

Status of and trends in the use of small pelagic fish species for reduction fisheries and for human consumption in Peru

N. Sánchez Durand and M. Gallo Seminario

Peruvian Institute of Fishery Technology

Km. 5.2 Carretera a Ventanilla, Callao

Peru

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SUMMARY

This paper examines the current status of the Peruvian small pelagic fisheries, including the stocks, landings, fishing areas and seasons, infrastructure, fish utilization, nutritional value of resources (particularly of anchoveta, *Engraulis ringens*) and the position of the national fisheries within the international context. The fishing fleet – small- and large-scale – and the processing activities for food and feedfish products are also reviewed.

Besides a brief description of the current fishery policies and a profile of the main institutions that form part of the fisheries sector, several aspects of the national fish product consumption and the main product exports are examined. The study highlights the importance of Peruvian production of fishmeal in world trade, as well as the potential for using the current resource of small pelagic fish for food fish products for internal and external markets. Proposals for newly developed products made from anchoveta are also described.

The economic and social implications of using a small proportion of the Peruvian anchovy catch as foodfish are assessed, including the impact that it would have on food security, value addition, manual labour supply and general poverty alleviation.

The review then describes the characteristics of the fishery in Chimbote City – the main fishing port in Peru, located on the northwestern coast – where the largest anchoveta landings occur and are used for the reduction and direct human consumption.

The history of the fishmeal industry, its peak years, and the problems in and limitations of catching and utilizing anchovy for different purposes, including direct human consumption, are described. The results of a series of interviews with artisanal fishers, processors and other professionals of the sector are presented in a case study in an attempt to gain a real understanding of the problems facing the pelagic fishery in the port of Chimbote, as well as the development potential of the fishery in the short and medium terms.

It concludes that the abundant anchoveta resource could contribute to easing some of the nutritional problems of Peru and the immediate region. However, achieving this goal will require improvements in landing infrastructure, renovation of processing plants and the development of a market that is able to repay the value of such a commercially and nutritionally valuable resource.

1. CURRENT STATUS OF THE PERUVIAN FISHERIES

Peru is one of the major fishing countries in the world. Its 3 100 km coastline is characterized by intensive oceanic upwelling, which, combined with various environmental and biological factors, makes its waters highly productive. According to IMARPE (2004–2005), the Peruvian sea hosts over 730 fish species. The fish fauna of the relatively narrow continental shelf includes pelagic fish stocks, and although the abundance of these stocks are subject to abrupt fluctuations, the Peruvian continental shelf area is a very large, extremely productive system with a great recovery capacity.

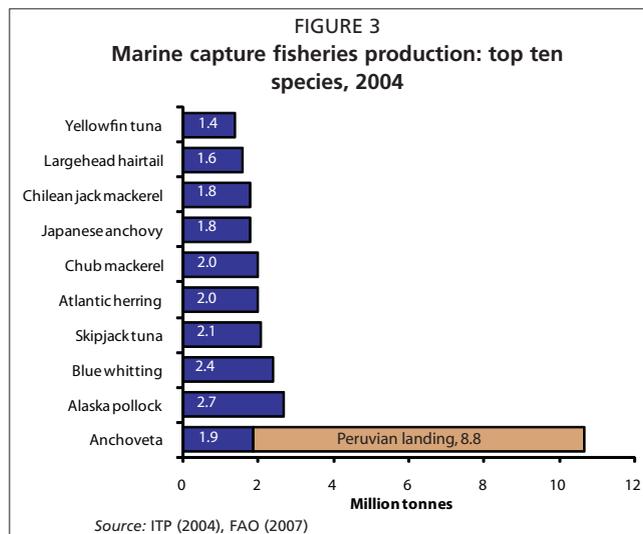
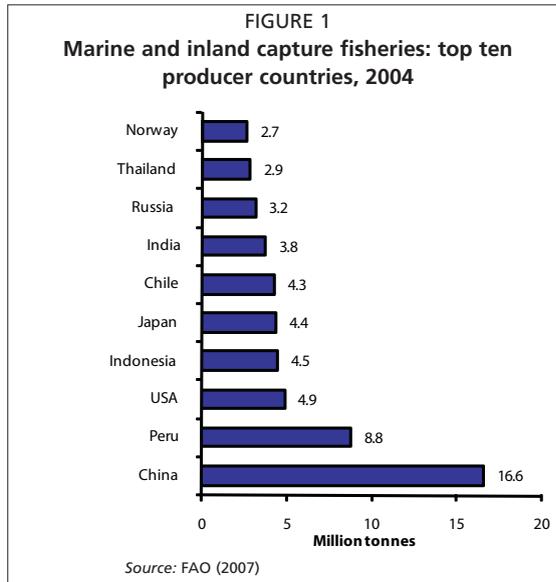
1.1 Ranking of global fisheries

Preliminary estimates for 2005 based on reporting by some major fishing countries indicate that the total landing of the world capture fisheries reached almost 93.8 million tonnes (FAO, 2007). Peru is the second largest country, after China, in terms of capture volumes and provided nearly 10 percent of the total world catch (Figure 1). Global capture production in 2004 reached 95 million tonnes, an increase of 5 percent in comparison with 2003, when total catch was 90.5 million tonnes.

The highest and lowest total catches in the past ten years (1995–2004), for which complete statistics were available at the end of 2006, coincided with the fluctuating catches of anchoveta (*Engraulis ringens*) (Figure 2), a species notoriously influenced by the El Niño effect on the oceanographic conditions of the southeast Pacific Ocean. Catches of this small pelagic species ranged from a minimum of 1.7 million tonnes in 1998 to a maximum of 11.3 million tonnes in 2000, whereas global total catches excluding anchoveta remained relatively stable, ranging from 83.6 to 86.5 million tonnes. With production totalling about 10.7 million tonnes in 2004, the anchoveta ranks first among the ten most-caught marine species by a considerable margin (Figure 3).

1.2 Peruvian fisheries resources

Peru’s marine resources are among the richest in the world. The country’s coastline is dominated by a cold current known as the Peruvian or Humboldt Current that flows from south to north, with waters that are extremely rich in oxygen and nutrients as a result of the intense upwelling.



The most important pelagic fish stocks inhabiting Peru's relatively narrow continental shelf are anchoveta, chub mackerel (*Trachurus murphyi*) and Chilean jack mackerel (*Scomber japonicus*) (Table 1), which together represented 95 percent of the catch volume in 2006. Although historically the standing stocks have been subjected to sharp variations, apparently due more to environmental conditions than to fishing pressure, it is clear that these stocks are potentially large and generally able to recover from periodic declines.

Of these the anchoveta is the main species, comprising 92.5 percent stocks of the total catch, according to 2005 records, and is mainly destined for the production of fishmeal. Nevertheless, the utilization of this raw material in the processing of other products with a higher added value (anchovies and other value-added products like canned, dry and minced fish paste) has also proven to be viable.

TABLE 1
Some characteristics of the main fish species in Peru, 2004

Species	Average spawning size	Average spawning age
Anchoveta	12 cm	12 months
Chilean jack mackerel	31 cm	3 years
Chub mackerel	32 cm	4 years

Source: ITP (undated)

1.3 Fishing activity in Peru

In general terms, the Peruvian fishery industry consists of two completely different sectors: the pelagic or industrial fishery and the demersal fishery (which includes the small-scale or artisanal fishery). The pelagic fishery, a large-scale and relatively modern operation, provides the raw material to the fishmeal and fish oil processing industries and accounts for almost 92 percent of the catch by volume (Figure 4) and approximately 91 percent of the value of fish products exports.

According to the Ministry of Production (PRODUCE, 2006b), the industrial fleet is made up of 1 302 licensed vessels, representing a hold capacity of 222 264 m³. The artisanal fishery is comprised of 5 950 vessels with a hold capacity of 45 570 m³ and with 24 150 registered fishers. The landings are dedicated mainly to the fishmeal and fish oil industries, which represented 91 percent of the industrial fishing activity in 2005 (Table 2). In 2005, the Peruvian fishery sector depended on the currently installed fish processing capacity as shown in Table 3.

TABLE 2
Summary of fish landings, processing and use in Peru, 2005 (thousand tonnes)

	Landings*	Processing**	Domestic consumption	Export
Total	9 400	2 444	565	2 492
Reduction fisheries	8 629	2 221	127	2 280
Fishmeal		1 931	66	2 001
Fish oil		290	60	279
Human consumption	772	223	438	212
Fresh fish	312		323	
Frozen fish	322	146	55	180
Canned fish	89	55	46	12
Cured fish	48	22	14	20

*Fish landings are measured in wet weight, while domestic consumption and export are measured in product weight.

**Volume of processed product does not equal the totals of domestic consumption and export, as part of the export volume in 2005 consisted of 2004 production.

Source: PRODUCE (2001, 2002, 2003a, 2004, 2005, 2006a)

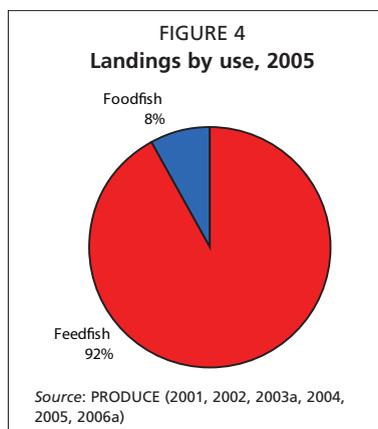


TABLE 3

Industrial-scale fish processing capacity in Peru

Activity	No. of plants	Installed capacity
Fishmeal		
Special meal	48	3 277 tonnes/hour
Standard meal	78	5 661 tonnes/hour
Residual meal	24	155 tonnes/hour
Processed products		
Canned	87	191 840 boxes/shift
Frozen	95	3 557 tonnes/day
Cured	17	1 592 tonnes/month

Source: PRODUCE (2001, 2002, 2003a, 2004, 2005, 2006a)

2. STATUS OF AND TRENDS IN SMALL PELAGIC FISH LANDINGS

The Peruvian marine ecosystem is characteristically a system of intense and highly productive coastal upwelling with water rich in nutrients. This allows the development of a large fish biomass, especially in the pelagic neritic environment, as is the case for anchoveta (*Engraulis ringens*), which sustains 90 percent of the national fisheries. Other important species are Chilean jack mackerel (*Trachurus murphyi*), chub mackerel (*Scomber japonicus*), sardine or South American pilchard (*Sardinops sagax*), South Pacific hake (*Merluccius gayi gayi*), jumbo flying squid (*Dosidicus gigas*), common dolphinfish (*Coryphaena hippurus*) and Peruvian scallop (*Argopecten purpuratus*). The oceanographic conditions off the Peruvian coast show seasonal cyclic variations and high variability associated with the El Niño Southern Oscillation (ENSO) in the Pacific Ocean. These characteristics of the Peruvian waters mainly affect the pelagic resources, altering their biological behaviour and their populations, the anchoveta being one of the most sensitive species.

2.1 Stocks

Recruitment has shown to be an important factor affecting anchoveta biomass variability in Peruvian waters. In general, strong recruitment is associated with cold oceanographic conditions. The higher recruitment months in the north-central stock occur from November to January and May to July, while recruitment in the south Peru–north Chile stock is observed from November to March (Pauly and Tsukayama, 1987).

