

# **Korean Aquaculture: Status and Future Directions**

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## Introduction

Korean fisheries has been through long history due to the geological profiles. Korean peninsula is surrounded by the East sea, the West sea (the Yellow sea) and the South sea. Various seafood have been caught or cultivated under different environment condition in three coastal area, as well as Korean government put large effort to explore the fishing ground to meet the market demand for sea food.

The quantity of production has been sharply increased until 90's which based on population growth and high demand for the seafood. Total fisheries production in 2005 (2,714,050 M/T) was a little increase compare with total production of 2004 (2,519,101 M/T) in quantity, and the value of production has increased by 6.3 % in 2005. The term of 'total fisheries production' is composed with all type of catches from distance fishing, coastal fishing, aquaculture and inland fishing, though excluding the quantity of importation (Fig. 1).

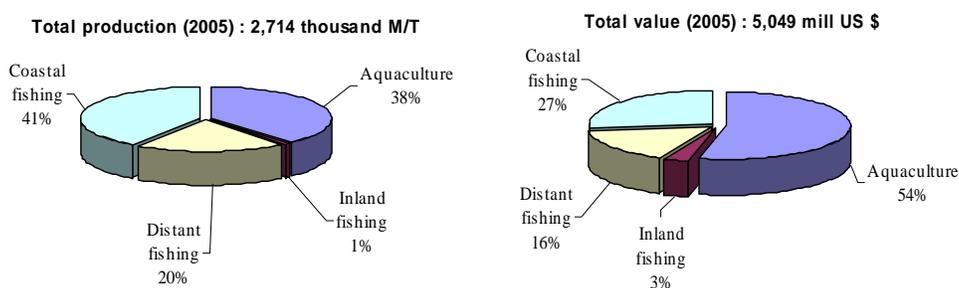


Fig. 1. Fisheries production and its value in 2005.

However, recent changes of preferable taste and way of cook amongst young generation does affect to the size of seafood market directly or indirectly. Only big fisheries company could cope this changes based on market survey but still rest of small size are not aware of the direction of such changes. Based on this trend, fisheries industry, in terms of structure and production as well as marketing strategy has to be considered toward future market demand.

Although aquaculture technology for live fish production was significantly improved during 1980 and government was aware of the important role of aquaculture production replacing the shortage of coastal catches, current situation of aquaculture industry doesn't look promising to supply the good quality and enough quantity of products to the market. Recently, the aquaculture industry has been facing serious difficulty not only due to water pollution, typhoon and red tide but also opening of fisheries market with the system under World Trade Organization (WTO).

## Status of Korean aquaculture

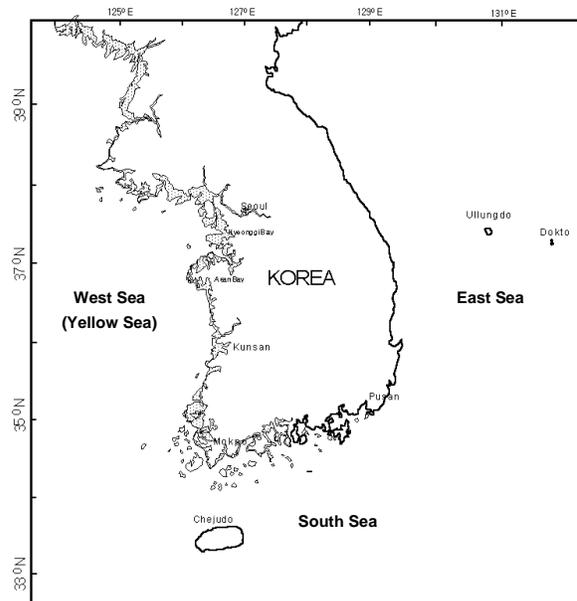
### *Brief history of Aquaculture*

Coastal aquaculture is the most active and predominant type of mariculture in Korea. It has been rapidly developed since last 30 years in Korean sea and the major species have changed every 10 years term as ; seaweeds culture (Laver, *Porphyra tenera*, Sea mustard, *Undaria pinnatifida*) used to be the main species of mariculture during 1960's, so as shellfish farming (Mussels, *Mytilus edulis*, oyster, *Crassostrea gigas*, arkshell, *Scapharca brogtonii*) during 1970's. Meantime, breeding and hatching technique has set up to some marine fish, red sea bream (*Pagrus major*), flounder (*Paralichthys olivaceus*) as well as black rockfish (*Sebastes schlegeli*) during 1980's. Since then, marine fish farming has become the most rapidly growing industry and economically profitable although family run business. During 1990's, the production of flounder and black rockfish (*Sebastes schlegeli*) has sharply increased and led the live fish supplies to the seafood market. Techniques of mass production for few marine finfish species was completely stabilized during these times and industry developed separately from hatcheries, grow-out production to the associated industries such as, feed manufacturing, farm construction and live-fish transportation etc. As growing market demand, more production but lower costs of fry supplies were ineludible direction to the industries, in consequence, more fry production units have been built up along the south coast up to 1998.

