ECONOMIC POLICY AND FISHERIES MANAGEMENT

ÉCONOMIE ET GESTION DES PÊCHES

THIRD FRANCE-JAPAN CONFERENCE IN OCEANOGRAPHY

TROISIÈME COLLOQUE FRANCO-JAPONAIS D'OCÉANOGRAPHIE

OCEANIS

série de documents océanographiques

Volume 18 (1992), Fascicule 4

INSTITUT OCEANOGRAPHIQUE, PARIS

OCEANIS

SÉRIE DE DOCUMENTS OCÉANOGRAPHIQUES

Adresse de publication INSTITUT OCÉANOGRAPHIQUE - FONDATION ALBERT 1er, Prince de Monaco
195, rue Saint-Jacques, 75005 Paris. Tél. : 43.25.63.10. Télécopie : 40.51.73.16.

Directeur de la publication P. BOUGIS.

Comité d'honneur M. FONTAINE, P. BOUGIS, F. DOUMENGE, G. GRAU, L. LAUBIER.

Equipe rédactionnelle C. BEAUVERGER, M. DELAHAYE, C. de LA BIGNE, J.-F. PAVILLON, A. TOULEMONT.

Secrétaire de rédaction A.-C. PADOUX.

Abonnements 1990 Un volume annuel : 6 fascicules (vendus également au numéro)
France : **480 F** Étranger : **580 F**
Remise aux étudiants.

OCÉANIS, Institut Océanographique (C.C.P. Paris 16.541.89 M)
Commission paritaire n° 59837
ISSN 0182.0745

Les articles issus de séminaires sont publiés sous
la responsabilité de leurs auteurs.

Les travaux publiés dans OCEANIS sont signalés ou analysés par :
Papers published in OCEANIS are listed or analyzed by:
Bulletin signalétique du C.N.R.S., Deep Sea Research, Marine Science Contents Tables, A.S.F.A., Chemical Abstracts, Underwater Information Bulletin.

Patrick

OCEANIS

série de documents océanographiques

VOLUME 18 FASCICULE 4 PAGES 371 - 503 1992

ECONOMIC POLICY AND FISHERIES MANAGEMENT
ÉCONOMIE ET GESTION DES PÊCHES

Third France-Japan Conference in Oceanography
Troisième colloque franco-japonais d'océanographie

IFREMER-Nantes, 2-5 July 1991

Successively organized in France and in Japan by the Société franco-japonaise d'océanographie (SFJO) and the Japan-France Society in Oceanography *(Nichifutsu Kayogakka)*, the French Japan Conferences in Oceanography take place every three years as part of the Maison franco-japonaise Joint Scientific Conference. Their aim is to enhance exchanges among French and Japanese professionals and scientists in all oceanographic and related matters. After Marseilles (1985) and Shimizu (1988), the Third Conference was held in Nantes, 2-5 July 1991. Three topics were dealt with : 1. Growth determinants in aquaculture. 2. Economic policy and fisheries management. 3. Coastal management : fisheries and leisure activities co-development. This issue of *Océanis* publishes the papers concerned with the second theme. The papers concerned with the first subject have been published in a previous fascicule.

Organisées à tour de rôle en France et au Japon par la société franco-japonaise d'océanographie (SFJO) et la Japan-France Society in Oceanography (Nichifutsu Kayogakka), les Rencontres franco-japonaises en océanographie ont lieu tous les trois ans. Leur objectif est de favoriser les échanges entre professionnels et chercheurs dans tous les domaines de l'océanographie. Au cours de cette troisième conférence, trois thèmes ont été traités : 1. Facteurs déterminants de la croissance. 2. Politique économique et gestion des pêcheries. 3. Co-développement des pêcheries et des activités de loisir dans les régions côtières. Le présent fascicule d' Océanis *publie ici les communications présentées sur le second thème. Les communications traitant du premier thème ont été publiées dans un fascicule précédent*

INSTITUT OCÉANOGRAPHIQUE

195, rue Saint-Jacques
75005 PARIS

OCEANIS Vol. 18, Fasc. 4, 1992

Série de documents océanographiques

Third France-Japan Conference in Oceanography

IFREMER, Nantes, 2-5 July 1991

ECONOMIC POLICY AND FISHERIES MANAGEMENT

Coordinators: D. Bailly (IFREMER, Paris) & K. Kase (Tokyo University of Fisheries)

INSTITUT OCÉANOGRAPHIQUE
195, rue Saint-Jacques
75005 Paris

-371- Océanis, Vol. 18, Fasc. 4, 1992
pp. 371-383

An introduction to Japanese and French fisheries

Denis Bailly[1], Guylaine Bourguignon[2] & Kazutoshi Kase[3]

[1] *IFREMER, Service d'économie maritime, 155, rue Jean-Jacques Rousseau, 92138 Issy-les-Moulineaux*

[2] *Tokyo University of Fisheries, Department of Fisheries Resources Management, Konan 4-5-7 Minato-Ku, Tokyo 108, Japan*

[3] *Tokyo University, Institute of Social Sciences, Hongo 7-3-1 Bunkyo-ku, Tokyo 113, Japan*

Key words : fishery, Japan, France.
Mots-clés : pêcherie, Japon, France.

Abstract

Fisheries and aquaculture in Japan and France are very different in terms of scale and management schemes. Japan, a leading country in the world for fisheries, has developed a unique mixed system of community-based coastal management and licensing schemes for off-shore and distant-water fisheries. Increasing demand, changes in consumption and the heavy constraint of access limitation to third countries' waters, make Japan more and more dependent on imports. Though few effort and access-limitation schemes are implemented locally in France, most of the management rules comply with the Common Fisheries Policy (CFP). The basic lines are the technical measures, the Total Allowable Catches (TACs) allocated to quotas at the regional level, and the reduction of the fleet size in accordance with the Multiannual Guidance Programme. Fleet reduction to increase productivity and stabilization of fishermen's incomes are the main objectives for the coming years. Producers Organizations (POs) play an increasing role. A rising demand and shifts in consumption are responsible for a stepping-up of imports.

Comparaison des pêches japonaises et françaises

Résumé

Les secteurs des pêches et cultures marines au Japon et en France diffèrent tant par leur taille que par les modes de gestion. Le Japon, un des leaders mondiaux en matière de pêche, a développé un système unique basé sur une gestion directe, par les communautés de pêcheurs, de l'exploitation des ressources côtières et des licences pour les autres pêcheries. L'accroissement de la demande, la modification des modes de consommation et la limitation de l'accès aux eaux des pays tiers rendent le Japon de plus en plus dépendant des importations. Bien qu'il existe des modalités de limitation de l'accès ou de l'effort mis en œuvre localement, d'une manière générale la gestion des pêches s'effectue dans le cadre de la "politique commune des pêches". Les axes principaux en sont des limitations techniques, les captures totales admissibles (TAC) réparties en quotas au niveau régional et la réduction de la flotte selon les objectifs fixés dans les "programmes d'orientation pluriannuels" (POP). L'amélioration de la productivité des unités de pêche et la stabilisation du revenu des pêcheurs constituent les objectifs principaux. Les organisations de producteurs (OP) joueront pour cela un rôle croissant. L'augmentation de la demande et les modifications dans les modes de consommation soutiennent un flux croissant d'importations.

FISHERIES OF JAPAN

Overview

Japan consists of four main islands and thousand of smaller islands lying off the eastern coast of the Asian continent, stretching for 3 800 km from north to south. Rugged mountains account for more than 80 % of the total land area and the population is concentrated along the coast. The coastlines are washed by warm currents from the south and cold currents from the north. Both coastal and off-shore waters are very productive and blessed with a great diversity of marine life.

These geographic conditions naturally led from very early times to the development of fisheries around Japan. Seafood is an important part of the diet and culture of the Japanese people.

The population of Japan is about 122 million. Its annual per capita consumption of fish at approximately 70 kg is the highest in the world, accounting for about 40 % of the Japanese dietary supply of animal protein. Moreover, there is a wide range of marine products and processed products are extremely varied.

Japan is the world's leading nation in fisheries production and international trade. In 1990 the total catch was about 10.3 million tons, the volume of imported fishery products was about 3.8 million tons and there was an export volume of 1.2 million tons.

Fisheries management

The Fisheries Law and the Fisheries Resource Protection Law are the two basic laws under which all Japanese fisheries are managed. The Ministry of Agriculture, Forestry and Fisheries (MAFF) and the prefectural governments have wide authority under the provision of these laws to establish restrictive measures. Authorized measures include : (1) limiting the number of vessels to be licensed; (2) establishing time and area closures; (3) designating prohibited species; (4) setting catch size limits; (5) limiting the size of vessels; (6) prohibiting the handling and sale of designated species; (7) prohibiting the disposal and discharge of materials injurious to the environment; (8) prohibiting the transplantation of marine life.

Management system

Two different types of management exist for Japanese fisheries : coastal and inland-water fisheries are managed under the fishing right system, off-shore and distant-water fisheries are managed under the fishing licensing system. All Japanese fishing vessels must be registered for the specific fisheries for which they are used (Fig. 1).

• Fishing Right System

The fishing right management system establishes exclusive rights to operate specific fisheries, including aquaculture, in designated areas. There are three categories of fishing rights : common fishing right; demarcated fishing right; set-net fishing right. These rights are imposed by the local fishermen's cooperatives whose members fish within the waters under the

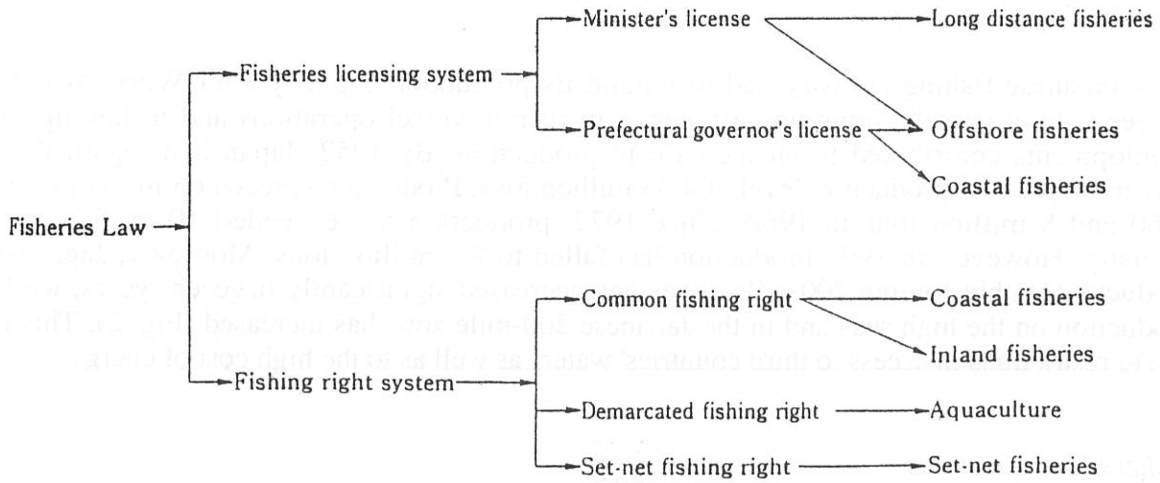


Fig. 1 - Fisheries rights and licensing system in Japan.
Droits des pêcheries et attributions des licences au Japon.

jurisdiction of the fishing right management system. All coastal waters are subject to these rights.

• Fisheries Licensing System

The fisheries licensing system is applicable to off-shore and distant-water fisheries. Each fishing vessel must obtain a licence under this system. Licences for fisheries under federal jurisdiction are issued by the MAFF. Those for fisheries under prefectural jurisdiction are issued by the prefectural governor. The minister and the prefectural governors are authorized to issue licences regulating vessel size, target species, prohibited species, fishing seasons and fishing areas. A licence is usually valid for 5 years. However, licences for vessels operating in international fisheries must be renewed annually.

• Fishing Vessel Registration System

Japanese fishing vessels must be registered with the prefectural government under the Fishing Vessel Law. The use of a vessel in a fishery other than the fisheries for which the vessel is registered is prohibited. Both construction and reconstruction of a fishing vessel require a permit from the MAFF or the prefectural governor.

Fisheries Cooperatives

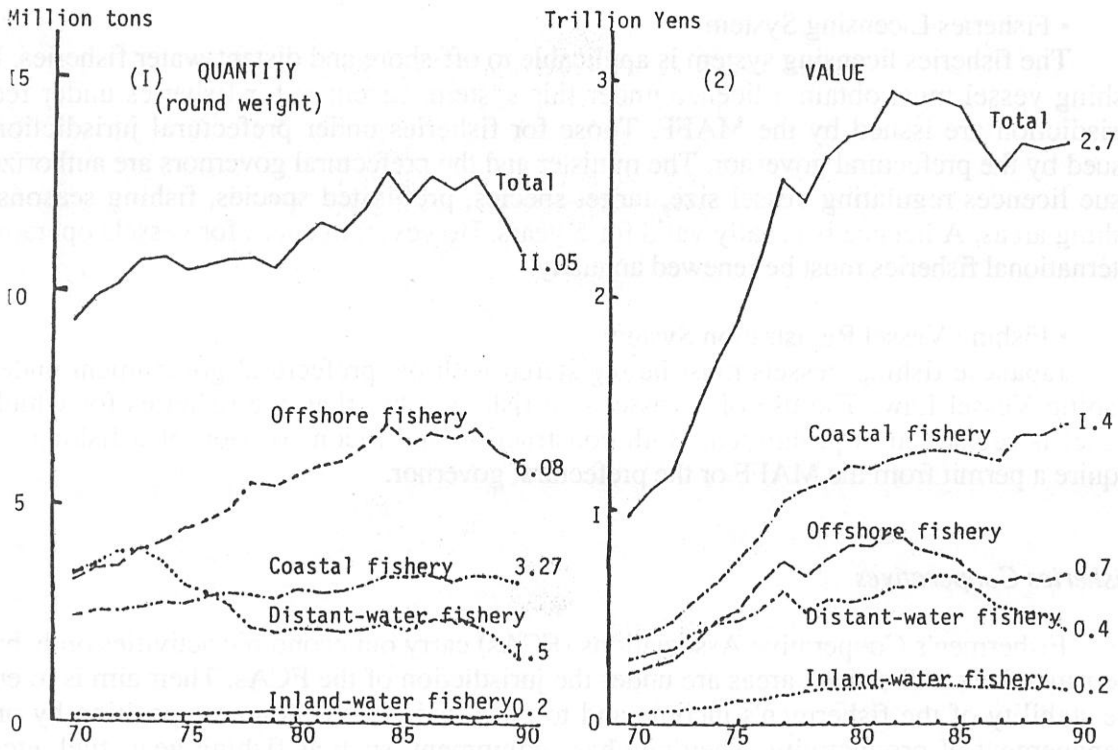
Fishermen's Cooperative Associations (FCAs) carry out economic activities on behalf of their members. All coastal areas are under the jurisdiction of the FCAs. Their aim is to ensure the stability of the fishermen's income and to raise their socio-economic position by proper management of productivity. They purchase equipment, such as fishing gear, fuel, etc., for their members and provide processing, storing and marketing facilities. Cooperatives also organize training, banking and welfare amenities for their members. As stipulated by law, local fishermen's cooperatives are given the exclusive right to administer the fisheries within their coastal zone. They play a very important role in the management of coastal fisheries and in maintaining the social structure of fishermen's communities.

The fishing industry

Japanese fishing industry had to rebuild its production capacity after World War II. Larger fishing vessels, improved efficiency in fishing vessel operations and technological developments contributed to an increase in production. By 1952, Japan had regained its maximum pre-war production level of 4.33 million tons. Production reached 6 million tons in 1960 and 8 million tons in 1968. Since 1972, production has exceeded 10 million tons annually. However, in 1991 production has fallen to 9.8 million tons. Moreover, Japanese production within foreign 200-mile zones has decreased significantly in recent years, while production on the high seas and in the Japanese 200-mile zone has increased (Fig. 2). This is due to restrictions in access to third countries' waters as well as to the high cost of energy.

Fishery Classifications

Japanese fisheries and aquaculture are classified into six categories: distant-water fisheries; off-shore fisheries; coastal fisheries; marine aquaculture; inland water fisheries; and inland water aquaculture. The major criteria for this classification are the area of operation and the size of the operation.



Source : Ministry of Agriculture, Forestry and Fisheries - Annual Report on Fisheries and Aquaculture - Japan

Fig. 2 - Trends in fisheries production in Japan.
- *Evolution au Japon de la production de la pêche.*

• Distant-water fisheries

These fisheries operate on the high seas and within the 200-mile zones of various nations around the world using large and highly efficient vessels. Representative fisheries include trawl fisheries, skipjack pole and line fisheries, tuna longline fisheries and squid jigging and drifnet fisheries. The latter will stop in 1993, following an international decision. The establishment of 200-mile zones by most coastal nations and the reduction of allocations to Japanese fishermen within the zones of the ex-Soviet Union and the United States, forced major changes in the structure of the distant-water fisheries. Mothership trawl operations for surimi had to leave the U.S. zone in 1987, followed by longline operations in 1988 and mothership salmon operations in 1990. Although production in other 200-mile zones has decreased, it has been sustained on the high seas. However, the production value has been declining since 1984, with the loss of allocations for higher valuable species within foreign 200-mile zones.

• Off-shore fisheries

These fisheries operate mainly in the waters of the 12-mile zone off Japan, using powered vessels over 10 gross tons. Medium and small enterprises are dominant in this sector, with large and medium size purse seine and trawl fisheries, squid jigging fisheries, saury stick-held dip net fisheries. Production from off-shore fisheries depends on resource conditions. Total off-shore fisheries production was about 6 million tons in 1990, which was about half the total Japanese fisheries production. However, the value of off-shore fisheries has decreased since 1982, because of a high level of production of low-value species such as sardine, which account for more than 30 % of production.

• Coastal fisheries and marine aquaculture

Coastal fisheries operate mainly within the 12-mile zone of Japan using setnets and fishing vessels less than 10 gross tons. Trawl, gillnet, pole and line fisheries, shellfish fisheries and seaweed collection are typical activities. Production has been stable at around 2 million tons since 1980. The production value has increased, owing to the high demand for high-value species.

Aquaculture facilities are generally located in protected inshore areas with favourable currents. Marine aquaculture has developed with an increasing variety of cultured species in response to the demand for higher grade fish. Aquaculture production accounts for about 11 % of total production and 25 % of total value. The main species cultivated are sea-bream, scallops, pearls and seaweeds such as kelp, undaria and laver (nori). Production of oysters, pearls and laver is almost 100 % dependent on aquaculture fisheries. For other species, aquaculture production represents 94 % for undaria, 83 % for yellowtail, 49 % for kuruma shrimp, 66 % for sea-bream, 53 % for scallops, and 31 % for kelp.

• Inland water fisheries and aquaculture

Inland fisheries production has decreased since 1978, due to the deterioration of the environment and of the habitat of target species. Production is around 100 thousand ton. About half of the production value is attributed to freshwater fish and corbicula.

