Empirical Analysis of the Typical Breeding Pattern of Clam in Hongdao Town and the Preliminary Estimates of Costs and Benefits

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Abstract　Based on the survey data about clam breeding farmers in Hongdao Town in August 2011，this paper analyzes the production and operation of typical clam breeding pattern，and estimates the costs and benefits. Through the analysis of operation conditions and economic conditions of Hongdao clam breeding，this paper aims to explore a more reasonable and effective breeding pattern so as to reduce breeding costs and market risks，and increase breeding farmers' income.

Key words　Hongdao clam，Breeding pattern，Cost-benefit analysis

1　Overview of the development of Hongdao clam industry

Hongdao clam has the scientific name of "Philippine clam"，and it is also known as Manila clam，because the original specimen was taken in the Philippines waters. The Hongdao clam is distributed vertically，from the intertidal zone to 10-meter deep seabed. It has a short growth cycle（usually a year and a half or so），so the skin is thin，the flesh is tender and the taste is good. The fishing of Hongdao clam has 70 years of history. This clam is strongly adaptable and fast-growing，and the breeding method is simple. It has the features of less investment，quick effect，low energy consumption，high yield，large gains and production stability，so it becomes one of the main shellfish varieties in Hongdao Town.

Its development has experienced several stages as follows：

（i）Germination stage（before 1988）. Before the 1990s，the Hongdao clam was mainly wild and naturally caught by the fishermen. Due to surging domestic and international market demand for such clams，the fishermen began to expand fishing efforts，resulting in severe recession of clam population resources. During this period，the level of processing technology and purification for clam was low，leading to shelling difficulties and low processing rate，and the clam was mainly freshly sold to the surrounding residents. The main feature of this stage was clam fishing.

（ii）Development stage（1988 – 1998）. In the 1990s，the Hongdao's beaches were open to individuals from the collective management，and individuals began contracting the beach to breed clams. With the success of clam breeding and accumulation of breeding experience，more and more breeding farmers joined the clam farming industry. Meanwhile，with the improvement of clam processing technology and application of purification equipment，

in addition to fresh clam sales，some were primarily processed，and the added value of clams began to improve. The main feature of this stage was that the breeding was combined with part of the primary processing，and the primary processed clams were supplied to the neighboring supermarkets，hotels and other high – end markets，and exported to Japan and South Korea.

（iii）Expansion stage（1998 – 2003）. With the rising price of clam products，the profit margins increased，and the individuals' enthusiasm for breeding clam also reached an unprecedented high. From 2000，the shallow and deep space of Hongdao was gradually leased by the farmers for breeding clam，and currently，the shallow waters of Jiaozhou Bay have been contracted by the breeding farmers. In order to obtain great economic returns，the breeding farmers gradually increased the density of breeding，exceeding the carrying capacity of waters and breeding volume，thus breaking the biological chain upon which clams survived，followed by increased mortality of clams and smaller size of clams. The main feature of this stage was that the breeding and processing were mixed，the breeding scale was rapidly expanded，the degree of processing was increased，and the exports of clams were increased.

（iv）Maturity stage（2003 to now）. Since 2003，the breeding scale and production of Hongdao clam have been basically stable. The production is remained at about 110000 tons，and the farming area is close to 50 000 mu，accounting for 17% of total sales of clams in Qingdao. Hongdao clam has become a well-known brand，and is exported to more than 20 countries and regions such as Japan and South Korea. According to the survey，the Hongdao clam production during this stage accounts for about 17% of Qingdao market. Some new varieties such as "Nanfangsha" are introduced from Zhejiang，Fujian and other places，and Hongdao Shellfish Association has also strengthened the training guidance for the clam farming techniques. The fishermen begin to take the rotation mode，so that the biological bait in the water is sufficient，creating space for the natural reproduction of clams.

At the same time，it further widens the clam industrial

chain, enhances the industrial competitiveness, and fosters the competitive clams industrial clusters. During this period, Hongdao Street fosters a large number of large-scale deep processing enterprises of aquatic products, such as Hongfu, Haoyuan and Jinbei. The daily total trading volume of clams in five piers of Hongdao is close to 150 000 kilograms. 50 local processing plants of aquatic products digest most of the clams, and all others are sold to the outside aquatic plants and seafood dealers. The main feature of this stage is that it is mainly based on deep processing, the proportion of clam-related industries increases, and at the same time, the clam leisure industry is also developed.