Recruitment levels for the anchoveta stock showed a general upward trend until 1993, registering two peaks in 1987 and 1993, with levels that exceeded 4.5 million tonnes. These strong annual classes facilitated the recovery of the stock, reinforcing the spawning stock structure. However, recruitment during the period from 1994 to 1997

showed a downward trend, with lower peaks than the average of the analysed series. In 1998, the recruitment estimates were optimistic and represented approximately 60 percent of the total biomass, which would have guaranteed a quick turnover of the stock during the biological year 1998/1999. The appearance of recruitment at the time came from the March 1998 spawning at the beginnings of the post-El Niño stage.

Evaluation of the anchoveta population in Peru is made by the Instituto del Mar del Perú (IMARPE), which determines and evaluates the changes of abundance, distribution and accessibility in relation to the environment in which they live. The results of these investigations support fisheries management and are based mainly on direct and indirect evaluation methods.

The results of the acoustic evaluations carried out during the period 1985–2005 showed an important growth in biomass after the 1982/1983 El Niño event, with high values in 1994, followed by a decrease during the El Niño period of 1997/1998, then at the beginning of 2000, a quick recovery occurred, reaching a maximum value in 2001.

The main management measures include a reduction in fishing effort via closed seasons in February–March and August–September to protect the spawning stock and a short closed season (three or five days) at any time of the year to protect juveniles (fish smaller than 12 cm in length). The annual fishing season is set according to the biological year, which occurs from 1 October up to 30 September of the following year.

2.2 Nutritional value

Fish, especially pelagic species, are an excellent source of high-quality animal protein. The high content of lysine and other essential amino acids makes these species a suitable complement to carbohydrate-rich diets that are consumed in places where protein sources are limited, such as in most developing countries. These resources are a valuable source of energy and are very rich in micronutrients not usually found in basic foods. In addition to being high in potassium, iron, phosphorus and calcium, the fatty component of fish contains significant amounts of vitamins A and D. Fish also constitute a valuable source of fatty acids, which are very important for proper development of the brain and body. Pelagic fish, in particular, are high in the polyunsaturated fatty acids eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), whose consumption yields many benefits in terms of human physiology, including a significant decrease in blood cholesterol levels and prevention of cardiovascular disease. The consumption of small quantities of these species of fish associated with basic foods can significantly improve the nutritional value of the food and the biological value of the diet, particularly in the case of children who have difficulty in digesting carbohydrates. Market research clearly indicates that people are increasingly aware of the nutritional value of fish, especially in developed countries and in some developing countries such as Peru. In many of these countries, the current trend is to consume natural and nutritional products. This ultimately promotes greater consumption of seafood, which might include small pelagic fish.

2.3 Landings

Over the period 1997 to 2005, landings showed a peak in 2000, when the captures of pelagic fish reached 10 million tonnes (Figure 5). As previously noted, the most important pelagic species are anchoveta, jack mackerel, chub mackerel, common dolphinfish and sardine, which together contribute 95 percent of the total volume landed (Table 4). The main demersal species is the South Pacific hake, which is considered fully exploited and whose capture is currently prohibited. Among the invertebrates, the most important species is the jumbo flying squid, which has an increasingly important presence in Peruvian coastal waters.

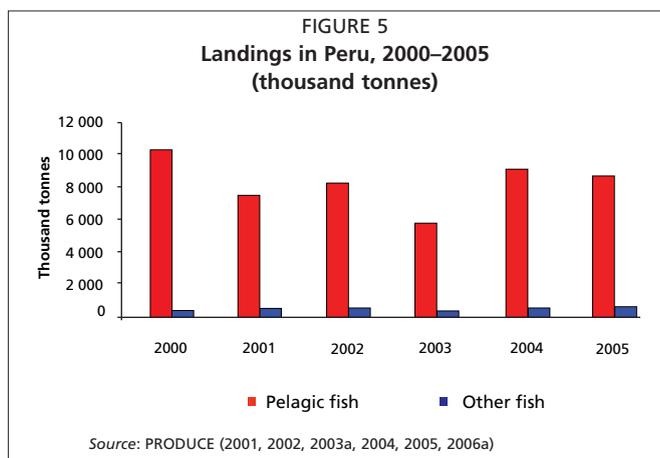


TABLE 4

Main landings, 1997–2005 (thousand tonnes)

Species	1997	1998	1999	2000	2001	2002	2003	2004	2005
Marine fish	7 838	4 310	8 392	10 626	7 956	8 741	6 061	9 574	9 353
Anchoveta	5 952	1 912	6 751	9 580	6 495	8 111	5 349	8 813	8 656
Sardine	625	908	188	226	60	7	9	2	1
Chilean jack mackerel	650	387	185	297	724	154	218	187	81
Chub mackerel	206	402	528	73	176	33	94	62	53
Common dolphinfish	5	21	2	11	28	30	36	31	37
South Pacific hake	178	82	37	83	125	46	8	39	31
Jumbo flying squid	16	1	55	54	72	146	154	270	291
Other fish	206	597	647	302	275	214	194	170	204
Continental	33	34	39	34	39	33	37	44	47
Total	7 871	4 344	8 431	10 661	7 995	8 775	6 098	9 618	9 400

Source: PRODUCE (2001, 2002, 2003a, 2004, 2005, 2006a)

2.4 Behaviour of the main fisheries

The main resource of anchoveta, with 92.5 percent of the total 2005 landings, was almost entirely dedicated to the production of fishmeal, even though its potential to be used as foodfish had been demonstrated. Another important species, South American pilchard/sardine, had been dedicated mainly to the production of fishmeal and as raw material for the fish canning and freezing industry. However, capture levels suffered a serious decline that is expected to reverse in the near future.

The Chilean jack mackerel and the chub mackerel are increasingly being used in fishmeal production, despite the higher profit that can be realized when these species are processed for direct consumption. The Resolución Suprema N^o 001-2002-PE mandates that sardine, jack mackerel and chub mackerel should only be dedicated to direct human consumption.

In 2005, the jumbo flying squid was a very important resource. Its availability 1995–2005 remained constant, and during 2006 it was one of the main frozen fish commodities exported.

As of 2006, the South Pacific hake was the main domestic commercial species and the landing was mostly frozen. Catches declined thereafter and the fishery closed subsequently.

Landing ports are located along the entire coast of Peru, the main ports being Chimbote in the Department of Ancash, Pisco in the Department of Ica and Chancay in Lima. The landings of anchoveta by fishing port for 2004 and 2005 are given in Table 5, while the distribution of ports along the coast is shown in Figure 6

TABLE 5
Anchoveta landings by port (thousand tonnes)

	2004	2005
Total	8 797	8 628
Paíta	370	193
Parachique	266	199
Bayovar	441	293
Chicama	1 226	575
Coishco	538	427
Chimbote	1 597	1 292
Samanco	176	173
Casma	238	147
Huarmey	307	330
Supe	506	629
Vegueta	402	439
Huacho	185	228
Chancay	753	786
Callao	625	606
Tambo de Mora	179	312
Pisco	262	940
Atico	62	233
La Planchada	40	197
Matarani	50	112
Mollendo	29	73
Ilo	546	443

2.4.1 Fishing areas

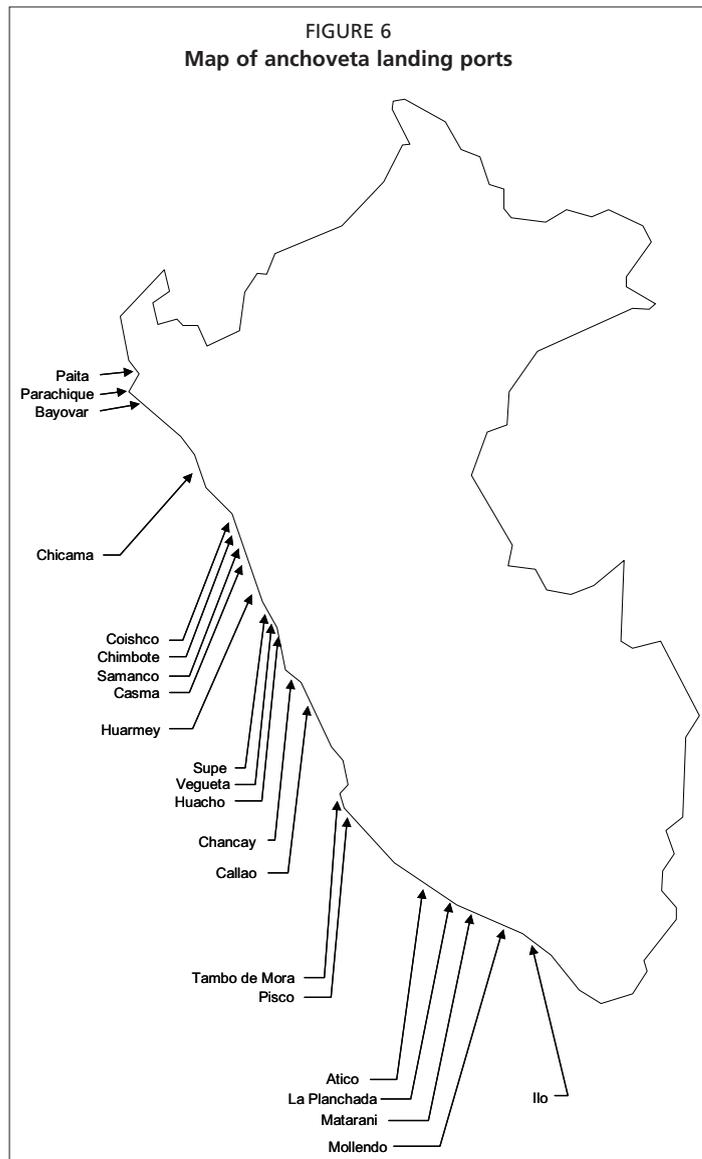
The raw materials, the bases of Peruvian fisheries, are resources subject to continuous changes due to climatic and ecological conditions in their natural habitat. Due to the system of currents and upwelling in the Peruvian sea, a broad biological diversity with its own population dynamics can be found.

The regions of the Peruvian sea where this marine diversity is found are classified as coastal, neritic and oceanic. The neritic region can be subdivided into pelagic, demersal and benthic regions. The pelagic-neritic region is the most productive, with species like anchoveta supporting over 90 percent of the national fisheries, in addition to Chilean jack mackerel and chub mackerel, which are still underexploited. In the demersal-neritic region, species like South Pacific hake are the main species landed in this region.

In Peru, however, the pelagic fishery is the most important. The areas and seasons change depending on the target species. Anchoveta, for example, is fished throughout its entire distribution, from 4° S to the southern borderline. In general, in the north and central areas, this species is caught within a coastal strip from 30 to 50 miles and while in the southern area, this species is caught within a coastal strip of 20 miles. It is located in three large areas:

- 7° to 10°30' S latitude between Pimentel and Supe, Chimbote being the main landing port;
- 11° to 14° S latitude between Huacho and Pisco, the latter being the main landing port; and
- 15° to 18° S latitude between San Juan and Ilo, the latter being the main landing port.

Anchoveta are generally found in waters with temperatures ranging between 14 and 22 °C, with an average temperature of 19.5 °C, salinity between 34.9 and 35 ppt and depths ranging from the surface down to 70 m. In the spring and summer, anchoveta are concentrated in shoals located within 30 miles of the coast. In autumn and winter, they are dispersed along a broader coastal strip, which can be as distant as 100 miles from the coast if the water is particularly cold.



