

KOREAN FISHERY DEVELOPMENT AND GROWTH : SUSTAINABILITY AT STAKE

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I. Introduction

Korean fisheries were limited to coastal fishing until the early 1960s, but since the mid 1960s the development of sea aquaculture and overseas fisheries has made a great contribution to a rapid growth of the Korean fishing industry. Korea is now one of the world's major fishing countries in production and trade.

The importance of Korean fisheries can be considered from several points: (i) the Korean fisheries sector has had and will continue to have a dominant effect on the national supply of animal protein, even though livestock meat and certain nonmeat foods have, in recent years, claimed an increasing share in consumer diets; (ii) it has provided coastal communities with an important source of income and employment; and (iii) it played an important role as a good source of foreign exchange earnings at the early stage of economic development.

However, the significant declining of the entire coastal fishery resources, coastal land use conflictions and ocean pollution are expected to put much more constraint on the sustainable development of the Korean fisheries sector than ever before. Furthermore, the introduction of 200mile Exclusive Economic Zone(EEZ) by most coastal states and the international forces arising from common fishery resource management and trade liberalization will have profound impacts on the Korean fishery economy.

In this regard, the main purpose of this paper is to overview the present status of Korean fisheries, to identify some important problems

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affecting Korean fisheries and to make policy recommendations for a sustainable* Korean fisheries sector.

II. The Present Status of Korean Fisheries

1. Coastal Fisheries

In spite of Korean fishermen's long association with fishing activities, market-oriented commercial fisheries have existed only for the last three decades. During the period there have been remarkable changes in coastal and offshore fisheries.

Changes in the number of fishermen and production structure are two important indicators of the transformation underway in Korean fisheries. In 1991 there were 119,800 thousand fishery management units, of which 23.5 percent could be categorized as full time management units. The number of fishery workers is 204,600 thousand which has been on the declining trend. Among those, 32 percent engages in vessel fisheries, 48 percent is employed in the mariculture sector and the remaining of 20 percent engages in collection of natural shell fish and seaweed.

The age structure of fishery workers showed the most significant change. The fishery workers of age 20 - 49 has decreased from 70.1 percent in 1971 to 57 percent in 1991 while during the same period fishery household members older than 60 have increased from 6.05 to 11.7 percent.

The number of fishing vessels and power have continued to increase over time. During the last two decades they expanded by 1.5 and 2.5 times, respectively. The ratio of power to nonpower vessels also showed a remarkable increase of 60 percentage from 21% in 1971 to 81% in 1991(table 1).

* The concept of sustainable development is defined as a framework for the integration of environment policies and 'development' strategies-the term development being used here in its broadest sense.

TABLE 1. Coastal Fishing Vessels (thousand)

		1971	1981	1986	1991
No. of Vessels	No.	67	80	93	104
Gross Tonnage	G/T	392	781	883	982
Power Vessels	No.	14	59	74	84
	G/T	307	757	862	961
Non-power Vessels	No.	53	21	19	20
	G/T	85	24	21	21
% of Powered Vessels	No.	21	74	79	81
	G/T	78	97	97	98

Source: Korea Fishery Administration, 1972-1992 Annual Reports of Korean Fisheries

As seen in Table 2, the fishery production including fish, shellfish, and seaweed has increased threefold over the past 20 years. About 70 percent of the 1991 catch was derived from the adjacent vessel fisheries(44%) and ocean culture(26%). In major fish species are included sardine, mackerel, filefish, anchovy, hair tail, squids, corvenias, blue crab, jack mackerel, cuttlefish, Alaska pollack, and saury. The remainder was made up by the distant water fisheries. However, post-harvest losses of more than 10 percent of the total catch are believed to arise through poor processing, storage and handling.

TABLE 2. Fisheries Production (thousand M/T)

Year	1971	1976	1981	1986	1991
Total	1,074	2,407	2,812	3,660	2,983
Adjacent	767	1,257	1,529	1,726	1,304
Sea Culture	147	411	701	947	775
Inland	1	15	40	57	30
Distant	159	724	542	930	874

Source: Korea Fishery Administration, 1972-1992 Annual Reports of Korean Fisheries

The inshore fisheries have played an important role in Korean fisheries in two ways: one is to serve as a major income source for small-scale coastal fishing households; another to supply high quality

species fish for national consumption, which is obtained from the exploitation of the coastal fishery stocks.

