

Improvement in Fisheries Post-Harvest Technology in Thailand

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Present Status of the Fish Industry

The fisheries of Thailand developed at a slow rate up to the early 1960's. Fishing activities were confined mainly to coastal waters and carried out by non-mechanized boats using traditional methods. The introduction of trawling brought about a rapid technological change. Within a short time, fish catches had increased several-fold and most of the national catch was being taken using modern methods. The fishing industry began to play an increasingly important role in the national economy. Today the Thai economy is a mix of agriculture, manufacturing, mining, and tourism. Fisheries is included under the Ministry of Agriculture and Cooperatives, so that in macro-economic considerations, fisheries is included as a sub-sector of agriculture, and is included in the latter's statistics. Agriculture, both in terms of primary production and agro-industry, remains the backbone of economic activity, accounting for nearly 70 percent of the workforce. However since 1985 — according to Government sources — manufacturing has taken over as the largest contributor to GDP.

In a relatively short period, over the last decade or so, the Thai fishing industry has grown rapidly to become the fourth largest in Asia (after Japan, China, and India), with export earnings totalling about U.S. \$750 million in 1985. Fish products rank among five top income earners in Thailand. In 1983, Thailand ranked seventh in the world in value of fish product exports. Table 1 shows the volume and value of Thai international trade in fish and fish products from 1970 to 1985.

Accurate statistics on total employment in the fisheries sector are not available. Preliminary results of a marine fishery census conducted in 1985, focussed on households rather than individuals. Table 2 contains the most

salient data reflecting the preliminary results of the census. It may be estimated that employment onboard fishing boats alone is in the order of 200 to 250 thousand persons. The processing sector (including freezing, canning, and pre-processing steaming and peeling/shucking) of the larger enterprise type, may be employing some 40 to 50 thousand persons, primarily women. Traditional processing, on the cottage industry scale, gives employment to additional thousands of women.

The shore-based activities directly related to fisheries are highly decentralized and several small operators participate in various phases of the movement of fish from boat to the customer. Many are family operation employing only family members, including school-aged children. Other small enterprises provide employment to hired labour as well.

The industrial type processing establishments (canneries, freezing plants, etc.) have developed in response to world demand for seafood either available in Thailand, or produced here cheaper than elsewhere. The domestic supply of fish and fish products goes through traditional channels and establishments much smaller in scale than those processing for export. Government policy strongly supporting free enterprise, favours the initiative of individuals who make their living dealing in fish directly or indirectly. The shorebased operations/flow channels of fish constitute a complex web of often highly specialized entrepreneurs, who make money on the operations but at the same time give employment to thousands of people.

The Thai fishing industry then, is a major contributor to the national economy. The Government attaches great importance to the industry and is determined to upgrade the weaker segments in it.

Table 1. Thailand: International trade in fishery commodities

Year	Imports		Exports	
	mt	US\$'000	mt	US\$'000
1985*	152,707	154,298	466,219	741,106
1984*	119,064	88,305	411,722	646,738
1983	58,562	42,821	336,076	544,039
1982	45,948	28,206	308,378	482,012
1981	46,947	22,223	313,351	412,451
1980	43,530	23,378	268,965	358,259
1979	79,938	20,996	284,423	362,760
1978	29,183	8,608	239,429	252,895
1977	18,575	6,682	181,107	176,783
1976	24,868	7,248	131,774	150,378
1975	19,682	6,260	97,998	105,361
1974	19,965	4,667	88,221	77,449
1973	19,542	4,628	104,133	82,496
1972	15,139	4,185	82,381	38,608
1971	...	...	54,500	23,996
1970	...	...	44,100	17,656
Average Growth Rate				
1976/1985	22.3%	40.5%	15.1%	11.2%
1970/1985	...	...	17.0%	28.3%

* 1984 and 1985 preliminary data

Source: 1976 - 1983 FAO Yearbook of Fishery Statistics, Vol. 59.

Remaining data: Department of Fisheries, Bangkok.

Table 2. Summary of results of census of marine fishery — 1985

1. Number of households by types of fishery & status — total number of households	84,401
— capture fishery	49,877
— capture fishery & coastal aquaculture (subtotal: Capture & capture & culture)	1,801 (51,678)
— coastal aquaculture only	5,848
— fishery employees' households	26,875
2. Number of fish dealers — total	4,637
a) local fish dealers	
— wholesalers	1,501
— retailers	2,584
b) non-local fish dealers	
— selling mainly at the Bangkok market	208
— selling to markets other than Bangkok	344
3. Number of fish processing households — total	14,184
a) by type of management	
— operators' households	13,979

Table 2. (continued)

— company	205
b) by type of engagement	
— processing only	6,342
— fishing & processing	7,842
c) by type of activity*	
— freezing	3,956
— canning	28
— fermenting	4,733
— steaming	1,723
— smoking	53
— fish/shrimp balls & crackers	211
— salting/drying	4,150
— reduction	109
— other forms of processing	488
4. Number of households with or without boats	
— total	51,678
— with boat	48,311
— without boat	3,367
5. Number of fishing boats by type of boat — total	53,440
— non-powered boats	8,302
— outboard engine	28,233
— inboard engine	16,905
6. Number of coastal aquaculture households by type of activity**	
— fish culture	1,710
— shrimp culture	4,504
— crab culture	184
— oyster culture	1,197
— sea mussel culture	265
— blood cockle culture	123
— horse mussel & other	11

Source: Preliminary Report, 1985 Census of Marine Fishery, National Statistics Office.