Inland aquaculture production has been around 90 thousand tons annually. The most important species is eel. Eel production accounts for more than half the total value of inland aquaculture production. Other important species include sweet fish, trout, carp and tilapia.

Fishing units and employment

The total number of commercial fishery management units has been declining since the 50s. Coastal fisheries account for 95% of the total number of management units. Approximately 71 % of the coastal fishery management units are engaged in fishing vessel fisheries and another 21 % in aquaculture. The remaining units are concerned with non-fishing vessel fisheries, fixed-net and shore seine fisheries.

The fisheries labour force has also decreased considerably since the mid-50s to about 390,000 in 1990. The decrease has been brought about by urbanization and industrialization resulting in the migration of younger people from the fishing communities to the larger cities and towns. Approximately 80% of the total labour force is employed by coastal fishery management units which mainly employ family members. The other 20 % is engaged in off-shore and distant- water fisheries. Women occupy 17 % of the total labour force and mainly work on land in processing and aquaculture. Men are mostly employed in fishing vessel operations.

International trade and consumption

Consumption

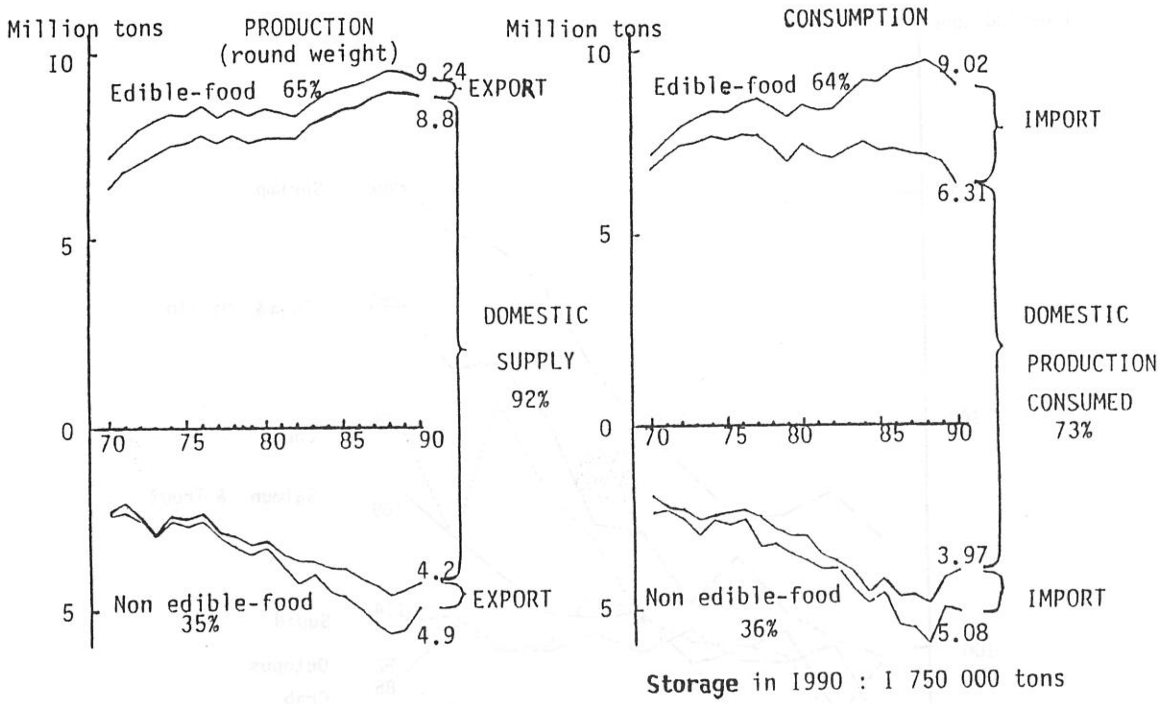
The total supply of fishery products was about 13.5 million tons in 1990. Excluding whale meat and seaweed, 64 % of the total supply was for human consumption (Fig. 3). The supply has been increasing owing to the high demand for feed for livestock and cultured fish. Demand for direct human consumption has been increasing slightly. Annual per capita consumption of fish is of 71 kg on a round weight basis. Japan's exceptionally high per capita consumption of fishery products differs significantly from that of other developed nations, which mainly depend upon livestock products for their protein supply.

International trade

Trade in fishery products has undergone changes over the last 20 years. At one time, Japan was the world's largest exporter, mainly of canned North Pacific salmon, crab and frozen tuna. Nowadays, Japan's exports account for about 5 % of the world's total trade in fisheries and it has become the world largest importing nation. Japan has experienced a high economic growth during the 1960s, with a corresponding rise in the nation's standard for food products.

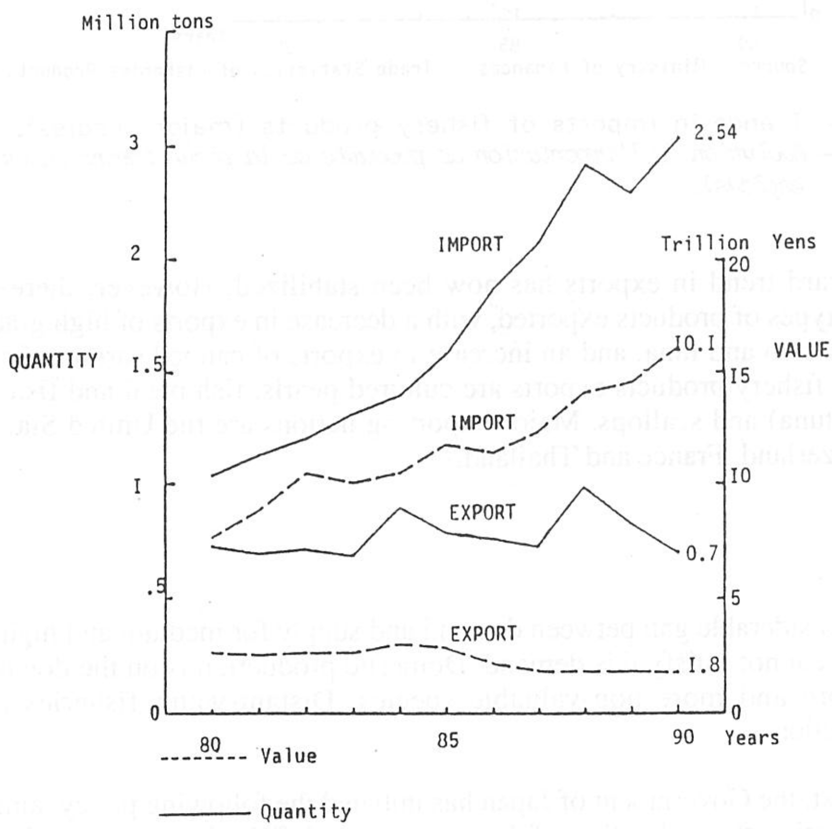
Imports exceeded exports in value for the first time in 1971. This trade deficit rapidly widened as imports increased due to the varied demand of the Japanese people and the reduction in distant-water fisheries during the emergence of the 200-mile era. In 1990, Japan's imports accounted for 30 % of the world's total trade in fisheries and equalled the total fishery exports of the top five leading fishery export nations (Fig. 4).

Shrimp account for the largest volume and the highest value of Japanese imports (Fig. 5). Other major import species include tuna, salmon, crab, squid, octopus, eel and cod. Major exporting nations to Japan are the United States, Korea, Taiwan, China, Indonesia, Canada and Australia.



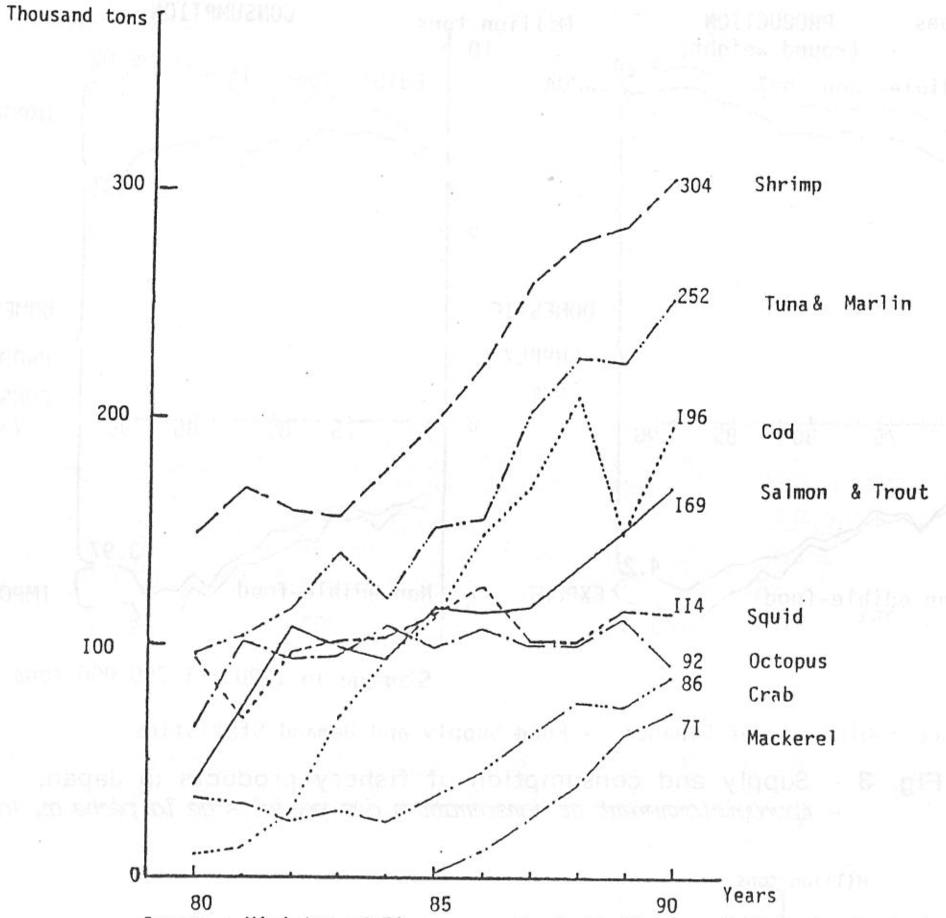
Source : Ministry of Finance - Food Supply and Demand Statistics

Fig. 3 - Supply and consumption of fishery products in Japan.
- *Approvisionnement et consommation des produits de la pêche au Japon.*



Source : Ministry of Finances - Trade Statistics of Fisheries Products

Fig. 4 - Trends in seafood trade in Japan.
- *Evolution au Japon de la commercialisation des produits de la mer.*



Source : Ministry of Finances - Trade Statistics of Fisheries Products

Fig. 5 - Trends in imports of fishery products (major species).
- *Evolution de l'importation de produits de la pêche (principales espèces).*

The downward trend in exports has now been stabilized. However, there has been a major shift in the types of products exported, with a decrease in exports of high grade products such as canned salmon and tuna, and an increase in exports of canned sardine, fish meal and oil. Japan's major fishery products exports are cultured pearls, fish meal and fish oil, canned fish (sardine and tuna) and scallops. Major importing nations are the United States, Taiwan, Hong-Kong, Switzerland, France and Thailand.

Conclusion

There is a considerable gap between demand and supply for medium and high grade fish. Japanese fisheries cannot satisfy this demand. Domestic production is on the downward trend and concerns more and more non-valuable species. Distant-water fisheries have faced international restrictions.

In this context, the Government of Japan has initiated the following policy, aiming to :

- Maximize the utilization of Japanese coastal fisheries resources by balancing fishing efforts with resource conditions and by promoting sea farming and aquaculture.
- Balance the supply of fisheries products with demand and to stabilize prices by

increasing the supply of quality products while maintaining adequate control over fisheries production and the importation of sea products.

- Reinforce the economic base of the industry and fisheries communities.
- Contribute to international fisheries cooperation and the management of high-seas fisheries resources.

FISHERIES IN FRANCE

Overview

The French EEZ is the third in the world and French fisheries rank fourth in the EEC for landings (after Denmark, Spain and the U.K.), third for their value (after Spain and Italy) and third for the fleet capacity (kw). France is also one of the main importers of sea products in the EEC.

The last decades are characterized by a slight increase in production with changes in structure (decrease of distant water fishing in the North Atlantic, development of shellfish culture and tropical tuna fishing), a rise in capacity and a reduction in the number of fishermen.

Two regions account for more than 60 % of the landings and half of the value in France : South Brittany and Northern France/Normandy (Table 1). But the average landing price is higher in the Bay of Biscay and the Mediterranean due to the proximity of Spanish and Italian markets, the structure of the landings (small quantities of high-value species) and the importance of direct sales to the wholesalers.

REGIONS	1990		
	Quantity (T)	Value (1000F)	Price (F/Kg)
Nord & Normandie	201 777	1 564 903	7.76
Bretagne-Nord	73 900	751 897	10.17
Bretagne-Sud	304 172	3 164 702	10.40
Loire Atantique-Vendée	63 264	986 277	15.59
Sud-Ouest	94 867	1 247 200	13.15
Méditerranée	66 152	838 600	12.68
TOTAL	804 132	8 553 579	10.64

Table 1 - The main regions of landings.
- *Principales régions de débarquement.*

Fisheries management

The Total Allowable Catches (TAC) are the core of the Fisheries Common Policy (CFP) since it was first agreed among EEC member states in 1983. In 1991, 18 species were subject to TACs. The TACs are decided through a long process of scientific advice and political bargain within the European institutions. Allocation of national quotas is a two-step process. First, a bargaining process takes place at the national level between state and industry representatives to determine the share of each of the regions. Shares of the quotas allocated to each region are then allocated to fishermen belonging to producer organizations and other fishermen. Not being individualized, quotas are not transferable. The market stabilization programme, based on product withdrawal and payment of compensation to the fishermen when the market price falls under a certain level, is the other main component of the CFP.

Technical innovation and incentives such as capital grant given by the European Community led to overcapitalization and decreasing productivity in the fisheries in the 80s. Although the allocation of TACs contributed to the conservation of species of major interest to the European fisheries, the poor economic results of the fishing enterprises called for strong action to reduce the fishing fleet in Europe. Global reduction objectives, based on technical characteristics such as gross tonnage and power, are set for each country in the Multiannual Guidance Programmes (MGP). To meet with these objectives and stabilize the evolution of the fleet capacity (in terms of power), the French government implemented in 1989 a permit system called "Permis de mise en exploitation" and a decommissioning programme. For the first time, a fishing effort reduction scheme was implemented in France at the national level. Almost all ships are concerned except those engaged in lagoons and estuaries, tropical tuna fishing and aquaculture.

The European Community also implements technical regulations such as mesh size, gear specification, etc. Apart from these regulations, national measures for management are based on financial incentives (loans and subsidies) and licensing schemes for trawlers and lagoon vessels in the Mediterranean and for some specific fisheries in the Atlantic. These licensing schemes, as well as specific technical regulations, are implemented by the administration but managed by the fishermen's organizations at the regional or local level. Subsidies and loans for building and making substantial modifications in ships are given by the government to individual professional fishing boats of more than 16 m for the Channel, the North Sea and the Atlantic, and of more than 18 m for ships registered in the Mediterranean. For smaller size boats, aid is allotted under the regional administration rule. An investment can be subsidized to a maximum of 22 % under the national programme, plus the regional grant. Aid in converting and modernizing ships is linked to the MGP objectives. Since April 1991, there is a specific aid programme when fishing vessels used for more than ten years are finally scrapped (Mellick plan).

Fishermen's organizations are basically of three types. The national interprofessional committee for marine fisheries and marine culture and its regional and local committees represent the fishermen and have an advisory role in affairs concerning the ministère de la Mer (reform of the 1945 act enforced in 1992). Other organizations are the cooperatives and the producers organizations (PO). The latter are in charge of the management of the quota and withdrawal price systems. In the Mediterranean, especially in lagoons and for small-scale fisheries, the fishermen are represented by the prud'homies.

Fisheries industry

After 10 years of relative stability between 700 and 760 thousand tons, fisheries and aquaculture production reached 805 000 tons in 1990 (Table 2). Cultivated shellfish accounted for more than a quarter (Table 3).

Years	DOMESTIC PRODUCTION		IMPORTS - EXPORTS						APPARENT CONSUMPTION	
			Imports		Exports		Balance			
	Quant.	Value	Quant.	Value	Quant.	Value	Quant.	Value	Quant.	Value
1980	708.6	7.7	496.0	9.1	140.9	2.8	-355.1	-6.3	1063.7	14.0
1981	717.0	7.7	518.6	9.6	146.6	3.0	-372.0	-6.6	1089.0	14.3
1982	689.3	7.5	524.5	10.1	161.9	3.0	-362.6	-7.1	1051.9	14.6
1983	711.5	8.1	549.0	10.8	180.2	3.4	-368.8	-7.4	1080.3	15.5
1984	705.1	8.0	552.3	10.9	159.0	3.4	-393.3	-7.5	1098.4	15.5
1985	717.8	7.9	589.8	11.1	203.9	3.9	-385.9	-7.2	1103.7	15.1
1986	722.0	8.4	626.4	12.3	228.4	4.1	-398.0	-8.2	1120.0	16.6
1987	751.0	8.4	700.8	13.7	235.1	4.5	-465.7	-9.2	1216.7	17.6
1988	769.4	8.5	729.2	14.3	257.0	4.7	-472.2	-9.6	1241.6	18.1
1989	733.2	8.2	784.1	14.8	311.3	5.4	-472.8	-9.4	1206.0	17.6
1990	805.4	8.6	863.2	15.4	341.2	5.2	-522.0	-10.2	1327.4	18.8

Table 2 - Production, imports, exports and apparent consumption for sea products (1980-1990) in thousand tons and billion Francs.
- *Production, importation, exportation et consommation apparente des produits de la mer (1980-1990) en millions de tonnes et milliards de francs.*

	Volume (tons)	Value (Million FF)
Coastal and off-shore fisheries		
Finfish	356 721	4 421.7
Crustacean	21 795	688.5
Bivalves	38 039	325.5
Seaweed	29 067	335.5
Distant waters fisheries		
Tropical tuna	128 765	663.7
Others	4 603	30.3
Aquaculture		
Oysters	144 197	1 630.4
Mussels	61 760	402.0
Other shellfish	2 694	29.8
Finfish	1 295	71.2
Total	805 426	8 624.8

Table 3 - Production of the French fisheries and aquaculture in 1990.
- *Production en France de la pêche et de l'aquaculture en 1990.*

Fisheries

In 1990, inshore and off-shore fleets contributed more than 60 % of the value of landings in France, while distant-water trawlers and the tropical tuna fleet accounted for 10 % and shellfish culture for 25 %. The two main fleets in terms of vessels, power and labour force are the inshore fleet (less than 12 m) and the small-scale trawlers (16 to 25 m, landing fresh fish). They employ more than 60 % of the fishermen (Table 4).