In addition, coastal water has been intensively utilized for ocean aquaculture. The Korean shallow-sea culture began to develop since the early 1960s. At the beginning of its development, seaweed (i.e., brown seaweed and laver) was the most important culture crops. In the early 1970s shellfish culture technologies were introduced into the Korean ocean-culture system. Oyster and arkshell were added to the major culture items. Fish culture is just on the germinating stage. As of the end of 1991, Korean mari-culture production accounted for more than 26 percent of the total fishery production.

TABLE 3. Mari-Culture Production (thousand M/T)

Year	Total	Shellfish	Seaweed	others
1971	147	98	49	-
1976	411	219	192	-
1981	701	318	383	-
1986	947	399	524	24
1991	775	308	446	21

Source: Ministry of Agriculture, Forest and Fisheries(MAFF), Major Statistics of Agriculture, Forestry and Fisheries, 1972-1992

The major offshore fisheries consist of otter trawl, angling, long line, and offshore trap. They operate powered-large-scale vessels which require relatively large capital investments and account for 23 per cent of the total Korean catch. The main species are highly migratory and considered trans-boundary* international resources that are commonly shared by Korea, Japan, and China.

* Trans-boundary fishery resources are highly migratory species, and they are subdivided into shared and straddling stocks. A shared stock is one that crosses the boundary of a coastal state EEZ into the EEZs of one or more neighbouring coastal states. A straddling stock, on the other hand, is one which crosses the boundary of a coastal state EEZ into the remaining high seas.

2. Overseas Fisheries

Korean overseas fisheries started in 1957 with the tuna fishery in the Indian Ocean. The middle of the 1970s was the takeoff period of Korean overseas fisheries. During this time there was a rapid expansion in production and fishing power. It has played an important role in the development and growth of the Korean fishery economy for the following reasons: (i) the fishery promotion and export-drive policies, (ii) the demonstrated viability of unexploited resources in some high seas, and (iii) the increase of domestic and international demand for fish and fish products.

The distant-water catch, which was merely 159 thousand M/T in 1971, showed a remarkable increase to 874 thousand M/T in 1991. The number of fleets was expanded from 298 to 771 during this time. Among the major overseas fisheries are tuna longliner in home port base, squid gill net, and trawl in foreign base.

However, according to the 1982 third Convention on the Law of the Sea, the international law of marine fisheries has substantially modified the freedom of fishing on the high seas by subjecting the general principle to a wide variety of specific conditions and restrictions. Recently the worldwide fishing jurisdiction was extended to a 200-mile exclusive economic zone (EEZ) with more international force than ever before. Such international forces, dictating either harvest of fish for domestic consumption or the acquisition of foreign exchange through the exports of high-value fishery products, are prime movers in determining jurisdictional claims on extended fishery resources.

In particular, the 200-mile EEZ declaration in 1977 by the U.S. and the USSR severely limited Korean distant-water fishing areas in the North Pacific Ocean. Since then the Korean North Pacific fisheries have gradually moved to the Bering high sea, which at present is the most important deep-sea fishing ground.

Furthermore, on December 20, 1991 the United Nations passed a resolution in favor of the large-scale pelagic drift-net fishing moratorium on the Pacific Ocean. It posed the most serious hardship in the recent history of the Korean overseas fisheries. Thereafter, responsible fishing has been emphasized on the global dimension through many international fishery organizations.

3. Trade of Fishery Products

The Korean fisheries development has been much influenced by Korea's outward-looking development policy emphasizing export growth. The essence of outward-looking strategy was to make use of the nation's comparative advantage in production of labor-intensive commercial goods.

However, unlike the agricultural and forestry sectors, the Korean fishery sector has been able to make better progress as an export-oriented industry with its relatively favorable natural resource endowment and abundant labor force.