* Figures do not add up to total due to multiple activities.

** Figures cannot be summed up due to multiple activities undertaken by one household.

Fishery Resources

The maximum sustainable yield (MSY) of marine resources in Thai waters is estimated to be 1.2 million tons, of which demersal fish comprise 970,000 tons and pelagic fish 230,000 tons. In the Gulf of Thailand and the Andaman Sea, fishing in excess of the estimated MSY has been pursued for many years. The stocks, particularly of large fish species have, as a result, declined sharply.

The declaration of 200 mile exclusive economic zones (EEZ) by neighbouring countries has further aggravation the problem, since Thailand has lost access to about 40 percent of the fishing grounds exploited prior to the introduction of EEZ. This, coupled with rising domestic demand and exports has forced fishermen back to the already overfished Thai waters. Joint venture agreements and licenses to fish in foreign waters could only partly offset the losses.

A mission which advised the Royal Thai Government on implications of EEZ for the Thai fishing industry estimated that Thailand may lose, as a result of the new legal regime of the sea, between 300,000 and 600,000 metric tons of fish annually. From a perspective of the past ten years that estimate has to be considered realistic. Among measures to counterbalance the losses in production, the mission recommended the reorientation of the work of the Fish Technology Division of the Department of Fisheries towards utilization of "trash" fish and non-traditional fish species for human consumption, and towards upgrading the quality of fish products, through improved handling and processing techniques.

Trawling and other modern fishing methods, accompanied by motorization of fishing boats and the gradual introduction of new types of fishing vessels resulted in an accelerated development of the industry. The predominant focus of the industry was on growth in the volume of landings, while the quality of fish landed and distributed through the complex distribution/trading network was of secondary concern and thus has not kept pace.

The pace at which the Thai fishery grew is illustrated in Table 3. The most rapid growth, averaging 17.3 percent per annum, took place during the decade 1962 — 1972. Heavy fishing within Thai waters, and the first results of the introduction of EEZ by neighbouring coun-

tries, combined with considerable fluctuation in aquaculture output, have resulted in a decline in total catch in the mid-1970s. The subsequent decade witnessed a comparatively modest average growth rate of 2.4 percent per year, and since 1982 growth has been arrested. It is unlikely that the marine fishery will be able to increase its production, due primarily to limitations of access to resources in foreign EEZ's.

Table 4 shows developments in the fishery — both marine and inland, between 1975 and 1985. It should be noted that the increase in total landings since 1977 was largely a result of the successful initiatives of the Government and the industry in negotiating fishing rights in foreign EEZ's.

The fluctuations in the marine nominal catches since that time are the result of not only changes in yield from Thai waters, but also of changing fortunes of joint ventures or access to fishery resources in foreign EEZ's.

Utilization of Fish Landed

The composition of marine fish landings in Thailand is typical of a tropical fishery, with a few species recorded separately and the bulk of landings composed of a mix of many species. Table 5 illustrates this, showing the species composition of marine fish landed. It will be noted that over half of the total landings of food fish is classified as "other" since it is composed of smaller quantities of several species.

Table 3. Growth rates of Thai fisheries

Year	Landing (mt)	Average Annual Rate of Growth	
		Year : Year	%
1955	213,000		
1962	339,700	62 : 55	6.9
1965	615,100		
1972	1,678,900	72 : 62	17.3
1975	1,552,800		
1982	2,120,000	82 : 72	2.4
1985	2,124,400	85 : 82	0.07

Table 4. Nominal catches 1975 — 1985 (mt)

Year	Total	Marine	Inland	% of Total	
				Marine	Inland
1985	2,124,400	1,958,800	165,600	92.2	7.8
1984	2,134,838	1,973,019	161,819	92.4	7.6
1983	2,249,808	2,099,808	150,000	93.3	6.7
1982	2,120,021	1,986,459	133,562	93.7	6.3
1981	1,988,650	1,824,069	164,581	91.7	8.3
1980	1,792,030	1,647,035	144,995	91.9	8.1
1979	1,944,202	1,811,026	133,176	93.2	6.8
1978	2,097,492	1,956,486	141,006	93.3	6.7
1977	2,188,492	2,066,118	122,374	94.4	5.6
1976	1,659,388	1,512,094	147,294	91.1	8.9
1975	1,552,836	1,392,144	160,692	89.7	10.3
Average Growth Rate	3.2%	3.5%	0.3%	—	—

Source: 1975 — 1983, FAO Yearbooks of Fishery Statistics.
1984 and 1985, Department of Fisheries, Bangkok.

Table 5. Marine fish landings — major species 1981 — 1984

	1984	1983	1982	1981
A. Total Landing — '000 mt	1973.0	2100.0	1986.6	1824.2
of which:				
food fish — '000 mt	1215.4	1296.7	1173.8	1027.7
— % of total	61.6	61.7	59.1	56.3
"trash" fish — '000 mt	757.6	803.3	812.8	796.7
— % of total	38.4	38.3	40.9	43.7
B. Major Species — '000 mt				
Indo-Pacific mackerel	129.1	79.8	86.1	71.7
Indian mackerel	33.4	53.2	21.5	20.5
Shrimp	136.2	160.3	187.4	148.2
Shellfish	153.6	115.6	157.2	154.3
Cephalopod	129.3	132.0	116.6	80.8
Other food fish	633.8	755.8	605.0	552.2
(Tuna-like fishes within "other")	(51.8)	(51.8)	(49.3)	(22.3)

Source: Fisheries Record of Thailand, 1984, Department of Fisheries.