Chilean jack mackerel occur along the coasts of Peru and Chile up to 52°S latitude, although, for example, during the El Niño event of 1983, their distribution extended to the north of the Guayaquil Gulf and the Galapagos Islands. The longitudinal distribution of this resource is wider and more dispersed, extending even 200 miles from the coast. This species has been caught in international waters between 200 and 500 miles from the coast. In general, the distribution of this species is characterized by its high dispersion.

- In the north, between Tumbes and Paita, Chilean jack mackerel are found in dense concentrations between Punta Picos and Lobitos, within the 15-mile coastal strip.
- Between Paita and Chimbote, this species shows a wider distribution, reaching 84 miles off the coast, the main concentrations being found between Paita – Sechura, Punta La Negra – Islas Lobos de Tierra, Islas Lobos de Afuera – Pacasmayo and between Chicama and Punta del Brujo.
- From Chimbote to Callao, Chilean jack mackerel are found off the coast of Samanco and Casma, at a distance of 20 to 42 nautical miles.

- Between Callao and San Juan, the distribution of the Chilean jack mackerel is very limited; they are mainly found off the coasts of Pucusana, Cerro Azul, Tambo de Mora, Punta Paracas, Punta Caballas and San Nicolás, at a distance of between 3 and 60 nautical miles.
- Between San Juan and Tacna, their distribution is very limited, Chilean jack mackerel being mainly found in Lomas – Punta Chala, Quilca, Matarani – Punta Bombón and Punta Coles between 2 and 6 nautical miles.

South American pilchard or sardine, which were previously an important commercial species, are mostly found in the north from Sechura Bay and the Galapagos Islands to Valparaiso, Chile, in the south, and up to 200 nautical miles off the coast. The areas of higher concentration are located south of Paita, from 60 to 70 nautical miles off the coast; in Pimentel, Eten, Salaverry and Huarmey between 6° and 10°S latitude; and in Punta Caballas and San Juan between 15° and 16°S latitude. They are found in waters with temperatures ranging between 14 and 25°C and salinity between 34.8 and 35.3 ppt, ranges that are wider than those of the anchoveta. Juveniles of this species can have a maximum total average length of 21 cm. This species tends to dwell in areas similar to those inhabited by the anchoveta.

Another species is the chub mackerel, for which there is limited fishing information in relation to its biological behaviour. This species is mainly used for direct human consumption and is distributed from Manta, Ecuador and the Galapagos Islands to Valparaiso, Chile.

2.4.2 Fishing seasons

October is the month of final spawning for anchoveta and is when the fishing season normally starts. Although the spawning season of the anchoveta runs from August through March, the peak months are August–September and February–March; therefore, these months are normally declared as a closed season. A similar annual cycle occurs in the case of sardine. Their capture is restricted during the same months as those of the anchoveta. The other small pelagics – Chilean jack mackerel and chub mackerel – generally have no fishing restrictions, as these fisheries are regarded as underexploited.

The largest catches of these resources (except the anchoveta) are made in the months of January through March, unless there are favourable oceanographic conditions in other months of the year. However, in general the fishing season is quite consistent from year to year.

The distribution of anchoveta biomass is coastal between depths of 0 and 60 m (Ñiquen and Bouchon 1991). In spring and summer, anchoveta occur mostly within the 30 mile limit, while in autumn and winter they are widely dispersed, reaching up to 100–120 miles from the coast when the cold waters prevail and homothermic and homohaline conditions exist. The main fishing areas are located between 7–8°S and 11–12°S latitude and are associated with temperatures of 16–20°C and salinities of 34.9–35.1 ppt. Anchoveta are highly gregarious, forming large and extensive shoals that facilitate their capture. The El Niño drastically affects stock distribution, with stocks moving closer to the coast, into deeper waters and finally southward to 10°S latitude (Ñiquen and Bouchon, 2004).

Anchoveta live to 3 to 4 years of age, but are usually captured when they are 1 to 2 years old. The size structure of individuals in the north-central stock fluctuates between 10 and 18 cm. Sexual maturity is reached at a length of 11–12 cm and an age of one year. The main spawning areas are located between Chicama and Chimbote and between Callao and Pisco. Spawning occurs throughout the entire year, with peaks in August–September and February–March. The largest spawning stock is observed from December to April.

2.4.3 Measures regulating the exploitation of pelagic fish

Measures regulating the exploitation of anchoveta are applied in two large areas:

- between the north and the latitude 16°S (northern-central stock); and
- between latitude 16°S and the south (southern stock).

The main regulatory measures are specific and include:

- quotas of permissible capture for periods and certain areas, based on information on the biological/fishery characteristics of the species;
- a short prohibited fishing season (three or five days) to protect juveniles (fish smaller than 12 cm);
- prohibited seasons during the periods of maximum spawning to protect recruitment, generally applied in February–March (secondary summer spawning) and August–September (main winter spawning); and
- regulation of fishing effort by limiting the number of vessels, the days of fishing and the processing capacity of the factories.

3. THE FISHING FLEET IN PERU

The national fishing fleet includes: (a) the industrial fleet, comprised of fishing vessels with more than 32.6 m³ of hold capacity (larger-scale steel vessels and smaller-scale wooden vessels); and (b) the artisanal fleet consisting of vessels with hold capacities of up to 32.6 m³.

3.1 Industrial fleet

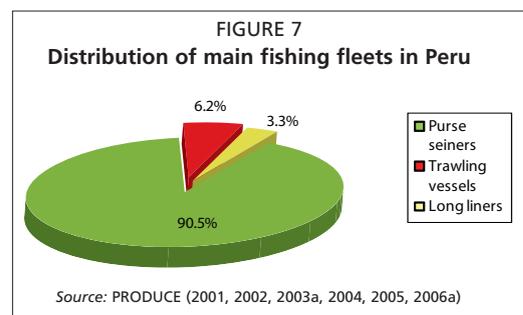
The development of fishing activities in Peru is strongly associated with the development of the anchoveta fishery and the growth and evolution of the purse-seiner fleet. As noted previously, approximately 90 percent of the fishery catches in the Peruvian sea are anchoveta, which is almost exclusively directed to the fishmeal and fish oil industry.

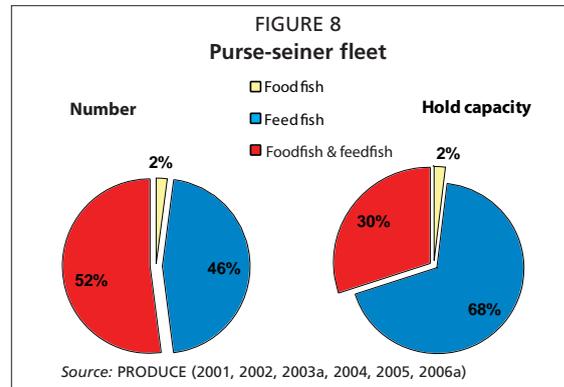
According to the Vice-ministry of Production of Peru (PRODUCE, 2006a), during 2005 the fishing fleet consisted of 1 345 vessels with fishing licenses, representing a capacity of 227 448 m³. Of the total, 1 217 units (91 percent) were purse seiners; 84 (6 percent) were trawling vessels and 44 (3 percent) were long liners (Figure 7).

The purse-seiner fleet (Figure 8) is comprised of vessels with fishing licenses for the following purposes:

- for foodfish, 25 vessels, with a holding capacity of 4 011 m³;
- for feedfish, 559 vessels, with a holding capacity of 143 667 m³; and
- for both foodfish and feedfish, 633 vessels, with a holding capacity of 63 251 m³.

If a comparison is made between the type and number of vessels and catching capacity, it can be observed that, on the average, the vessels authorized to supply foodfish are much smaller than those dedicated to feedfish. Furthermore, the vessels in the purse-seiner fleet licensed for anchoveta as foodfish have 100 m³ of hold capacity group (Table 6). In terms of vessel hold capacity range, 245 vessels (80 percent of these units) register capacities between 32.6 and 50 m³ and 117 vessels have capacities between >50 and 100 m³. Likewise, it can be observed that the fleet with larger holding capacity (> than 350 m³) comprises 48 vessels, which are made of steel and have modern preservation systems such as Refrigerated Sea Water (RSW) and Chilled Sea Water (CSW) systems.





The majority of vessels used for foodfish anchoveta are wooden vessels (475) (Table 7), which represent 89 percent of the total number. These vessels do not have appropriate preservation systems on board, generally using boxes and ice. Steel vessels (58) represent 11 percent of the total number and have RSW or CSW systems.

TABLE 6
Distribution of purse-seiner hold capacity by fishery, 2005

Species	Holding capacity range (m ³)				
	32.6–50	50–100	100–270	270–350	270–350
Anchoveta	3		1		
Anchoveta, jack makarel and chub mackerel	2				
Anchoveta, sardine, chub mackerel	2				
Anchoveta, sardine, other fish	73	26	10	3	11
Anchoveta, sardine, jack mackerel and chub mackerel	157	135	39	6	37
Anchoveta, sardine, jack mackerel and chub mackerel, other fish	8	15	4		
Anchoveta, sardine, other fish		1			
Total	245	177	54	9	48

Source: PRODUCE (2001, 2002, 2003a, 2004, 2005, 2006a)

TABLE 7
Type of construction material of purse-seiner vessels by fish species/species-groups, 2005

Species	Steel	Wood
Anchoveta		4
Anchoveta, jack mackerel and chub mackerel		2
Anchoveta, sardine	15	107
Anchoveta, sardine, chub mackerel		2
Anchoveta, sardine, jack mackerel and chub mackerel	43	331
Anchoveta, sardine, jack mackerel and chub mackerel, other fish		27
Anchoveta, sardine, others		2
Total	58	475

Source: PRODUCE (2001, 2002, 2003a, 2004, 2005, 2006a)

In 1999, the Ministry of Fishery of Peru established the maximum size of purse-seiner nets for anchoveta and sardines in relation to vessel hold capacities (Table 8). To guarantee the implementation of this measure, a net-size adaptation process was established whereby users require an Adaptation Certificate for purse-seiner nets.

TABLE 8

Purse seine net length for licensed vessels

Holding capacity (m ³)	Net length (m)	
	Anchoveta	Sardine
32–90	220	260
100–199	280	330
200–299	330	390
300–399	385	450
400–499	400	500
500–599	495	520
600–more	550	550

Source: PRODUCE (2001, 2002, 2003a, 2004, 2005, 2006a)

3.2 Artisanal fleet

According to the results of the Second Structural Survey of the Artisanal Fishery in Peru, the artisanal fleet (small scale) consists of 9 667 vessels with a hold capacity ranging between 0.5 and 30 gross registered tonnes (GRT). In terms of regional distribution, the regions of Piura, Lima and Ancash register 66 percent of the total number of small-scale vessels (Table 9).

TABLE 9

Distribution of small-scale vessels by region

Region	Number of vessels
Tumbes	667
Piura	2 898
Lambayeque	222
La Libertad	333
Ancash	1 294
Lima	2 178
Ica	784
Arequipa	816
Moquegua	347
Tacna	128

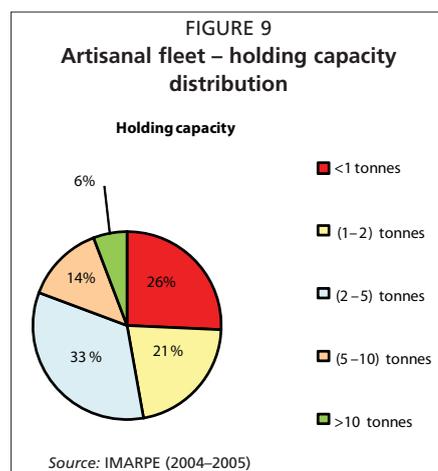
Source: IMARPE (2004–2005)

Artisanal vessels are made mostly from wood (99 percent). Eighty-one percent of the hold capacity of this fleet consists of vessels smaller than 5 tonnes, while only 6 percent of the total hold capacity consists of vessels larger than 10 tonnes (Figure 9). Gillnets and longlines are the most frequently used fishing gear in this sector.