During the period from the mid 1970s to the mid 1980s, the Korean government sought to attract large foreign capital. Part of the foreign borrowing was allocated to the fisheries sector for modernizing fishing vessels and equipment and for developing distant-water fisheries. As a result, the Korean fisheries production in 1991 exceeded domestic consumption by some 600 thousand M/T.

In 1991 Korean fishery products were exported to more than 80 countries and the export volume was US\$1.6 billion dollars. About 88 percent of the export quantity was concentrated on the Pacific Basin countries including Japan, the United States, Taiwan, Hong Kong, Singapore, and Australia.

On the other hand, the imports amounted to US\$576 million from 33 countries. About 43 percent came from the Pacific coastal countries: the United States, Russia, Argentina, China, New Zealand, Japan, and Thailand. Recently Korean imports of fishery products have increased rapidly and this upward import trend is expected to continue, thanks to trade liberalization policies of fishery products.

There is no doubt that Korean government has implemented restrictive policies on the importation of fishery products. As of January 1, 1991, while the import liberalization ratio of entire commodities amounts to 97.6 percent, that of fishery products remains at 74.2 percent which is much lower than those of agricultural and forestry products. Such import restrictions have been mainly due to small-scale coastal fishery problems: relatively low level of income and living standard and limited opportunities of off-shore fishery jobs.

It has generally been recognized that the small-scale fisheries

sector in many countries has serious socio-economic problems, which tend to become more pressing under the rapidly changing social, technological, and trade environments. In Korea, the smallscale fishing sector still is an important source of animal protein supply and provides employment opportunities for a large protion of the labor force in fishing communities. In spite of much effort to improve the state of small-scale fisheries, fishermen and their families continue to live on the edge of subsistence and human dignity. This reality is expected to impede Korea's effort to soon liberalize imports of all fishery products without exception in the immediate future.

III. MAJOR PROBLEMS OF KOREAN FISHERIES.

1. Coastal Fisheries Management System

Korea's fishery management policies are primarily aimed at: (i) a commitment to rational management of scarce fishery resources, (ii) the protection of the income and employment of fishing households, and (iii) the restructuring of national fisheries over the future years to bring capacity in line with the available resources.

Fishery regulators have found ways to control virtually every aspect of the fishing operation to achieve these policy goals. Regulations affecting vessel type, dimensions, horsepower, and tonnage are common, as are regulations affecting the type, size, and construction of fishing gears. Fishermen also face regulations pertaining to the time and place of fishing.

Because of the central importance of the openaccess, common property problem in fisheries, primary consideration is given to exclusiveness of fishing rights. Conventional methods of regulation consists mostly of restrictions on the type of gear, limitations on the size of fish caught, the closure of certain areas and seasons to specific fisheries and ceilings on the total number of vessels.

The Korean fisheries administration has managed most major fisheries under a rigid institutional management regime over the past five decades. The current legal system consists of the basic fisheries law and related rules and ordinances. From the legal point of view, fisheries are divided into three categories: fishing right fisheries,

license fisheries, and other fisheries subjecting to reporting only. Coastal fisheries such as sea aquaculture are under the exclusive fishing right arrangement. The adjacent and distant-water fisheries are managed by the license fisheries system. The rest is conventional free-fisheries comprised of primitive small-scale fisheries.

The fishing right and license fisheries system are the fundamental institutional arrangements of the fisheries management in Korea. Entry into commercial activities is controlled by both systems. Virtually all methods of fisheries management mentioned above have been adopted in Korea. In 1965 the joint control zone between Korea and Japan was established and some offshore fisheries now utilize the joint fishing ground.

It appears that the institutional arrangements themselves do not have serious problems for rational fisheries management. However, from the operational point of view, they have a number of problems. In operating the fishing right and license systems, an important problem is the coordination of a variety of fishing activities to maintain the order of fishing operations. Another is associated with the less attention paid to the conservation of fishery resources (Park 1979).