Note: Line — "Tuna-like fishes" from FAO Yearbook of Fishery Statistics, Vol. 58.

"Trash" fish continuously comprises about 40 percent of total landings, and it comes basically from trawlers. It includes small, low value species, used predominantly for reduction to fish meal, and by catfish and duck farming enterprises. Onboard, this fish is kept in holds

in bulk, virtually without ice. Unloading from larger trawlers is also in bulk, straight onto trucks for delivery to reduction plants or farms.

Since the market for trash fish is extremely good, either as direct feed or as raw material

for reduction, and the prices are rather high, the vessel operators do not have sufficient incentives to try and recover fish which could be used for direct human consumption or as raw material for processed food products.

It is not known whether the small fish constituting the bulk of the "trash" fish are full grown or are juveniles of species which can grow to a larger size. This aspect is particularly important from the viewpoint of resources management, on which the future of the national fishery may depend.

Table 6 indicates the utilization of fish and the changes in utilization patterns which have taken place since 1970.

It is evident that the proportion of fish marketed fresh has decreased from 47 percent in 1970 to 26.3 percent in 1984. The absolute volume of fish marketed fresh has also declined considerably. Freezing is rapidly gained importance. This is primarily due to exports. Canning, non-existent in the first half of the 1970's, now absorbs almost 9 percent of the total fish supply from national landings.

The volume of raw material utilized for cured fish products varies from one year to another, as does the percentage share of that group in total landings. Curing is often the processing method of last resort, utilizing fish which is unsuitable for other purposes, either

because of its quality/freshness or because of its small size.

The post harvest losses of fish in Thailand like in other Asian countries are negligible. Fish classified unsuitable for direct human consumption is either cured viz fermented and used for instance as sauce, or reduced to fishmeal.

The increase in modern processing of fish for export, and the continuing high proportion of trash fish in local landings, however, pose serious problems to the supply of food fish to the domestic market and its national per capital consumption.

The Fish Processing Industry

As discussed under "Utilization of Fish Landed", only 26 percent of fish landed is marketed fresh or chilled, while almost three-quarters of the landings are processed in one way or another. A major portion of the landings (approximately 40 percent) is reduced to fishmeal. Freezing, canning, and curing jointly absorb more than 34 percent of the national landings. It is recognized that the canning industry imports increasingly larger quantities of tuna for processing in Thailand. Imported fish is not included in the fish utilization statistics. Table 7 lists the numbers of fish processing establishments registered in 1984 broken down by type of production.

Table 6. Utilization of fish

	1984		1980		1974		1970	
	Tons	%	Tons	%	Tons	%	Tons	%
Marketed Fresh	560,900	26.3	590,400	26.2	600,000	36.9	680,500	47.0
Frozen	201,000	9.4	155,600	6.9	65,000	4.0	21,000	1.5
Cured	346,700	16.2	526,800	23.4	223,000	13.7	204,900	14.1
Canned	181,300	8.5	116,300	5.2	0	0.0	0	0.0
Other	844,900	39.6	866,300	38.4	740,000	45.5	541,200	37.4
TOTAL	2,134,800	100.0	2,255,400	100.0	1,628,000	100.0	1,448,400	100.0

Note: Percentages may not add up to 100 due to roundings.

Line: "Other" indicates fish used primarily for reduction/animal feed.

Source: Department of Fisheries, Thailand.

Table 7. Thailand: Fish processing establishments 1984

	Number of Plants	Capacity	Total Annual Production*	% of Total Fish Produced	Production Tons/Plant (Annual)	Production Kilograms/Plant/D 300 Days/Year
1. Cold Storage	78					
— freezing capacity: tons/day		1,991				
— storage capacity: tons		49,746				
— actual throughput: tons			200,240		2,567	8,557
2. Ice Plants — cube ice (boxes)**	152		23,508,939		154,664	
— flake ice (tons)	3		214,940		71,647	238,822
3. Canneries	38		264,557	19.4	6,962	23,207
4. Fish Sauce	113		24,227	1.8	214	715
5. Fishmeal	95		881,518	64.8	9,279	30,930
6. Shrimp Paste	2,860		14,558	1.1	5	17
7. Salted Fish	800		59,863	4.4	75	249
8. Dried Shrimp	284		42,800	3.1	151	502
9. Dried Squid	865		46,833	3.4	54	180
10. Dried Mussel	776		7,884	0.6	10	34
11. Steamed Fish	138		10,812	0.8	78	261
12. Smoked Fish	184		2,925	0.2	16	53
13. Fish/Shrimp Crackers	78		886	0.1	11	38
14. Fish Balls	64		3,467	0.3	54	181
15. Budu Sauce	37		428	0.1	12	39
Total Tonnage of Raw Material (— Fish)			1,360,758	100.0		

Source: Statistics of DOF, Bangkok.

* Production of fish processing establishments expressed in tons of raw material.