According to the Second Structural Survey of the Artisanal Fishery in Peru, the artisanal fisher population comprises about 37 727 persons, 35 percent of whom are in the region of Piura, followed by 15 percent in Lima. Of the total, 55 percent of the fishers have completed high school and 7.1 percent did university studies. Ten percent of the fishers are owners of their fishing vessel.

3.3 Fish-landing infrastructure

Along the Peruvian coast, there exist 36 artisanal landing facilities. In addition, there are six piers for fish landing, of which three are public and three are private. Most of the facilities have structural deficiencies that impact the quality of landings. The last official



inspection by the sanitation authority showed that these facilities often do not fulfill the requirements set down in the Sanitary Norm for fishery and aquaculture activities (Decreto Supremo N° 040-2001-PE).

4. PROCESSING ACTIVITIES IN PERU

4.1 Fishmeal industry

Peru is the most important producer of fishmeal in the world, and fish processing is the second main contributor, after mining, of foreign currency to the national economy. The landings for the fishmeal industry represent more than 90 percent of the total landings in Peru and consist of small pelagic species, formerly sardine and now mainly anchoveta (Table 10).

TABLE 10
Landings destined for fishmeal production (thousand tonnes)

Species	Year									
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Total	8 772	6 999	3 696	7 788	9 913	7 208	8 157	5 165	8 811	8 629
Anchoveta	7 460	5 923	1 206	6 732	9 556	6 348	8 083	5 336	8 797	8 628
Other fish	1 311	1 076	2 491	1 056	357	860	74	12	13	–

Source: PRODUCE (2001, 2002, 2003a, 2004, 2005, 2006a)

It is important to note that Resolucion Suprema N^a 001-2002-PE sets down that catches of sardine, jack mackerel and chub mackerel must only be dedicated to direct human consumption.

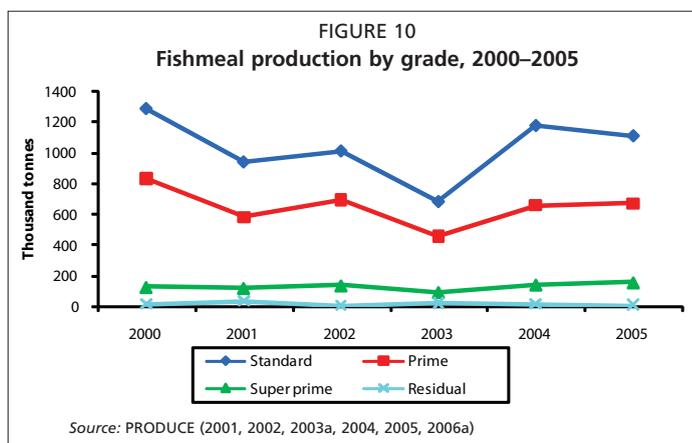
4.1.1 Fishmeal production

The landing of 8 628 704 tonnes of anchoveta for the fishmeal industry in 2005 generated a production of 1 930 727 tonnes of fishmeal and 290 422 tonnes of fish oil (Table 11). The production, however, was severely impacted by the 1998 El Niño event, with production levels declining to 832 043 tonnes of fishmeal and 122 956 tonnes of fish oil.

TABLE 11
Fishmeal and fish oil production, 1997–2005 (tonnes)

Product	Year									
	1997	1998	1999	2000	2001	2002	2003	2004	2005	
Fishmeal	1 597 134	832 043	1 769 532	2 241 529	1 635 427	1 839 209	1 224 484	1 971 449	1 930 727	
Fish oil	330 042	122 956	514 818	587 312	302 875	188 949	206 154	349 821	290 422	

Source: PRODUCE (2001, 2002, 2003a, 2004, 2005, 2006a)



4.1.2 Processing plants

One hundred and three processing plants (69 percent of the total) engaged in the manufacture of fishmeal and fish oil are located along the central coast of Peru. There are also 35 plants (23 percent of the total) located in the northern area and 12 (8 percent of the total) in the southern area. In Peru, there are presently around 150 industrial plants engaged in the manufacture of fishmeal, with

a processing capacity exceeding 9 093 tonnes/hour. These plants produce mainly the traditional fishmeal (57 percent of the total), although with the recent investments made in new machinery and equipment, there is a growing trend to produce prime and super-prime meal (43 percent of the total) (Figure 10).

Over 80 percent of the production is exported. The main markets for Peruvian fishmeal are Asian countries, mainly China, due to its important aquaculture industry. Germany is the main European importer.

4.2 Foodfish production

There is an important industry for frozen and canned fish products and an artisanal industry for cured fish products, which although small, has been growing rapidly in the past few years.

4.2.1 Fish freezing industry

The South Pacific hake is the main species used by the freezing industry, yet landings have been declining. In order to ensure the sustainability of this resource, the fishery has been regulated through closed seasons and capture quotas. The other main species landed for this industry is the jumbo flying squid, with the most important landing ports being located in the northern area of Peru, mainly in Paita.

Frozen fish production is concentrated mainly in Piura, where most of the plants are located due to the proximity of the main resources of South Pacific hake and jumbo flying squid. Traditionally, the main species destined for frozen production is hake; however, with the recent decrease in landings of this species, jumbo flying squid, squid and scallops now constitute the basis of this industry. Due to the variability in landings of South Pacific hake, it has been necessary to implement measures to promote the use of other species such as red prawn and spider crab, as well as highly migratory species such as tuna and jumbo flying squid.

Production is directed mainly to the export markets, which results in greater numbers of plants adopting hazard analysis and critical control point (HACCP) systems to ensure satisfactory quality for export. The small pelagics used in the freezing industry represent only 5 percent of the total landings for frozen seafood production in Peru.

There are 95 industrial plants along the Peruvian coast that are engaged in the manufacture of frozen products, with a total processing capacity of 3 557 tonnes per day. The production of frozen fish and invertebrates in 2005 reached 144 831 tonnes, following an upward trend that began in 1999 with the increasing presence of jumbo flying squid in the landings.

4.2.2 Fish canning industry

The industrial canning activity in Peru began during the Second World War and grew during the 1950s such that by 1956 there were 69 plants with daily production capacities ranging from 50 to 1 500 boxes and using mainly eastern Pacific bonito (*Sarda chiliensis lineolata*) and Pacific menhaden (*Ethmidium maculatum*). Increasing costs and the rise of the fishmeal industry marked a decline in the canning industry. The appearance of new markets and new technological advances provided important new growth, transforming Peru in 1981 into the main global producer of canned fish. New crises have affected this industry, including the reduction of fishing levels caused by El Niño, inflationary problems, market requirements, etc.

At present, the canning industry in Peru is in a state of change. With the drastic reduction of landings of sardine (the main species used by this industry in recent years), it has become important to look for other species like the anchoveta that have large prospective markets and a socio-economic environment favouring investments. It is necessary, therefore, to diversify the products as well as modernize the production lines to make them efficient and profitable.

The main species landed for the canning industry in 2005 were jack mackerel, chub mackerel and anchoveta. The Peruvian Government has been carrying out several product development projects with anchoveta, traditionally directed to the production of fishmeal, and jumbo flying squid, species that can be used in the processing of products with a higher value added and wide acceptance in different markets.

The main fish landing ports for canned processing are concentrated in the northern area of Peru. Paita, Coishco and Chimbote are where almost 80 percent of the landings for this industry occur. There are 87 canning plants, mainly located in Chimbote, Paita and Lima, with a total installed capacity of 191 840 boxes per shift. In 2005, small pelagics like anchoveta, chub mackerel and jack mackerel represented 68 percent of the landings for this purpose. Anchoveta, with 14 887 tonnes, constituted 16 percent of the landings. It is important to note that the anchoveta landings for this industry are mainly artisanal, and that the use of vessels fitted with boxes of ice is necessary to guarantee the quality of this species for direct human consumption.

TABLE 12

Anchoveta landings by production category (thousand tonnes)

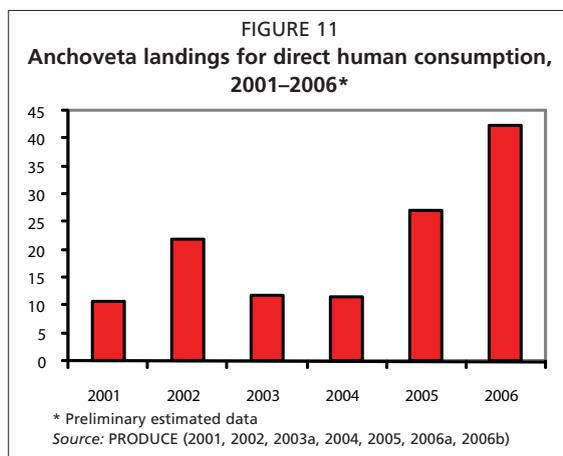
Year	2001	2002	2003	2004	2005	2006**
Fishmeal	6 348	8 083	5 336	8 797	8 628	5 884
DHC*	10.56	21.83	11.68	11.35	27.07	42.38
Fresh fish	0.40	0.01	0.39	0.32	0.35	0.01
Canned fish	3.29	13.36	4.82	2.63	14.89	30.95
Frozen fish	1.14	4.33	0.66	0.21	1.41	0.75
Cured fish	5.73	4.13	5.81	8.19	10.43	10.67

*Direct human consumption.

** Preliminary estimated data.

Source: PRODUCE (2001, 2002, 2003a, 2004, 2005, 2006a, 2006b)

The volume of anchoveta used for canning has grown since 2001 (Table 12, Figure 11). The Instituto Tecnológico Pesquero del Perú (ITP), the state organization in charge of research and development of new products for human consumption, has adapted technologies making possible the use of anchoveta to manufacture products with a higher value added, including canned and cured products. These technologies have been transferred to the private industry.



4.2.3 Fish curing industry

The main species used for curing are pelagics like anchoveta, jack mackerel and chub mackerel. In 2005, these species represented 76 percent of the 28 075 tonnes landed for this purpose.

In the north, Pisco has become the main landing port for the curing industry, due to the availability of anchoveta for use in the production of anchovies that are directed to export markets. In the northern area of the country, landings are also destined for the artisanal production of salted chub mackerel, mainly used for household consumption.

