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Present Status and Prospects of Oyster Industry in Korea

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Oyster is the most important item next to tuna based on the market value in Korea's fisheries exports and it shares more than 90% of the world oyster market. Oyster industry is a vital component of the Korea's aquaculture industry. However, it has faced many problems such as (1) a lower productivity of the culture system, (2) an environmental deterioration of the farming area, (3) a higher labor cost, (4) a shortage of of oysters to export, and (5) a poor seedling in nature. Therefore, including it's business forecast, the above problems and some countermeasures are discussed in this paper.

Key words : Oyster industry, Korea

Introduction

Major aquaculture products in the world market are salmons, mussels, and oysters. The major countries for salmons, mussels and oysters are Norway, Spain, and both Japan and Korea, respectively. Ten species of the oyster are farmed in the world. In 1990, their production was 876,630 tons in total. Among the ten species, the Pacific cupped oyster, *Crassostrea gigas* was 86.4%, and the next was the American cupped oyster, *Crassostrea virginica* 9.4% (FAO, 1992).

In the early 1970's, production of farmed oysters in the world was 710,000 tons. Major countries in production were USA with 350,000 tons and Japan with 195,000 tons. The production of those two countries alone were 76.7% of the world total (Pillay, 1973). However, by 1990, the leading countries in production were Japan and Korea. They produced 53.4% of the world total, 877,000 tons (FAO, 1992). USA produced 66,500 tons, which was less than a fifth in comparison with that of 1970. A tremendous decrease in production of oysters of USA was due to a shut-down of farm areas by two third, which was mainly caused by an enviornmental deterioration (Baker, 1994).

The oyster culture in Korea has a long history, but it has been carried out with the bottom system, a customary style, until recent date. The annual production of farmed oysters in the 1960's was about 40,000 tons, but it increased drastically to over a 100,000 tons by the middle of the 1970's. It was owing to an introduction of the off-bottom culture system with seeds of the Pacific cupped oyster from Japan.

Oyster markets in the world had been dominated by Japan till the middle of the 1980's but thereafter, they have imported oysters from Korea around 10% of their production to meet their domestic market demand (KFY, 1994). Recent years, Korea controls the world oyster market with more than 90% (Cha, 1993).

The oyster industry in Korea has, however, faced many problems. The followings are the some of the problems they face : 1) a lower productivity of culture system due to both a repeated cultivation and a dense culture, 2) an environmental deterioration of the farming area, 3) a higher labor cost, 4) a shortage of oysters to export, and 5) a poor seedling in nature. As a result, most people engaged in this industry tend to think the industry is fading, and they are

trying to find an alternative business.

Oyster industry is a vital component of Korea's aquaculture industry, and we cannot ignore the problems any longer. Therefore, including the business forecast, the above problems and some countermeasures are discussed in this paper.

Present Status

Oyster industry among marine fisheries in Korea is very important. As shown in Table 1, the average amount of marine products exported between 1991 and 1993 were 1.553 billion US dollars a year, and major commodities were tunas caught in the high seas, farmed oysters, *Crassostrea gigas*, and farmed blood cockles, *Anadara granosa*.

Table 1. Annual amount of marine products exported by commodity group in Korea from 1991 to 1993 (KFY, 1994)

Unit : Million US $

Item	Total amounts 1,553 (100%)
1.* Tunas	370.6 (23.9)
2. Oyster (cultured)	95.0 (6.1)
3. Blood cockle (cultured)	91.2 (5.9)
4. Fish jelly	78.5 (5.1)
5. Wakame (cultured)	69.4 (4.5)
6. Sea eel	60.2 (3.9)
7. Hiziki (cultured)	42.9 (2.8)
8. Cuttlefish	32.1 (2.1)
9. Crab	31.5 (2.0)
10. Japanese clam (cultured)	30.9 (2.0)
Subtotal	902.3 (58.3)

*Ranking

Approximately forty marine products have been cultured in Korea during that time, and the major items are shown in Table 2. The six items make up 91.8% of the total production. Wakame, *Undaria pinnatifida* is the first with 36.8%, and the next is oysters with 26.8%.

However, in terms of dollars exported, oyster is the first with 95 million dollars, and the next is blood cockle. This is the most important reason why oyster industry is important among the farmed marine products in Korea.