** Production of cube ice expressed in boxes, as reported in official statistics.

Production per plant/day at 300 days a year is a hypothetical throughput of raw material per day to illustrate the small size of certain processing establishments.

Cold Storage and Freezing Facilities

A total of 78 plants with an aggregate daily rated capacity of 1,991 tons of freezing, and cold stores for 49,746 tons were in operation in 1984. All plants are owned by private interests, with the exception of those few owned by the Cold Storage Organization (CSO).

Although there are no statistics on the utilization of freezing capacities, they may be considered more than adequate (Table 8), despite seasonal variation in daily landings. Freezing plants are probably not utilized to capacity even during peak season.

The annual throughout of cold storage facilities of 200,240 tons as compared to capacities gives an average rotation ratio of 4, again reasonable, and perhaps leaning towards underutilization. Production of ice also seems to be adequate for the annual catch; however, seasonal variations in landings and the hot season may require more ice than available from daily production. Reports by various fish handling and processing specialists confirm

that premium quality fish, viz high value species, are always well packed and iced. The use of ice seems to be determined by the ex-vessel price of fish rather than its availability.

Canneries

Total exports of canned seafood in 1985 were 132,489 tons, an increase of 3.2 times over 1981. Canned products have become the most important group of fish export product. The most notable feature of this industry has been the rapid increase in the production and export of canned tuna. Canned tuna in 1985 constituted 66 percent by volume and 63 percent by value of canned seafood exports; at the same time it constituted 25 percent of total exports by value. Tuna landings from the national catches are not sufficient to supply the canning industry and therefore imports of tuna are growing rapidly. The 1985 imports of fish totalled 152,707 tons, composed largely of raw material for the canning industry. It is estimated that in 1986 imports of tuna will reach 250,000 tons; in 1983 this was below 40,000 tons.

Table 8. Export of fish and fish products, by major product groups

	1981		1982		1983		1984		1985	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Total exports	313,351	8,756	308,378	11,231	336,076	12,677	411,722	15,081	466,219	18,528
Frozen shrimp	19,699	2,081	22,647	2,764	20,150	3,165	19,428	2,799	24,041	3,439
Frozen cephalopods	39,000	1,248	42,656	1,784	39,321	1,637	42,821	1,693	46,289	2,121
Fishmeal	111,042	968	83,074	701	93,246	785	85,487	743	74,791	605
Crustacean and molluscs meal	20,289	327	20,713	377	34,761	579	43,825	764	53,673	1,000
Fresh & frozen fish	49,000	530	53,116	688	53,409	686	75,254	1,017	96,444	1,377
Dried cephalopods	2,900	450	3,565	607	3,440	630	3,918	800	4,386	1,045
Dried shrimp	1,976	180	2,217	216	5,524	448	6,234	551	5,925	532
Canned seafood*	40,848	2,092	65,770	3,186	74,391	3,968	110,491	5,862	132,489	7,347
of which:										
— tuna	—	—	—	—	n.a.	n.a.	39,862	1,854	87,134	4,620
— crustaceans and molluscs	—	—	—	—	24,437	1,847	29,047	2,162	29,542	2,142
— sardines	—	—	—	—	n.a.	n.a.	2,412	60	3,012	92
Other fish products	28,597	880	14,620	908	11,834	779	24,264	852	28,181	1,062

Source: Department of Fisheries

Note: *Statistics on exports of canned tuna prior to 1984 are not available

Quantity: mt; Value in million Baht

In 1984 there were 38 registered canneries with major concentrations in Samut Prakan (11 plants), Samut Sakhon (8 plants), and Bangkok (7 plants). The total production of canned seafood for that year was 110,491 tons, for which 264,557 tons of raw material were used. Data regarding capacities of the individual plants are not available; however, the average annual throughput of raw material was in the order of 7,000 tons. The canning industry produces mainly for export, and most of the canneries were constructed recently. The modern canneries are built to international standards.

Initial processing of many species eventually used by the modern canning plants is carried out at various places outside the plants, and pre-processed raw material is then purchased by the canneries. Such initial processing is carried out in peeling sheds, shucking stations, market floor, houses, or any other available space, even on the street. Small shrimps are peeled raw, or cooked and then peeled; crabmeat is picked, cephalopods are cleaned, clams are shucked, and fish are filleted. The products resulting from these operations then become the raw materials for the canning and other processing industries, as well as for plants producing traditional products. These facilities are not registered with any Government agency and are under no formal control. The operational formal conditions are in most cases inadequate.

When the canneries and cold storage plants received products from such facilities, quality has already suffered seriously. These facilities are an impediment to achieving good quality products and seriously affect the quality of canned and frozen products for export.

Processing of Traditional Products and Pre-processing

As may be seen from Table 7, of the total fish processed some 15.8 percent were used for what is called "traditional products". The most important among these (in terms of raw material used) are salted fish, dried squid, dried shrimp, and fish sauce. Some of these products are also exported, however the bulk is marketed domestically.