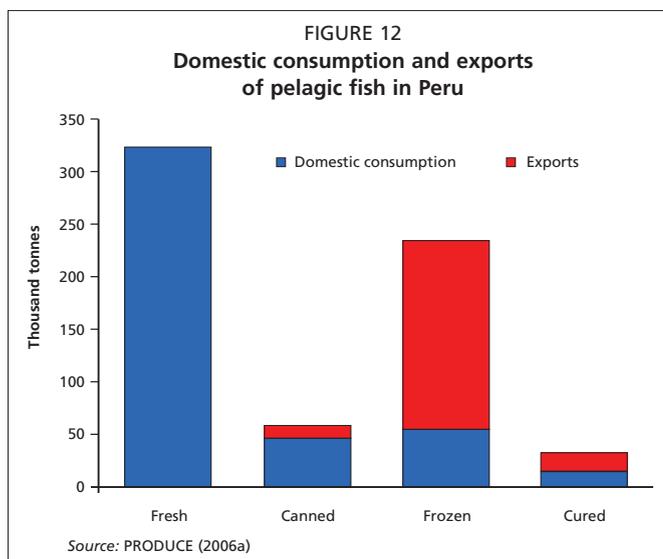
Taking into account that the traditional cured products (salted, dry and dry-salted) are widely accepted in the north, the main plants are located in this part of the country. The processing plants for “anchoas”, which are mainly exported, are located in the south from Chimbote to Tacna, particularly in Pisco. It is important to note that there has been a substantial increase in the number

of small-scale artisanal companies engaged in the production of salt-cured fish, known as “la saladita”. Most of these plants are located in the north and their products are directed to social programmes.

5. DOMESTIC CONSUMPTION AND EXPORT PATTERNS

In Peru, 8.2 percent of the landings (771 600 tonnes in 2005) sustain the processing industry dedicated to direct human consumption. In 2006, the freezing industry was the most active, using 41.8 percent of the landings for direct consumption, most of the production being dedicated to the export markets (Figure 12).

Fresh/chilled fish is mainly used for domestic (household) consumption, representing 66 percent of the landings for foodfish, followed by the canned industry with 18.7 percent and the freezing industry with 9.3 percent, which are directed to both household and export markets.



5.1 Per capita consumption in Peru

According to the State of World Fisheries and Aquaculture (SOFIA) published by the Food and Agriculture Organization of the United Nations (FAO, 2007), the per capita worldwide supply reached 16.5 kg per year. In Peru, the average consumption of the last few years is nearly 20 kg per year (Table 13). Fresh fish is the main component of the per capita fish supply in Peru, representing 63 percent. Canned and frozen fish represent approximately 15 percent, while cured fish represent just 6 percent.

TABLE 13

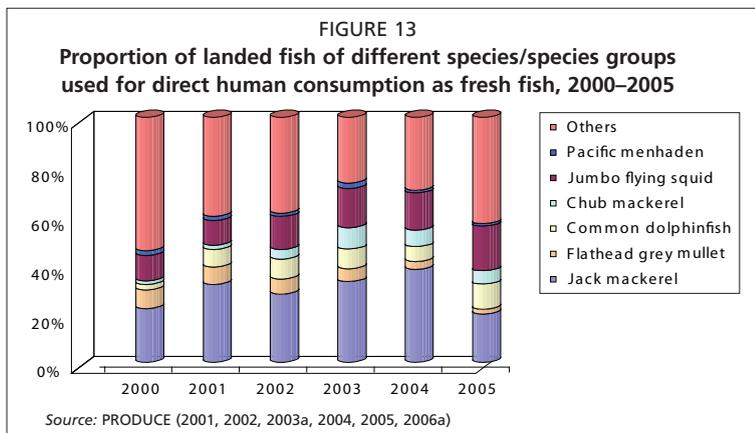
Per capita consumption of fish products in Peru, 2000–2005

Year	Consumption (kg/person/year)				Total
	Canned fish	Frozen fish	Cured fish	Fresh fish	
2000	4.0	1.2	1.9	14.1	21.2
2001	3.4	2.2	1.7	15.1	22.4
2002	1.7	2.7	1.5	13.1	19.0
2003	3.8	1.9	1.3	13.6	20.6
2004	2.6	2.7	1.1	13.9	20.3
2005	3.1	2.8	1.1	11.9	18.9

Source: PRODUCE (2001, 2002, 2003a, 2004, 2005, 2006a)

5.1.1 Fresh fish

Fresh fish are mainly used for household consumption. In 2005, 285 947 tonnes of fish were consumed in fresh form, the main species being jack mackerel, jumbo flying squid, common dolphinfish and chub mackerel (Figure 13) and accounted for 53.5 percent of total landings. Demand for fresh fish, which is mainly supplied along the coast, has shown a regular and sustained trend over the last few years. Most of the fish consumed fresh are pelagic and of low cost. This factor is critical in determining the preference of consumers. There is also a small market for white-flesh fish, characterized by its shortage and high price, which make it inaccessible to the low-income group.

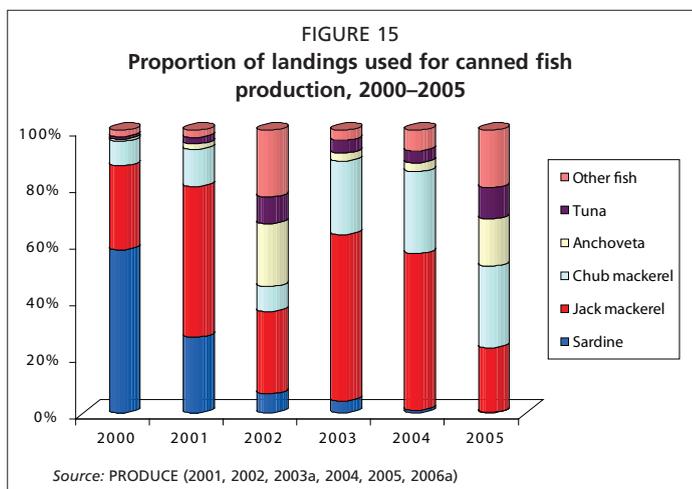
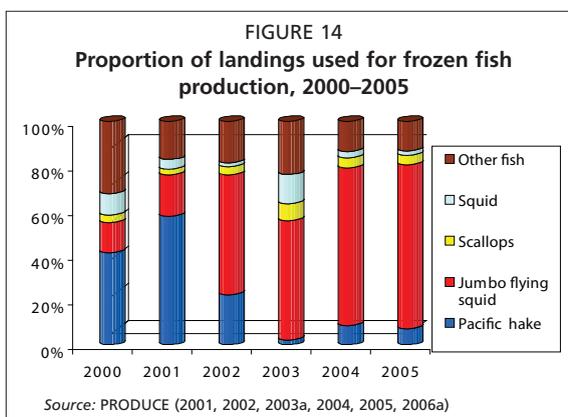


5.1.2 Frozen fish

The landing of 321 221 tonnes of seafood for freezing in 2005 generated a production of 145 575 tonnes of processed products. Fifty-three percent of the frozen products was used for household consumption, and the balance was sent to export markets. This, in terms of internal consumption, represented a contribution to the annual per capita consumption of

2.8 kg, the highest average of the last few years.

The jumbo flying squid is currently the main species landed for the freezing industry, replacing the Pacific hake (Figure 14). In 2005, jumbo flying squid represented 73 percent of the landing for freezing. In Peru, frozen products (mainly whole fish) are mostly consumed in coastal areas or in areas of close proximity that are equipped with cold storage and supermarket chains that enable the products to be distributed under satisfactory quality conditions. Frozen whole fish is sometimes stored and thawed before it is sold for direct consumption.



5.1.3 Canned fish

The production of canned products is based on the use of pelagic species such as jack mackerel, chub mackerel and, more recently, anchoveta (Figure 15). In 2005, the landing of 89 359 tonnes of fish for canning resulted in a production of 55 502 tonnes of canned fish, of which approximately 22 percent was exported. It is important to note, however, that the canned fish industry has been very sensitive to the drastic decrease of the sardine

in Peruvian coastal waters. Before 2000, the landings of this species did not exceed 100 000 tonnes and were directed to fishmeal and canning production.

Of the total production, 46 000 tonnes were directed to domestic consumption, resulting in an annual per capita consumption above 3.1 kg. Canned products, because of their easy storage, are easily distributed throughout the country. It should be emphasized that in 2005 small pelagics represented 60 percent of the total landing destined to the canning process.

5.1.4 Cured fish

In 2005, 48 105 tonnes of fish were landed for the curing industry. This production was for domestic consumption and for export. The domestic sale of 14 500 tonnes of product (which includes that of continental origin), mainly salt-cured, resulted in an average annual per-capita consumption of 1.1 kg.

The main species used for curing are chub mackerel, Chilean jack mackerel and flathead mullet (*Mugil cephalus*) (Figure 16). However, in recent years, the anchoveta has been used in the production of “anchoas” (anchovies), in 2005 representing almost 45 percent of the total landings used for curing. It is important to recognize the training and technological transfer in the landing ports conducted by the ITP within the framework of the National Training Programs.

5.2 Characteristics of fish consumption

5.2.1 Metropolitan consumption

Lima, the capital of Peru, harbours a third of Peru's population. The low-income earners consider price to be one of the main factors in their purchase decision-making.

Pelagic species such as jack mackerel, sardine and chub mackerel are mainly consumed usually as fresh fish. The medium- and high-income population show preference for white fish such as the palm ruff (*Seriolella violacea*), Pacific bonito and humpback smooth-hound (*Mustelus whitneyi*).

Marketing research studies indicate that fish is the Lima resident's favorite meat, and that it is considered the most nutritious. All income strata show a predisposition toward the consumption of novel fish product forms such as frozen products, new types of canned fish, pastes, etc. They also show a preference for anchoveta, a good tasting species that they consider of high nutritional value. This has been taken into account by the ITP for the development of new small-pelagic products and packaging that are adapted to the necessities and customs of the medium- and low-income population.

5.2.2 National consumption

Peru has 27 million inhabitants, 72 percent of whom live in urban areas and 28 percent in rural areas. Annual per capita consumption of fish is 20 kg. There is greater consumption of these resources in areas near the coast and minimal consumption in the interior regions of the mountains and jungles of Peru.

Consumption of fresh fish occurs primarily in the coastal region of the country (Table 14), with a per capita consumption of about 13 kg. Likewise, frozen fish is consumed mainly along the coast and in adjacent areas where cold chain facilities are available for distributing frozen products under satisfactory quality conditions.

Canned and cured fish products, due to their preservation characteristics, are distributed throughout the different regions of the country, although the contribution of these two products to per capita consumption is very low.

A quick examination of the rural populations of Peru indicates that there is a high percentage of residents that experience problems in accessing the basic foods needed

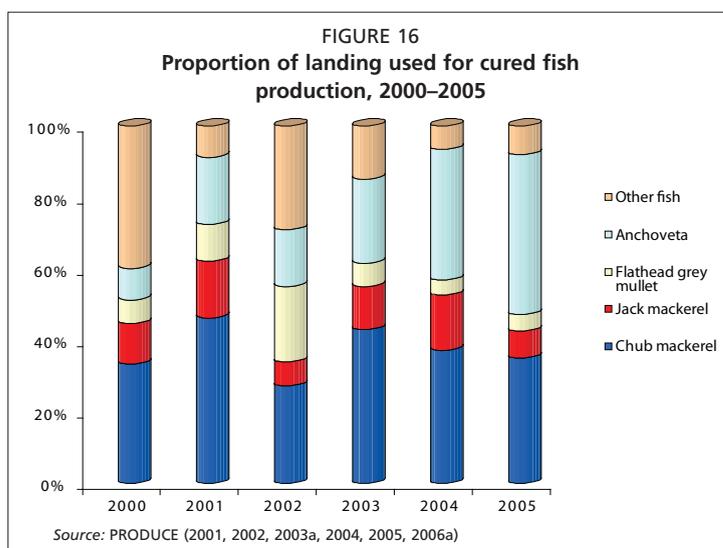


TABLE 14

Patterns of fish consumption in Peru

Product	Per capita consumption (kg/person/year)	Site of consumption	Species
Fresh fish	13.0	Coastal areas	Jack mackerel, jumbo flying squid.
Canned fish	3.1	Nationally	Jack mackerel, anchoveta
Frozen fish	2.8	Major cities	South Pacific hake, jumbo flying squid
Cured fish	1.1	Interior provinces	Chub mackerel and jack mackerel, anchoveta

Source: ITP (2004)

to meet their minimum nutritional requirements. This situation becomes worse in the highland regions and rural forests of the country, where people invest almost the entirety of their incomes in the purchase of food, highlighting the need for nutritious low-cost products. Likewise, rural populations present a high proportion of children who have difficulty in digesting carbohydrates and proteins, mainly resulting from micronutrient deficiencies, which implies the need to supply foods of high nutritional value.