Table 2. Annual production (MT) of major mariculture products in Korea from 1991 to 1993 (MAFF, 1994a)

Ranking Item	Total production 916,339 (100%)
1. Wakame	336,860 (36.8)
2. Oyster	245,319 (26.8)
3. Laver	180,924 (19.7)
4. Japanese clam	36,662 (4.0)
5. Mussel	24,789 (2.7)
6. Blood cockls	16,287 (1.8)
Subtotal	840,841 (91.8)

For the three year period from 1991 to 1993, the annual production was 245,000 tons with shells and 32,000 tons without shells. Approximately 40% of the total oyster production was consumed in domestic market, and the rest was exported as live, frozen, canned, and dried oysters. Canned and live oysters consist of 79.5% of the total amounts exported in terms of US dollars (Table 3). All live and fresh oysters were exported to Japan, and canned oysters were exported mainly to USA, Canada, Australia.

Table 3. Annual amount of oysters exported by commodity group in Korea from 1991 to 1993 (KFY, 1994)

Unit : Thousand US $

	Amounts (%)	Major countries
Live & Fresh	31,445 (33.1)	Japan
Frozen	14,062 (14.8)	
Canned	44,065 (46.4)	USA, Canada
Dried	5,377 (5.7)	
Total	94,949 (100)	

Problems and Countermeasures

With an introduction of the off-bottom culture system in the late 1960's, farm areas for oysters in coastal waters of Korea had continually developed and increased. As a result, there was a tremendous increase in production of oysters. In 1987, the production of oysters reached a peak with 288,000

tons with shells. However, production per unit area or unit volume has decreased since the early of 1980's. This is the first problem I like to address.

The annual production of total oyster meat and oyster meat per long-line (100 m) from 1971 to 1992 are shown in Fig. 1. In the latter half of the 1970's, the average oyster meat per long-line was 0.56 tons, but it decreased 0.39 tons in the 1980's and 0.36 tons in the early 1990's.

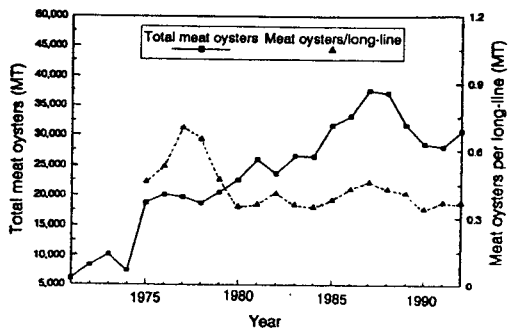

Fig. 1. Annual production of total meat oysters and meat oysters per long-line (100 m) in Korea from 1961 to 1992.

In the 1970's, farm areas of oysters have been drastically extended with a riding on the wave of prosperity. With a taking advantage of an opportunity, denial facilities such as a without license and an extra facility which occupied 18% of total farm areas as shown in Table 4 and an extra numbers of ling-line than official regulations as shown in Table 5 have been prevalent (FOTI, 1986). All of the above contributed to the problems of dense culture.

A dense culture for a long period has let oyster farms deteriorate. In addition to the afore-mentioned high dense culture, a repeated cultivation of same species on the same farm for more than twenty years has resulted a drop of productivity as proven by Ito and Imai (1955).

There are two short-term countermeasures to recover and raiseup the decreased productivity of oysters. One is to introduce a recess system, and the other is a quota system. The recess system is to let a certain farm recess after a fixed number of years in procuction and rotate, like the rotational method used in the agriculture. A quota system is to fix the maximum amount of oysters to be farmed per unit area and controlling the buyers to purchase no more than the fixed quantity. To decrease the oyster quantity produced per unit area within an environmental capacity (Cho, 1980 ; MST, 1992), there should be a mid- and long-term counterplans to prevent dense culture.