The number of processing establishments officially reported by the Department of Fisheries was 6,199 in 1984, and the amount of raw material processed was 214,683 tons, giving an average of 34.6 tons per operator. Table 7 gives the average annual production in terms of raw material, by type of products. Since details on the processing establishments producing traditional products are not available, a calculation has been made in Table 7 showing daily production, assuming that these establishments operate 300 days per year. Although this calculation may not accurately reflect the number of

production days (affected *inter alia* by weather conditions or fishing season) it does provide an impression of the average size of the processing establishment. It is clear that virtually all traditional products are manufactured by what could be defined as "cottage industries." Daily raw material throughput per establishment ranges from 17 kg in the case of shrimp paste, to 715 kg for fish sauce. Establishments producing salted fish and dried squid and shrimp used between 180 kg and 502 kg of raw material daily.

The scenario painted above is only part of the overall fish processing scene in Thailand. The recent Census of Marine Fishery of 1985, the results of which are summarized in Table 2 showed that in the coastal areas alone there were 14,184 "fish processing households," of which there were 13,979 "operator households," and 205 company-type operations. The difference between the official statistics and the census is significant and indicates that only a percentage of the processing establishments in existence are recorded regularly by the respective Government Agencies.

Furthermore, it would seem that the entire operation of pre-processing, on which the canning industry depends for raw material, is not fully reflected in the official statistics. The number of processing establishments, as reflected in the census summary, shows the importance of the processing operations from the point of view of employment. The processing and pre-processing operations are largely based on the principles and practices of small business, i.e., the operators buy fish, process it, and resell it to canneries. Some pre-processing is done by fishing families, which in addition to providing a livelihood for thousands of families, is also a traditional activity.

Fishmeal Plants

There were, according to official statistics, 95 fishmeal plants in 1984, with major concentrations in the provinces of Samut Prakan, Samut Sakhon, Chumphon, Nakhon Si Thammarat, and Songkhla. Their production capacity is not available; however, the production in terms of raw material was estimated to be 881,518 tons. The fishmeal industry grew from 25 plants in 1970 to 99 plants in 1981, but the number declined in recent years. The principal source of raw material was trash fish, with a small percentage of sardinella and anchovies.

Throughput of raw material averaged 9,279

tons per plant in 1984, viz an average daily production of some 31 tons, assuming 300 days of operation per year. Variations in throughput ranged between 1970, when it reached 35 tons per day, to a low of 22 tons per day in 1982, indicating that capacities are not fully utilized.

The quality of the finished product is below international standards. Protein is reported to be often below 60 percent, ash content at 22 to 35 percent, and sand content 3 to 5 percent. These characteristics are largely the result of the quality of the raw material. Product quality suffers from the fact that many of the fish are delivered in a partly decomposed condition.

In addition to fishmeal, meal made from crustaceans and molluscs constitute an important part of the total output. In 1985 it comprised 42 percent to total meal exports. Forty to 50 percent of fishmeal produced is consumed locally; the rest is exported mainly to Malaysia, Singapore, and Indonesia.

The industry incurs losses in protein and weight (yield) of the final product due to poor handling of the raw material at sea and ashore. Improvements in this field would result in considerable economic gains for the industry.

Export of Fishery Products

In 1987 Thailand ranked seventh, in terms of value, among the worlds' fish exporting nations, after Canada, USA, Norway, Denmark, Japan and the Republic of Korea. Three years earlier, in 1981, Thailand was eleventh, behind countries listed above and Iceland, The Netherlands, Mexico and Spain. Thailand has become a major processor of fish relying to a large extent on imports of raw material. In global terms, disregarding individual species and products, Thailand's 1985 exports converted to round weight of fish are comparable to around 50 percent of the annual national catch. Table 8 shows that the volume of growth between 1981 and 1985 was of the order of 50 percent, the value of exports — in local currency — grew more than two-fold.

A remarkable shift has taken place in the structure of export commodities, from products with a lower value-added component, towards products of high value. The processing industry has depended on cheap

labour available in Thailand and exploited structural changes taking place in the world fishing industry and the international trade in fish and fish products. The most spectacular growth occurred in cephalopods and most recently in canned seafood, particularly tuna. It is expected that in 1986 exports of canned tuna will exceed the 100 thousand tons mark.

The present status and future outlook of the tuna, cephalopod, shrimp, canned shrimp, crabmeat and clam and dried fish components of the industry is briefly described below.

Tuna

Official statistics regarding Thai exports of canned tuna prior to 1984 are not available. However, the industry estimates that in 1979 exports were in the order of 3.2 thousand tons; in 1980 — 4.6 thousand tons; in 1981 — 12.6 thousand tons; in 1982 — 17.5 thousand tons; and in 1983 — 28.6 thousand tons. In 1985 exports reached 87.1 thousand tons, the equivalent of 8.5 million cases.

By 1985 Thailand became the largest canned tuna exporter in the world. Already in 1983, Thailand replaced the Philippines as the largest tuna exporter to the United States of America, by far the largest canned tuna market in the world. The following year Thailand increased its exports to the United States further and also consolidated its foothold in the European markets.

One of the most interesting aspects of Thailand's success in the industry is that it has emerged as the largest canned tuna exporter in the world without having a large tuna fishery of its own. Thailand is almost completely dependent on frozen tuna imports to sustain its processing operations. Yet it has been able to maintain supplies and increase its canned tuna production at a time when international market was in recession. Skipjack, yellowfin and albacore are imported from Japan, Taiwan, the US, Maldives, Papua New Guinea, and the Solomon Islands. Long-term contracts on raw material procurements up to a 12-month period are arranged to ensure continuous supplies for the production lines.