Another characteristic of the rural populations is a lack of chilling equipment and adequate essential infrastructure, which hinders the distribution of fresh and frozen foods. Consequently, the products destined for these areas must have a long shelf life at room temperatures (e.g. canned products).

5.3 Exports

5.3.1 Fishmeal and fish oil

Fish products represented about 13 percent of total Peruvian exports in terms of value, and Peru is the major supplier of fishmeal in the world. In 2005, Peru exported 2 million tonnes of fishmeal and 278 thousand tonnes of fish oil, generating revenues of US\$1 295 million (Table 15).

Fishmeal exports, although reduced in volume due mainly to the regulatory measures to conserve anchoveta stocks, have increased in terms of value due to higher prices in the international markets (Figure 17). This is because of the growing demand mainly from the Asian countries for aquaculture feeds. For the first time, in 2005 the price of fishmeal was over US\$1 000/tonne.

The main markets for Peruvian fishmeal are Asian countries, mainly China, importing approximately 52 percent of the domestic exportable production (Table 16).

TABLE 15

Exports of fish by value, 2000–2005 (million US\$)

	2000	2001	2002	2003	2004	2005
IHC *	954.60	926.50	891.10	822.50	1 103.60	1 295.20
Fishmeal	874.00	835.40	821.70	742.40	955.80	1 148.10
Fish oil	80.60	91.10	69.40	80.10	147.80	147.10
DHC **	177.10	197.50	164.60	204.60	277.70	331.20
Canned fish	44.20	43.20	25.40	36.00	35.80	31.50
Frozen fish	114.30	129.30	116.70	148.30	217.00	267.00
Cured fish	7.40	6.70	5.30	6.80	6.30	9.30
Other fish	11.20	18.30	17.20	13.50	18.60	23.40
Total	1 131.70	1 124.00	1 055.70	1 027.10	1 381.30	1 626.40

* Indirect human consumption.

**Direct human consumption.

Source: PRODUCE (2001, 2002, 2003a, 2004, 2005, 2006a)

Germany is the main European importer (12 percent). The main importers for fish oil are Belgium, Denmark and Chile (Table 17).

5.3.2 Direct human consumption

A significant growth in non-traditional exports has occurred over recent years, mainly in the form of frozen products (e.g. 179 662 tonnes in 2005). These include jumbo flying squid, South Pacific hake and scallops that are exported to European countries such as Spain and France, with hake fillets mainly going to the United States of America (Figures 18 and 19; Table 18).

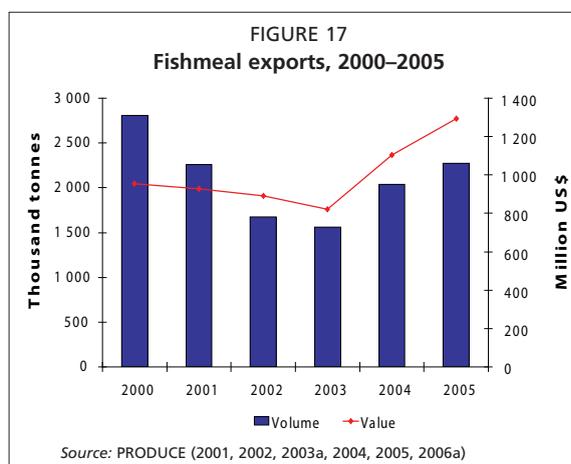


TABLE 16

Fishmeal export value (FOB, thousand US\$)

Country	2004	2005
China	425 962	505 561
Germany	76 602	134 757
Japan	114 314	103 032
Taiwan POC	84 026	52 020
Spain	20 602	25 841
Viet Nam	16 322	25 107
Indonesia	19 582	23 812
Turkey	27 136	21 023
Canada	28 770	20 246

Source: PROMPEX (2005, 2006)

TABLE 17

Fish oil export value (thousand US\$)

Country	2004	2005
Belgium	26 230	48 197
Denmark	12 909	24 639
Chile	40 487	22 923
Canada	14 038	13 495
Japan	3 154	6 727
Italy	39	5 412
Australia	3 713	4 391

Source: PROMPEX (2005, 2006)

TABLE 18

Frozen seafood export value (thousand US\$)

Product	2004	2005
Squids, dry frozen	82 541	94 712
Dry frozen scallop shells	24 415	32 759
Other frozen fillets	24 887	28 591
Non-conserved prepared molluscs	26 711	27 356
Lines of prawns with shell	15 253	26 594
South Pacific hake fillets	13 606	16 268
Other frozen fish meat	9 316	10 931
Frozen whole prawns	5 603	9 015
Other fish	14 668	13 514

Source: PROMPEX (2005, 2006)

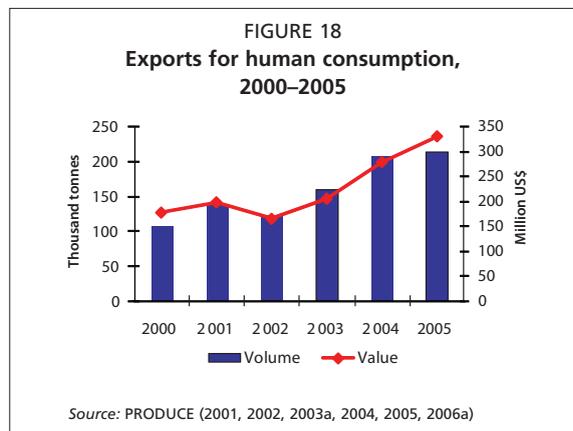


TABLE 19

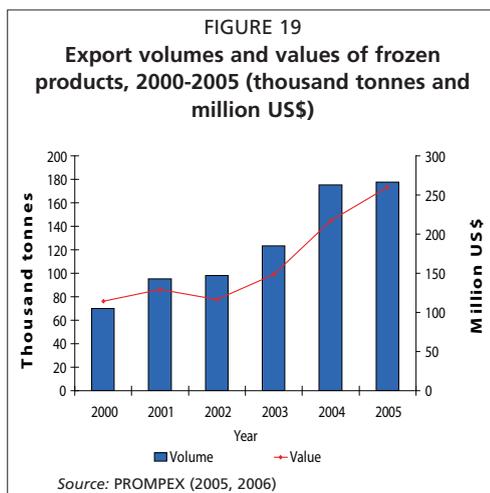
Export values of canned products (thousand US\$)

Products	2004	2005
Other canned fish	11 277	6 403
Tuna, bonito	5 154	6 145
Clams, false abalone	4 352	5 991
Whole anchovies	3 755	2 855
Other conserves of whole fish	2 897	2 694
Sardine	2 299	2 021
Whole mackerel	3 961	1 642
Other conserves	2 105	4 259
Total	35 800	32 010

Source: PROMPEX (2005, 2006)

In comparison to previous years, the export of 13.1 thousand tonnes of canned products generating the revenues of US\$32.01 million reflected a relative decline in global consumption of canned product (Table 19, Figure 20). According to FAO (2007), canning represented 24 percent of the fish processed for food use in 2004, while this percentage was 27 percent in 2002 (FAO, 2005). However, it is important to note the canned exports of whole anchovies and sardines to the European and Latin American markets.

It is clear that the production of high value-added seafood products for direct human consumption (DHC) would significantly increase the fishery sector's contribution to the Peruvian economy, increasing the value of exports and employing more labour, while making more rational use of fishery resources.



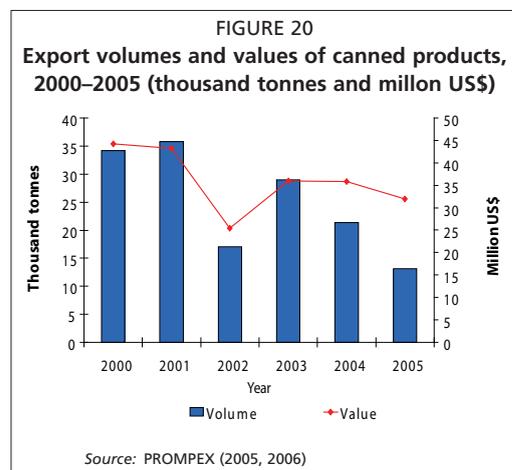
6. NATIONAL FISHERIES DEVELOPMENT ADMINISTRATION

6.1 Political framework

Fishing management actions are in accordance with the Reformulated Sectoral Strategic Multi-annual Plans 2004–2006, Program 044: Promotion of the Fishery Production. These include:

- promotion of farming and breeding of fish resources through the application of fishery regulation plans;
- responsible administration of the fishing effort on the main species that sustain the national fishery, assuring their sustainability and optimizing economic and social benefits;

- promotion of fish consumption in order to increase the per capita consumption of aquatic resources, with the participation of the state and private sector and highlighting the nutritious qualities of these resources and their different presentation forms;
- technological transfer of and training on the production technologies developed by ITP, particularly to the national fishing industry, as well as to the agents involved in the fishery sector;
- implementation of measures and actions oriented towards establishing an effective regulatory framework to guarantee the sustainability of fishery resources, as well as for the development of fishing activities and aquaculture;
- monitoring, control and surveillance of fishing effort in order to guarantee the responsible use of fishery resources, in the areas of capture, landings and processing, including aquaculture and the execution of sanitation and environmental guidelines; and
- environmental control in order to preserve biological diversity and care for the ecosystems and the quality of the environment.



6.2 Legal framework

Following the crisis of the national fishery sector that occurred at the beginning of the 1990s, Law No. 750 was promulgated for promoting private investment in the sector. In 1992, the General Fishery Law (DL 25977) established that the state must promote the sustainable development of the sector, harmonizing the economic and social benefits with the preservation of the environment and the sustainable use of the resources. Under this framework, catch quotas, seasons and fishing areas, extraction methods, minimum sizes of the fish, etc., were defined. Four modalities for field operation were also established for the sector through:

- the concession of the state infrastructure;
- research activities, commercialization, growth of the fleet or installation of industrial fishery establishments;
- permission to operate vessels with Peruvian or foreign flags; and
- licenses to operate processing plants.

This law sets down that licenses, concessions or authorizations are granted according to the commercial value of the species to be exploited. In the case of species that are fully exploited, such as the anchoveta, the grant of authorizations for fleet increases, new permissions and fishing licenses is restricted. For those species that are under-exploited, access for exploitation is allowed, permitting orderly growth. When the species are not being exploited, research and development programmes are developed to ensure their rational use.