Between 1985 and 1990 (Table 4), the French fleet has undergone a reduction in the number of vessels (-33 %) and a slight increase of power (+2.5%), mainly due to changes in the inshore fleet. Within the FCP France has to fulfil an overall reduction in tonnage and total power. The French "plan pêche" (Mellick plan) enforced in 1991, aimed at a further reduction of the number of vessels. By the end of 1991, the total power was reduced to 1,050,000 Kw.

LENGTH	Number of vessels	Power	Tonnage	Crew
< 12 m	6 556	405 901	31 081	10 498
12 to < 16 m	850	157 013	21 348	3 377
16 to < 25 m	1 022	338 054	59 147	7 115
25 to < 38 m	122	66 546	21 754	1 366
> 38 m	104	182 971	75 244	2 652
Total	**8 654**	**1 150 485**	**208 574**	**28 196***

* Including 3 187 other crewmen working on more than one type of boat

Table 4 - Fishing fleet and crew (31.12.1990).
- *Flottes de pêche et équipages au 31 décembre 1990.*

The rapid growth of demand for sea products between 1980 and 1990 (more than 25 % in volume and value) has increased the share of imports in the supply to the French market (from 65 to 80 % in value). The exports increase faster than the imports and the production in value, but they show a decreasing average price. The French trade gap is due mainly to imports of high price products (salmon, shrimp) and of frozen fish for processing (cod, coalfish, tuna).

Aquaculture

The French aquaculture sector has two components. A more than one hundred-years old and well developed shellfish industry accounting for 24 % of the total value of landings. 144 000 tons of oysters and 61 000 tons of mussels were produced in 1990 in all coastal regions, mainly by family businesses. The general trend is an increasing size of the units, mainly because of marketing economies of scale. More than 95 % of the oyster production is consumed in France. The high demand for mussels is covered by imports with a good seasonal complementarity with French products.

A strong effort has developed since the early 70s to cultivate new species. Major results are in the intensive culture of sea-bass and sea-bream in the Mediterranean, salmon, clam and, recently, turbot and seaweed culture.

The main constraint to the expansion of aquaculture is site limitation. Competition for space is strong on the French coast, and major conflicts arise between aquaculture and agriculture or tourism.

Conclusion

At present, the European Commission seems to consider that the fisheries management conducted under the CFP principles has not worked satisfactorily at a global level. The TAC/quota system is a very laborious procedure taking into account a small share of the total value of the landings. It is not efficient for the management of multispecies fisheries. The pressure to reverse the trend of increasing fishing capacity is very high but still shows a limited success. The set of global objectives is not satisfactory regarding the diversity of the fleet among and within the European countries. Therefore the implementation of such regulatory tools as multiannual and/or multispecies TAC and licensing schemes are envisaged.

After a difficult start, France seems able to control the evolution of its fishing fleet. Still, means to ensure economic stability of the fishing units and to control the social impact of fleet reduction have to be designed. The producers organization will play an increasing role in this process in the future.

Increasing demand and shift in consumption toward high added-value products temporarily supports the low productivity. It also nourishes a strong flow of importations that places the industry under sharp competition. This competition will be still more difficult when the Single Market Act is implemented in 1993.

References

Antona M., D. Bailly & H. Rey, 1991.- Country profile : France.- *Bulletin of the European Association of Fisheries Economists*, n°3.

Comité central des pêches maritimes, 1991.- Rapport sur la production de l'industrie des pêches maritimes en 1990.- Nanterre : CCPM.

Comité central des pêches maritimes, 1991.- Le commerce extérieur des produits de la mer 1990.- Nanterre : CCPM.

Chaussade J. & J.P. Corlay, 1990.- Atlas des pêches et des cultures marines, France, Europe, Monde.- Rennes : Ouest-France/Le Marin.

Ministry of Agriculture, Forestry and Fisheries, 1991.- Annual Report on Fisheries and Aquaculture.- Tokyo : Statistics Bureau of MAFF.

Yamamoto T. & K. Short, 1991. International perspectives on Fisheries Management.- *Proceedings of the JIFRS/IIFET/Zengyoren Symposium on Fisheries Management, Tokyo, septembre 1991.*

The main constraint to the expansion of aquaculture is site limitation. Competition for space is strong on the French coast and major conflicts arise between aquaculture and [illegible].

Conclusion

At present, the European Commission seems to consider that the fisheries management conducted under the CFP principles has not worked satisfactorily at a global level. The TAC/quota system is a very laborious one, there taking into account a small share of the total value of the landings. It is not efficient for the management of multispecies fisheries. The pressure to reverse the trend of increasing fishing capacity through MAGP still shows limited success. The set of global objectives is not satisfactory regarding the diversity of the fleets among and within the European countries. Therefore the implementation of such regulatory tools as multiannual and/or multispecies TAC and licensing schemes are envisaged.

After a difficult start, France seems able to control the evolution of its fishing fleet. Still, means to ensure economic stability of the fishing units and to control the social impact of fleet reductions have to be designed. The profession [illegible] process in the future.

Increasing demand and shift in consumption toward high added-value products temporarily supports the low productivity. It also nourishes a strong flow of importations that places the industry under sharp competition. This competition will be still more difficult when the Single Market Act is implemented in 1993.

References

Antona M., D. Bailly & H. Rey, 1991.- Country profile : France. *Bulletin of [illegible]*

Comité central des pêches maritimes, [illegible] maritimes en [illegible].- Nanterre : CCPM.

Comité central des pêches maritimes, [illegible] 1990.- Nanterre : CCPM.

Chaussade J. & J.P. Corlay, 1990 - Atlas des pêches et des cultures marines. France, Europe, Monde.- Rennes : Ouest-France/Le Marin.

Ministry of Agriculture, Forestry and Fisheries, 1991.- Annual Report on Fisheries and Aquaculture.- Tokyo : Statistics Bureau of MAFF.

Yamamoto T. & K. Short, 1991. International perspectives on Fisheries Management. *[illegible]* septembre 1991.

 Océanis, Vol. 18, Fasc. 4, 1992
pp. 385-395

The roles and problems of coastal fish culture in Japan

Katsuhiro Miki & Masaaki Sano
National Research Institute of Fisheries Science, Kachidoki 5-5-1, Chuo-ku, Tokyo 104, Japan

Key words : Japan, fishery, coastal aquaculture, feeds, biotechnology.
Mots-clés : Japon, pêche, pisciculture côtière, alimentation, biotechnologie.

Abstract

An overall study has been made of aquaculture in Japan. The role and importance of coastal fish farming activities are examined and compared with catch fisheries. Recent advances in technology have increased production. New feeds are being tested and farmers have to keep abreast of the trends in research carried out in fishery institutes.

However, coastal aquaculture in Japan faces many problems, particularly of over-production, pollution and diseases. There is also growing awareness among consumers regarding the healthiness and safety of aquacultural products and an increasing demand for top quality of cultured fish.

Rôle et problèmes de la pisciculture côtière au Japon

On envisage dans cet exposé le rôle et l'importance de la pisciculture côtière au Japon; ses résultats sont comparés à ceux des pêcheries traditionnelles. Les récents progrès de la technologie ont permis d'accroître la production. De nouveaux aliments sont expérimentés et les aquaculteurs suivent de près les recherches menées dans les laboratoires spécialisés.

Cependant, l'aquaculture au Japon est confrontée aux problèmes de la surproduction, de la pollution et des maladies. Elle doit aussi tenir compte des plus grandes exigences des consommateurs en ce qui concerne la qualité des produits issus de l'aquaculture.

Japanese aquaculture in general

Brief history

The first form of aquaculture in Japan is said to have been an attempt to rear carp as ornamental fish. Culture of aquatic organisms – mainly carp, oyster and sea laver – for human food began in the early 17th century.

Japan's feudal era ended in 1868, and Japan opened up to American and European influences. As a result, aquaculture in Japan began to develop rapidly with the application of technology from abroad and the encouragement of the government. During the period from 1868 to 1945, the culture of trout, eel, and pearls progressed again. Before World War II, oyster, sea laver, and pearl were the main products of coastal aquaculture, and carp, eel, and trout were reared in freshwaters.

Aquaculture developed more rapidly after the 1960's when Japanese economy began to increase steadily beyond the level achieved before World War II. The reasons are as follows:

• The increased demand for marine products resulting from an increase in per capita income.

- Government encouragement of coastal aquaculture.
- Technical innovations in aquaculture experimented in fisheries research institutes.

In recent years Japanese aquaculture has developed more rapidly than ever with the introduction of biotechnology. An increase in the demand for high-priced fish, especially live fish, has resulted in an increased demand for cultured fish.

Increases in aquaculture production

The total production of Japanese fisheries in 1988 was about 12.8 million tons, of which the production from catch fisheries was about 11.4 million tons (89 %) and production from aquaculture about 1.4 million tons (11 %). In value terms, however, the total production in the same year was 2.7 trillion yen, of which the production from catch fisheries was about 2.0 trillion yen (75 %) and the production from aquaculture 0.7 trillion yen (25 %). This was due to the fact that the price of aquacultural products was generally higher than that of catch fishery products. This clearly reveals the economic importance of aquaculture in relation to the total fisheries production.

From 1980 to 1987 the production of aquaculture in quantity terms increased at an annual rate of 3.5 %, whereas that of catch fisheries increased at an annual rate of 1.6 % during the same period (see Table 1). An increase in demand for high-priced fish, particularly the recent demand for live fish, has accelerated the increasing production of cultured fish. On the other hand, the total production of fisheries has been declining in value since 1983, due to a decrease in the value of fish from catch fisheries.

Of the total aquacultural production in 1988, that of coastal culture was 1,327 thousand tons (93 %), and that of freshwater culture was 99 thousand tons (7 %). From 1980 to 1988, the production of coastal aquaculture increased in quantity at an annual rate of 3.7 %, while that of freshwater culture remained unchanged.

In coastal aquaculture, a greater diversity of species has been farmed in recent years. Consequently, seaweed, yellowtail, pearl, sea bream, scallop, oyster, kuruma prawn, and coho salmon are currently the major species in coastal culture (see Table 2). The entire seaweed and yellowtail culture amounts in value to nearly half the total production of coastal aquaculture. On the other hand, eel, smelt fish (ayu), trout, carp, and tilapia are the major species produced from freshwater culture. However, in value terms, the production of eel culture amounts to more than half the total freshwater culture production (see Fig. 1).

Table 1 Fishery Production in Quantity by Sector (1980-88)

Unit: 1,000 Ton

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988
Total	11,121.3 (100)	11,318.7	11,388.1	11,967.3	12,315.9	12,171.3	12,738.9	12,464.6	12,784.7 (115.)
Capture	10,036.3 (100)	10,267.0	10,353.3	10,313.5	11,607.3	10,987.0	11,446.9	11,230.4	11,358.7 (113)
Marine Capture	9,908.6 (100)	10,143.0	10,231.1	10,596.6	11,501.4	10,376.9	11,340.7	11,129.4	11,259.2 (114)
Inland Capture	127.7 (100)	124.0	122.2	116.9	106.5	110.1	106.2	101.0	99.5 (78)
Aquaculture	1,085.5 (100)	10,51.7	1,034.3	1,153.3	1,208.1	1,184.2	1,292.0	1,234.3	1,426.1 (131)
Coastal Culture	991.8 (100)	959.7	938.4	1,059.3	1,110.8	1,088.1	1,198.3	1,137.4	1,327.4 (134)
Freshwater Culture	93.7 (100)	92.0	96.4	94.0	97.3	96.1	93.7	96.9	98.7 (105)

Source : "Annual Statistics of Fishery and Aquaculture Production"
Ministry of Agriculture, Forestry and Fisheries

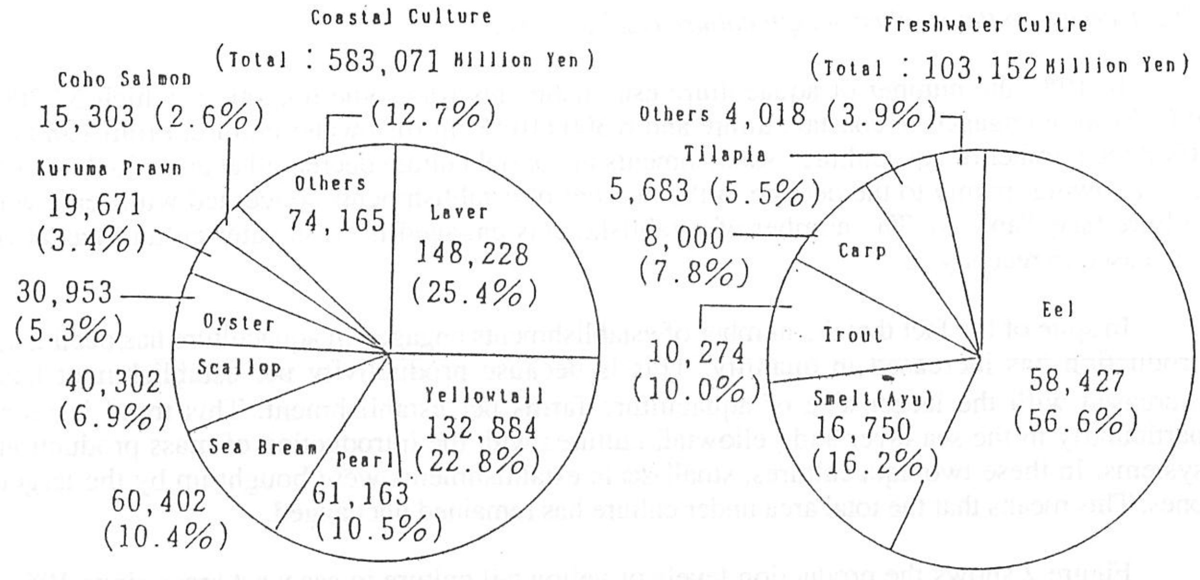


Fig. 1 - Production of fish culture per species, in terms of value (1988) (source: Annual statistics of fishery and aquaculture production).

- Production de la pisciculture par espèces.

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988
Total .	71,480(100)	70,564	68,171	64,525	63,430	62,407	60,382	58,719	57,243(80)
Fish Culture	8,016(100)	8,473	8,839	8,477	8,169	8,223	8,138	8,262	8,024(100)
Yellowtail Culture	3,941(100)	3,883	3,878	3,670	3,411	3,205	3,094	3,079	2,831(72)
Sea Bream Culture	2,689(100)	2,831	2,940	2,924	2,894	3,014	2,946	2,909	2,853(106)
Horse Mackerel Culture	599(100)	737	830	821	718	723	628	651	601(100)
Other Culture	787(100)	1,022	1,191	1,062	1,146	1,281	1,470	1,623	1,739(221)
Animal Culture	2,042(100)	2,100	1,989	2,027	1,876	1,930	1,831	1,774	1,693(83)
Sea-Squirt Culture	1,887(100)	1,957	1,837	1,840	1,698	1,699	1,647	1,570	1,474(78)
Kuruma Prawn Culture	121(100)	128	129	134	142	148	154	157	159(131)
Other Culture	34(100)	15	23	53	36	83	30	47	60(176)
Shellfish Culture	12,436(100)	12,115	12,057	11,845	11,967	11,748	11,677	11,767	12,096(97)
Scallop Culture	5,800(100)	5,507	5,558	5,507	5,564	5,452	5,585	6,001	6,452(111)
Oyster Culture	6,211(100)	6,135	5,977	5,911	5,781	5,781	5,519	5,255	5,081(82)
Other Culture	425(100)	473	522	427	622	515	573	511	563(132)
Sea Weed Culture	47,045(100)	45,923	43,328	40,180	39,389	38,458	36,631	34,809	33,286(71)
Laver Culture	28,325(100)	26,495	24,436	22,044	21,297	20,405	18,889	17,304	16,289(58)
Undaria Culture	14,544(100)	14,289	14,142	13,570	13,027	12,985	12,805	12,433	12,065(83)
Kelp Culture	3,270(100)	3,913	4,052	4,037	4,352	4,451	4,411	4,410	4,311(132)
Other Culture	906(100)	1,226	698	529	713	617	526	662	621(69)
Pearl Culture	1,941(100)	1,953	1,958	1,996	2,029	2,048	2,105	2,107	2,144(110)

Source : "Annual Statistics of Fishery and Aquaculture Production"

Table 2 - Production of fish culture per species in terms of quantity (1980-1988).

-Quantité de la production de la pisciculture par espèces (1980-1988).

The decrease in the number of aquaculture establishments

In 1988 the number of aquaculture establishments was some 63,500, of which 57,200 (90 %) were engaged in coastal culture and 6,300 (10 %) in freshwater culture. From 1980 to 1988 the number of aquaculture establishments in coastal culture decreased at an annual rate of 2.7 %, owing mainly to the decline in the number of establishments concerned with sea laver culture (see Table 3). The number of establishments engaged in freshwater culture has also decreased in recent years.

In spite of the fact that the number of establishments engaged in aquaculture has declined, production has increased in quantity. This is because productivity per establishment has increased with the larger size of aquaculture farms per establishment. This trend is seen particularly in the sea laver and yellowtail cultures with the introduction of mass production systems. In these two aquacultures, small-scale establishments were bought up by the larger ones. This means that the total area under culture has remained unchanged.

Figure 2 shows the production levels of yellowtail culture in seacoast areas since 1965. These data show that the production of yellowtail on the coasts of the South Pacific and the East China Sea has increased, while production on the Central Pacific coast and Seto Inland waters has remained unchanged. The latter areas were once the largest producing areas where natural environments were suitable for yellowtail culture. The main reason for the shift in the yellowtail culture area from the Seto Inland waters to other sea coasts is due to the form of water pollution known as "red tide" which occurs quite often in the Seto Inland waters. Also, many parts of the Seto Inland water coast have become industrial zones, resulting in severe water pollution problems.