The development of the tuna canning industry in Thailand is largely the result of the world's situation, of which the Thai fish processing sector has availed itself so successfully. The world tuna industry has not recovered from the recession which took hold in 1981.

Measures which were initially taken to deal with the situation have resulted in a major restructuring of the industry. Some of the changes include:

- Changed pattern of resource exploitation. The US purse seine fleet moved from the Eastern to the Western Pacific, and the French and Spanish fleets moved from the Eastern Atlantic to the Western Indian Ocean,
- The closure of all but one tuna canning plant in the continental United States and the expansion of offshore operations in the US territories of Puerto Rico and American Samoa, and
- A rise in the canning capacity in low cost producing countries, particularly in Thailand, Mexico and the Philippines.

In fact, US trade groups are concerned about the developments which directly affect the US industry and market. In early 1986 they appealed to the International Trade Commission to conduct a thorough survey of the tuna industry in the USA, Thailand, Taiwan, Philippines, Japan, Mexico and some other countries. The ITC is expected to submit a report to the US Congress by the end of 1986. The outcome of the report may affect US canned tuna import policies and tariffs.

It seems that the changes which were taking place in the tuna industry worldwide have not yet come to an end. The industry is still evolving, and adjustments are continuing to occur. Most observers of the industry agree that the major problems are: (i) excess production and processing capacity relative to demand; (ii) increased competition among high and low cost producers; (iii) market dependence on one single product form i.e. canned tuna. These problems have surfaced in the early 1980's and have continued to plague the industry despite short term improvements in market prices and tuna consumption worldwide.

Cephalopod

Three groups of cephalopods are of a commercial importance worldwide: squid, cuttlefish and octopus. World landings of cephalopods increased between 1970 and 1984 by some 650 thousand tons from 1.0 million tons in the former year to 1.65 million tons in the latter year. Japan, the Republic of Korea, Spain and China are the main catching nations.

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World production is on an upward trend to satisfy market demand. Thailand joined the group of countries traditionally fishing for cephalopods, and its catch in 1984 reached 130 thousand tons.

Thai exports of cuttlefish in 1985 constituted 8.1 percent of the country's total fishery exports by value. By weight, 25.7 thousand tons of cuttlefish were exported, of which 13.9 thousand tons were to Japan. In tonnage terms, exports to Japan constituted 54.1 percent; however in value terms this was almost 77 percent. The second important buyer was Italy, with 6.7 thousand tons constituting 26.1% by weight and 14.2 percent by value. The third important market was France, where 3.3 thousand tons were exported.

The total exports of frozen squid were 11.2 thousand tons, of which two-thirds were exported to Italy. Frozen octopus exports totalled 9.4 thousand tons, of which 4.4 thousand tons went to Japan and 3.4 thousand tons to Italy. The only other meaningful quantity — 982 tons — was imported by Spain.

Thai production and exports of canned cephalopods were negligible, as the international market has a preference for fresh (frozen) product.

Besides fresh and frozen, cephalopods are marketed in many forms: canned, dried, salted, fermented etc. The growth of fresh and frozen products over the last several years has been remarkable. Input for preparations has also shown a steady increase. The quantity cured is on an upward trend, although this form of utilization seems to be quite sensitive to production trends.

Shrimp

World shrimp production reached 1.9 million tons in 1984; Thailand produced 137.3 thousand tons or 7.4 percent of the world's total.

Marine catches are thought to be at or near their upper limit. However, production of cultured shrimp is increasing rapidly, although from a relatively small base. World demand for shrimp remains strong. It is one of the most important products entering the world seafood trade channels.

Canned shrimp

The total 1985 exports were 12.2 thousand

tons, sold to: USA — 5,300 tons; France — 2,600 tons; and Canada 1,600 tons. Other importing countries received the remaining 2.7 thousand tons.

In the USA the consumption of canned shrimp was on the decline and it affected the price levels. Besides, its price was adversely affected by poor quality of the products. The market for canned shrimp is very small in relation to that of frozen product.

Canned crabmeat and clam

Clams and crabmeat are not as important in the importers' market as are other products, and the end consumer buys them as a luxury item rather than a "ready meal" item, which is a function performed by canned tuna. It is for this reason that market is unstable and those items are more vulnerable to changes in disposable incomes of consumers.

Dried fish

In many countries drying is the simplest solution to preserving fish. Drying was the only preservation method over many centuries and a variety of traditional dishes include cured fish products sometimes as condiments, like fish sauce, but often as the main protein source.

Often regarded as poor peoples' food, dried fish has retained its importance in the major producing countries and its production has even increased. Several products have also a good international market. Higher priced speciality items like sharkfins, fishmaws, dried shrimp and dried squid and cuttlefish account for the lion's share of market in this category of products. However, consumers have become more quality conscious and improvements in processing methods and presentation are becoming more important.

In Southeast Asia, value wise, Thailand is the leading exporter followed by Singapore and Malaysia, while Japan, Hong Kong and Malaysia are top importers of various products. Small quantities are exported to Europe, and notably the United Kingdom and the Netherlands.

Thailand's total export of dried products in 1985 exceeded 20 thousand tons. Japan is the leading import market for dried cephalopods, especially cuttlefish and squid. Hong Kong imports a substantial portion of dried shrimps Thailand produced. The average value realized by Thailand from exports of dried cepha-

lopods in 1985 was US\$40.19 millions and for dried shrimp US\$20.46 millions.