Preserving the conditions for healthy populations will be obtained by preserving clean environment with water quality policies and by avoiding overstocking. For example, in France, for every site of oyster culture mandatory levels of rearing densities should be followed by professional people (Bodoy, 1993). In Korea, oyster farms in

Table 4. Denial facility of oyster farm in Gyeong-Nam coast in Korea in 1985 (FOTI, 1986)

	Numbers of long-line	%	Numbers of long-line	%
Legal facility	71,550	82		
Denial facility	15,660	18		
Without license			8,426	9.7
Extra facility			7,234	8.3
Total	87,210	100		

Table 5. Extra facility of space between hanging lines and numbers of hanging line per long-line in Korea in 1985 (FOTI, 1986)

	Space between hanging lines	Numbers of hanging line per long-line
Legal	Over 70 cm	142
Jeon-Nam coast	26~30 cm	333~385
Gyeong-Nam coast	50~58 cm	170~200

Table 6. COD contents in water (mg/l) and bottom mud (mg/g · d) in shellfish farms in Korea in 1993 (MAFF, 1994b)

	Surface	Bottom	Mud
	Mean (Max.)	Mean (Max.)	Mean (Max.)
Jinhae Bay (East)	2.38 (4.40)	2.05 (4.12)	31.22 (38.00)
Wonmoon Bay	2.35 (3.93)	2.16 (3.55)	28.26 (31.66)
Hansan · Keoje Bay	1.75 (4.51)	1.67 (4.75)	11.08 (17.69)
Koseong · Jaran Bay	1.62 (3.88)	1.42 (3.51)	13.82 (16.24)
Gamakyang Bay	1.34 (3.63)	1.45 (3.86)	12.41 (16.23)
Deukryang Bay	1.17 (2.60)	1.18 (2.15)	4.38 (5.62)
Standard	1.0	1.0	20.0

Wonmoon Bay, the west part of the Jinhae Bay, the facilities were cut down by 40% in 1994 for the first time. Farms in Puk Bay will be the next. The movement of shutting down the farm area should be expanded to all oyster farms as soon as possible.

The second problem is the environmental deteriroation of the farms. COD content, an index of environment, shows that almost all farms in Korea are deteriorated. For example, the amount of organic carbons in bottom muds in Jinhae Bay, in where the off-bottom system was firstly introduced, was 0.5~1.0% in 1971 (FRDA, 1972), but it increased to 1.5~3.1% in 1983(Yang and Hong, 1988). It shows that the amount of organic carbons increased three times for the 12-year period. Table 6 shows the COD contents of the major oyster farms in Korea in 1993. The COD contents in seawater and in bottom muds in all oyster farms of Jinhae Bay was higher than the standard amount.

In late 1970's, an increased amount of organic contents was found in bottom muds of the Jinhae bay (Cho and Kim, 1978 ; Cho et al., 1982). The amount of sulfide in bottom muds in the bay also increased from 0.07 mg/g · d in 1976 to 0.29 mg/g · d in 1991 (FRDA, 1977 ; Choi, 1993), which was higher than the standard value, 0.20 mg/g · d. A lower oxygen content in bottom waters has also occurred almost every year since the middle of 1980's (Hong, 1987).

Another facter for the deterioration of the farms is land-originated various pollutions and pollutions from the culture itself. The best way to prevent pollutions from land would be an areawide total COD pollutant load control, which is thoroughly adopted by Japan already (EAJ, 1990). There is a same law in Korea, but it is useless because troublesome supplementary articlesattached to the law limits the enforcement of the law (Lim, 1988).

To cut down pollutions due to the culture itself depends upon farmers and officials on duty. Farmers should avoid a dense culture. Also, at license renewal time, officials shoulod thoroughly check the maintenance of the farm.

As shown above, accumulations of organic materials on bottom muds influence a drop of oyster productivity (Seisi and Tetus, 1942). Some studies are being done to improve the environment of oyster farms in Korea. For example, a machine was invented to improve deteriorated bottom mud, and it was found effective (MAFF, 1994b). However, it is still in an experimental stage. At the same time, special boats for cleaning and plowing bottom have been launched since 1994, and there is a plan to build more boats every year until it reaches a satisfied level. They are, however, not as effective as we expected and should be improved. A research on an improvement of oxygen contents in the deteriorated farm (Choi et al., 1994) is worth consideration.

A fallen oyster production due to the above has resulted in a shortage of oysters to export. Around 60% of oyster meat a year from 1991 to 1993 was exported and the most important item was canned oysters as shown in Table 3. Quantity of canned

oysters exported has been, however, sharply decreased since 1989. In case of 1992, it dropped to 24% in comparison with that of 1988. The reason was due to sharp decrease in oyster production as shown in Fig. 1.