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988	
Total	991,343 (100)	959,582	938.105	1.059.782	1.110.761	1.088.136	1.198.271	1.137.385	1.327.398	(134)
Fish	169.717 (100)	174.904	175.005	190.931	190.355	195.516	196.682	220.338	241.946	(143)
Yellowtail	149.311 (100)	150.754	146.304	155.879	152.198	150.961	145.878	158.367	165.928	(111)
Sea Bream	15.040 (100)	18.303	20.694	25.180	26.441	28.746	34.008	38.242	45.176	(302)
Coho Salmon	1.355 (100)	1.150	2.122	2.760	5.049	6.990	7.533	12.177	16.196	(369)
Horse Mackerel	2.293 (100)	3.229	3.529	4.305	3.710	5.008	4.588	5.562	6.155	(283)
Bastard Halibut				648	838	1.572	1.365	2.294	3.097	
Globefish	59 (100)	163	505	563	461	750	306	1.028	1.156	(1.575)
Striped Jack	228 (100)	161	265	345	498	461	613	947	381	(386)
Filefish	6 (100)	3	15	11	31	53	41	68	49	(817)
Others	925 (100)	1.141	1.171	840	829	975	1.350	1.153	2.108	(250)
Aquatic Animal	7.320 (100)	8.583	9.393	9.840	10.981	9.827	11.007	10.330	12.584	(173)
Sea-Squirt	5.749 (100)	6.909	7.382	7.389	8.903	7.660	8.552	7.372	9.541	(168)
Kuruma Prawn	1.546 (100)	1.566	2.000	1.949	2.037	2.151	2.134	2.982	3.020	(195)
Others	25 (100)	8	11	2	41	16	21	76	23	(92)
Shellfish	302.094 (100)	294.317	327.435	333.753	331.595	360.095	392.033	412.119	454.321	(150)
Oyster	261.323 (100)	235.241	250.288	253.247	257.125	251.247	251.574	258.776	270.358	(104)
Scallop	40.399 (100)	59.095	76.866	85.111	73.948	108.509	139.866	152.407	181.929	(450)
Others	372 (100)	481	281	395	521	339	593	1.236	1.537	(413)
Sea Weed	512.570 (100)	481.332	425.520	520.200	577.766	522.536	598.482	494.232	518.374	(121)
Laver	357.572 (100)	340.510	263.312	360.594	396.530	351.788	403.112	321.238	442.806	(124)
Undaria	113.532 (100)	91.272	118.340	112.935	114.586	112.375	135.621	115.918	110.539	(97)
Kelp	38.562 (100)	44.221	42.980	44.345	62.756	53.593	54.143	49.582	59.696	(155)
Oters	2.904 (100)	5.329	1.988	2.325	3.394	4.380	5.606	7.494	5.333	(184)
(Freshwater Culture)										
Total	93.714 (100)	91.976	96.395	94.005	97.272	96.085	93.587	96.369	98.665	(105)
Ξel	36.518 (100)	33.984	36.542	34.189	38.030	39.568	36.520	36.994	39.556	(108)
Trout	19.972 (100)	20.234	20.689	20.713	19.320	19.297	20.408	20.239	19.132	(96)
Carp	25.045 (100)	23.784	24.093	22.397	21.071	19.105	17.339	19.375	18.130	(72)
Smelt(Ayu)	7.389 (100)	9.492	10.222	10.318	11.705	10.967	11.396	12.105	13.633	(171)
Tilapia	2.392 (100)	2.465	2.540	3.233	3.544	4.180	4.113	4.524	4.760	(199)
Crucian Carp	1.151 (100)	1.299	1.215	1.592	1.192	1.155	1.709	1.163	1.532	(133)
Others	547 (100)	723	394	1.263	1.510	1.513	1.502	1.259	1.920	(351)

Source : "Annual Statistics of Fishery and Aquaculture Production"

Table 3 - Number of establishments engaged in coastal aquaculture.
- *Nombre d'établissements engagés dans l'aquaculture côtière.*

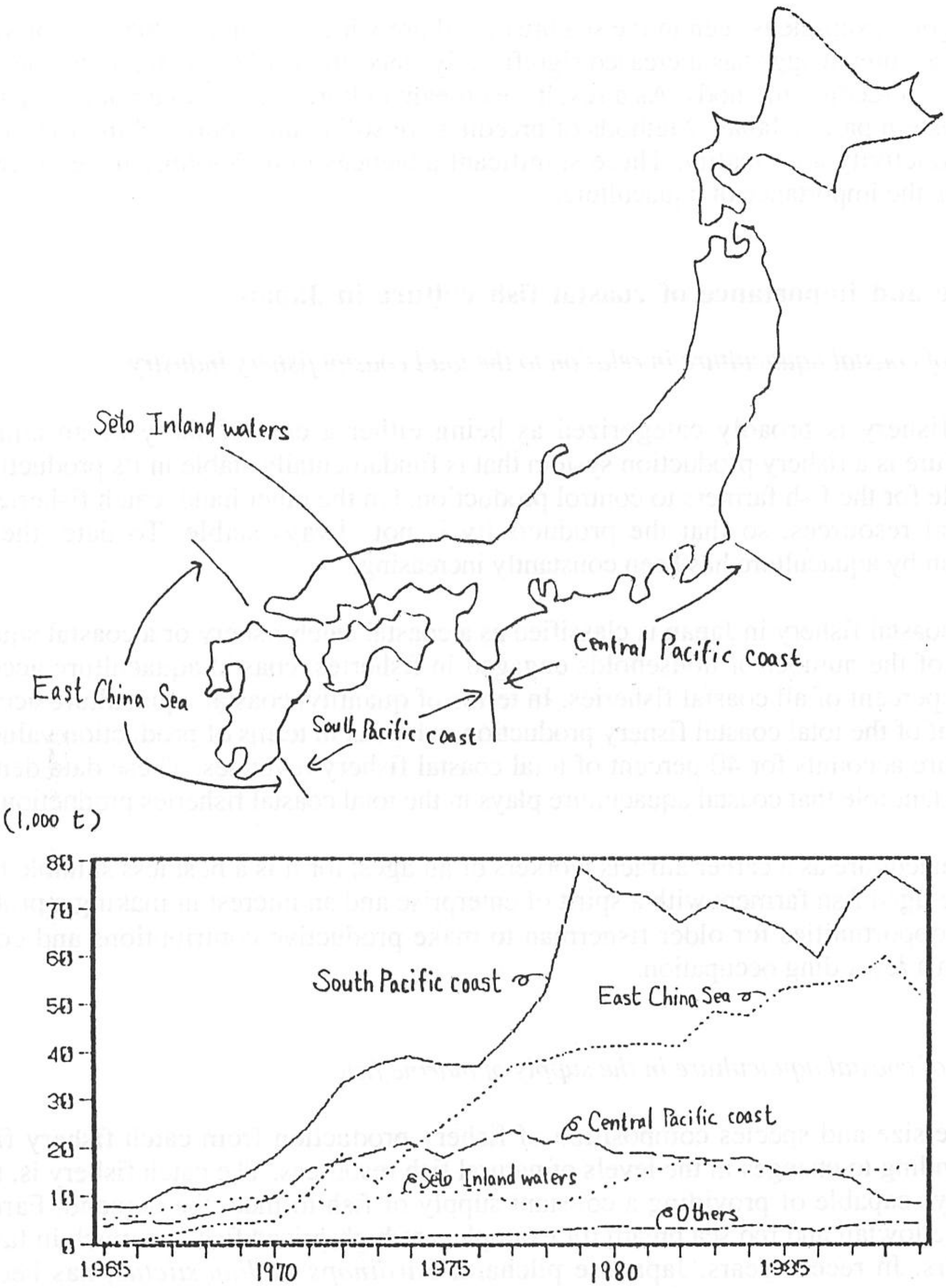


Fig. 2 - Production (in thousands tons) of yellowtail coastal culture (1965-1989) (source: Annual Statistics on fishery and aquaculture production).
- *Production (en milliers de tonnes) de la culture côtière de la sériole. (1965-1989).*

Advances in aquaculture technology

In recent years biotechnology has been applied to aquaculture. Advances in the technology of artificial breeding have made it possible to rear a greater variety of fish, and also to mass-produce fish eggs. Progress in artificial breeding has resulted in the improvement both of productivity and of the quality of the products.

A good example is seen in the sea bream culture which began in 1965. The production of artificial sea bream eggs has increased significantly since about 1970, owing to the development of artificial breeding methods. As a result, sea bream culture has become popular, particularly in the western part of Japan. Methods of breeding are still being improved in order to increase both productivity and quality. These significant advances in technology have all resulted in increasing the importance of aquaculture.

The role and importance of coastal fish culture in Japan

The role of coastal aquaculture in relation to the total coastal fishery industry

A fishery is broadly categorized as being either a catch fishery or an aquaculture. Aquaculture is a fishery production system that is fundamentally stable in its productivity, as it is possible for the fish farmers to control production. On the other hand, catch fisheries depend on natural resources, so that the productivity is not always stable. To date, the level of production by aquaculture has been constantly increasing.

A coastal fishery in Japan is classified as a coastal catch fishery or a coastal aquaculture. In terms of the number of households engaged in fisheries, coastal aquaculture accounts for about 20 percent of all coastal fisheries. In terms of quantity, coastal aquaculture accounts for 30 percent of the total coastal fishery production, whereas in terms of production value, coastal aquaculture accounts for 40 percent of total coastal fishery revenues. These data demonstrate the important role that coastal aquaculture plays in the total coastal fisheries production.

Aquaculture as a career attracts workers of all ages, for it is a business suitable for young or middle-aged fish farmers with a spirit of enterprise and an interest in making a profit. There are also opportunities for older fisherman to make productive contributions and continue to engage in a rewarding occupation.

The role of coastal aquaculture in the supply of marine fish

The size and species composition of fishery production from catch fishery fluctuates, corresponding to changes in the levels of natural fish resources. The catch fishery is, therefore, not always capable of providing a constant supply of fish to meet the demand. Farmed fish, such as yellowtail and red sea bream for example, are high-priced fish and much in favour with consumers. In recent years, Japanese pilchard, *Sardinops melanostictus*, has been caught around Japan in great quantities, representing 40 percent of the total marine catch. Due to excess production and low prices, pilchard is used as fish feed, mainly for yellowtail and red sea bream. The production levels of yellowtail and sea bream are easily controlled by fish farmers. Thus one function of coastal aquaculture is to adjust the balance between the demand for fish and the supply available from catch fisheries.

Other aspects of coastal aquaculture

In Japan, coastal aquaculture has often developed in remote areas where there are few other industries. In many cases the aquaculture industry plays a major role in the economy of such areas, creating employment. Aquaculture also has a close connection with other related industries. The aquaculture industry, by using fish for feed, helps support the operations of the purse seine fishery, which catches a huge quantity of pilchard.

The problems of coastal fish culture in Japan

Over-production

The three main causes of over-production are:

- The sea areas suitable for coastal fish culture are limited.

Sea areas suitable for coastal fish culture are limited for topographical and oceanographical reasons. Each particular sea area is generally divided for aquacultural purposes among many different fish farmers. All fish under culture are therefore reared under the same conditions and no individual unit can produce better quality fish than the others. So, the only way for a fish farmer to increase his income is to produce a greater quantity of fish. This results in the over-production of culture fish.

- The uncertainty of aquaculture production.

In fish culture in Japan, it takes at least two years to rear fish to commercial size, so that it is impossible to foresee the future balance between supply and demand at the time when fish eggs are stocked. Moreover, of course, as there is always the danger of infectious diseases, fish farmers tend to rear as many fish as possible to overcome such uncertainties. Unpredictability in fish farming is one of the main causes for over-production.

- The limited number of species suitable for aquaculture.

In the past, yellowtail was the only fish that could be reared commercially. This induced almost all fish farmers to concentrate on this species, and consequently to over-production. Today a wider variety of fish can be reared but there are still technical constraints.

- Costs and earnings of the coastal fish culture.

Coastal fish culture in Japan is mostly a family business employing very little outside labour. The salaries of the members of each family are seldom in fact paid. Thus when calculating production costs, the cost of family labour is rarely taken into account. As a result, if the sale price of fish is higher than the production cost with its hidden labour cost, fish farmers can still continue to run their fish culture. This characteristic of the household economy in aquaculture has been another cause of over-production.

Over-production has been a recognized problem for many years, yet the situation has not significantly improved. Currently, however, with an increased demand for a wider variety of more expensive marine products, the quality and variety of aquaculture products have become more important. Great efforts have been made in improving the quality of products as well as the variety of cultured fish available.

Efforts are now also directed towards improving the quality of fish eggs and feeds. For instance, in feeds for yellowtail culture, a change from raw fish to the moist pellet has begun in some areas. This will improve the condition of the environment around the aquaculture grounds as well as improving the flesh of the cultured fish. Besides, a healthier environment also enhances the quality of the product. This has already been seen in some areas, where fish produced are superior to those in other areas reared by old methods. Naturally they reach a higher price on the market.

Pollution in aquaculture areas

Pollution obviously affects the quality and survival rate of the fish, resulting in lower profits for the fish farmer. Three types of pollution exist in aquaculture:

• Pollution caused by the fish farmer

The suitability of the water is the most important factor in aquaculture and the quality of the water must meet the minimum standards set by the Japan Fisheries Resource Conservation Association in 1972. The standard concerning the sufficient supply of dissolved oxygen in the water is essential. An abundance of clean water is required to keep the cultured fish free from disease, just as it is necessary to ensure a sufficient exchange of water. When the water exchange rates are very low, a fall in the survival rate, a decline in the growth rate and the spread of infectious diseases all follow.

One cause of a decline in the water exchange rate is the dense growth of moss worms and other living organisms on the threads of the net cages. A more serious cause, however, is the density of fish stocked in a fish farm. Fish farmers tend to keep too many fish for the limited space of their facilities. Often too they place the cages too close to each other.

Another critical problem is caused by aquaculture itself. When an aquaculture area is used for many years, a thick sediment of waste feed will accumulate on the bottom of the sea. This sediment contains a significant amount of sulfurated hydrogen, lowering the levels of dissolved oxygen in the water.

These problems occur not only in individual fish farms, but also in the water area as a whole, such as a bay or a small inland sea where many aquaculture cages share the same water mass. As the water areas of each fish farmer are located side by side within the same aquaculture ground, pollution in one unit will spread to the neighbouring fish farms.

Over-exploitation of aquaculture grounds is partly due to a policy whereby a right to continue aquaculture should be given equally to all who wish to do so, as long as the person is a member of a fishery cooperative society.

• Pollution from sources other than fish farms

Pollution is also caused by other human activities, primarily by industrial waste, domestic and farm sewage, or by oil spills from tankers or factories.

Industrial waste sometimes contains heavy metals (such as organic mercury), petroleum or cyanide that are extremely harmful to human health, whereas domestic sewage often contains high levels of phosphorous and nitrogen. These can sometimes lead to water pollution such as eutrophication, i.e. a decrease in dissolved oxygen and an increase in suspended particles. Water drained from farms is often contaminated by fertilizers and pesticides and can have a harmful effect on human health and lead to the eutrophication of water used for aquaculture. The most damaging source of pollution is oil. Oil pollution contaminates aquaculture products and gives them an unpleasant smell. When an oil spill covers the surface of the aquaculture grounds, it prevents the supply of oxygen from the air.

These types of pollution are beyond the control of fish farmers. A more comprehensive effort by those responsible will be needed to find solutions to these difficult problems.

• Pollution caused by red tide

A red tide is caused by a massive growth of particular phytoplankton in eutrophic water, damaging aquacultural products with a combination of poisonous substances from the phytoplankton and or by oxygen deficiency. As aquaculture facilities are static, they cannot be protected from a red tide. Red tide is due to many complicated factors, the mechanisms of which are still not fully understood. This type of pollution is especially serious in closed waters like the Seto Inland Sea.

Diseases

Fish farms have suffered more diseases than any other type of culture and, recently, outbreaks of fish diseases have occurred more frequently and in a wider variety than in the past.

In value terms, the total production of marine fish culture in 1989 amounted to 252 billion yen, of which the amount damaged by fish diseases was 18 billion yen, or 6.9 % of the total.

• Changes in aquaculture practices

To address the problems of fish diseases, several steps must be taken. First, current aquaculture practices such as dense stocking and heavy feeding must be changed. New aquacultural methods must be developed in order to rear healthier fish. New artificial compound feeds must replace the raw or frozen pilchard that is thought to be one of the causes of fish disease.

• Preventive measures

It will be necessary to develop preventive measures against infectious fish diseases. Pathogenic organisms in water can easily be spread by naturally occurring fish, currents and raw feed. The only possible solution is to keep aquaculture grounds as clean as possible. Many diseases come from abroad and so far the quarantine system for the importation of fisheries products has proved inadequate. Stronger measures must be taken to prevent the introduction of diseases from outside Japan.

• The development of medical practices related to aquaculture

Methods of medical treatment of fish diseases must be developed. It is important to give specific medication in the proper dosage in the early stages of development, but it is difficult to cure diseases completely through medication. It would be better if efforts were directed towards the prevention of infection rather than to the curing of diseases.

The quality of aquaculture products

In terms of quality, products from extensive aquaculture, such as scallop and seaweed, are as good as naturally occurring products. The quality of almost all the products from intensive feeding aquacultures are inferior though to naturally occurring products. The flesh and tint of these types of cultured fish are not as good as in naturally occurring fish of the same species. Consumers tend to feel that fish from intensive feeding aquacultures are lower in quality than those from naturally occurring sources. This results in lower market prices for the products from intensive feeding aquacultures.

The causes of these problems are attributed to an extraordinarily intensive aquaculture system in terms of the type of feed in use, and an excessive use of feed. High density of fish are reared in a small space. The fish are under-exercised and grow fat. To achieve quick results fish farmers tend to feed them on raw or frozen pilchard, which is cheap, but high in calories and this makes the fish fat. Besides, this type of feed is completely different from that eaten in natural conditions. The result is that the tint and taste of their flesh is inferior to that of naturally occurring fish.

Fish should be reared in a large enough space to allow them to exercise. Improvement in the quality and quantity of feed is also necessary. It will be very difficult to put these two measures into practice as they are closely related to the cost of production, but they must be taken.

Consumer concern about the healthiness and safety of aquaculture products

With the growth of fish culture the problem of consumer confidence in the healthiness and safety of aquaculture products has become a problem for society, for consumer awareness is now much more vigilant. As a result of initiatives from consumer groups, boycotts of cultured fish have been staged several times. Two questions are asked; one is whether there are residual drugs or chemicals in cultured fish, and the other is whether pollution has occurred caused by the use of harmful paints on the bottom of fishing boats and on fishing nets.

The use of medication for fisheries is strictly regulated and fish farmers must fully observe these regulations to eliminate the fears of consumers, who are frequently concerned that residual amounts may be present in cultured products.

The problem of pollution that results from harmful paints cannot be solved by aquaculture fishermen alone. Harmful paints should not be used for fishing boats or fishing net equipment. Fish farmers are ultimately responsible though for the supply of safe products to the consumer.

The challenge of the development of new feeds

• The development of an artificial compound feed

For fish culture, good artificial feeds are required. At the present time, raw or frozen pilchard are fed to cultured fish in large quantities. This feeding style lowers the quality of cultured fish with regard to the taste and the tint of the fish flesh. It also causes both pollution of the aquaculture grounds and the spread of fish diseases. An artificial compound feed is now being developed, which will contain all the required nutrients. The composition of the flesh of the fish can be controlled by adjusting the balance of protein and fat. Also, vitamins or pigments can easily be added to the feed. The size, weight and firmness of the fish can be determined with a minimum of excess feed.

• New protein sources to replace pilchard

Until now, almost all feed for fish culture relied on pilchard. A new protein source to replace pilchard must be found. There are in fact indications that pilchard resources may decline and disappear in the future. Soybean cake or corn gluten are being examined as new sources of inexpensive vegetable protein. The waste products of the fish processing industry are also being studied for possible use.