The main problem experienced by exporters of dried products to Japan and Europe is poor quality, originating with the quality of the raw material, but sometimes the result of processing methods.

Problems Facing The Industry

1. Shortage of raw material

We have seen that as a result of the decline of fish production, the demand of the fishery industries could not be satisfied. The shortage of raw material has resulted from:

1.1 Overfishing

The Marine Fisheries Division, Department of Fisheries reported that MSY of the Gulf of Thailand and the Andaman Sea is approximately 1.5 million tons comprising 970,000 metric tons of ground fish and 490,000 metric tons of pelagic fish. Fish production in Thai waters alone has reached the MSY for several years. The catch of economic species has also declined during the same period.

1.2 Declaration of 200 EEZ of neighbouring countries

Thailand has lost access to about 40% of her traditional fishing grounds as a result of the introduction of EEZ. It is estimated that the decrease amounts to 300,000 — 600,000 tons annually.

1.3 Growth of the fish processing industry

The number of fish processing plants has grown rapidly since 1981 especially those producing mainly for export. Factory capacities are not fully utilised. Since marine fish production is in sufficient, cultured species such as shrimps and imported raw materials such as tuna are also used.

2. Quality of fish and fishery products

It is recognized that the quality of the fish before it reaches the market or processor is often poor — this due to poor handling at various stages in the industry.

2.1 Fish handling on board

The method of fishing used influences the quality of the catch and this particularly time for trawlers because catches are usually left on board for long time with small quantities of ice. Low value species additionally suffer from poor bulk storage conditions.

Fish are stowed in ice in containers of various materials and designs. Handling on board is improving gradually, through the introduction of plastic containers.

Chilled sea water storage is done in certain areas by storing fish in 200 l container. Catches are sent to shore by transport boats under the pooling system. As a result, fish are no longer held for the whole fishing days (21 days) and this has improved quality in the catches.

2.2 Fish landing complex and fish market

There are presently 19 major ports which, between them, account for 77 percent of the total marine landings. The Fish Market Organization administers 10 of these fishing ports and three fish markets and there are some private landing jetties. Landing facilities appear to be adequate in terms of capacity, but there are major problems in fish handling methods and sanitation. Although plastic containers have been introduced for unloading the catch and for handling of catches on shore, about 25 — 30% of containers are still of basket and wooden boxes. Lack of clean water for washing fish is a problem at all landing sites. Delay in auctioning is another cause of fish deterioration.

2.3 Fish Transportation

From the landing place, fish is usually transported by truck in bulk or in fish boxes depending on its value. Refrigerated trucks/containers are used to transport raw materials to processing factories. However fish used for traditional or for preprocessing usually travel by open truck. Shrimps, cuttle fish, squid and baby clam are held in fiberglass tanks on trucks. High temperature often cause product deterioration at this stage.

2.4 Processing plants

Most processing factories producing for export are built to international standards.

Local and traditional products are processed by small to medium scale processors who are handicapped by having to use raw materials of doubtful quality. Initial processing is carried out in peeling sheds in which there is seldom any quality control. Moreover because raw materials are limited and competition for raw materials is intense, factories with low purchasing power get poor quality raw materials. Delay in processing also aggravates quality problems. In-plant quality control exists but needs upgrading including the training of staffs.

3. Technology

Production of traditional products is still labour-intensive and dependent on the environment. Product quality leaves much to be desired and education in quality control is needed.

Export production depends heavily on imported technology and equipment and expertise on certain production methods is hard to come by. There is a need to develop technology that suits local raw materials, conditions and markets. Factory production and quality control staff need training to keep up with market requirements.

4. Rejection of Thai Fish Exports

Thai seafood exports are handicapped by a poor reputation. Handling practices at sea, on the landing jetties, and during processing are frequently not up to international standards. The result is frequent rejections and generally lower prices.

Official rejection figures more over take no account of quality problems which were negotiated (almost always with an attendant loss in value) after passage of goods from exporter to the importer. The problem of rejections grew as development of the export trade accelerated.

The main reasons for rejections of canned and cured product were animal filth and decomposition, while frozen shrimp was contaminated with *Salmonella*. It is not surprising, bearing fish flow channels in mind, that canned clams, shrimp, and crabmeat were contaminated with animal filth, or were even decomposed. Surprisingly, however, canned tuna also suffers from that problem, despite the fact that the raw material does not go through pre-processing typical for crustaceans and shellfish.

Most fish processing plants, especially the newer ones, operate their processes to recognized standards. The raw material received for processing, particularly that originating from local boats, is already contaminated soon after catching or, more often, in pre-processing. Fish inspection and quality monitoring services of the Department of Fisheries are extremely limited and confined mainly to Bangkok. Sanitary certification of plants is done voluntarily. Many types of export certificates are involved, and there is a lack of clearly defined lines of authority

between the various Government agencies for their issuance. This is administratively confusing and technically unsafe. A virtual lack of fish inspection in Thailand, and absence of minimum quality standards are the main obstacles to upgrading the quality of final products, whether for the domestic or export markets.

Quality control is essential for the success and healthy development of the fishery industry producing for exports. Improved quality of raw material may result in higher yields, lower operating costs, greater market acceptability, and increased profits. There is a direct relationship between quality control and profitability.