These failures of the legal arrangements led to: (i) the decline of coastal and offshore fisheries resources (in particular, the drastic decline of the stocks of high-value species); (ii) prevailing illegal fishing activities; (iii) the existence of overcapacities in some fisheries; (iv) the environmental degradation of fishing grounds, primarily caused by toxic pollutants and tide-land reclamation; (v) and international overexploitation of the high seas (East China sea) surrounded by Japan, China and Korea.

As a result, the coastal fisheries face a persistent tendency toward depletion of fish stocks accompanied by a high level of overcapacity, comparatively low catches and poor economic returns. Before the 1980s the trend of depletion was slow, however, as fishing grounds close to ports were depleted and catches declined, fishermen continued to move further afield working new areas. Such expansion of fishing areas could not have continued indefinitely. Eventually, the overall coastal and offshore catch per unit effort began to fall since the mid 1970's.

In this depletion process, a reduction in fish population was

followed by a smaller size of individual fish catches. With the increased fishing intensity the population of large fish has been depleted, and the proportion of smaller fish has increased over time.

2. The Management of Trans-boundary Fishery Resources

In light of the mobility of most fishes in the ocean environment, it is inevitable that coastal states, upon establishing EEZs, find that many of the fishery resources encompassed thereby crossed the borders of their EEZs. The Law of the Sea Convention says little about such resources, other than that a coastal state faced with such a trans-boundary resource should be prepared to cooperate with neighbouring coastal nations and others in harvesting the resource.

Since the introduction of the extended fishery jurisdiction, trans-boundary fishery resources have proven to be common in the Pacific and other oceanic regions of the world. Within the Pacific Ocean, there is virtually no sub-region in which trans-boundary fishery stocks are absent.

International legal experts have now come to subdivide trans-boundary fishery resources into "shared" stocks and "straddling" stocks. A shared stock is one that crosses the boundary of a coastal state EEZ into the EEZs of one or more neighbouring coastal states. A straddling stock, on the other hand, is one which crosses the boundary of a coastal state EEZ into the remaining high seas. Obviously one can have stocks that are both shared and straddling in nature.

The experience which the international community has had with shared stocks, since the advent of Extended Fisheries Jurisdiction, leads us to say the following with confidence. If neighbouring coastal states sharing a particular fishery resource refuse to cooperate in the management of the resource, the economic consequences in all likelihood will be severe. The outcome may well prove to be similar to that of an entirely unregulated common property resource. Japan, China and Korea in the Far Eastern region provide a case in point.

Unquestionably, the single most important example of shared fishery resources in the Pacific is provided by the high valued tropical tuna species. The Pacific harvests of tropical tuna, which have an annual landed value of not less than US\$1.5 billion, account for about

65 percent of the world harvest. Important tropical tuna fisheries exist in the waters of the Pacific Islands region, ASEAN and off Pacific Latin America.

The other form of trans-boundary fishery resources, the so called straddling stocks, has a much more difficult management problem. These stocks cross the coastal state EEZ into the remaining high seas. While in the high seas, the stocks are subject to exploitation by distant water fishing nations. Within the Pacific, the Republic of Korea along with Japan and the U.S. are main distant-water fishing nations.

The management issue is difficult because the property rights with respect to the portions of the stocks in the high seas are vague at best. With the Law of the Sea Convention providing little guidance, it proves difficult to construct effective cooperative management regimes.

At the beginning of the Extended Fisheries Jurisdiction, the issue of straddling stock management was not seen as one of great importance. However, it has arisen in the acute form in the Bering Sea between the 200 mile zones of Russia and the United States. The issue has become one of the serious concerns for the coastal states as well as the distant-water nations.

3. Increasing Demand for and Stagnating Supply of Fishery Products

There has been a shift from cereals to animal products in domestic food consumption. The major components of cereals are rice, wheat, and soybeans while the key components of animal products are fishery and livestock products. The annual per capita consumption of rice which is the main staple of Korean people reached a high of 136Kg in 1979, and has since declined approximately 6.7 percent. The per capita consumption of all cereals has also been falling since 1987.