• Diversification of artificial feeds

A wide variety of feeds suitable for different species must be developed. The needs of consumers have diversified in many ways, with a growing demand for a variety of fish of high quality. In order to meet the desires of consumers, a wider variety of fish must be cultured. However, existing feeds are not always fit for all species. Therefore, new feeds that are suitable for a variety of fish should be developed. Even for the fish species currently under culture, it is necessary to provide new types of feed that are suitable for the nursing of larvae and juveniles. The supply of live plankton feeds that are now used is not sufficient to meet the current demand. Therefore, a fine-grained artificial compound feed should be developed. For spawner fish, special highly nutritious feed is required, as the quality of feeds given to spawners greatly influences the growth of their offspring.

Problems concerning the supply of eggs

With some species of fish eggs cannot be produced in sufficient quantity, as they are often gathered from natural resource areas. This situation causes three problems.

First, these kinds of eggs cannot be supplied at all times, as the supply of eggs is greatly influenced by the fluctuations of the natural environment. As a result, the price of eggs is very unstable. This unpredictable egg supply is very unfavourable for the aquaculture business.

Secondly, catching the juvenile fish in large numbers for eggs is thought to be injurious to the natural stock. This is a particularly serious threat to yellowtail stocks.

Thirdly, certain kinds of eggs are imported from abroad, and sometimes new fish diseases unknown in Japan are introduced. For example, IPN (infectious pancreatic necrosis) and BKD (bacterial kidney disease) of silver salmon are spreading at present.

Methods must be developed to produce eggs artificially in large quantities of any species suitable for rearing.

Prospects of aquaculture in Japan

Many problems still remain in Japanese aquaculture. Nevertheless, aquaculture is expected to complement the shortage in the supply of fish from the capture fisheries to meet the demand. Catch fisheries produce fish in large quantities, but often the products are of a lower quality. On the other hand, aquaculture may not be able to produce as great a quantity of fish, but the products can be high in quality and in great demand. In any event, the production of catch fisheries will have to be supplemented by that of aquaculture.

An intensification in the competition among fish farmers suggests that cost considerations in the aquaculture business will be a very important factor in the future. For individual aquaculture households a reduction in production costs will be necessary. However, there are some problems that cannot be solved by the individual fish farmer, as he shares the same aquaculture grounds and the same markets with other fish farmers. To solve problems such as pollution and over-production, cooperative measures among all fish farmers are necessary. If these problems can be overcome in the future, the importance of aquaculture will increase, with the enhancement of aquaculture as a complement to the catch fisheries industry.

Océanis, Vol. 18, Fasc. 4, 1992
pp. 397-399

Present condition of fisheries regulations and Japanese experiments in controlling access to resources

Osamu Baba & Katsuji Hiroyoshi
Tokyo University of Fisheries, 4-5-7 Konan Minato-Ku, 108 Tokyo, Japan

Outline of fisheries regulation in Japan

In Japan there are mainly two types of fisheries regulations. One concerns the fishery rights in coastal zones and the other the license system for fishing vessels operating offshore and in pelagic sea. The former system is divided into three categories of fishery rights, according to the characteristics of the use of fishing grounds. The license system comprises two kinds of permits: one is given by the Ministry of Agriculture, Forestry and Fisheries and the other by the regional government. All types of commercial fisheries in Japan are operated under these regulation systems. (Fig. 1).

- Fishery right system
  - Fixed net fishery right : large scale fixed net fishery
  - Demarcated fishery right: mainly marine culture
  - Common fishery right : fisheries in shallow waters and inland waters fisheries (fisheries other than those in the above two categories)
- License system
  - Minister (designated) license: mainly pelagic and offshore fisheries (distant water trawls, long line fisheries on distant water, and so on)
  - Prefectural governor license : all the fisheries other than those included in fishery right system and Minister license fisheries
- Free access fishery···mainly small scale angling and others

Fig. 1-Outline of fisheries regulation in Japan.
-Schéma de la réglementation japonaise des pêches.

Changes in the structure of fishery production and rise in coastal fishery production

In recent years, pelagic and offshore fisheries are on the decline, owing to the problems arising from the 200-mile fishing zone regulation, among others. As shown in Table 1, production of pelagic fisheries has fallen below the two million tons mark in 1989. Now, for most of the parties concerned, the prospect that these fisheries will hold a major position in Japan must be abandoned. Promotion of coastal fisheries has therefore attracted considerable attention. The percentage of coastal fisheries production has leveled off in volume in recent years but in value it has increased gradually. Now coastal fisheries make up more than 50 % of the total fishery production in value (Table 2).

(unit: 1000tons)

	1970	1975	1980	1985	1987	1988	1989	rate of increase 1989/1987
Total production	9315	10545	11122	12171	12465	12785	11913	▲ 4.4
Coastal fisheries	2438	2708	3029	3356	3288	3442	3395	3.3
(Marine culture in coastal fisheries)	(549)	(773)	(992)	(1088)	(1137)	(1327)	(1272)	(11.9)
Offshore fisheries	3279	4469	5705	6498	6634	6897	6340	▲ 4.4
Pelagic fisheries	3429	3168	2167	2111	2344	2247	1976	▲15.7
Inland waters fisheries & culture	168	199	221	206	198	198	202	2.0

Source: "Annual statistics of fishery and aquaculture production" Ministry of Agriculture, Forestry and Fisheries.

Table 1 - Fishery production in Japan per type of fishery.
- *Production des pêches au Japon, par type de pêche.*

(%)

	1975	1980	1989
Total production (value in billion yen)	100.0 (1921)	100.0 (2784)	100.0 (2702)
Coastal fishery (marine culture included)	39.9	43.1	50.1
Offshore fishery	27.7	29.8	24.3
Pelagic fishery	24.8	20.6	19.0
Inland waters fishery & culture	5.9	6.1	6.7
Others	1.8	0.5	0.0

Source: "Annual statistics of fishery and aquaculture production" Ministry of Agriculture, Forestry and Fisheries.

Table 2 - Composition ratio of fishery production per type of fishery (in value).
- *Structure de la production des pêches par type de pêche (en valeur).*

	1975	1980	1985	1989
Capital intensity (1000yen)	1477	2116	2222	2306
(growth index)	(100)	(143)	(150)	(156)
Fishery production (kg)	9423	9605	9574	10344
(growth index)	(100)	(101)	(102)	(110)

Table 3 - Evolution of capital intensity and production in fisheries, 1975-1989. (Source: Fishery Economy Survey Report (fishery household), Ministry of Agriculture, Forestry and Fisheries.)
- *Evolution de l'intensité capitalistique et de la production des pêches, 1975-1989.*

The role and function of regulation at coastal fisheries

The regulation at coastal fisheries, under the fishery right system, controls the use of fishing grounds. The main object of such a regulation is to achieve an integrated and rationalized fishery production and to promote the fishermen's welfare and the possibility of controlling the fisheries production. Traditionally, coastal fisheries were operated by local fishermen. The regulations are therefore set up with the aim of managing fairly the use of fishing grounds.

The regulation, under the fishery right system, grants absolute and exclusive rights to fisheries cooperatives, which are organized by local fishermen, for managing the use of fishing grounds on the basis of various types of rules; the fishery right is regarded correspondingly as landownership. It also guarantees fishermen the right to fish under the management of fishery cooperatives. For instance, a local fishery cooperative guarantees the right to fish to each fisherman provide he respects the rules on fishing grounds, fishing season, fishing gear, etc. according to the type of the fishing method he uses or the fish species captured. All the articles above-mentioned appear in the Japanese Fisheries Law.

Limitation of fisheries regulation under the Fisheries Law

Despite the regulation for coastal fisheries, problems of over-exploitation have not been solved. The object of fisheries regulation under the Fisheries Law is not in fact the management of resources, but the promotion of fishery productivity and the adjustment of conflicting interests between fishermen. Furthermore, in a liberal economy it is quite difficult to control the competition for fishing facilities investment and fishing activities among fishermen. For example, the growth index of the capital intensity (capital/labor ratio) has continually exceeded that of fishing production per fishery household (see Table 3).

As a matter of fact, it has constantly been a deep concern for both fisheries cooperatives and government to develop coastal fisheries while maintaining a balance between the raising of fishermen's standard of living and the use of resources.

Japanese attempts to control access

Under the conditions above-mentioned, new experiments of fishery management and control of access have been implemented in various regions. But these activities are independent from the coastal fisheries management undertaken on a nationwide scale. These new experiments are mainly implemented by fisheries cooperatives or fishermen themselves, and have the following common characteristics :

(1) Implementation of a more strict control of fish catches.

(2) A pool of catch value or joint operation, with the aim of removing harmful effects due to excessive competition.

(3) Temporary suspension of fishing aiming at cutting down the fishing effort and raising the fish price.

These new experiments in the fisheries management have brought out some obvious problems. First, it may prevent fishermen to proceed to a strict control of their catches. Second, in restricting catch competition fishermen may be deprived of an important incentive. Third, such attempts at controlling access in coastal fisheries are implemented only in a region without linking them with other regions. The decrease in fishing resources has generally led fishermen to a fiercer competition, which is at present difficult to control.

-401- Océanis, Vol. 18, Fasc. 4, 1992
pp. 401-410

Investment and factor remuneration in small-scale fisheries

Frédéric Lantz[1] & Rui Junqueira-Lopes[2]
[1] *IFREMER, 155, rue Jean-Jacques Rousseau, 92138 Issy-les-Moulineaux*
[2] *University of Evora, Portugal*

Key words : small-scale, fishing capacity, income sharing, investment financing.
Mots-clés : pêche artisanale, capacité de pêche, partage du revenu, financement de l'investissement.

Abstract

Investment behaviour is a complex process which plays a major role in fisheries dynamics because it determines the size of the fishing fleet. The purpose of this paper is to examine the consequences of the main characteristics of fishing activity on investment. The theoretical dynamic model of a fishery shows us the "bang-bang" pattern of investment. Furthermore, fishing activity has a high intrinsic variability. Thus, the system in which income is shared between the crew and the ship owner is also considered as a way of sharing risks and so reducing the variability of investment return. Finally, the type of investment financing (subsidies, loans) can strongly stimulate fisheries dynamics but can also have some undesirable effects.

Investissement et rémunération dans les pêcheries artisanales

Résumé

L'investissement est un processus complexe qui joue un rôle majeur dans la dynamique des pêcheries, puisqu'il détermine la dimension des flottilles de pêche. L'objet de cet article est d'étudier les conséquences des principales particularités de la pêche sur l'investissement. Le modèle dynamique d'exploitation des pêcheries nous montre le type "bang-bang" de l'investissement. Par ailleurs, la pêche a une forte variabilité intrinsèque. Ainsi, le système de répartition à la part entre l'équipage et l'armateur peut être considéré comme un système de partage du risque qui réduit la variabilité de la rentabilité de l'investissement. Enfin, le mode de financement (subventions, emprunts) peut encourager positivement la dynamique des pêcheries, mais peut aussi avoir des effets indésirables.

Introduction

Fishing activity depends on the development both of capital (fishing fleet) and of resources. Net investment is a way of increasing the fishing capacity and so investment behaviour plays a major role in fisheries dynamics.

Small scale fisheries developed considerably in France during the eighties : fish catches grew from 1,5 to 2,9 billions of francs between 1985 and 1990 which represents 75 % of the total landings in France this last year. During the same period the fishing capacity of the small-scale fishing fleet increased by 7,8 % in GRT terms and by 11,7 % in KW terms[(1)]. Now, the multi-annual guidance programme (MAGP) of the EEC aims to reduce fleets in order to avoid overfishing.

(1) Horsepower of the ship's engines.

Several questions arise concerning fisheries management and investment behaviour. In the first section we present the theoretical background of investment decision to point out the "non-smooth" process of capital accumulation in fisheries.

In the following sections we address in particular two major problems concerning return and investment. We examine the consequences of the system of income-sharing between the crew and the ship-owner which reduces the return variability and subsequently the investment risk. In the last section, we focus on the influence of the type of investment financing on fisheries dynamics.

Theoretical background of investment decision

The purpose of this section is to analyse the investment process in a bio-economic model. More details about this model are developed by Clark (1985) and Junqueira-Lopes (1985).

We consider a single species model where x(t) is the biomass, p (fixed) is the unit price of harvest h(t), c(x) is the cost per unit of catches and δ is the discount rate. K(t) represents the capital, I(t) the investment, γ the depreciation rate of capital and S(t) the final value of the ships.

The model could be expressed as :

$$(1)\quad \begin{cases} \max \int_0^T e^{-\delta t} \{ [p - c(x)]h(t) - I(t) - \gamma K(t) + S(t)\}\, dt \\ \text{with the following constraints :} \\ \dot{x} = F(x) - h \\ \dot{K} = I - \gamma K \\ x(0) = x_0 > 0 \\ K(0) = K_0 > 0 \end{cases}$$

x(t) and K(t) are the state variables; h(t) and I(t) are the control variables. From model (1), we obtain the hamiltonian :

$$(2)\ H = e^{-\delta t} \{ [p - c(x)]h(t) - I(t) - \gamma K(t) + S(t) \} + \lambda_1 [F(x) - h(t)] + \lambda_2 [I(t) - \gamma K(t)]$$

and we deduce the canonical system :

$$(3.1)\quad \dot{x} = \frac{\delta H}{\delta \lambda_1}; \qquad (3.2)\quad \dot{K} = \frac{\delta H}{\delta \lambda_2};$$

$$(3.3)\quad \dot{\lambda}_1 = \frac{-\delta H}{\delta x}; \qquad (3.4)\quad \dot{\lambda}_2 = \frac{-\delta H}{\delta K};$$

$$(3.5)\quad \lambda_1(T) = 0; \qquad (3.6)\quad \lambda_2(T) = 0$$

Furthermore, we assume that the investment and the harvest are bound together :

$$\begin{cases} 0 \le I(t) \le I_{max}(\pi(t)) \text{ (internal financing)} \\ \text{or } 0 \le I(t) \le I_{max} \text{ (external financing)} \end{cases}$$

$$0 \le h(t) \le h_{max}$$

where $\pi(t)$ and h_{max} are respectively the profit and the maximum harvest (which is assumed as a function of the fishing capacity).

To solve the model, we need to use the following switching functions :

$$(4.1)\ \sigma_I = \frac{\delta H}{\delta I} = -e^{-\delta t} + \lambda_2$$

$$(4.2)\ \sigma_h = \frac{\delta H}{\delta h} = e^{-\delta t} [\, p - c(x) \,] - \lambda_1$$

From equation (4.1), three possibilities appear for σ_I :

$$\sigma_I = 0 \quad \Rightarrow \lambda_2 = e^{-\delta t} \quad \Rightarrow \dot{\lambda}_2 = -\delta\, e^{-\delta t}$$

which is not consistent with equation (3.4) $\dot{\lambda}_2 = \frac{-\delta H}{\delta K} \neq 0$

$$\sigma_I > 0 \quad \Rightarrow \lambda_2 > e^{-\delta t} \quad \Rightarrow I(t) = I_{max}$$

$$\sigma_I < 0 \quad \Rightarrow \lambda_2 < e^{-\delta t} \quad \Rightarrow I(t) = 0$$

Therefore the control variable I(t) could only be 0 or I_{max}.

Similarly we deduce from equation (4.2) the optimal pattern of the harvest function :

$$(5) \begin{cases} \sigma_h < 0 \Rightarrow \lambda_1 > e^{-\delta t} [p - c(x)] \Rightarrow h^*(t) = 0 \\ \sigma_h = 0 \Rightarrow \lambda_1 = e^{-\delta t} [p - c(x)] \Rightarrow 0 < h^*(t) < h_{max} \\ \sigma_h > 0 \Rightarrow \lambda_1 < e^{-\delta t} [p - c(x)] \Rightarrow h^*(t) = h_{max} \end{cases}$$

The control (I) is called "bang-bang" because the optimal values of investment are its minimum and maximum bounds. Complete study of the optimal investment behavior requires a distinction to be made between several initial states of x(0) and K(0).

If we assume that the initial biomass x(0) is greater than the optimal stock of fish x* (underexploitation of the resource) and that there is no external fund to finance investment, then we distinguish two cases for the investment pattern, according to the initial level of the capital K(0) :

Case 1 : K(0) < K* (the initial value of capital is suboptimal)

time	I*	K	δK/δt
$0 \leq t < T_1$	$I_{max}(\pi(t))$	increase	$I_{max}(\pi(t)) - \gamma K$
$t > T_1$	γK^*	constant	0

where T_1 is the period where $K = K^* > K(0)$.

Case 2 : K (0) > K* (the initial value of capital is overoptimal)

time	I*	K	δK/δt
$0 \leq t < T_2$	0	decrease	$- \gamma K$
$t > T_2$	γK^*	constant	0

where T_2 is the period where $K = K^* < K(0)$.

The main issue of this modeling is the "bang-bang" pattern of investment. If we examine the case 1 (K(0) < K*), the capital is the factor which limits the income's increase during the first period ($t < T_1$). Therefore investment has to be the highest. During the second period ($t > T_1$) the resource's availability limits the expansion of income : investment has to be just equal to the fishing fleet renewal.

However, the model is not completely solved because the optimal pattern of capital remains still unknown. Its determination requires an additional equation which links the maximum harvest and the capital :

$$(6)\quad K = \frac{1}{\mu} h_{max}$$

where μ is a coefficient of capital efficiency and 1/μ is the marginal cost of investment.

If we assume that the initial biomass is underexploited (x(0) > x*) and that the initial capital is optimal (K(0) = K*), then the objective function becomes :

$$(7)\quad V_1(h_{max}) = \int_0^T e^{-\delta t}\,[p - c(x)]\,h(t)\,dt - \int_0^T e^{-\delta t}\,[I + \gamma K(t) - S(t)]\,dt$$

The second term of equation (7) is the discount value of the fishing capacity during all the periods and is equal to the capital (K). Thus, according to equation (6), the objective function can be written as :

$$(8)\ V_1(h_{max}) = V_2(h_{max}) - \frac{1}{\mu} h_{max}$$

with,

$$(9)\ V_2\,(h_{max}) = \int_0^T e^{-\delta t}\,[p - c(x)]\,h(t)\,dt$$

Thus, the function V_2 is a short-run profit function excluding the capital costs and only considering the direct fishing costs.

Consequently, the optimal value of the maximum harvest h^*_{max} is derived from the following equation :

$$(10.1)\quad \frac{\delta V_1}{\delta h_{max}} = 0$$

i.e.

$$(10.2)\quad \frac{\delta V_2}{\delta h_{max}} = \frac{1}{\mu}$$

and we deduce the optimal pattern K* from (6) : $K^* = (1/\mu)\ h^*_{max}$.

The condition (10.2) means that the optimal pattern implies that the marginal short-run profit is equal to the marginal cost of capital.

Another important issue of this modeling is to explore the relationships between the optimal harvest $h^*(t)$, the optimal maximum harvest h^*_{max} and the optimal capital K* (equations (5), (6) and (10.2)).