The third problem of oyster industry in Korea face is a reduction in seedling in nature. Thirteen million ryens (=strings) of seeds are needed a year in Korea. A ryen consists of fifty oyster shells and each shell contains about thirty seeds. Oyster seeds had been produced in nature till the early of 1990's, but the production fluctuated significantly depend upon climatic conditions. Seedling in 1992 was very poor and the produced quantity was less than 50% of what we needed. It was worse the following year. Therefore, seeds have been imported from USA and Japan. Oyster larvae corresponding to 330 thousand ryen in 1993 and 4,460 ryens in 1994 from USA and seeds corresponding to 250 ryens from Japan were purchased (Table 7). Such purchases can only be a short-term counterplan.

Table 7. Oyster seeds (as a numbers of hanging line) imported from USA and Japan from 1993 to 1995.

Unit : Thousand lines

	1993	1994	1995 (Schedule)
U.S.A. : Larva	330	4,460	400
Seed	−*	−	3
Japan : Seed	−	250	300
Total	330	4,710	703

*A hanging line consists 50 collectors and numbers of seed are about 30 per collector. Korea requires about 13 million lines per year (Personal communication with The Oyster Culture Cooperative, Korea)

With the government support, nursery facilities to produce artificial seeds have been under construction since 1994. But we lack the technical experts to work with the nursery facilities. The same problem in seedling also occurred in France in the first half of 1930's and from 1967 through 1981 (Bodoy, 1993). Japan also faced the same situation in 1990 (Mori, 1994). It has been reported that either TBT contained in paints using for protection of the corruptive and adhesive organisms (His and Robert, 1980 ; Mori, 1994) or a short of stimulants in the seawaters (Coon and Bonar, 1985) are involved with poor seedling. But it is yet to be proven.

There is also two another problems beside the afore-mentioned. One is that oyster processors want to expand oyster farms for sufficient oysters to export while farmers stand against them for the reason that an increase in production leads to a reduction in price (Cha, 1993). That is the very reason why some processors import oysters from China, but the oyster quality is not as good as the Korean and it causes frictions with the native farmers. The other is a cultivation of sea-squirts such as *Styela clava* and *S. plicata* without licenses in same area of oyster farms. They deteriorate the oyster farm enviornments and create a competition for plankton-feeders. Sea-squirts have been cultured since the late of 1980's for a good profit. Nowdays, their production is only a little over 10 thousand tons (MAFF, 1994 a) but expected to grow.

Prospects

Oyster processers in Korea worry about a decrease in consumption market due to a high price caused by an insufficient amount oysters. They also fear over a possible competition from China who is producing a large quantity oysters each year. If the Chinese oyster market keeps growing, Korea will not be able to take the lead in the world oyster market.

To save the oyster industry of Korea from an anticipated and severe international competition from China, the problems aforementioned should be solved as soon as possible. In addition, the labor cost should be cut down with an introduction of mechanization. Also, quality of oysters should be

improved by keeping quality mother shells instead of selling which is the current situation. To find a way to sell oysters as 'half shell' instead of selling in oyster meat will be another way to increase the best margin.

To conclude, it is inevitable that Korea will not be able to continually keep her domoinant position in the world oyster market with the beginning of a full-scale competition from China. Therefore, the oyster industry in Korea should be preserved and supported by the government as a major aquaculture item.

References

Baker, J., 1994. A keynote address. EMECS '93 held on Nov. 10−13 at Baltimore, Maryland, U.S.A.

Bodoy, A., 1993. The French experience in the management of oyster production. pp. 41−54. *In* Proceedings FOID '93 held on Feb. 12 at National Fisheries Univ. Pusan, Korea.

Cha, S. H., 1993. A stable supply of oysters for canned provisions influence the export. Monthly magazine, Korean Aquaculture 93 /9. (In Korean).

Cho, C. H., 1980. Farming density of oyster in Hansan-Geoje Bay. Bull. Kor. Fish. Soc., 13 : 45−56 (In Korean with English summary).