2　Cost-benefit analysis of typical breeding pattern

Currently, the aquaculture farming area has been extended from the single mudflat to the shallow or deep sea, and the typical breeding pattern is mainly based on the artificial bottom breeding in the shallow or deep sea. The artificial bottom breeding, an extensive breeding pattern, is to spread the artificially cultivated clam larvae around the levelled intertidal mudflat where the debris and pests are eliminated, and make it naturally grow.

　　This breeding pattern has small investment, easy management and better breeding efficiency, with the advantage of large-scale breeding. Bottom breeding is to put the clam larvae in the clean waters for natural growth, without putting artificial feed, so the quality of products is the highest among a variety of breeding pat-

terns.

2.1　Sample sources　The breeding farmer samples of Hongdao clam are mainly selected from several villages with a large breeding scale in Hongdao, such as Dongdayang Village, Xidayang Village, Guantao Village, and Suliu Village. There are few other village samples. The representative breeding farmers are selected from each village, and a total of 60 typical questionnaires are distributed. 51 valid questionnaires are called back, with the response rate of 85%. The specific distribution of samples is shown in Table 1.

Table 1　Distribution of breeding farmer samples

Villages	Number of samples	Villages	Number of samples
Dongdayang Village	12	Qianyang Village	5
Xidayang Village	13	Houyang Village	4
Guantao Village	5	Xiaoyang Village	5
Suliu Village	4	Goujiao Village	3
Total sample size	51		

Data source: Research and survey statistics, August 2011.

2.2　Cost composition　We perform the statistical analysis of the 51 collected samples. Overall, the input costs for breeding farmers mainly include larvae purchase costs, larvae transport costs, employment expense, family labor discount, fishing fees, mudflat rental fees, mudflat payment, water & electricity fees, repair costs, and other miscellaneous expenses (see Table 2).

Table 2　The composition of average breeding costs in the mudflat of Hongdao (shallow sea) (2011, yuan/mu)

The total costs	Cost category	Expenditure items	Expense costs yuan/mu	Share in the total costs//%
The total costs (6841 yuan)	Direct costs (3650 yuan)	Larvae fees	3000	43.9
		Water & electricity fees	450	6.6
		Machinery operating costs	120	1.75
		Other direct costs	80	1.17
	Indirect costs (691 yuan)	Equipment depreciation costs, maintenance costs	240	3.5
		Selling charges	43	0.63
		Larvae transport costs	408	5.96
	Labor costs (2350 yuan)	Employment expense (breeding link)	800	11.69
		Employment expense (fishing and the follow-up links)	1200	17.5
		Family labor discount	350	5.1
	Mudflat leasing fees (150 yuan)	Mudflat (shallow sea) rental fees	120	1.75
		Mudflat payment	30	0.44

Data source: The field survey and research data, August 2011.

　　In 2011, the average total cost of breeding Hongdao clam was 6 841 yuan per mu, and the direct cost in the breeding costs was 3 650 yuan, accounting for 53.4% of total costs; the clam larvae cost in the direct cost was 3000 yuan, accounting for 82.2% of direct cost, and accounting for 43.9% of the total costs; the indirect cost was 691 yuan, accounting for 10.1% of the total costs; the labor cost was 2350 yuan, accounting for 34.4% of the total costs; the mudflat rental fees and mudflat payment were 150 yuan, accounting for 2.2% of the total costs. It can be found that the labor cost and clam larvae input cost are high in the total costs of Hongdao clam breeding, and it is the labor-intensive industry.

　　The machinery operating cost in the direct cost was only 120

yuan, and the equipment depreciation cost in the indirect cost was 240 yuan, indicating that the clam breeding in Hongdao is moving towards facility-based development, but overall the level of breeding mechanization and technology content is still relatively low. The feed cost in the direct cost was 0, indicating that the Hongdao clam breeding has moved towards shallow sea breeding, the nutrition required by clam is mainly supplied by the sea area, and the ecological extent is further improved.

　　From the indirect cost composition table, the Hongdao clam production has a small scale due to the decentralized management, so the management fees are low; in the labor cost composition, the management during the whole process of breeding is mainly farmers'

own labor, basically without needing workers, but the clam fishing link needs more workers, and the fishing payment is also high, reaching 1200 yuan, accounting for 17.5% of total costs. This also proves the fact that the mechanization level of Hongdao clam fishing operation is low. Overall, the basic state of Hongdao clam breeding is intensive labor and decentralized operation.

2.3 Average benefit calculation (total input – total output)

According to the description of the Hongdao clam breeding farmers, it will take only 20 hours or so to transport a car of clam larvae from Putian to Qingdao, and the long-distance transport generally uses 20 – 30 t refrigerated trucks to transport. The transportation cost to Qingdao is about 17000 yuan per car.

