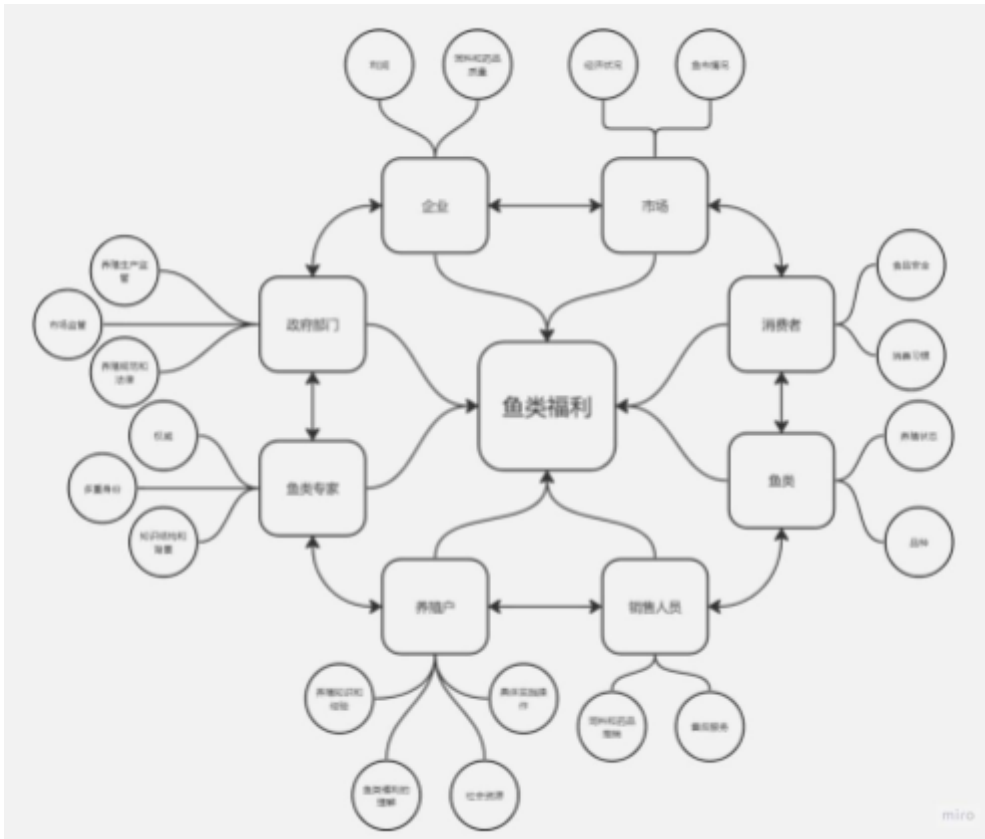
After this field visit, our biggest feeling is that fish welfare needs to be paid attention to, in addition to how farmers should treat fish humanely, the main body is usually multiple intertwined and flowing. Since the time of our survey is close to the fish selling season, farmers' discussions on fish sales have far surpassed their attention on fish farming itself. Due to the impact of the epidemic, farmers are discussing when is the best time to sell fish to ensure that this year's harvest will not suffer losses, while concerns about fish diseases and mortality seem to be put in the second place. In this section, we hope to discuss the different roles of different actors such as the market, farmers, consumers, fish experts, feed and drug salesmen, fish research or technicians, and local governments in the face of fish welfare. Although there are some mixes among these subjects, for example, some farmers are both corporate employees and fish experts, but we still hope to try our best to analyze the impact of these intertwined subjects on fish welfare.

First of all, the expansion of the aquaculture industry is connected to the logic of the capital market—through the reproduction of fish bodies, large-scale, and then resource-based processing, these fish are transformed into products, which in turn become the capital of capital. one ring. Many of the farmers we surveyed are actually practicing fish farming as an investment. For farmers, investment failure means bankruptcy. Due to the instability of the market, most farmers, especially small family farmers, are facing great investment risks, and they are always worried that changes in market prices will affect their income. year's income. Affected by the epidemic, the instability of the market has further deepened, and the consumer market has also become extremely unstable. The pressure of farmers' survival has been far greater than their desire to make a large profit. Neglect of fish quality and welfare in the process. Another impact on farming practices is the mutual shaping between the consumer market and farmers. Because most of the fish consumption in China is still in a relatively rudimentary state, and the consumption power of the mid-to-high-end market is insufficient. Even if the farmers invest a lot of energy and resources to improve the quality of fish, the rising cost is likely to make the sales of the products difficult. become difficult. Therefore, in most cases, farmers can only follow the market. If there is no demand for fish welfare in the market, it is difficult for farmers to change their farming practices.