However, the per capita consumption of fishery and livestock products, fruits, and vegetables is on the increase. In particular, fishery products are among the major animal protein foods consumed domestically. During the last 15 years, the per capita consumption of fishery products has increased by 20.9 percent. For the current Korean population of some 43 million, the increase in per capita fishery

products translates into 238,300 M/T of marine fishery products.

Among the factors affecting food consumption, income* and relative prices are crucial economic variables influencing food demand and consumption. Park et al.(1990) estimated the price and income elasticities for fishery products at 0.51 and 1.35, respectively. Thus, it can be said that Korean fisheries expansion has relied on the growing demand for fishery products. Furthermore, there have been changes in demographic characteristics of the population, such as an increasing proportion of older people and regionally changing distribution.

In recent years the Korean population has become more healthconscious. Health considerations include nutrition, weight, and consumption of substances associated with blockage of the blood circulatory system, heart conditions, and strokes. The health consciousness and the per capita GNP growth can be expected to increase the national demand for fishery products in the future. However, supply is expected to be stagnated at the present level of 3.5 million tons unless distant-water and coastal fishery situations get more favorable in the future.

4. Fishery Resource Nationalism

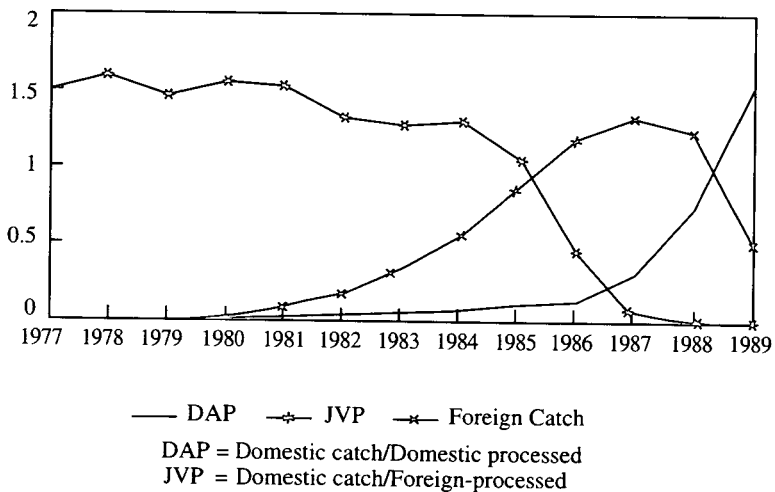
The Korean fisheries sector has become an integrated part of the Korean economy, while interdependence among the coastal countries is becoming increasingly important. Korean overseas fisheries are expected to continue to play an important role in the entire Korean fisheries development in the future, which requires far more cooperation between distant-water fishing nations and coastal states for a better management of international fishery resources and less friction in the trade of fishery products.

Given the current trend of fishery resource nationalism, it would appear that the Extended Fisheries Jurisdiction would provide a valuable windfall to the fortunate countries gaining more exclusive fishing rights, and penalize those countries now operating in the 200 mile zones of others (O'Rourke 1977).

* During the last 15 years the growth of disposable income has changed substantially the composition of Korean consumers' food basket(see The Food Balance Sheet, 1991).

For example, the expansion of exports of U.S. fishery products in recent years is attributed to a large extent to the dramatic expansion in the domestic harvest of groundfish in the U.S. EEZ off Alaska. The growth in domestic harvest has occurred at the expense of foreign harvesting and processing. Under the U.S. law, first priority for quota allocations is given to fish which are domestically harvested and processed; the second priority goes to fish which are U.S. harvested/foreign-processed (fishing joint ventures); and lastly to fish which are harvested and processed on foreign vessels. As seen in figure 1, the quota for foreign catches has been completely terminated since 1989 (Pereyra 1989).

FIGURE 1. Alaska Groundfish Harvests 1977-1988 and 1989



Being part of international fisheries will make the Korean fisheries sector susceptible to instability and uncertainty. Foreign fishery policies will be quite different from the past in terms of resource management and utilization. Volatility will also continue, and may become more intense if Korean distant-water fishery development and trade are expanded.