Cho, C. H., H. S. Yang, K. Y. Park and M. K. Youm, 1982. Study on bottom mud of shellfish farms in Jinhae Bay. Bull. Kor. Fish. Soc., 15 : 35−41 (In Korean with English summary).

Cho, C. H. and Y. S. Kim, 1978. Environment in the oyster farm area. Superficial mud characteristics near Chungmu. Bull. Kor. Fish. Soc., 11 : 243−247 (In Korean with English summary).

Choi, W. -J., 1993. Numerical simulation of the formation of oxygen deficient water mass in Jinhae Bay. Ph.D. Thesis, Fisheries Natl. Univ. of Pusan. 97pp. (In Korean with English summary).

Choi, W. -J., C. -K. Park and S. -M. Lee, 1994. Numerical simulation of the formation of oxygen deficient water-mass in Jinhae Bay. Bull. Kor. Fish. Soc., 27 : 413−433. (In Korean with English summary).

Coon, S. L. and D. B. Bonar, 1985. Induction of settlement and metamorphosis of the Pacific oyster, *Crassostrea gigas* (Thunberg), by L-DOPA and catecholamines. J. Exp. Mar. Ecol., 94 : 211−221.

EAJ, 1990. Water quality management in Japan. Water Quality Bureau, Environment Agency of Japan. 27p.

FAO, 1992. Aquaculture production, 1984-19 90. FAO Circular No. 815, Revision 4, 206 pp.

FOTI, 1986. An efficient management's program on the mariculture farm. Fisheries Officials Trainning Institute. A policy seminar held on July 21-23 at Pusan, Korea (In Korean).

FRDA, 1977. Tchnical Report. No. 36. Natl. Fish. Res. Dev. Agency (In Korean).

FRDA, 1972. Tchnical Report. No. 12. Natl. Fish. Res. Dev. Agency (In Korean).

His, E. and R. Robert, 1980. Action d'un sel organo-metallique, l'acetate de Tributyletain, un les oeufs et les larves D de *Crassostrea gigas* (Thunberg). Int. Council Explor. Sea, Mariculture Committee, CM 1980 F/ 27, 10p.

Hong, J., 1987. Summer oxygen deficiency and benthic biomass in the Chinhae Bay system, Korea. J. Oceanol. Soc. Kor., 22 : 246 −256.

Ito, S. and T, Imai, 1955. Ecology of oyster bed. 1. On the decline of productivity due to repeated cultures. Tohoku J. Agr. Res. 5 : 9−26 (In Japanese with English summary).

KFY, 1994. Korean Fisheries Yearbook. The Fisheries Association of Korea (In Korean).

Lim, G. -T., 1988. Enactive review of Korean Environmental Protection Act. pp. 1405-1419. In memoration of Bong-Soo Cheong, Bull. Natur. Sci., Dong-A University (In Korean with English summary).

MAFF, 1994a. Statistical Yearbook of Agriculture, Forestry and Fisheris. Ministry of Agriculture, Forestry & Fisheris, Republic of

Korea (In Korean).

MAFF, 1994b. Studies on the development of restoration techniques to improve the polluted sediments of coastal shellfish and finfish growing areas. Ministry of Agriculture, Forestry & Fisheries, Korea. 317p. (In Korean with English abstract).

Mori, K., 1994. An urgent problem related to the coastal waters surroungding oyster-culture areas in Asia. pp. 122－123. The 1st Korea and Japan's symposium on aquaculture held on May 20－22, 1994 at cheju Natl. University.

MST, 1992. The modelling on environmental capacity in the coastal growing area of Wonmun Bay. Ministry of Science & Technology, Korea. 175p. (In Korean with English abstract).

Pillay, T. V. R., 1973. The role of aquaculture in fishery development and management. J. Fish. Res. Bd. Can., 30 : 2202－2217.

Seisi, R. and T. Tetuo, 1942. On the unusual death of the oyster in relation to the sulfide-contents in the bottom deposits of the brackish water Lake Hamanako. J. Oceanogr., 1 : 75－84 (In Japanese).

Yang, D. B. and J. S. Hong, 1988. On the biogeochemical characteristics of surface sediments in Chinhae Bay in September 1983. Kor. J. Fish. Soc., 21 : 195－205.