In the case of the anchoveta, the law establishes control measures for catch levels as well as gear utilization. For example, fishing bans are normally imposed to allow the species to reproduce. Due to the El Niño phenomenon of 1998, a provisional ban system guided by constant monitoring by the Instituto del Mar del Perú (IMARPE) was established. According to this system, fishing bans depend exclusively on the behaviour in real time of the biomass, for which the periods of capture cannot be previously specified. In spite of the limitations that this system has had on the planning of fishing activities, it has been extremely successful in promoting the quick recovery

of the anchoveta after El Niño events. However, the problem of the common property persists and, therefore, fleet overcapacity is still seen in the sector.

Some investment measures have also been established for anchoveta utilization. For example, the expansion of the fishing fleet is not allowed, and only the replacement of vessels of the same hold capacity is authorized. Even so, in the year 2000 it was already considered that fleet capacity was in excess given the available biomass. To solve this problem, the National Society of Fishery proposed the creation of a Fund for the Protection of the Biomass (FOPROBI), whose objective would be to reduce the fleet capacity by around 30 percent (50 000 m³) in terms of hold capacity. This would be achieved through the purchase and withdrawal of excess vessels. The cancellation of fishing licenses and the retirement of the vessels would be compensated with grants. This proposal outlined that a grant fund of up to US\$200 million would be made available over a period of 10 years, during which time private companies would contribute to financing of the plan. However, this initiative remains unimplemented due to disagreement over the type and age of the vessels to be retired and because the fishing managers want the participation of the banking and state sectors in providing funds. Although the fishing companies recognize that it is necessary to reduce the fleet size, they apparently prefer to maintain the “status quo” for the time being.

Proposals for changing the resource management system, especially for anchoveta, to a quota-based system have met with a similar response. Distribution of quota would favour the most efficient companies, although in the initial distribution other considerations could prevail (e.g. the social impact), because in the end, rights would be negotiable.

In the last few years, following threats of a reduction in the anchoveta biomass and the biomass of other species like Chilean jack mackerel, there has been a move towards establishing an access system to fishery resources by means of individual quotas. The utilization of non-transferable quotas for South Pacific hake served as a pilot test. A total capture quota of 10 000 tonnes was established and distributed among the trawl vessel owners. The quotas have validity for one year, and they were assigned in relation to the historical capture of the applicant vessels.

The state authority is aware that a quota-based system requires much more careful monitoring than has previously been the case. An inspection organization is needed to control fish landings, and the crews of the entire fishing fleet need training; the implementation of satellite-based vessel monitoring systems (VMSs) is also necessary. The port authorities also have to be strengthened to ensure their capacity to determine infringements and take necessary actions.

Another important aspect of the fishery legislation is the conservation of the environment. The high concentration of fish processing factories in various ports along the Peruvian coast has caused some damage, mainly due to unregulated emissions. For this reason, if any new plant is to be installed, it is necessary to conduct an Environmental Impact Assessment (EIA). For those plants already operating, an Adaptation Program for Environmental Management (PAMA) is required. Increased environmental regulation has been a great step towards improvement of the conditions of the fishing ports, as well as an increase in the efficiency of the productive units. Although the legislation has resulted in the reduction of large quantities of toxic effluents, especially organic loads, it has not regulated the release of vaporous emissions.

6.3 Institutional framework

6.3.1 Key institutions

Fisheries regulation is the responsibility of the Ministry of Production (PRODUCE), which combines the former Ministries of Industry and Fisheries. The Vice-ministry of Fisheries (VMP) formulates, executes and directs sector policies, and its objective

is the rational administration of the fishery resources and the preservation of the environment. For this purpose, the ministry has specialized directorates and public decentralized organizations within its structure that assume, among others, the following specific functions:

- **The Aquaculture National Directorate** is in charge of implementing and supervising the relative sector policies for farming resources from marine and inland waters. It supervises the legal frame of this activity and grants the corresponding rights.
- **The Artisanal Fisheries National Directorate** proposes and executes policies for the development of the artisanal fishery. It programs, executes and evaluates training for the fishers and artisanal fishing processors and proposes regulatory norms for artisanal fishing.
- **The Fishery Extraction and Processing National Directorate** administers the extractive activities and proposes and implements sector policies with regard to the processing scales of the fishery resources. It evaluates applications to develop catching activities and fish processing; grants the corresponding authorizations, permits and licenses; supervises the granted rights; and promotes the research required for the sector.
- **The Control and Surveillance National Directorate** proposes, implements and supervises policies for the sector relative to the monitoring, control and surveillance of fishing activities and aquaculture, in agreement with the effective guidelines, and evaluates and applies the corresponding sanctions. It administers the vessel monitoring system (VMS), Sistema de Seguimiento Satelital (SISESAT) and imposes sanctions for proven infringements.
- **The Environment National Directorate** formulates and proposes policies and strategies for allowing harmony between the development of fishing activity and the environment. It supervises the execution of the norms and environmental control measures and registers the public and private institutions destined to the implementation and certification of environmental studies of the sector.

The fishery sector is also responsible for the following five public organizations that provide technical support to the sector:

- **El Instituto del Mar del Perú (IMARPE)** conducts scientific research at sea, in continental waters and on their living resources and is dedicated to their rational development. This institute studies the atmosphere and marine biodiversity, evaluates the fishery resources and provides information and advice to support decisions on fishing, aquaculture and the protection of the marine environment. IMARPE has laboratories and offices for data processing at its central headquarters in Callao, as well as a series of laboratories along the coast at all the main fish landing points. It also has a scientific research vessel and three smaller vessels for coastal work.
- **El Instituto Tecnológico Pesquero del Perú (ITP)** promotes and conducts scientific and technological research in order to achieve the optimal use of fish resources and to disseminate results. Its mission includes the transfer of technical knowledge on the handling, preservation and processing of fishery resources. It also promotes fish consumption through the development of new products based on traditional and non-traditional species. As the competent authority of the Servicio Nacional de Sanidad Pesquera (SANIPES), ITP is responsible for the inspection, surveillance and sanitary quality control of the capture, landing, processing and commercialization of fish and aquaculture products in the wholesale markets. At present, ITP is carrying out an intensive programme for transfer and promotion of high value-added product based on anchoveta.

- **El Fondo de Desarrollo Pesquero (FONDEPES)** promotes, executes and supports technically, economically and financially the development of marine and continental artisanal fishing activity and aquaculture, mainly with regard to aspects of basic infrastructure. It manages the Fund for Aquaculture Research (FIA). This organization is currently under organizational restructuring and is being amalgamated with the Centro de Entrenamiento Pesquero (CEP-Paita).
- **El Centro de Entrenamiento Pesquero (CEP-Paita)** designs and executes actions to improve the training and personal development of fishery sector workers, especially the artisanal fishers. CEP-Paita contributes to the improvement of the socio-economic status of the artisanal fishers in the country.
- **The Peruvian Amazon Research Institute (IIAP)** evaluates the natural resources of the Peruvian Amazonia and its productive potential. It promotes the application of the results of the scientific and technological research and proposes procedures and norms to the relevant institutions for the sustainable use of natural resources. This institution advises public-sector organizations on policy development and informs them of their research plans.

The interaction between the Vice-ministry of Fishery and the decentralized institutions is close. For instance, IMARPE coordinates with the VMP so that it can regulate the closed season periods based on its investigations of available biomass, while ITP advises the VMP in matters of surveillance and sanitary control of the seafood production chain and in promoting fish consumption at the national level. IMARPE and ITP also combine their work, because the information on the marine species obtained by IMARPE is used by ITP in developing new alternatives for human consumption.

6.3.2 Coordination among government levels

Since 2003, Peru has been executing institutional decentralization, transferring national government functions to the regional governments. The functions to be assumed by the regional governments include:

- developing plans for fishery and aquaculture policies in their jurisdictions;
- administering and supervising the activities and fishery services under their jurisdictions;
- executing control actions and surveillance;
- administering the use of the landing services infrastructure and fishing processing within their jurisdictions; and
- supervising the execution of norms related to the artisanal fishery and its exclusivity within the five-mile coastal waters zone.

At present, PRODUCE is delegating the implementation of some of the national recurrent fisheries management tasks to its Regional Directions.

Coordination also exists among local governmental authorities charged with the execution of the tasks related to the sanitary control of fish products in local markets, the National Society of Fisheries (SNP) and trawling owners' associations. SNP is a private organization that includes members from most of the fish companies of Peru. SNP associates are fishmeal and canning company representatives, as well as the cold store operators, trawlers, shrimp farming company representatives and some capital goods and services suppliers. SNP maintains a close relationship with the VMP in formulating fisheries development policies. The trawling owners' associations were created mainly to negotiate landing prices with the fishmeal industry or with the crew, who are strongly supported by the labour unions.

7. POTENTIAL ALTERNATIVE USES OF PELAGICS FOR DIRECT CONSUMPTION AND VALUE-ADDED PRODUCTS

The majority of anchoveta landings is directed to the production of fishmeal to be used as feed – this use is controversial as the capacity to use this species for direct human consumption has been well demonstrated. Numerous studies present technological alternatives and their economic feasibility that allow the processing of the anchoveta into commercially attractive products for human consumption that might contribute to the alleviation of the food security problem in Peru.

Although a number of barriers (e.g. market, provision of necessary investments and installed capacity of processing plants) prevent a significant part of this resource from being used for direct human consumption, appropriate processing technologies for this species are not one of the barriers. The institution conducting research and development of new products in Peru, ITP, has implemented and adapted various technologies for the handling and processing of the anchoveta with different presentations and market possibilities.

The fishery statistics over recent years in Peru show a sustained increase in anchoveta landings destined for direct human consumption, especially for canned and cured products.

7.1 Pelagic fish used for direct consumption

In Peru, the main species used for direct human consumption are small pelagics. In 2005, 724 602 tonnes of aquatic species were landed, of which 362 995 tonnes were fish and 353 558 tonnes were invertebrates, mainly jumbo flying squid. Of the total fish landings, 222 325 tonnes (61.3 percent) were pelagics, including Chilean jack mackerel, mackerel and common dolphinfish.

The use of anchoveta as a foodfish has increased over the years, and in 2005 anchoveta was the most commonly used species after Chilean jack mackerel, chub mackerel and common dolphinfish, especially as canned and cured product. However, being a small and fatty species, anchovy catches that are subjected to mechanical pressure can quickly deteriorate due to breakage of the belly area and/or enzymatic action. They, therefore, need special attention on board during their capture and preservation.

Experience elsewhere suggests that it is possible to obtain raw material of appropriate quality for human consumption by using small- and medium-sized vessels. However, in order to ensure good quality fish, some practical requirements must be met. Thus, it is necessary to:

- minimize the time between capture and the start of processing;
- use exclusive vessels to catch fish for human consumption that are equipped with preservation systems for small pelagics;
- maintain the cold chain for the raw material from its storage on board the vessels to the hoppers and storage rooms on land;
- use appropriate landing systems that do not impact upon the quality and physical integrity of the catch; and
- use ice in the processing chain and avoid bacterial contamination through the application of sanitary measures.

The artisanal fishery is a productive sector that constitutes a traditional source of fish for direct human consumption. The sector provides thousands of direct and indirect jobs and contributes to the coastal economies. However, the sector is in a permanent crisis, with its main constituents immersed in a subsistence economy, due to their vulnerability to sea conditions, seasonal and inter-annual resource variability, and a lack of modern vessels and fishing technologies, which translates into lower economic returns due to the low quality of the landed products.