The maximum harvest h^*_{max} is bound by the coefficient of capital efficiency μ and could limit h(t) at a suboptimal level ($h(t) < h^*(t)$). On the other hand, a high value of the coefficient of capital efficiency μ could define h^*_{max} greater than $h^*(t)$.

In this case, the fishery exploitation, starting with $x(0) > x^*$, has two stages :

- During the first period ($t < T_1$), both effort and fishing capacity increase. The fishing function is at its top bound $h(t) = h_{max}$.

- At the end of this period ($t = T_1$), the biomass is stabilized at an optimal level.

- Subsequently, the catches can grow during the following period because h^*_{max} is greater than $h^*(t)$.

The over-capacity $K_{over} = (1/\mu)\ (h^*_{max} - h^*(t))$ has to be dropped out of the fleet to avoid overfishing.

Thus, an optimal pattern of fishery development could involve an overoptimal size of the fishing fleet if the capital is very efficient.

In this context, over-capacity should not be considered as a consequence of a common property resources exploitation, because the model that we have solved describes a regulated fishery.

During the first period of the fishery's development, the management policy promotes the growth of effort and investment to reach the equilibrium level of the harvest and the fleet size. Nevertheless, if the marginal cost of investment is very low, the potential effort which is induced by the capital quickly increases and the maximum harvest exceeds the optimal level of harvests.

Variability and the income-sharing system

The investment decision could be strongly affected by the high intrinsic variability of the fishing activity which comes from both resource availability and the market (price determination).

This problem has been examined by Clark *et al.* (1985). The objective of this section is to focus on the influence of the income-sharing system on the investment decision.

The income-sharing system divides the total expenditures of a fishing trip (excluding wages) in two parts (Anderson, 1986) : the running costs directly related to the fishing trip (C_R) and the vessel cost (C_F) related to the ship. The running costs are shared between the owner and the crew. Wages (w) and profit are calculated as follows :

$$(11)\ w = s\,(R - C_R)$$

$$(12)\ \pi = (1 - s)\,(R - C_R) - C_F$$

where s is the crew's share and R is the gross earning. If we consider that a shipowner invests I_0, the net present value of his cash flow is :

$$(13)\ V_3 = -I_0 + \int_0^T \left(\frac{(1-s)\,(R(t) - C_R(t)) - C_F(t)}{(1+\delta)^t}\right) dt$$

From (13), we can calculate the constant unit cost which equalizes V_3 to 0. If we note that the gross earning (R) is the product of the price by the landings h(t), we deduce :

$$(14)\ P_C = \frac{1}{(1-s)}\left[\frac{I_0}{\int \frac{h(t)}{(1+\delta)^t}\,dt}\right] + \frac{1}{(1-s)}\left[\frac{\int \frac{C_F(t)}{(1+\delta)^t}\,dt}{\int \frac{h(t)}{(1+\delta)^t}\,dt}\right] + \left[\frac{\int \frac{C_R(t)}{(1+\delta)^t}\,dt}{\int \frac{h(t)}{(1+\delta)^t}\,dt}\right]$$

As s grows, 1/(1-s) is higher and the part of the running costs per unit becomes smaller. The income sharing system reduces the relative influence of the running costs which are generally the most variable expenditures.

The income sharing can be considered as a risk sharing (Platteau, 1989). The variability in gross earnings and running costs (fuel price variations for instance) are shared between the shipowner and the crew. From equation (12), if we assume that the vessel costs have no variance, the profit variance can be written as :

$$(15)\mathrm{Var}(\pi) = (1 - s)^2\,\mathrm{Var}(R - C_R)$$

Furthermore, if R(t) and $C_R(t)$ are constant and are independent, the variance of the net present value V_3 becomes :

$$(16)\ \mathrm{Var}(V_3) = (1 - s)^2\,\mathrm{Var}(R - C_R)\,\frac{(1-\delta)^T - 1}{\delta\,(1+\delta)^T}$$

As shown in equations (15) and (16), both the return variability and subsequently the investment risk are reduced with the income sharing.

To assess the importance of variability and uncertainty in the investment decision, we have run an econometric equation on a representative sample of the biggest French small-scale fishing vessels (12-25 meters length category). Malinvaud (1987) shows that the rate of profit has a greater effect on investment when the risk increases. We have used an accelerator-profit model (Artus & Muet, 1984) on longitudinal data and we obtain the following estimation :

$$\frac{I}{K} = \underset{(1.98)}{0.582}\,\frac{\pi}{R} + \underset{(1.47)}{0.115}\,\frac{\dot{R}}{R} + \underset{(0.87)}{0.248}\mathrm{DEP} + \underset{(0.01)}{0.0192}\,\mathrm{SUB} - \underset{(-0.02)}{0.006}$$

$R^2 = 0.4$; n = 374 ; period = 1987

( ) = student

where DEP is the depreciation and SUB are the subsidies.

The low value of the coefficient of the variation rate of the gross earning (0.115) is explained by the weakness of constraint for the sea-products demand. On the other hand, the coefficient of the rate of profit is very high (0.58) and is greater than the average value (0.4) for the French industry (Oudiz, 1978).

Consequences of investment financing

Financing is a crucial problem for investment in small-scale fisheries in France. There are three ways to finance shipbuilding : loans, subsidies and the owner's equity. Considering a representative sample of 753 small vessels (12-25 meters length category) between 1971 and

1987, we have computed the three financing shares which are respectively 70 %, 18 % and 12 %. Futhermore, the owner's equity share slows down from 17 % to 10 % during the period. It is therefore important to study the influence of the type of investment financing on fisheries dynamics.

From model (1) the optimal pattern of investment with x(0) > x* and external financing remains just the same as with internal financing. Two cases are also distinguished according to the initial value of the capital (K(0)) :

Case 1 : K(0) < K*

time	I*	K	δK/δt
$0 < t < T_1$	I_{max}	increase	I_{max} - K
$t \geq T_1$	K*	constant	0

Case 2 : K(0) > K*

time	I*	K	δK/δt
$0 < t < T_2$	0	Decrease	- K
otherwise :	some ships are excluded from the fleet	Decrease	- K = number of excluded ships
$t \geq T_2$	K*	Constant	0

In the first case, the only change from the previous result is that we could reduce the length of the period before T_1 because I_{max} is no longer bound by the profit.

In the second case (overcapacity), the decrease of the fleet could be obtained quickly if some ships were excluded : the final value of the ships S(t) could be increased to reach this objective.

However, the dynamics of investment with external financing raises some questions about the link between the loans and the return. If the investment decision is taken without any long-run investigation on the fish stocks and the future return (myopic decision), we could observe both a high profitability and a dangerous financial situation.

As the overall rate of profit is greater than the rate of interest, the loans stimulate both the capital accumulation and the financial return. Nevertheless, the increase of fishing capacity could exceed the optimal level and could cut down the long-run profits.

Moreover, the loans refund involves a short-run solvability constraint, which becomes very important when the gross earnings slow down (Leon, 1987).

This seems to be the situation of the small-scale fishery in the Bay of Biscay. From 1979 to 1987, the number of ships increased at an 5.1 % annual rate. These investments strongly stimulated the fishing activity : the added value rate grew from 63 % to 68 % between 1985 and 1989 and the rate of return increased from 16 % to 27 %. Unfortunately, the index of financial autonomy (ratio of owner assets and liabilities) decreased from 58 % to 25 % during the same time.

In other respects, the subsidies can have undesirable effects on the ship's costs if there is no (or not enough) competition between the shipyards or the equipment suppliers. In this case, the shipowners would accept a higher cost if they receive some subsidies which cut down their real expenditures.

To test this hypothesis, we selected a sample of 342 trawlers during the 1979-1987 period (Catanzano & Lantz, 1990). We ran an econometric equation to explain the ship's cost by its technical characteristics and obtained the following estimation :

$$\ln(I) = \underset{(6.87)}{1.647} + \underset{(10.3)}{1.332} \ln(L) + \underset{(5.11)}{0.38} \ln(HP) + \underset{(21.8)}{0.093}\, t + \Sigma\, \alpha_i\, \mathrm{Dum}(i)$$

$R^2 = 0.896$; $n = 342$; period = 1979-1987
( ) = student

where L is the ship's length, HP is the horsepower of the engine, t is a linear trend and Dum(i) are dummy variables to differentiate some technical elements (gears and type of hull).

The ship costs are in constant currency; also the coefficient of the trend signifies that there is a 9 % p.a. inflation for the same technical characteristics (L, HP, Dum(i)).

This could be explained partly by the introduction of electronic equipment. Nevertheless, this means that the real cost of investment rises and subsequently that part of the increase in subsidies finances this growth in cost.

Conclusions

The "bang-bang" pattern of investment provides a helpful theoretical background to explain the evolution of investment in small-scale fisheries. The implementation of EEZ in 1977 was a new starting point for these fisheries which increased with a protected market (fresh fish market). The subsidies and financial policy strongly encouraged investment until the mid-eighties. Now, the second multi-annual guidance programme of the EEC (1988-1993) aims at fleet reduction to avoid overfishing. This pattern looks like a sequence of maximum investment (at the beginning of exploitation) and then a lack of net investment.

A second issue to emerge is the long-run link between return and investment which depends on both the resource dynamics and the marginal cost of capital. The two variables, capital and resource, have obviously no common pattern which reach an optimal level. When there is overcapacity and a slowdown of profits, the fishing enterprises suffer financial stress with their heavy debts. Therefore, the external financing of investment which stimulates the fishery development could have some negative effects when the optimum (generally unknown) is exceeded. Thus, the management policy requires to be frequently adapted to fisheries dynamics.

References

Anderson L.G., 1986.- The economics of fisheries management.- Baltimore : Johns Hapkins University Press, 296 p.

Artus P. & Muet P.A., 1984.- Un panorama des développements récents de l'économétrie de l'investissement.- *Revue Économique*, 5 : 791 - 827.

Catanzano J. & Lantz F., 1990.- Coûts de construction en pêche artisanale entre 1971 et 1987.- IFREMER-CGPA, 30 p.

Charles A., 1986.- Coastal state fishery development.- *J. of Development Economics*, 24 : 331-358.

Clark C., Charles A., Beddington J. & Mangel M., 1985.- Optimal capacity decisions in a developing fishery.- *Marine Resource Economics*, 2 : 25-52.

Junquiera-Lopez R., 1985.- L'économie des ressources renouvelables.- Paris : Economica, 141 p.

Leon Y., 1987.- L'endettement des agriculteurs et ses limites.- *Économie Rurale*, 185 : 58-65.

Malinvaud E., 1987.- Capital productif, incertitude et probabilité.- *Annales d'Économie et de Statistique*, 5.

Muet P.A., 1979.- Modèles économétriques de l'investissement : une étude comparative sur données annuelles.- *Annales de l'INSEE*, 35 : 85 - 132

Oudiz G., 1978.- Investment behavior of French industrial firms : a study on longitudinal data.- *Annales de l'INSEE*, 30-31.

Platteau J.P., 1989.- La contribution de la nouvelle économie institutionnelle pour l'analyse des relations contractuelles et des formes organisationnelles dans le secteur de la pêche maritime.- Symposium Pêche Artisanale. ORSTOM-IFREMER - Montpellier.

-411- Océanis, Vol. 18, Fasc. 4, 1992
pp. 411-417

Japan's fisheries market

Guylaine Bourguignon
Tokyo University of Fisheries, Management Division, Economy of Fisheries,
4-5-7 Konan Minato-Ku, 108 Tokyo, Japan

Key words : Japan, halieutics policy, fisheries market.
Mots-clés : Japon, politique halieutique, marché des pêches.

Abstract

Japan's fisheries market is described, showing the transformations which have occurred in the last twenty years and the present trends.

Although the fisheries industry is very important and flourishing, Japan is one of the greatest importers of marine products.

Japanese halieutics policy depends first of all on the "Fisheries control market" which imposes strict regulations. National production is coordinated by the Fisheries Law and the Fisheries Resources Conservation Law.

Details are given of how the market fonctions in production and consumer areas and how marine products are distributed. Price formulation and the import quota system are described in detail.

Le système de commercialisation des pêches au Japon

Résumé

Le système de commercialisation des pêcheries japonaises est décrit, en montrant les transformations qui se sont produites depuis vingt ans, ainsi que les tendances actuelles du marché.

Malgré l'importance et la prospérité de ses pêcheries, le Japon est un des plus grands importateurs mondiaux de produits de la mer.

Sa politique halieutique s'exerce en premier lieu par un "Contrôle du marché des pêches", qui impose une stricte réglementation. La production nationale est réglementée par la loi sur les pêcheries et la loi sur la protection des ressources marines.

La façon dont la commercialisation fonctionne à la production et dans les points de vente aux consommateurs, ainsi que la répartition des produits de la mer, sont étudiées. Le processus de fixation des prix et le système de quotas pour les importations sont exposés en détail.

Introduction

Japan's trade in fishery products has undergone a big change in the last 20 years. In 1971 import in value exceeded export for the first time. This trade deficit then rapidly increased as imports grew due to the restriction on Japanese distant-water fisheries with the emergence of the "200-mile area". At the same time, the demand on the domestic market increased. Now Japan is the world's largest importing nation of fishery products. In 1989 Japan's imports accounted for 30 % of the world trade in fisheries and its exports accounted for 3 %.

Japan is the target of nearly all fishery products in the world. Ninety-eight countries export fishery products to Japan (USA, Republic of Korea and Taiwan were the three largest exporters in 1989). Japan not only absorbs its own production, but also buys the world production (imports) to satisfy its high domestic demand, and regularize its domestic market.

In times of recession, priority goes to the national sector. Japan's fisheries control market represents the first step in Japanese policy for halieutics, which consists in attributing fishery licences for clearly defined vessels and particular activities, limiting the fishing zone in space and the fishing season in time, as well as applying catch quotas regarding quantity and the types of species caught.

The strong point in Japanese halieutic policy strength is that it does not have to deal with employment problems nor fix depreciation terms. Above all it strives to ensure the balance of the domestic market.

Japan's fisheries market system

There is no "regulation system" clearly defined by the government. Apart from taxes (very low) and legal administrative import procedures, the regulation of the market consists mainly in balancing national production and the level of imports. In fact, the regulation of the market is an important factor in the highly developed marketing system of Japan.

Fisheries system

The most original aspect of the fisheries industry in Japan is the joint participation of the government and the professional organizations. Moreover the decentralized system allows the local administrations and professional organizations to intervene in establishing the national government dispositions. National production is coordinated by the "Fisheries Law" and the "Fisheries Resources Conservation Law". In practice the aims of the domestic production system are achieved through the "Fisheries Coordination Committees", whose principal members are elected by fishermen and fishery cooperative associations. These associations usually operate like commercial firms and have their own financial division. The main part of the fishery sector management is in their hands.

Marketing system - Price formulation

Figure 1 is a typical pattern of fish distribution and price formulation in Japan. Markets are divided into two categories. Most of the fish catches are landed at fishing ports throughout Japan, and consigned for sale at wholesale markets at the ports. Then buyers (wholesalers, processors, cold-storage operators) send the fish to the inland wholesale markets in consumer areas, either as fresh products or after processing. There is no direct intervention in price formulation. Price stability depends on the quantity and quality of the product available on the market. For example, there are no financial instruments allowing the government to sustain the prices (except for mackerel and Pacific saury : sustained prices; and Pacific saury : cold-storage subsidies). Most of the professional organizations have their own financial division and decide or not to give direct support to their members.

Marketing in producing areas

Most of the wholesale fish markets at the fish landing centres have been built, owned and made available by fishery cooperatives or local governments. In the case of a market built by a fishery cooperative, the cooperative acts as the consignee, while a local government market is generally run by private firms. At this stage, the consignees are obliged to accept the national production at a fixed price, on a commission basis of about 5 %.

The producers can fix a limit price, but afterwards price formulation is subject to competition between fishery products during auctions. The suspension of auctioning is left to

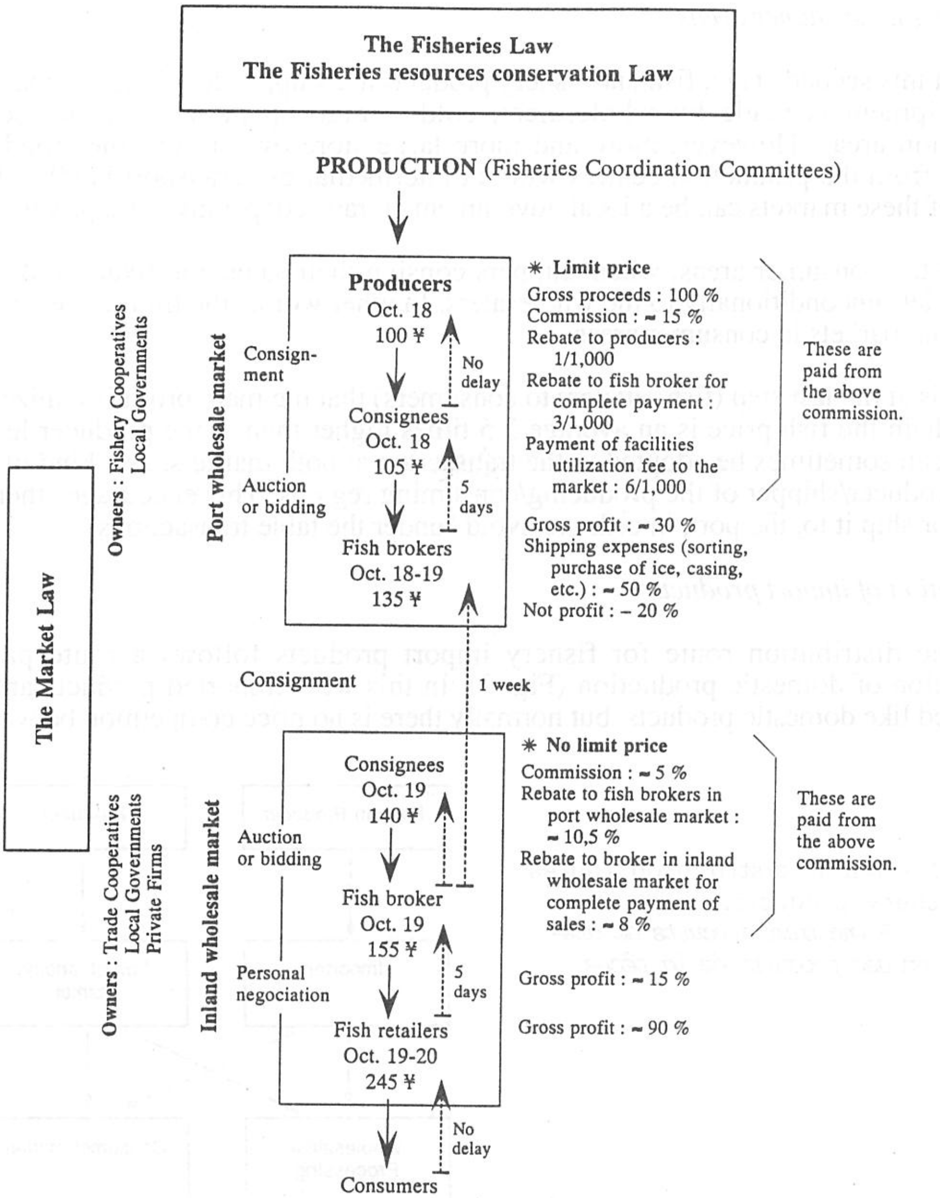


Fig. 1 - Marketing system and price formulation (----- = delay of payment). (source: JICA and personal modifications. Japan International Cooperation Agency.)
- *Le système de commercialisation et de fixation des prix (---- = délai de paiement).*

the wholesaler, when the fish price does not reach a certain level. This is a way of introducing a price limitation system into the central wholesale market.