5. Technological Changes and Information Needs

Presently most fishery experts would agree that Korean fishermen and fishery businesses will have a wide range of new fishery technologies available, at least by the turn of the century. Emerging and potential high technologies could completely revolutionize fishery production, marketing, and decision-making processes. Biotechnology may be used to substantially expand fishery resource bases through artificial hatchery systems and to realize mari-culture potentials.

Although opportunities remain for individual inventors to develop technologies based on just need with little advanced knowledge, advances in biotechnology will provide better future. Most fishery research activities are conducted with targeted objectives and goals under government supports. Biotechnology tend to accelerate change over a short period. Although its benefits are expected to be significant, however, negative socio-economic impacts are likely to be large and diverse in the long run.

The informational needs* for the rational management of fishery resources are increasing at all levels of analysis of important public policy issues. However, perhaps the most important issue of ocean conservation (i.e., the condition of certain key commercial species of fish) has attracted little attention, because of a lack of data.

The problem of inadequate data is exacerbated in the case of coastal fisheries management by its inability to support analysis of the issues of coastal fishery resource conservation policy. For many years fishery biologists and economists have emphasized the necessity of making an integrated database on coastal fishing effort, but the government response has been too fragmentary to provide a basis for effective management action.

6. Growing Environmentalism

There has been a growing concern among the fishermen as well as the

* Effective management of national(or global) fishery resources and analysis of the impact on fishery resources caused by the creation of the extended economic zones are handicapped by the existing state of the fishery statistical information (Final Report of An International Planning Group/Workshop, 1991).

general public about environmental degradation of coastal regions surrounding the Korean Peninsular. Fishing communities are insisting on coastal fishing grounds that are free from pollutants discharged from nearby industrial complexes and cities. There is a changing attitude of the fishermen towards stewardship of coastal natural resources.

These environmental concerns and attitudes combined with individual and local group behaviors may result in new guidelines and limits for developing industrial belts along the coastal areas. The public is growing less tolerant of certain types of industrial activities which lead to ocean water pollution and endangerment of fishery resources and wildlife.

In addition, there is an increasing concern about a wide range oil spill problems, often caused by huge oil tankers. The influence of the concerned public has resulted in the revised marine environmental protection law.

Participation in political and decision-making processes by those interested in these issues will further create new limits on permissible industrial activities and practices. Some of the limits will impose binding constraints which will tend to increase costs of industrial production and marketing and in some cases of industrial research (Clark 1977).

IV. POLICY RECOMMENDATIONS FOR A SUSTAINABLE FISHERY DEVELOPMENT

1. Adjustment of Coastal Fishing Intensity

Efficient management of Korean fisheries requires more tight control of fishing intensity on the adjacent water, if economic gains are to be obtained and improved. The first step would be an effective freeze in the number of vessels in general and of trawlers in particular through prohibition of the construction of new vessels. The next step is to specify a large mesh size for badly depleted resources. Licenses would need to be made non-transferable without exemptions and be retracted upon the retirement of either the owner or the vessel, whichever comes first, until the fleet is reduced to its optimum size.

License fees(which are now none-existent) would need to be introduced at the estimated market value of the license. As effort is reduced, the license fees should be revised upward to capture the newly created rents and to reduce the incentive for expansion of fishing effort.

The government could speed up the attrition process by offering to buy back* and cancel the licenses of fishermen who choose to leave the industry, using the proceeds from the license fees. This option could be made more attractive by offering to retain and/or relocate those who leave the industry as well as by developing alternative employment opportunities.

The ultimate success of an adjacent fishery policy lies in the appropriate mix of fisheries management and non-fishery development strategies. The fisheries management should be supported by a concrete database including biological and economic components. Under the dual structure of the Korean economy, non-fisheries development policy may provide marginal fishermen with alternative job opportunities to leave the fishery and hence may help restructure the Korean adjacent fisheries.

2. Preserving Ecologically Sensitive Coastal Areas**

Local government considering coast-industrial development options tend to view new employment and financial sources as an added economic benefit, and commercial interests sense the potential for increased profits. But the commitment of coastal lands for heavy industry sites may create a wide variety of oceanic environmental problems with impacts that extend considerably beyond the direct, localized impacts of the plants.