### *Geological background*

Total costal line in Korea peninsula is 11,542 km along with 3000 islands. Three typical geographical profiles showed as follow ;

- **East coast** (dong hae-an) shows simple and straight in general. Mountainous land sharply slides down to the seaside and water depth drops 100 m within 500m away from the beach. Warm water from Tshuma current and cold water current from Liman confronts around 37°N, where used to be an active fishing ground. However, aquaculture in this coast is not well developed because accessibility for land use for inland-farm is not sufficient and also high wave for cage culture.



- **South coast** (nam hae-an) is archipelagic and most islands are located in this area. Strong currents, mainly influenced by Tsushima is dominant as water depth is relatively shallow (20-50 m with 1 km away) compared with east coast. All type of aquaculture have been placed in this area and known to be the most active place for aquaculture since 1960.
- **West coast** (The coastal line of Yellow Sea, seo hae-an) is also archipelagic even mud flat is well developed along the west coast. The tidal flux is recorded as 5-10 m during a day. Landscape along the west coast is also flat and muddy containing 50-70% of clay. Shellfish and some crustacean are actively cultivated in this area.

***Environmental conditions for aquaculture***

Having typical four seasons in a year, fluctuation of water surface temperature is shown in Table 1. Salinity surrounding Korean peninsula is ranged from 31.4-34.4‰ all year around and salinity in the west coast is lower than the east coast.

Table 1. Variation of surface water temperature monitored for 30 years at three coastal sides in Korea

	(°C)					
	Feb	April	June	Aug	Oct	Dec
East coast	10.3	13.5	17.5	22.5	19.2	14.4
West coast	4.8	6.5	15.7	24.8	18.8	10.1
South coast	9.6	11.8	17.5	24.9	21.5	12.4

Most cages culture takes place in the embayed sites where

- water depth is below 50 m
- have no strong wave action
- can escape from typhoon (3-5 times during July to August).

However, the problem recently faced in this shape of farming area is water pollution and the red tide. Although not clear evidence of using moisture pellet to the farm cause water pollution and red tide, the frequency of outbreak of red tide is increasing along coastal area. It does effect to the hatching process which requires high quality of seawater intake from seashore as the most hatcheries are located along the coastal area.

### ***Licensed Area for aquaculture***

Licensed area for aquaculture in 2005 has reported 124,688 ha and 1,822 ha for fish culture. The biggest area and number are owned by seaweed culture as 69,503 ha and 2,149 farms, respectively, and then shellfish (Fig. 2).

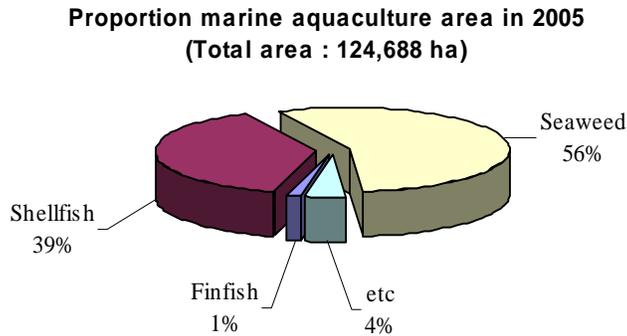


Fig. 2. Aquaculture area by species in 2005.

### ***Aquaculture production***

The major portion of marine aquaculture production is seaweeds, next is shellfish. However, we have to take notice that fish production is increasing rapidly. In 2005 it was about 81 thousand tons (Table 2). Inland aquaculture production is different from that of marine aquaculture. In inland aquaculture, fish production is the biggest component, being nearly 16 thousand tons in 2005. In fish culture, flatfish culture is the primary industry, and then rockfish, seabream and mullet in that order. Eel is the largest species produced in inland aquaculture, next is trout, cat fish and carp in that order in 2005. However, carp and yellow tail production is decreasing rapidly.

