

Aquaculture in Korea

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South Korea is peninsula with a 2,413 km coast line. The total land mass of the country is 98,480 km², (including 290 km² of inland water) but usable land is only 20% of the total and the population is thus concentrated around the coast. Not surprisingly Koreans obtain more protein from fishery products than red meat. The Korean Food Year Book 2007 reported that annual per capita sea food consumption was 48.1 kg in 2005. Because of the high consumption of fishery products, the industry is recognized as an important national industry, although it contributes only 1% of Korean GDP.

Extensive aquaculture has been practiced in Korea for several hundred years, but modern intensive culture (mainly of sea weed and shellfish) did not emerge until the 1960's. However, production was less than 100,000 metric tons in this period. From the 1970's aquaculture production increased year on year from around 147,000 metric tons in 1971, to reach more than 700,000 metric tons in 1981 and over 1.2 million metric tons in 2006.

Year	Capture		Culture	Total
	Coastal	Offshore		
1971	766	159	147	1,073
1976	1,257	724	410	2,407
1981	1,528	542	701	2,811
1986	1,726	930	947	3,660
1991	1,304	874	775	2,952
1996	1,623	715	874	3,214
2001	1,252	739	656	2,647
2006	1,109	639	1,259	3,007

Table 1. Contribution of capture fisheries and aquaculture to Korean fishery production (1971-2006)

Mariculture

Mariculture makes up 99% of aquaculture production. Production is dominated by seaweeds and followed by molluscs and finfish.

Fishery products	Tonnes	%
Seaweed	764,913	60.7
Shellfish	391,060	31.1
Finfish	91,123	15.2
Others	12,128	0.9
Total	1,259,274	100

Table 2. Production of different aquaculture products in Korea 2006

Seaweed culture

Seaweed culture in Korea is mainly concentrated on the south western coast where almost 90% of cultivation takes place. *Undaria* dominates production constituting 42% of the total wet weight. However, *Porphyra* is the most valuable species totalling 65% of overall value. *Porphyra* cultivation in Korea reached a turning point in the 1960s when the method of seeding changed from natural to artificial using oyster shells. Since the early 1980s, the previously used

Seaweed	Tonnes	%
Porphyra	217,559	28.4
Undaria	322,371	42.1
Laminaria	201,919	26.4
Hiziki	21,125	2.8
Others	1,939	0.3
Total	764,913	100

Table 3. Production of cultured seaweeds in Korea in 2006

floating system was replaced by a rack system, and frozen, seeded nets are commonly used. Production has also been boosted by the transplanting of new species and expansion of the culture areas.

Porphyra production from aquaculture is currently estimated to be 217,559 tons (wet wt.) which is equivalent to more than 10 billion sheets of dried laver. *Porphyra* needs to be exposed to the air from time to time. On ground that is unsuitable for racks, floating rafts are used. These consist of frames of plastic tubing to which up to 100m of nets can be attached. The frames are arranged in such a way that the nets are exposed to the air for 3-4 h every day. *Undaria* and *Laminaria* are cultured using a long-line method in which culture ropes are laid in parallel with the main water flow. The ropes are checked every month to thin the plant densities and to remove trapped debris and fouling organisms. The plants are kept approximately 1~2m below the surface.

Mollusc culture

Production of molluscs reached 391,060 MT in 2006, making up 31.1% of the total mariculture production. The major species cultured are oysters (*Crassostrea gigas*, *Pinctada fucata*), mussels (*Mytilus coruscus*), Manila clams (*Ruditapes philippinarum*), ark shells (*Anadara satowi*, *A. broughtonii*), cockles (*A. granosabisenensis*, *A. subcrenata*), scallop (*Patinopecten yessoensis*), and abalone (*Haliotis discushannai*). Oysters dominate production. In 2006, oyster production was 283,296 MT, accounting for 72.4% of the total yield of cultured invertebrates.

Molluscs	Tonnes	%
Oyster	283,296	72.4
Mussel	81,617	20.9
Manila clam	14,327	3.7
Arkshell	7,127	1.8
Abalone	3,050	0.8
Others	1,643	0.4
Total	391,060	100

Table 4. Production of cultured mollusc species in Korea 2006

Culture of oysters, mussels and pearl oysters is based on the long line system. In this system, the floating lines are laid on the water surface. The long lines are 100m in length and laid 5 ~ 10m apart. Vertical ropes are hung from the long line at intervals of 50 ~ 70cm and seed collectors are attached to these ropes at intervals of 30 ~ 50cm.