The choice of location for heavy industry depends to some degree on the extent of effluent discharge and the anticipated degree

* The Korean government began to develop a buyback program of fishing licenses in order to reduce fishing intensity on the Korean water. Park et al.(1992) suggested that the present number of off-coastal fishing vessels be reduced to the 67% level.

** Ocean environment issues have been national as well as international concerns, and action programs are being developed to protect ocean-biological systems(see for details Our Common Future(1987) which is a report of World Commission on Environment and Development).

and type of waste treatment. In the past national development process, industrial pollutants discharged from the coastindustrial complexes have endangered on and near-shore ecosystems during the last two decades.

Although pollutants will be controlled to some extent through the currently strengthened environmental protection law, provincial authorities will have an essential role in controlling coastal land use. By establishing a provincial coastal landuse control mechanism, provinces can influence the type and location of agricultural and industrial developments, and hence the type and location of waste discharges to local waters, as well as encroachment into vital culture grounds and fish habitat areas.

Industrial facilities with difficult discharge problems such as petrochemical, steel processing, and food processing plants, should not be located on confined inshore waters. Moreover, tidal streams, dead-end harbors, and poorly flushed water bodies should be completely avoided because of their extremely limited capacity to accept and assimilate even small amounts of contaminants.

3. Development of Fishery Information System and Technology

Advanced coastal states are much more concerned about fishery resource management than exploitation. Most commercial fish stocks tend to show their natural growth limit. Ocean biologists agree that the current state of human capability of expoliting fishery resources is far greater than the natural growth rate of a variety of resource stocks. Korea is one of the major coastal states facing serious overexploitation problems.

Japan, the U.S., and European coastal countries have already used remote sensing technology for fishery resource management and stock monitoring work, supported by the man-made satellite networks. Also, advanced countries are operating large stock-monitoring vessels with high-tech equipment, which are able to provide a large amount of precise biological, oceanic-climatic data necessary for analyzing biomass and for designing sustainable fishery development policies. In this regard, Korea should develop a scientific fishery stock-monitoring system which is supported by computer-aided information technologies and large public investments.

In an effort to increase ocean culture productivity of seaweed, shellfish, and ground fish, Korean fishery researchers and extension agents have promoted a conventional package technology consisting of a number of components such as variety, culture method, and disease control. Recently, Korean ocean biologists began to develop new varieties of culture fish species and seaweed through biotechnology. Government financial support has increased substantially to promote comparative technological advantages under the international trade liberalization pressure.

However, these new technologies are being developed by biological scientists to achieve biological or production goals with little or no regard to economic and social objectives. The socio-economic aspects of biotechnology are not appreciated or even understood by many biological scientists and policymakers. An unsolved critical issue in the development of biotechnologies is the consideration and integration of socio-economic science objectives along with those of biological sciences.

4. Improving the Relations Between Coastal States and Distant Water Fishing Nations

Korean major distant water fishing grounds include the East China Sea, the North Pacific, the South Atlantic, and the South Pacific.

East China Sea: it is still an international water, and fishery stocks are under joint utilization with Japan, China, Taiwan, and Korea. Those countries neither introduced the new regime of the sea (200 nautical mile EEZ) in this area nor established the common principles for a sound fishery resource management. Biological behaviors of many fish species have a trans-boundary characteristic and are very complicated(e.g., spawning in coastal waters and growing in international waters). Thus, international fishery cooperation is urgently required for preventing resource overexploitation and developing sustainable fisheries in this region.

North Pacific Ocean: the 1977 proclamation of 200-mile EEZ by the U.S. and the former USSR extended their jurisdiction over a large portion of the North Pacific Ocean except for the Bering and the Okhotsk high seas. As a result, since 1977 Korean fishing activities in Russian waters have been completely terminated, while the U.S.

quota for foreign catch continued until 1987.

Such fishery policies of the two countries confined Korean fishing freedom in the North Pacific to the Bering high seas. Moreover, the recent comprehensive fishery agreement between the United States and Russia imposed an additional hardship on Korean overseas trawlers. The two superpowers also agreed upon establishing Bering Fisheries Authority aiming primarily at enhancing fishery resource stocks in the Bering high seas area.