The consignees play a financial role for they pay the fishermen immediately in cash, but receive payment from the buyers five days later. In the same way, they usually allocate credit to the buyers. Many of buyers are wholesalers who concurrently operate cold-storage or processing businesses. Retailers are also registered as buyers. It is not surprising that they are chosen by the wholesale market for their good business relations and past experience. At this step, price formulation is automatically established by auction. The wholesale markets at the ports do not make a lot of profit. Often they have a "non-profit" balance which is made up by the member's fee and other financial sources. A consignment system is essential for rapid distribution in the consumer areas.

Marketing in consumer areas

At this second stage, fish and fishery products are shipped to wholesale markets in cities. This shipment is made by wholesalers, cold-storage operators or processors from the production areas. However, more and more large store owners or other food dealers buy directly from the production centres without intermediaries. Transport is 90 % by road. The owner of these markets can be a local government, a trade cooperative or a private firm.

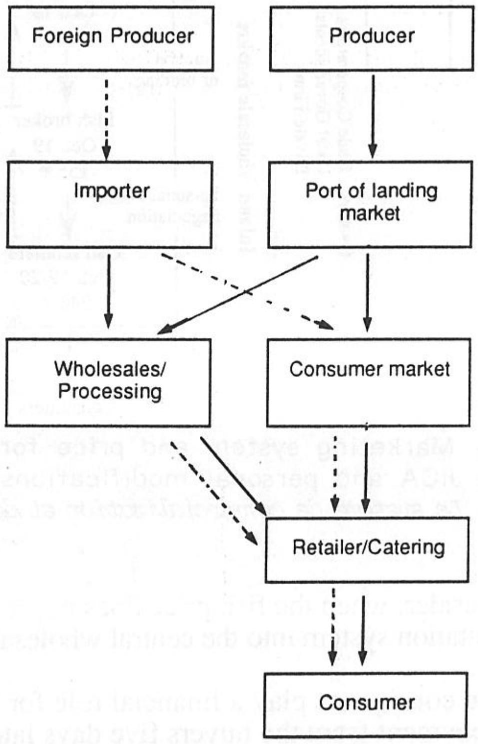
In the consumer areas, when shippers consign their sales, the fixation of the fish price must be left unconditionally to the wholesalers. In other words, the limit price system does not operate in markets in consumer areas.

It is at the last step (fish retailers to consumers) that the main profit is realized. At the end of the chain the fish price is an average 2.5 times higher than at the producer level. A rebate system can sometimes be adopted in the transaction at both markets, as a kind of bonus given to the producer/shipper of the producing/consuming regions. This encourages them to land the fish at, or ship it to, the port, in order to avoid "under the table transactions"

Distribution of import products

The distribution route for fishery import products follows a route parallel to the distribution of domestic production (Fig. 2). In this way, imported products are treated and processed like domestic products, but normally there is no price competition between them.

Fig. 2 - Major distribution routes for fishery products.
- *Principaux circuits de distribution des produits de la pêche.*



Japan's fisheries market system may seem very complicated from outside. Nevertheless, the consignment sale method and the separation of producing and consuming centers enable :

- Speedy transaction and distribution. Currently, the delay between landing and consumer buying is less than 3 days, regarding fresh products.
- Speedy financial transactions. The main actors are paid immediately and the consignees have a bank role.

- Collecting, sorting and dividing fish and fishery products ready to be sold for each use (fresh, processing, cold-storage...).
- Price formulation reducing the risk for the wholesalers, since fish prices are totally free and apt to fluctuate widely.

The consignment sale method regulates the whole fishery channel and, by collecting the supply, provides the opportunity to obtain a quick reaction to the market trends.

Import quota system

The ratio of fishery imports in domestic consumption reached approximatively 30 % in 1989. Some of these products are subject to the Import Quota (I-Q) system. The basic law concerning import trade controls is the Foreign Exchange and Foreign Trade Control Law. Goods subject to the I-Q (non-liberalized items) are listed in the Import Publication and today number 77. The remaining items concern agricultural and fishery products, which can have an impact on the supply and demand of domestic commodities. Therefore, the quota amounts are calculated after detailed consideration of supply and demand for each item.

Japan's goal regarding importation is to prevent competition between foreign goods and domestic products. In the past, almost all imports of fish products were subject to a global import quota, but Japan has progressively liberalized this sector. In the process, the import of some species has been liberalized; for others, independent quotas have been established. The I-Q system is one of the most obvious tangible elements in the market regulation system.

Quota announcement

The import quota ceilings are usually set twice a year (first and second half). These ceilings are determined by the Ministry of International Trade and Industry (MITI), after agreement with the Ministry in charge of the item, taking into consideration the trend in supply and demand, prices of the items, foreign relations... The quotas are extended on a time basis. Thus the timing of allocation of quotas for individual items differs and announcements are made individually, without taking into account the financial fiscal year (1st April to 31st March). For example, regarding the production of squid and cuttlefish, as the Japanese fishing season starts in April, the quota is announced in August because estimations concerning the domestic supply are not available before July. This quota has remained at the same level since 1986.

In every case, an allocated import quota is valid for ten months (four months under import licence + six months under import authorization). Importers have three weeks to apply for import licences, after which unused import licences are not re-allocated.

Distribution

The quotas are distributed among three categories : import trading companies, processors and fishermen. Past experience is essential to qualify for these quota licences. Most of the quotas are allocated to traders and processors, in order to provide raw materials for the processing industry. The fishermen do not share in all quotas, but it should be remembered that transhipments are not taken into account in the imports. Most of the time, the quotas are not used fully. They are rarely distributed on a "first-come/first-served" basis. Fishery import quotas applied by Japan include the following products : cod (excluding Alaska pollack), yellowtail, mackerel, jack mackerel, sardines, anchovies, sauries, scallops and adductors of shellfish (Table 1).

GROUP (1)	VOLUME 1986 FH	VOLUME 1986 LH	VOLUME 1987 FH	VOLUME 1987 LH	VOLUME 1988 FH	VOLUME 1988 LH	VOLUME 1989 FH	VOLUME 1989 LH	VOLUME 1990 FH	VOLUME 1990 LH	VOLUME 1991 FH	VOLUME 1991 LH
1. Global quota for fish (2) (0301 and 0302) and shellfish (0303) Including : – cod (but not Alaska pollack) – mackerel – yellowtail – sardines – horse mackerel – sauries – scallops and adductors of shellfish	23 mio$	39 mio$	39 mio$	46 mio$	83,5 mio$	119,5 mio$	119,5 mio$	124,4 mio$	124,4 mio$	131 mio$		
2. Herring (0301 + 0302)												
Non Pacific species	35.000 t	35.000 t	34.000 t	0	25.000 t	25.000 t	26.000 t	26.000 t	26.000 t	26.000 t		
Pacific species			50.000 t		50.000 t		50.000 t		50.000 t		50.000 t	
3. Cuttlefish and squid, live, fresh, chilled or frozen (excluding Mongo Ika) Sepia officinalis	20.000 t	33.000 t	20.000 t	33.000 t	20.000 t	33.000 t	20.000 t	33.000 t	20.000 t	33.000 t		
4. Hard roes of cod (including Alaska pollack) (0301 + 0302) brine, dried or smoked	7.000 t	8.000 t	7.500 t	8.500 t	9.000 t	11.000 t	12.000 t	13.000 t	13.500 t	13.500 t	15.500 t	
5. Alaska pollack	330.000 t	910.000 t	310.000 t	870.000 t	390.000 t	534.000 t	450.000 t	181.000 t	700.000 t	332.000 t		
6. Dried squid	4.500 t		4.500 t		4.500 t		4.500 t		4.500 t			

(1) The description concerns the products for which Japan's legislation (MITI import notice of May 1987) foresees the possibility for opening a quota and refers to the CCCN nomenclature. However, there is no detailed reference for the presentations of the products for which the quotas are actually applied.

(2) Applied to 98 countries (not ergo omnes) including Ireland, Italy, Netherlands, Greece, Spain, Denmark, F.R.G., France and Portugal.

Table 1 - Import quotas applied by Japan (FH: first half; LH: Last half).
- *Quotas d'importation appliqués par le Japon (FH : 1e moitié; LH : 2e moitié).*
Source : Fisheries Agency of Japan (EEC - Tokyo Delegation).

• Quota in value

The quota covers various presentations of these species. As the quota is fixed in value (US $), the smaller quantities of higher added value presentations (semi-processed products), or higher prices (for example cod), may be realized to the detriment of non-processed products or cheaper species. Moreover they may depend on domestic market trends, or on the requirements of the processing industry.

• Global quota

Japanese authorities consider that from the processors' point of view these species can be substituted. The global quota allows for the possibility of interchanging the species according to the requirements of the processing industry. For this reason, the import licence does not explicitly mention the nature of the product.

• Quota in volume

This includes fishery products caught in large quantities by the Japanese fleet. It can have a direct influence on the domestic market. A fixed volume is determined according to the market demand and the national supply.

Squid market subjected to the import quota system

In Japan, imported squid and cuttlefish are subjected to the I-Q system (except *Sepia officinalis*, *Mongo ika*). Since 1987, the squid international market is oversupplied, due to higher catches and the successful performances of the Japanese fleet.

In 1987, Japanese squid production was 62 % higher than in 1986 and is still high. Japan has not revised its I-Q level for squids. The squid market is oversupplied by domestic production. The I-Q volume has remained the same since 1986, and is fixed at 10 % of the 1985 production. But even during this period of international glut, the I-Q has not been used to the full.

Nevertheless even when the market drops slightly (prices fell by about 20 % in 1988), the government is content with maintaining the I-Q volume. It was the Japanese Squid Fishery Associations which decided to cut their catches by about 20 % in 1990, by shortening the fishing season, in order to reduce high inventories.

The regulation of the market under the I-Q system is much easier to handle. During this period, the situation on the EEC market has been more disorganized. EEC authorities have had to take several measures to limit the shortfall : against overproduction by reducing fishing licences, against low prices by cutting the guide price and by according financial aid for cold storage, and against imports under the reference price by blocking such shipments.

The I-Q system protects the Japanese market from the international economic situation. However this system does not deal fairly with liberalized products under the GATT.

Conclusion

Japan's fisheries control market may seem complicated from the outside. Apart from administrative procedures (food sanitation, import procedures, quarantine ...) more or less strict, import quotas have the most visible effect on market management. Taxes are very low in Japan.

The fisheries channel is "integrated vertically". The different actors take part in production, trading and in the processing activities as well. This makes for coordination all along the line. Hierarchical traditions must not hide the flexible operating of the channel, which works far better with a decentralized system.

Océanis, Vol. 18, Fasc. 4, 1992
pp. 419-426

Evolution of the consumption of sea products in France: A stable market undergoing many transformations

Martine Antona & Hélène Pitiot
IFREMER, Service d'économie maritime, 155, rue J.J. Rousseau, 92238 Issy-les-Moulineaux

Key words : sea product, household consumption, France
Mots-clés : produits de la mer, consommation domestique, France.

Abstract

Trends in French household consumption of sea products during the eighties are globally analysed. The main types of fish and other sea products (fresh, deep-frozen, processed, non-processed) consumed in the home are described. The changes in home consumption (products, species) and in the catering sector are given special attention.

The longstanding consumption of marine products by coastal and rural communities is seen to be a continual component of consumption behaviour, now expanding in industrial countries. Seafood consumption patterns follow socio-demographic criteria (geographic region, urban or rural communities, socio-professional groups, age of the head of household, family size) just as much as economic criteria such as income and prices.

Évolution de la consommation des produits de la mer en France : un marché stable soumis à de nombreuses transformations

Résumé

Les tendances de la consommation des ménages concernant les produits de la mer sont analysées pour la période 1980-90. La consommation est présentée pour les différents segments (produits frais, surgelés, transformés, non transformés et nouveaux produits). L'accent est mis sur les évolutions différenciées que connaissent la consommation des ménages à domicile et la consommation hors foyer (espèces et nature des produits consommés).

Ces éléments permettent de situer la consommation des produits de la mer en tenant compte des comportements de consommation qui se généralisent parmi les pays industrialisés. Les caractéristiques de l'évolution de la consommation des produits de la mer ne sont pas liées uniquement à des critères strictement économiques comme le revenu et les prix. On note une influence des critères socio-démographiques (catégories socio-professionnelles, habitat rural ou urbain, région, âge et taille de la famille).

Introduction

The consumption of marine products in France is relatively high compared to the EEC average. In 1985, France ranked fourth with 20 % more than the average EEC sea products consumption (after Spain, Portugal and Belgium) (Fig. 1).

Sea products consumption in France has increased over the last two decades and global sea-product consumption per inhabitant was particulalrly high in the eighties. This increase accelerated after 1985, and from 1980 to 1985, the French statistical institute (INSEE) found a growth of 5.5 points in the volume index (base = 100 in 1980) and from 1985 to 1990 a growth of 24.2 points (Fig. 2). However, this apparent evolution needs further analysis. The eighties

EEC COUNTRIES	Volume index	OTHERS	Volume index
	100		
Germany	47,4	Finland	74,9
France	120,3	Norway	164,6
Italy	105,9	Sweden	121,4
Holland	61,1	Japan	394,4
Belgium	117,6	Canada	80,8
Luxembourg	68,3	USA	46,7
U.K.	72,8		
Ireland	70,4		
Denmark	87,3		
Greece	99,7		
Spain	190		
Portugal	140,4		

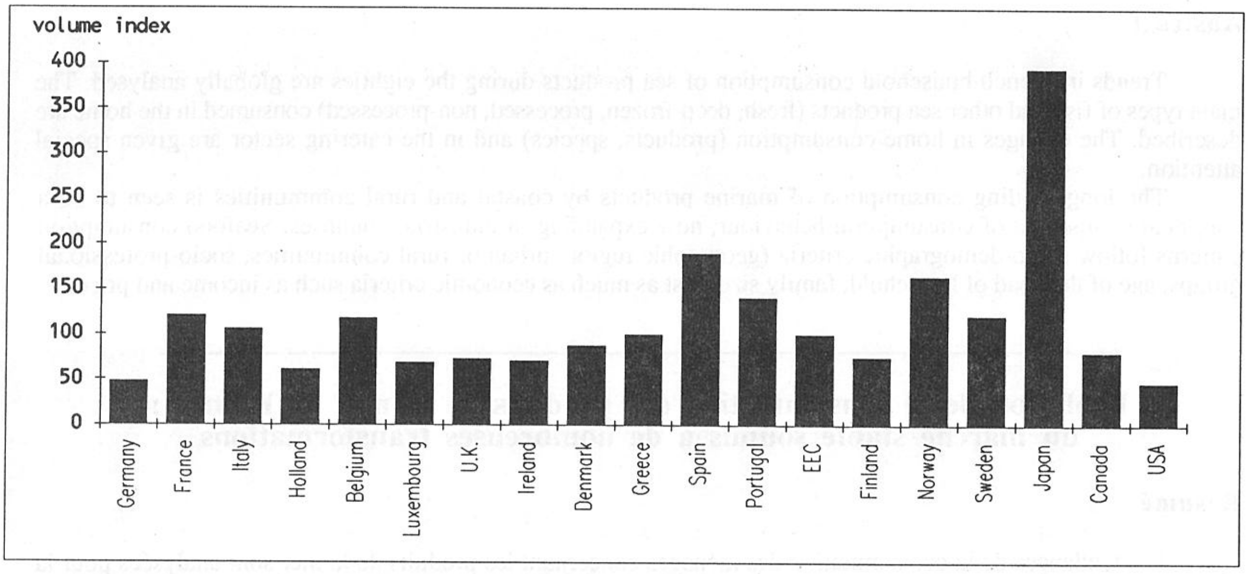


Fig. 1 - Final fish consumption per capita (1985) in some countries. (Source: M. Gombert, 1991, La consommation des ménages en 1990. INSEE, Résultats n° 133-134, série consommation et modes de vie, n° 27-28).
- *Consommation totale de poisson par personne (1985) dans quelques pays.*

was a period of important changes in the structure of consumption and in ways of consuming sea products. Sea products consumption integrates these new consumer habits.

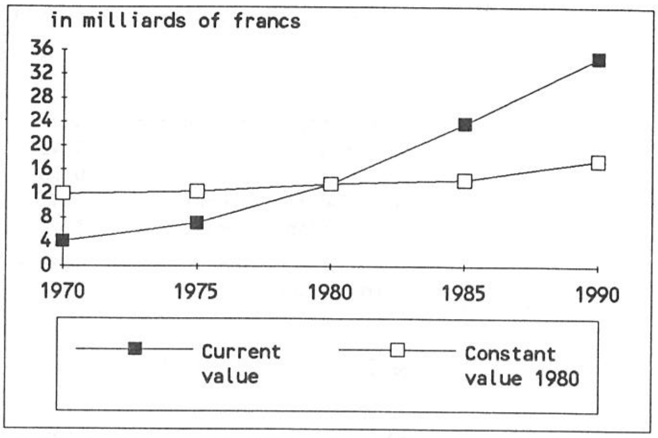
Trends in French household consumption

Household seafood consumption, unlike global seafood consumption, is characterized by a small decrease: average annual per capita household seafood consumption was 6.9 kilos in 1978-1980 and only 6.6 kilos in 1983-1985 (Fig. 3). Just as for frozen or fresh fish, there was a similar decrease in the total household consumption of butchery meat (average of 23.7 kilos of butchery meat from 1978 to 1980 and 21.7 from 1983 to 1985).

This global increase over the decade seems to be due to an important increase in non-domestic consumption, i.e. in the catering sector. According to SECODIP panel data obtained for the FIOM (Market intervention and organization fund for sea products), the share between domestic consumption and the catering sector consumption differs with each kind of products. In 1988, the catering sector represented both in volume and value around 20 % of the total consumption of fresh fish, dried and smoked fish, fresh molluscs, and canned fish. This percentage was even higher for fresh crustaceans and deep-frozen fish: around 34 % in value and 40 % in volume (Fig. 4).