Role of Government in Upgrading the Industry

The Department of Fisheries has full responsibility for fisheries research and development. The Fishery Technological Development Division (FTDD) is the technical arm responsible for developing fisheries post-harvest technology. Its main activities include the upgrading quality of fish and fishery products and maximizing utilization of marine, brackish and freshwater fish. Since 1968, the Division has carried out research and development on methods of handling, distribution and promotion of technical improvements leading to better quality in fish and fish products, both traditional and conventional. The Division also promotes new product development and the design of low cost fish processing equipment. In the early 1980's, the Government inaugurated its 5th National Social and Economic Plan for poverty eradication. The division has made its goal in the Plan utilization of low value fish for human consumption and the use of fish and fish products to alleviate malnutrition.

Since 1985, Thailand has been anxiously looking for increased exports and improved foreign exchange. This calls for new initiatives and efforts in the area of product development, value added products and improvement of quality of exported goods and standard of fish processing plants. The Division has expanded the work on quality control to cover plant inspection, product inspection and product certification as well as research and development. Transfer of technology has become one of its major activities with training and seminars provided at all levels from fishermen and villagers to processing plant managers.

quality control personnel and also consumers. The seminars focus on the production, utilization and quality control of fish and fishery products. The upgrading of technical competence, facilities and services is done in cooperations with the international institutes such as SEAFDEC, International Development Research Center (IDRC), Canadian International Development Agency (CIDA), Food and Agriculture Organization (FAO), Australian Development Aid Bureau (ADAB), ASEAN Food Handling Bureau (AFHB) and INFOFISH, and with local and foreign universities.

The FTDD has been particularly active and successful in upgrading the technological level of small-scale and export-oriented factories. This has been achieved through the promotion of good manufacturing practice. This link with the private sector facilitates communication and exchange of information and has contributed to the identification of problems of industrial importance, and their probable solution.

Fish Marketing Organization (FMO), a state enterprise within the Ministry of Agriculture and Cooperatives, is another body actively involved in fisheries post-harvest activities. FMO provides, on behalf of the Government, the essential infrastructure for fish marketing such as ports and wholesale market. The organization is also responsible for the maintenance and operation of fishing harbours and fish auctions, monitoring the activities of fish agents and giving them assistance. Furthermore, FMO is empowered to encourage the establishment of fishermen's cooperatives and associations and to support their activities. In cooperation with the Department of Fisheries, FMO has improved the handling system at fish markets and landing complexes by introducing the returnable container system and providing handling equipment at major fish landing complexes and fishermen cooperatives. Further work on upgrading the quality of fresh fish under the inspection and quality control program will be initiated in major fish markets.

Universities have provided the industry with graduates in Food Science, Food Technology and also Fishery Food Technology. Six universities now offer courses in these fields.

Others government institutes with active roles in fisheries post-harvest technology are the Department of Medical Science, the

Food and Drug Administration, the Thai Industrial Standard Institute and the Ministry of Industry. These institutes have authority to control sanitation, processing methods and food processing plants in general. The Department of Medical Science also issues Analysis Certificate and Health Certificate for all kinds of food.

Government institutes concerned with the industry support the private sector at all levels. It is realized that neither Government nor the private sector alone can achieve quality improvement of raw material and products. Closed collaboration is needed.

Government bodies also mediate between government institutes of importing countries and exporters.

Future Development

The Government of Thailand's Sixth National Social and Economics Plan (1987-1991) focuses on poverty eradication, export promotion and financial stability of the country. The Plan emphasizes diversification of production and the fisheries sector is seen as an area with good opportunities for development especially through culture of shrimp and fish. Development of value-added and quality products is also being encouraged.

The Department of Fisheries is involved in working toward the goals of Sixth National Social and Economic Plan. Priority has been given to increasing the export of high value fishery products and to promoting further development of fisheries. This is being done to help alleviate the country's trade deficit while at the same time creating additional employment especially in rural areas. Fishery product development, especially using low valued species is viewed as an important means of increasing the supply of protein for human consumption.

To accomplish the above goals, the following activities are planned:

1. Increased production through expansion of agriculture and joint venture fisheries.
2. Upgrading of the quality of fish and fishery products.

Quality improvement requires close collaboration between government agencies and private sectors, supporting infrastructure and well trained staffs to follow up the work and is therefore, a time consuming program. To

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achieve this an inspection and quality control program acceptable to government and private sector should be implemented.

3. A strengthening of capabilities in fish handling and processing, including the following:

3.1 Upgrading of facilities and widened study in:

- The utilization of low value fish, production of marketable value-added products and the upgrading of quality of traditional products,
- Develop processing technology for local species, and
- Packaging technology for fishery products.

3.2 Specialized training of staffs in order to cope with fish handling and processing problems in the following areas:

- Grading of product quality/quality determination, and
- Production technology on freezing, canning, minced fish, dried/smoke fish etc.

Competent staffs must be trained to specialize in depth in certain area to address specific problem faced by industry.

3.3 Technical assistance and training are required to maintain the above activities.

Quality improvements will not come from regulation alone. All parties concerned in

fishery industry have to be educated, trained or made aware of raw material and product quality. However, the private sector needs competent technical assistance from government.

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