Cage farms for finfish culture near the shore

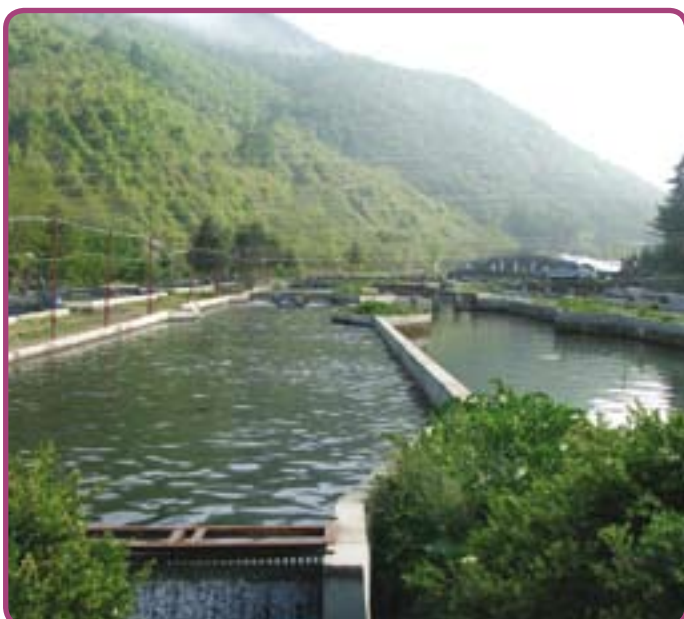
Bottom culture is employed for molluscs such as arkshells and Manila clams. The parameters affecting site selection include water depth, water temperature, algal foods and bottom substrate. Normally, water depths for bottom culture are less than 20m for most species but arkshells are cultured below the intertidal zone down to 40m depth.

Finfish

With the development of advanced aquaculture technology, olive flounder, *Paralichthys olivaceus*, together with black rockfish, *Sebastes schlegeli*, sea breams, *Pagrus major* and *Acanthopagrus schlegeli*, and grey mullet, *Mugil cephalus*, have been important marine finfish cultured since the late 1980s. Finfish production in 2006

Finfish	Tonnes	%
Olive flounder	48,852	48.1
Rock fish	27,517	30.2
Sea breams	8,777	9.6
Grey mullet	5,651	6.2
Sea bass	1,571	1.7
Others	4,090	4.5
Total	91,123	100

Table 5. Production of cultured finfish in Korea 2006



Rainbow trout farm

was 91,123 tonnes, 15% of total marine production, but because of trends in consumption in Korea, finfish culture is the most valuable aquaculture production. The highest production of cultured fish was from olive flounder (48.1%), followed by black rockfish (30.2%), sea breams (9.6%) and grey mullet (6.2%). Although culture of olive flounder started only in the late 1980s, Korean production exceeded that of Japan by 1997.

Olive flounder is reared in land-based raceway culture systems where water is pumped ashore.

Farms are usually located on the south and west coasts and each farm usually produces on average about 110 tonnes per year with mean stocking densities of 20kg/m³. Other fish species such as sea breams or mullet are grown in floating cages or enclosures. Cage cultures are more common. The cages are 5m x 5m or 10m x 10m in size and stocked with 700-1000 juveniles per m³ at a length of 4cm to 5cm.

Freshwater culture

Freshwater culture represents only 1% of total Korean aquaculture production. Eel ponds were first constructed in 1924 near Busan, but the operation was discontinued in the 1940's. A further attempt was made in 1966 in Noksan, Kimhae, near Busan, using wild evers. The rainbow trout was first introduced into Korea in 1965, but the annual production remained negligible (below 10 tonnes) until 1980. Production then increased reaching 704 tonnes in 1987 and more than 5000 tonnes in 2006. The main area of trout production is Gangwon-do, where relatively large amounts of upland cool spring water are available. In some sites ground water is used.

Korea has traditionally been a seafood exporter but increasing domestic demand and decreased local production means Korea currently imports \$ 1.7 billion more seafood products than it exports. It is unlikely that Korean capture fisheries will be increased due to stock depletion and that aquaculture will be increasingly important. However, the Korean aquaculture industry also faces problems such as natural disasters (typhoons and red tides), low price imported products and lack of highly skilled manpower. To circumvent these problems there will be expansion of offshore culture sites, and increasing use of automated management systems.



Submerged nets for sea weed culture