Consumption in value (in milliards of francs)

	Current value	Constant value 1980
1970	4,148	11,916
1975	7,165	12,318
1980	13,612	13,612
1985	23,677	14,363
1990	34,756	17,648



Consumption: volume index (100 = 1980)

1970	87,5
1975	90,5
1980	100
1985	105,5
1990	129,7

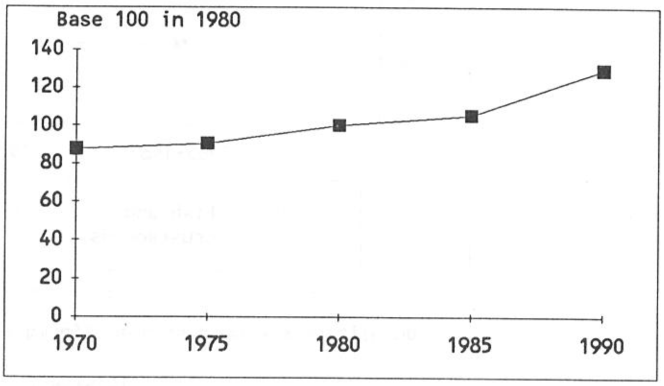


Fig. 2 - Household consumption of fish products in France (1970-1990) (source: M. Gombert, 1991, La consommation des ménages en 1990. INSEE, Résultats n° 133-134, série Consommation et modes de vie, n° 27-28).
- *Consommation de poisson des ménages en France de 1970 à 1990.*

Domestic consumption

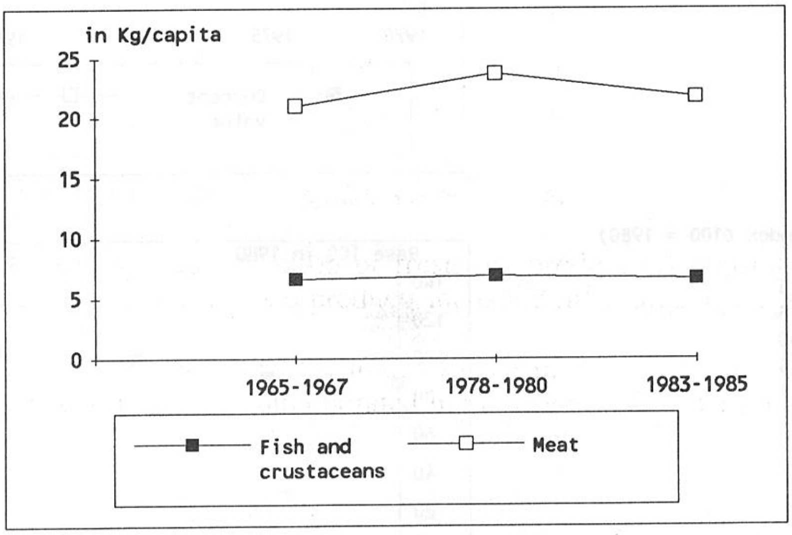
Three main factors related to consumer habits characterize household consumption:
- the decrease in the number of meals eaten at home,
- the increasing consumption of prepared dishes of sea products (not included in household seafood consumption data),
- changing marketplaces.

The decrease in the number of meals eaten at home

For the non-agricultural population (i.e. 83 % of total population), 33 meals per week were eaten at home in 1981 and 32 in 1985. The rural and agricultural population consumes even less than the average amount of sea-products. This points to one of the reasons for the decrease in domestic consumption per capita, while the household consumption unit mean also decreased over the period 1981-1985 (from 2.08 to 2.03). However, further data are required to explain the decline in household consumption after 1985.

Consumption by type of fish products

	1981 (in kg)	1985 (in Kg)	1985/1981 (in %)
Fish (wet, frozen, other	6,8	6,43	-5,44
Wet fish	5,48	5,17	-5,66
Frozen fish	0,98	0,94	-4,08
Prepared frozen meals	1,03	1,68	63,11
Canned fish or meals	3,46	4,46	28,9



Quantities consumed at home (in Kg /capita)

	1965-1967	1978-1980	1983-1985
Fish and crustaceans	6,6	6,9	6,6
Meat	21	23,7	21,7

Fig. 3 - Household consumption of fish products in France, per capita (source: A. Mercier, 1984, *op. cit.*; M. Bertrand, 1991, *op. cit.*; M. Gombert, 1991,*op. cit.*). - *Consommation de poisson des ménages en France, par personne.*

The increasing consumption of prepared dishes of sea products

From 1980 to 1989, consumption of fresh sea products decreased by 4.6 %, while consumption of canned and frozen sea products increased in volume by 62.7 % and 47.4 %.

Data on domestic consumption of seafood - frozen and fresh fish - provided by INSEE do not however include sea products incorporated in prepared fresh or frozen dishes. The main change in sea products consumption is clearly the growing preference for seafood already prepared or incorporated in fresh, frozen or canned dishes.

In the last INSEE report on household consumption, M. Gombert argued that consumers are abandoning traditional food products which are not directly consumable (i.e. which have to be processed at home before consumption) and prefer more sophisticated dishes already processed by industrial means. The new consumer choices favour fresh or frozen filets, coated fish, canned fish, prepared dishes containing fish and surimi. The only source of data on sea products processed and incorporated in prepared meals is the French frozen and deep-frozen industry federation which publishes annual statistics. No information is available on vacuum-packed prepared sea products.

	Home Consumption	Catering Consumption	Total Consumption	Share of demand by household	share of demand by catering sector
Fresh fish(1)					
volume (tonnes)	152,404	37,428	189,832	80%	20%
value(millions of francs)	6,969 MF	1,671 MF	8,640 MF	81%	19%
Smoked dried salted fish(1)					
volume	12,616	3,157	16,133	78%	22%
value(millions of francs)	1,195 MF	284 MF	1,479 MF	81%	19%
Fresh Shellfish (1)					
volume	124,807	31,216	156,023	80%	20%
value(millions of francs)	2,339 MF	620 MF	2,959 MF	79%	21%
Fresh Crustaceans(1)					
volume	22,209	13,905	36,114	61,50%	38,50%
value(millions of francs)	1,399 MF	728 MF	2,127 MF	66%	34%
Fresh Molluscs (1)					
volume	4,341	920	5,261	82,50%	17,50%
value(millions of francs)	187MF	26 MF	213 MF	88%	12%
Frozen sea products (2)					
volume	106,706	69,213	175,919	60,50%	39,50%
value(millions of francs)	4,778 MF	2,230 MF	7,008 MF	68%	32%
Canned and semi canned fish (2)					
volume	62,313	14,945	77,258	81,50%	19,50%
value(millions of francs)	2,491 MF	381 MF	2,872 MF	86,50%	13,50%
TOTAL ALL PRODUCTS					
value(millions of francs)	19,358 MF	5,940 MF	25, 298 MF	76,50%	23,50%

(1) All quantities sold in all forms without corrections (fillets whole steaks)
(2) net weight or net minimal weight of fish depending on the presentation

Fig. 4 - French consumption of sea products in and outside home (1988). (source: FIOM, 1988, Rapport annuel d'activité.)
- *Consommation en France des produits de la mer à la maison et au dehors.*

Direct consumption of frozen seafood* increased by 55 % between 1984 and 1989 (Fig. 5), due to a growth in the consumption of processed and non-processed frozen products (respectively 71 % and 44 %). For non-processed sea products, frozen fish and crustaceans, consumption rose while that of frozen molluscs levelled off.

The rise in freshwater fish consumption (+ 69 %) was due to the substitution of imported salmon for native trout. The sale of processed products, fritters, surimi and prepared dishes containing fish increased slightly.

The canned fish consumption structure is also changing with regard to choice of species. Since 1980, the production of canned tuna contributed to the development of canned fish consumption (Fig. 6).

These observations show great transformations in seafood consumption options due to different elements such as a global change in consumer behaviour linked with a new way of life and the trend towards substitute products with the rising price of seafood. The price index increased from 100 to 164.5 between 1980 and 1985 and reached 197.4 in 1989, whereas the household income index increased only from 100 to 141.4 between 1980 and 1985. Thus, the seafood consumption budget rose steadily in the total consumption budgeting: 2.8 % in 1985 compared to 2.4 in 1970.

* Direct consumption of frozen sea products is related to household demand and not to industrial demand for further processing.

	1985 in tonnes	1985 (in %)	1989 in tonnes	1989 (in %)	evolution 1989/85 (in %)
Non Processed	67,398	39,68%	115,685	43,92%	71,64%
whole fish	23,193	13,66%	47,123	17,89%	103,18%
crustaceans	27,178	16,00%	49,181	18,67%	80,96%
molluscs	17,027	10,03%	19,381	7,36%	13,83%
Processed	102,441	60,32%	147,703	56,08%	44,18%
fillets	38,375	22,59%	46,738	17,74%	21,79%
coated fish	30,318	17,85%	33,819	12,84%	11,55%
fritter and surimi	9,966	5,87%	20,376	7,74%	104,46%
sea product prepared meal	23,782	14,00%	46,77	17,76%	96,66%
TOTAL	169,839	100,00%	263,388	100,00%	55,08%

Fig. 5 - Consumption of frozen and deep frozen sea products per category. (in tons). (Source: Statistiques de la FICUR, 1990.)
- Consommation des produits de la mer congelés et surgelés, par catégorie.

Changing marketplaces

The change in marketplaces is also an important cause of the great variations in household consumption structures, probably resulting from the development in the distribution sector over certain geographical areas (Meuriot, 1985). Shoppers are less inclined to buy sea products at special shops (fishmongers), except in the city of Paris, where buyers enjoy a particularly favourable distribution of sea products. An increase of seafood purchases in super/hypermarkets characterizes the evolution from 1981 to 1985 in all areas and regions of France. This increase is due to an unequal distribution development causing delays in the homogenization of marketplaces. There has also been an increase in purchases at open air markets in all regions: in 1985 a quarter of the total sea-product purchases were made at open air markets, no doubt mainly fresh fish and sea-food (Fig. 7).

Conclusion

Changes in seafood consumption in France over the period studied reveal two main new consumer choices: first a preference for easily and quickly prepared sea products already processed, second a preference for fresh and unusual products for more sophisticated home cooking at week-ends.

Further studies are needed on seafood consumption according to the type of household (size of the household unit, age of the head of the household, locality,...), to identify the changes in consumer choices and demand which can be attributed to demographic and sociological patterns and those due to the economic patterns such as changing prices of the seafood, relative prices and varying income.

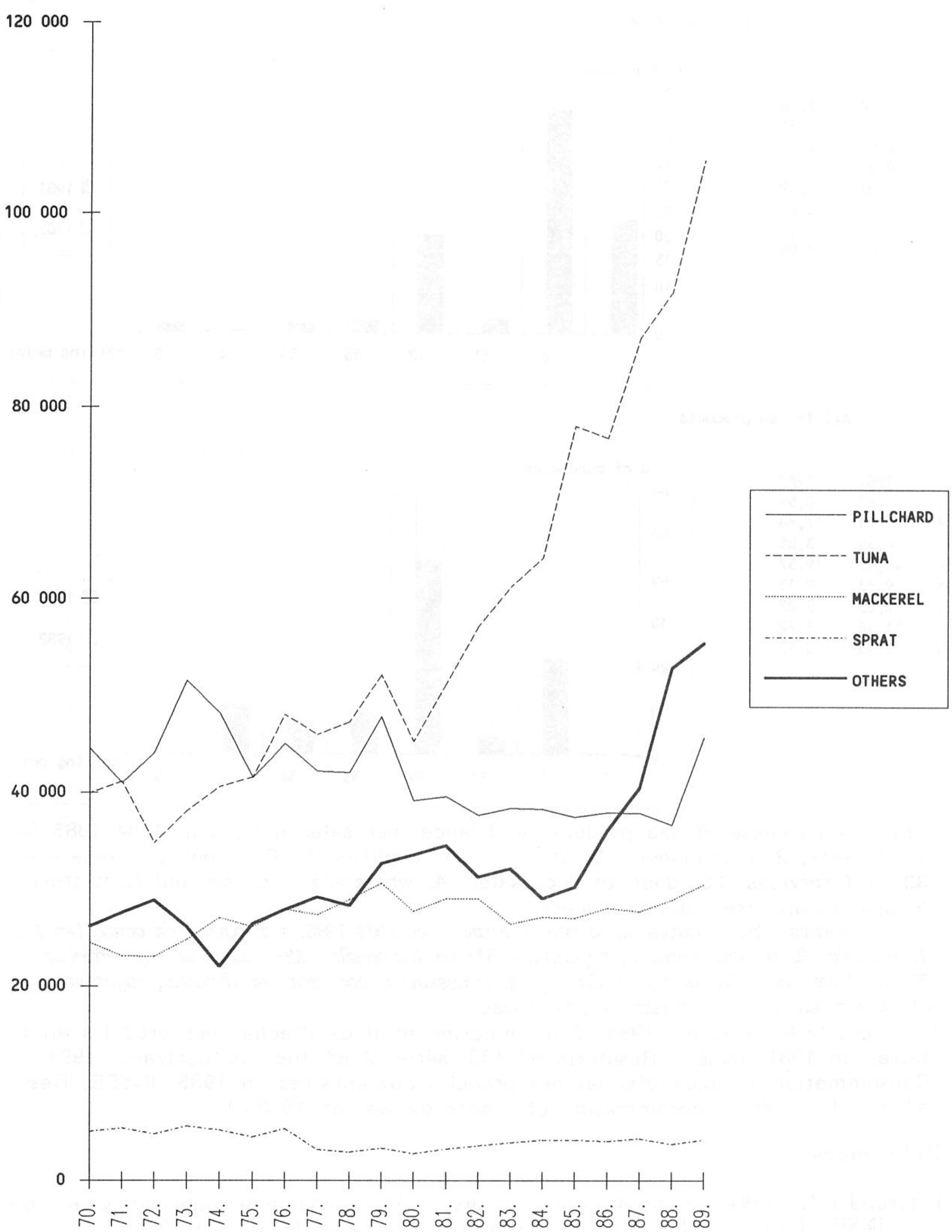
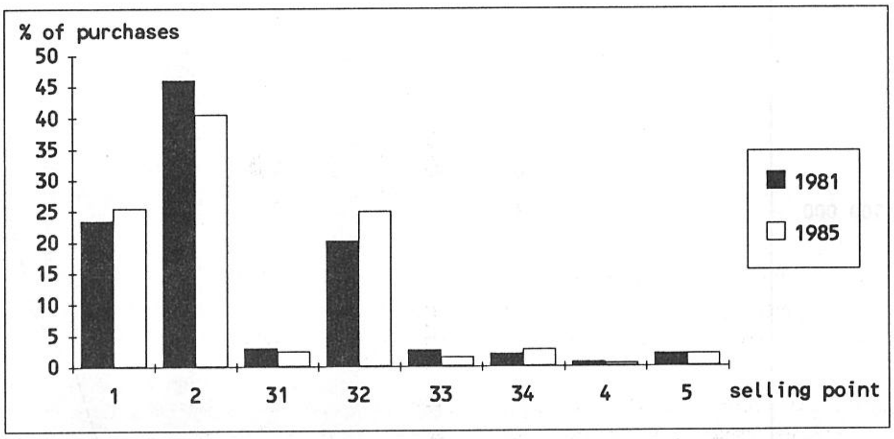


Fig. 6 - Consumption of canned fish products per species (in tons). (Source: C.C.P.M., Rapport annuel 1990.)
- *Consommation de poisson en conserve par espèces (en tonnes).*

Fish, shellfish, crustaceans

	1981	1985
1	23,42	25,42
2	45,99	40,51
31	2,99	2,39
32	20,21	24,91
33	2,63	1,49
34	2,04	2,73
4	0,71	0,5
5	2,01	2,05



All frozen products

	1981	1982
1	0,62	0,51
2	21,71	17,88
31	4,55	3,85
32	44,17	59,57
33	9,53	9,13
34	7,83	5,22
4	11,46	3,72
5	0,13	0,12

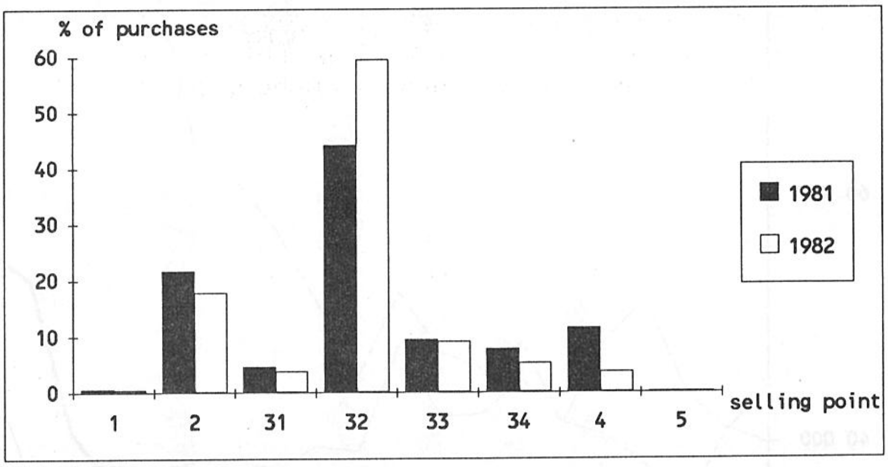


Fig. 7 - Purchase of sea products in France, per sales outlets in 1984-1985 (in %). 1. Markets; 2. fishmongers; 3. Stores - 31: traditional; 32: hyper and supermarkets; 33: self-services; 35: door to door sales; 4. wholesalers, co-op and firm stores; 5. direct purchase from producers.

-Achats des produits de la mer en France, en 1984-1985, par points de vente (en %). 1. Marchés; 2. poissonniers; 3. magasins - 31: traditionnels; 32: hyper- et supermarchés; 33: self-services; 34: vente ambulante;- 4. grossistes, coopératives d'achat, magasins d'entreprises; 5. achat direct au producteur.

(Source: M.A. Mercier, 1984, Consommation et lieux d'achat des produits alimentaires en 1981, INSEE, Résultats n° 463, série M n° 108. M. Bertrand, 1991, Consommation et lieux d'achat des produits alimentaires en 1985, INSEE, Résultats n° 112-113, série Consommation et modes de vie, n° 19-20.)

References

Bertrand (M.), 1991. - Consommation et lieux d'achat des produits alimentaires en 1985.- INSEE, Résultats n°112-113, Série consommation et modes de vie, n°19-20.

C.C.P.M., 1990. - Rapport annuel sur l'industrie des pêches maritimes.

FICUR, 1990. - Annuaire statistique.

FIOM, 1988. - Rapport annuel d'activité.

Gombert (M.), 1991. - La consommation des ménages en 1990.- INSEE, Résultats n°133-134, Série consommation et modes de vie, n°27-28.

Meuriot E., 1985. - Tendances à long terme de la consommation des produits de la mer en France. *In : Valorisation des produits de la mer*, Rapport interne DRV/SDA: 7-22.

Mercier M.A., 1984. - Consommation et lieux d'achat des produits alimentaires en 1981.- INSEE, Résultats n°463, série M n°108.