According to the transportation burden of 10 t per vehicle, transportation charges of 17000 yuan and 10000 grains per kg of clam larvae, it is calculated that the transportation cost of clam larvae per mu of mudflat is about 408 yuan (The average transportation cost per kg of clam larvae is 170000000 million yuan/10000 kg = 1.7 yuan/kg, 2400000 clam larvae per mu of mudflat/10000 = 240 kg, so the transportation cost of clam larvae per mu of mudflat is 240 kg × 1.7 yuan = 408 yuan).

The total cost per mu = Larvae fees + Water & electricity fees + Machinery operating costs + Other direct costs + Equipment depreciation costs, maintenance costs + Selling charges + Larvae transport costs + Employment expense (breeding link) + Employment expense (fishing link) + Family labor discount + Mudflat rental fee (shallow sea) + Mudflat payment = 3000 + 450 + 120 + 80 + 240 + 43 + 408 + 800 + 1200 + 350 + 120 + 30 = 6841 yuan.

Table 3   The profit per mu calculated based on one certain kind of larvae density

Larvae density per mu	1600000 grains/mu
Clam larvae appreciation degree	16 times
The total costs	6841 yuan
Profit per mu	16000 yuan
Net profit per mu	9159
Appreciation degree	134%

Data source: Research and survey statistics, August 2011 (clam larvae survival rate of 25%, clam specification of 50 grains/kg, clam price of 2 yuan/kg).

Based on the sample survey, for the 51 breeding farmers, the larvae density for most of them is about 1600000 grains/mu; the appreciation degree of clam larvae is 16 times; the total cost per mu is about 7000 yuan; the income per mu is 16000 yuan or so, and the net profit per mu is about 10000 yuan; the appreciation degree of breeding link is around 130%.

3   Typical case study

The breeding farmer of Hongdao clam Mr Yu contracts 300 mu of shallow sea. In April 2010, he ordered 18000 kg of Putian clam larvae, and the average specification was 15454 grains/kg. The net larvae rate was 90.5%, and the price was 660 grains/yuan.

Total number of grains = 18000 kg × 15454 grains/kg × 90.5% = 251700000 grains;

Larvae density = 251700000 grains/300 mu = 839000 grains/mu = 1258 grains/m^2;

After 15 months of breeding, it was reared into clams in July 2011, and the specification averages 100 grains/kg.

Total production:

2940000 kg, the converted production per mu = 2940000 kg/300 mu = 9800 kg/mu;

Yield rate:

Total number of grains = 2940000 kg × 100 grains/kg = 73500000 grains; yield rate = 73500000 grains/25170 grains = 29.2%;

Total income:

2940000 kg × 5 yuan/kg = 3675000 yuan; (wholesale price of 5 yuan/kg);

Converted income per mu:

3675000 yuan yuan/300 mu = 12250 yuan/mu;

Cost composition:

Larvae cost: 72000 kg × (15454 grains/kg)/(660 grains/yuan) = 421473 yuan;

Transportation cost: 30000 yuan;

Space expenses: 2 years × 300 mu × 120 yuan/ mu = 72000 yuan;

Larvae dropping fees and other expenses: 15000 yuan;

Management and protection cost: 75000 yuan;

Fishing fees: 0.6 yuan/kg × 2940000 kg = 441000 yuan;

Charge for the mudflat (shallow sea): 2 years × 300 mu × 30 yuan/mu = 18000 yuan;

Vessel and depreciation charge and other expenses: 26000 yuan;

The investment costs in the previous period:

42.1473 + 3.0 + 7.2 + 1.50 + 7.5 + 2.6 + 1.8 = 657473 yuan;

Converted investment costs/mu = 657473 yuan/300 mu = 2192 yuan/mu;

Total costs:

42.1473 + 3.0 + 7.2 + 1.50 + 7.5 + 44.1 + 2.6 + 1.8 = 1098473 yuan;

Converted costs per mu: 1098473 yuan/300 mu = 3662 yuan/mu;

Total profit:

3675000 yuan – 1098473 yuan = 2576527 yuan;

Average profit = 2576527 yuan/300 mu = 8588 yuan/mu;

The actual appreciation times of clam larvae: 3675000 yuan/441473 yuan = 8.3244 times;

Output/Initial input: 3675000 yuan/657473 yuan = 5.59 times;

Total income/Total costs: 3675000 yuan/1098473 yuan = 3.35 times;

Yield rate: 2576527 yuan/3675000 yuan = 70.11%;

Appreciation degree: 2576527 yuan/1098473 yuan = 2.35 times.