Secondly, the party with stronger capital, such as feed and pharmaceutical manufacturers in the aquaculture industry, has knowledge, technology, capital and markets, and ordinary family farmers can only purchase products produced by these manufacturers. For many small family farmers without professional knowledge, they can only judge the quality of feed and medicine by constantly summarizing their purchase experience. Even for enterprise farms, they admit that they can only get the best choice through trial and error. As the salesman and after-sales service personnel of feed products and animal health products, because they usually have relevant academic backgrounds, they become the most important personnel who can provide relevant farming technical support to small family farmers. But there is usually an unavoidable "gap" between the farmers and the salesmen of these products. For many small family farmers, they usually hope to use the cheapest price and the fastest method to cure fish diseases and reduce the cost of farming. However, due to the gap in professional knowledge, they hope to obtain these salesmen and after-sales. On the other hand, they are also afraid of being overly recommended by these people to buy some redundant or high-priced products, which will increase their own farming costs. It is this relationship of "estrangement" and "distrust" that prevents the farming of small family farmers from becoming smoother. At the same time, it also makes these frontline technicians feel that their work is difficult to carry out, so they feel discouraged. Of course, different entities want to get a share of the aquaculture industry, especially these feed and animal health product companies. They have fierce competition for "customers". Driven by the rising raw material market, some pharmaceutical companies, farms and feed mills are also constantly "cutting down" on their products because of cost control, which in turn has become a bottleneck for fish welfare improvement.

Finally, for others not involved in aquaculture, such as consumers, the concerns are more about fish quality and food safety. Consumers' concerns about food safety have further increased the instability of the market and the risks of the aquaculture industry. This dilemma is an opportunity to force farmers to improve their farming practices and fish welfare, but at the same time, facing these technical problems in the farming industry itself, this dilemma has undoubtedly become the biggest challenge for farmers. In the farms surveyed this time, we also found that the local government is in a dilemma in the supervision of farming, especially in terms of water source pollution and the standardization of farming operations. Due to the complicated situation and relatively limited staff at the grassroots level, it is necessary to be in-depth and effective. Supervision and management is actually very difficult.



(Fish welfare intertwined with multiple subjects)

## 6. Appendix

### 6.1. Interview Outline Framework

Farm research interview outline framework

#### 1. Basic information

- Know the background information of farmers or employees
- Understand the basic situation of the cultured species, including the farming area, farming mode, water depth, density, farming cycle, output, output value, etc.

#### 2. Farming practice

- Understand the basic practical operation of the farmers, including preparations before farming, disease prevention and control during the farming process, vaccines, water quality control, feeding, fishing and transportation, slaughter

- and the use of farm equipment.
  - Understand the difficulties farmers face in the farming process.
  - Learn how farmers understand their relationship to farmed fish.
  - Find out what farmers think about raising "good" fish.
3. External support and cooperation for farming
- Learn about the certification of the farm, the relevant government subsidies, and the cooperation with relevant research institutions.

## 6.2. Interview object directory

Interviewees (anonymized)	Identity	interview date	interview location
Dr. F	PhD in Aquaculture, Corporate Staff	2022.10.18	Guangzhou, Guangdong
Manager T	PhD in Aquaculture, Corporate Staff	2022.10.18	Guangzhou, Guangdong
Manager L	Master in Aquaculture, Corporate Employee, Fish Knowledge Technician	2022.10.24-10.30	Lianyungang City, Jiangsu Province
Boss L	Loach farming self-employed	2022.10.24	Lianyungang City, Jiangsu Province
Teacher Z	Enterprise employees, grass carp farming cooperative households	2022.10.24	Lianyungang City, Jiangsu Province
Brother X	Self-employed grass carp farming	2022.10.25	Lianyungang City, Jiangsu Province

Teacher S	Enterprise employees, local fishery experts, self-employed carp farmers	2022.10.26	Lianyungang City, Jiangsu Province
Boss T	Self-employed catfish farming	2022.10.27	Yancheng City, Jiangsu Province
Teacher M	Enterprise employee, self-employed crucian carp farming	2022.10.28	Yancheng City, Jiangsu Province
Uncle Z	Self-employed crucian carp farming	2022.10.28	Yancheng City, Jiangsu Province
Uncle M	Loach farming self-employed	2022.10.29	Lianyungang City, Jiangsu Province
Uncle L	Self-employed grass carp farming	2022.10.30	Lianyungang City, Jiangsu Province
Boss U	Self-employed carp farming	2022.10.30	Lianyungang City, Jiangsu Province
Dr.E	Candidate for PhD in Aquaculture, Founder of California Sea Bass Fry Farming Company	2022.11.02	Pudong New Area, Shanghai