Table 2. Aquaculture production by culture species

	(M/T)					
	2000	2001	2002	2003	2004	2005
Total	653,373	655,827	781,544	826,298	917,715	1,041,058
Fish	25,986	29,297	48,073	72,393	64,476	81,421

Shellfish	222,608	217,078	212,433	291,116	304,889	326,255
Seaweed	374,456	373,538	497,557	452,054	536,748	621,156
others	30,323	35,914	23,481	10,735	11,602	12,226

### ***Aquaculture profile***

Aquaculture in the sea has developed differently by three coastal types.

**East coast:** Because of simple coastal line and tough wave action, no active aquaculture has been taken place in this side of coast. Flatfish (*P. olivaceus*) culture on the land based tank is main species near southern-east coast and scallop (*Patinopecten yessoensis*) farming is in northern east coast.

**South coast:** Archipelagic environment makes this side of coast environment ideal to install the cages. Particularly, KyoungNam and ChonNam province are traditionally key areas to produce the variety of seafood and record the highest aquaculture production through all types of aquaculture, such as cages for bream and rock fish, in-land based grow-out farm for flatfish, long-lining for oyster and mussel. The species cultivated is list below

- Finfish : rockfish (*S. schlegeli*), red sea bream (*Pagrus major*), Striped perch (*Oplegnathus fasciatus*), Black porgy (*Acanthopagrus schlegeli*) and seabass (*Lateolabrax japonicus*) in the cages and flatfish (*P. olivaceus*) in the land based on-growing tank.
- Shellfish : oyster (*Crassostrea gigas*), mussel (*Mytilus galloprovincialis*), cockleshell (*Tegillarca granosa*), arkshell (*Scapharca brogtonii*), pearl oyster (*Pinctada fucata martensii*) and abalone (*Haliotis discus hannai*) etc.
- Seaweeds : laver (*Porphyra tenera*), sea mustard (*Undaria pinnatifida*) and sea weed fusiforme (*Hizikia fusiforme*) etc.
- Others : Sea squirt (*Halocynthia roretzi*)

**West coast:** shrimp (*Penaeus japonicus*, *P. chinensis*) and Chinese mitten crab (*Eriocheir chinensis*) is mainly cultivated in Taean, ChungNam and Sinan, ChonNam. Rockfish (*S. schlegeli*), black porgy (*Acanthopagrus schlegeli*), seabass (*Lateolabrax japonicus*) and river puffer (*Takifugu obscurus*) is also produced in this region. Shellfish culture such as short-necked clam (*Ruditapes phillipinarum*) and oyster (*Crassostrea gigas*) is also active in the

coast. Currently, use the earthen pond for the finfish culture has been tried and obtained reasonable results.

***Cheju province:*** Warm and good quality of water supply, in particular, bore water available from the coast are advantage of this island. Flatfish (*P. olivaceus*) production is mostly competitive for Japanese market after being recognized as the best quality fish.

### **Future directions of Korean aquaculture**

The integrated aquaculture management has created an alternative plan in order to overcome many problems. In the integrated aquaculture management, the scope of aquaculture ground extends to open areas where have never been included as a part of until very recently. The aquaculture ground is divided into 3 subdivisions: the areas for land-based aquaculture, the polytrophic aquaculture, and the offshore aquaculture. Land-based aquaculture, systems are principally positioned on the upper parts of inertial zone and the locations over the inertial lines. In the former system, culture waters are exchanged by the gravity which was caused by the tidal movement, while exchanging with an aid of electronic power in the latter system. Cultures of tank, pond, raceway, silo, and recirculation are available. Urban aquaculture is also belonging to this management. The polytrophic aquaculture basically focuses on the ecosystem-based aquaculture, where two different trophic organisms are maintained in a given aquaculture ground. In practical sense, systems for algal seaweeds and bivalves are alternatively deployed. The seaweeds in the polytrophic system utilize nitrogen compounds from metabolic activity of the bivalves, otherwise the compounds are accumulated on the ground as an organic pollutant. The offshore aquaculture is most advanced technology for finishing and shell fishing. One of the biggest problems in front of the successful introduction of the offshore aquaculture is how to overcome the high surface energy which can physically damage cages in the open environment. There is less likelihood that the cage will be damaged by physical energy, even during typhoons, for the cage is submerged. The submerged cage can eliminate visual impact coming from deployment of cages in the coastal waters. The most outstanding advantage of the offshore aquaculture is the aquaculture activity in the waters having higher carrying capacities.