However, other distantwater fishing countries have had a limited scope of participation in the authority creation process. No country may deny the need to set rules for developing a more reasonable management scheme of fishery resources in the high seas. An important thing is that the superpowers' leadership may need to be able to obtain positive cooperation from other major fishing nations. Wider and more positive cooperation among the major parties could be achieved by a two step procedure: the first step is that the major fishing states take active part in the joint scientific research on the Bering fishery resources; the second is to set up common principles based on the research results and to control their fishing efforts in accordance with the rules. This model of international cooperation may be extended to the South Atlantic squid fisheries.

Finally, the South Pacific, which is dominated by the Pacific Island Nations(PINs), is the most important tuna fishing area for the Korean distant-water longliners. Until the 1970s, fisheries of the PINs have been entirely concerned about exploiting of their coastal resources for subsistence consumption. This situation has been changing, though, with the declaration by most Island States of their EEZs (Lawson 1980).

The bulk of the South Pacific tuna catch is still being taken by distant water fishing fleets, mainly Japanese, Korean, Taiwanese and Russian. Most overseas fleet activities are being now conducted under terms of access agreements between the distant-water fishing countries and the individual coastal states, with economic benefits received by the South Pacific Island States from such foreign access agreements plus a substantial amount of related fishery development assistance including provision of vessels, shore facilities, gear, and training. However, there seems to be no better option for the developing Island States because factors such as lack of capital, less

availability of technologies, and lack of education and training, constrain their increased involvement in their own tuna fisheries (Kearney 1984).

Thus, reciprocal cooperation between the major distant-water fishing states and the PINs are necessary for a sustainable fisheries development in this region. As one of the major distant fishing nations benefiting from the regional resource exploitation, Korea has to increase its responsibility for a cooperative fishery resources management in this region. Furthermore, Korea should be able to make a substantial contribution to regional economic development through expansion of fishery products imports and increased assistance for research, technical training, and infra-structural promotion.

V. CONCLUSION

The greatest challenge for a sustainable Korean fisheries development in the 1990s will be in the design and implementation of management schemes to conserve fishery resources. The ultimate purpose of domestic fishery management is to control fisheries in a manner that will continue to yield net benefits for the fishing industries which are in accord with national goals.

Four strategies should be directed towards this objective: (i) preventing overexploitation by controlling fishing activities; (ii) improving the quality of fish currently sold to consumers; (iii) developing the utilization of new fish resources, including fish farming and the use of little-known species; (iv) improving marketing and presentation of the product to make such species readily acceptable to the consumer. Before implementing these strategies, it is essential that clear directives based on government's social, economic, and political objectives should be defined as far as they affect fisheries because there could be considerable potential conflicts. These include, for example, its objectives for income distribution and employment, for regional development (rural as opposed to urban growth), and its objectives on the desirable level of technology and scale of operation and ownership.

From the international perspective, the change in national

ownership of resources, following the extension of economic zones, has led to a changed global scenario in which new international (North-South, South-South, or North-North) relationships could form the basis of improved fishery resource management. The problem of straddling stock management problem is crucial because cooperation between coastal states and distant-water fishing nations will be required, even where a coastal state chooses not to grant distant-water fishing nations access to its EEZs.

The primary needs of developing coastal states are: (i) for additional trained personnel in all aspects of fisheries management and operations; (ii) for fishery infrastructure promotion, and (iii) for the channels to freer trade in fish products. The requirements of developing coastal states obviously create opportunities for additional North-South fishery cooperation.

In addition, fishery cooperation on a sub-regional(South-South or North-North) basis is necessary for accomplishing the full benefits of the Extended Fishery Jurisdiction through regional cooperative resource management scheme. In this regard, it is clear that Korea has good opportunities for additional or new international fishery cooperation in many areas such as personnel education and training, technology transfer, infra-structural promotion of developing coastal nations, and participation in developing and implementing the high seas resource management schemes.

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