It is important to promote a change of attitude in the artisanal fishers to finally break the vicious circle in which this sector is immersed by encouraging integration into the

managerial sector and the abandonment of low productivity processes, and establishing strategic alliances with the processing and marketing organizations in order to produce and receive increased added value. In this way, the artisanal fishery might serve as a key tool for increasing the per capita fish consumption and/or providing raw materials to other companies or for export through diversification of the fishery. It is necessary to offer high-quality products through the adoption of modern handling and preservation methods on board that allow the quality of the fish to be maintained after it is captured.

The artisanal fishery sector could assume the responsibility for supplying the anchoveta required by the large and small processing companies. To this end, a training programme has been started that includes training of national fishers in the techniques of manipulation of anchoveta on-board small fishing vessels (i.e. vessels smaller than 10 tonnes).

7.2 Impacts of the utilization of anchoveta

In contrast to other countries where the fisheries have reached the limits of sustainable production, in Peru supplies can be increased if part of the catch used by the fishmeal industry is used for human consumption. According to the Projection of the Peruvian Population published by the National Institute of Statistics of Peru (INEI), it is estimated that by 2020 Peru will have a population of 31.5 million inhabitants, and to maintain the current annual per capita fish consumption, 654.6 thousand tonnes of fish would be required. This would mean an increase of around 89.3 thousand tonnes (Table 20).

TABLE 20

Projected growth in population and seafood consumption in Peru

Year	Population (millions)	Consumption (thousand tonnes)
2005	27.2	565
2010	28.9	600
2015	30.3	630
2020	31.5	655

Source: INEI (undated)

The Peruvian Government has designed plans for the establishment of a Food Security System using fish, particularly anchoveta, to achieve the required increase in production, and is aware that this would require a series of incentives that include the transfer of technologies and the development of a restructured internal market. A significant increase in the volume and types of fish products offered based on the anchoveta would be essential to cover food supply deficiencies of a significant part of the projected Peruvian population. These products would bring many additional benefits related to achieving food security and economic and social well-being.

7.2.1 Food security

Fishing could contribute to the improved food security of the country by providing the residents of depressed areas with a source of low-cost protein that substitutes for traditionally consumed foods. In order to increase the annual per capita fish consumption from 20.8 to 25 kg by 2010, an additional 157 300 tonnes would be required, corresponding to 1.8 percent of the anchoveta catch in 2005 (Table 21).

TABLE 21

Potential increase in fish consumption in Peru

Year	Population (millions)	Per capita consumption (kg/year)	Total consumption (thousand tonnes)	Increase in consumption (thousand tonnes)
2005	27.2	20.8	565.2	
2011	28.9	25.0	722.5	157.3

Source: ITP (undated)

7.2.2 Added value

During 2005, Peru's fishmeal exports were valued at US\$1 295 million and used 8.6 million tonnes of raw material. The use of these catches in the production of food for direct human consumption would add significant value to the resulting products and would increase the overall productivity. Assuming that the production of 1 tonne of fishmeal requires 4.5 tonnes of anchoveta costing US\$80/tonne, the sale value of the final product would be US\$800/tonne, giving an added value of US\$440 (Table 22). Alternatively, 4.5 tonnes of raw material at a cost of US\$150/tonne that is converted to canned product would have a sale value of US\$8 100, generating an added value of US\$7 425. This is an added-value relationship of 17:1, even though the price of the raw material used for human consumption is higher, as to maintain its quality requires the use of ice on-board, additional labour for handling, etc. (Table 22).

TABLE 22

Examples of added value through product development

Product	Raw material (tonnes)	Price of raw material (US\$)	Estimated quantity of product	Sale price (US\$)	Sale value (US\$)	Added value (US\$)	Increase added value (ratio)
Fishmeal	4.5	80	1 tonne	800/tonnes	800	440	1.0
Canned fish	4.5	150	405 boxes	20/boxes*	8 100	7 425	16.9

* Each box contains 50 cans of ¼ club (a can of 1/4 club contains a net weight of 120 g and a liquid medium of 35 g. Each can contains from 6 to 9 pieces of anchovy).

Source: ITP (undated)

From these calculations, it can be projected that the current value of US\$1 300 million generated by using 8.6 million tonnes of anchoveta for reduction could be generated by using only 11 percent of the anchoveta landed during 2005 if it were directed to food production. This would not significantly affect the reduction industry.

7.2.3 Labour

The term "food security" refers not only to assuring an adequate and affordable production of food but also to establishing of mechanisms for labour and employment opportunities. A greater use of small pelagic resources, like the anchoveta, for the production of food would generate employment that would increase the socio-economic level of the population participating in such activity.

According to the last analysis of employment in the fishery subsector, 6 631 workers, both full- and part-time, were employed for the processing of feed-fish products. If we consider the same level of employment and the landing volumes and production corresponding to the year 2005, the utilization ratio would be 0.77 (number of workers required per 1 000 tonnes of landing) (Table 23).

By contrast, a production study of canned anchoveta at the industrial level indicates that the production of 7 160 boxes, corresponding to 2 880 tonnes of raw material, required 189 workers. If 1 percent of the fishmeal landings were assigned to anchoveta ¼ club production, then 86 287 tonnes of material would generate work for 5 662 people, as compared with the 66 positions that are provided by the fishmeal industry.

The study highlighted the sale value of canned products at US\$8 100/tonne against that of US\$440/tonne for fishmeal and also considered that assigning 1 percent of the

TABLE 23

Comparison of labour utilization for fishmeal versus canned products

Product	Landing (tonnes)	Production	Labour (workers)	Utilization ratio (workers/1 000 tonnes)
Fishmeal	8 628 704	2 221 149 tonnes	6 631	0.77
Canned fish	86 287	2 14 520 boxes	5 662	65.62

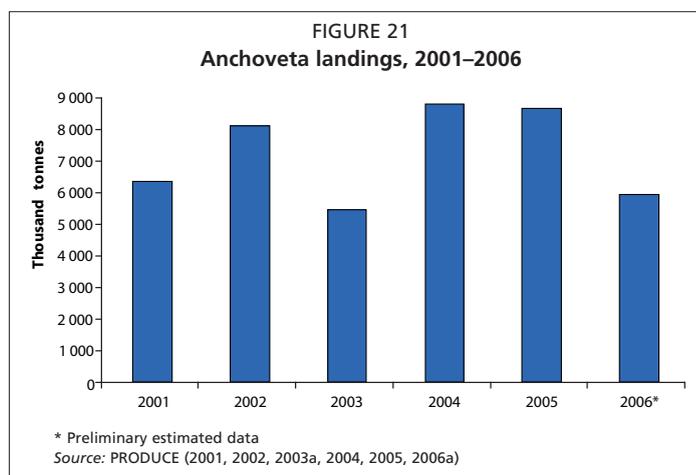
Source: Ministerio de la Producción, personal communication

fish currently destined to fishmeal to direct human consumption would generate work for 5 662 people, compared with the 6 631 positions that are provided by the fishmeal industry.

7.3 Technological applications for anchoveta

The industrial production of fishmeal using anchoveta will continue to be an important social and economic activity in the country. It is a resource that, despite being fully exploited and threatened by recurrent El Niño events, still maintains a constant biomass and landings.

With average annual catches exceeding 7 million tonnes over the years 2001-



2006, it will require considerable effort to change from traditional fishmeal production to the production of products for human consumption, both in terms of technical processing and in market development. However, a number of socio-economic and technical factors advocate using a part of the anchoveta catch in the processing of added-value products, the technical feasibility of which has been studied and promoted by ITP. So, within this context, the question would be “Why use anchovy as foodfish?”

The answers are because:

- Anchoveta is the main Peruvian fish resource and the most important reserve of animal protein for Peruvians. Anchoveta grows fast and catches remain constant (see Figure 21).
- Anchoveta is a resource of great nutritional value that provides a good quality protein with a high lysine content and other essential amino acids. Having a high content of minerals (K, Fe, P, Ca, I) and vitamins (A and D), it presents a valuable source of omega-3 fatty acids (EPA and DHA) that are essential, especially for pregnant and nursing women (Table 24).
- Alternative fish resources for popular consumption such as Chilean jack mackerel and chub mackerel present irregular landings (Figures 22 and 23) and are more expensive due to the added effort involved in their capture.
- The use of anchoveta for human consumption would contribute to solving food security problems in Peru. In addition to fresh fish products, it is possible to process products of high nutritional value, low cost and long shelf life under room temperature, whose use would be fundamental in combating malnutrition.
- The inclusion of anchoveta in the market could make an important contribution to increased national annual per capita fish consumption, now at 20 kg (Figure 24). By using 7 or 8 percent of the regular captures of this resource (some

540 000 tonnes), national fish consumption could be doubled.

- The technical, economic and commercial feasibility of anchovy-based products has already been proven. These products include canned and prepared frozen fish, dried anchovies, surimi and surimi-based products and a great number of “delicacies”, such as anchoas for both domestic and international markets (Figure 25).
- The use of anchoveta in the foodfish industry offers higher benefit/cost when compared in terms of added value with the traditional fishmeal industry. The foodfish industry generates greater demand in terms of labour, supplies and inputs due to the great number of industries associated with the sector.
- The use of this resource and its processing to higher value-added products provide great opportunities for the growth of Peruvian fisheries, elevating Peru’s level of international competitiveness.
- Direct consumption of anchoveta would benefit the artisanal fishing sector, provided suitable handling and preservation techniques were developed to ensure the quality and the physical integrity of the landed product (Figures 26 and 27).

In general terms, it is believed that the benefits derived from this proposal would be multiple and would favour the vessel owners and artisanal fishers, as well as the processors and consumers. ITP has carried out systematic work dedicated to introducing the concept of using this resource as foodfish for direct human consumption through the use of traditional and modern technologies. These products based on anchoveta are described below.

7.3.1 Canned products

The experience of ITP in the development of non-traditional fish products has been used in the design and adaptation of technologies for canned products based on anchoveta. These include:

- headed and gutted anchoveta (tube type) packed in flat cans type ¼ club (125 g) (Figures 28 and 29) or oval cans (½ lb and 1 lb); tinapa (180 g); tuna (175 g), using different sauces and presentations (e.g. tomato sauce, oil, smoky sauce, mustard, red wine, onions, garlic, etc.);
- minced skinless anchovy loins in vegetable oil, packed ½ lb tuna can or 1 lb tall containers; similar to traditional grated fish in Peru;
- anchovy skinless fillets in vegetable oil, packed in tuna cans, ¼ club or other containers;
- concentrated soups based on anchovy pieces; they consist of canned preparations of various styles, blended with anchovy broth and pieces to make a concentrated product that must be reconstituted before

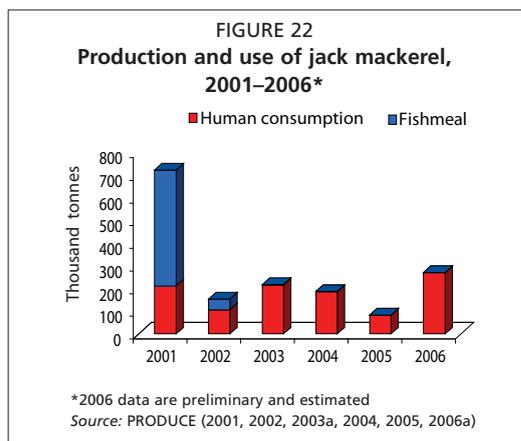
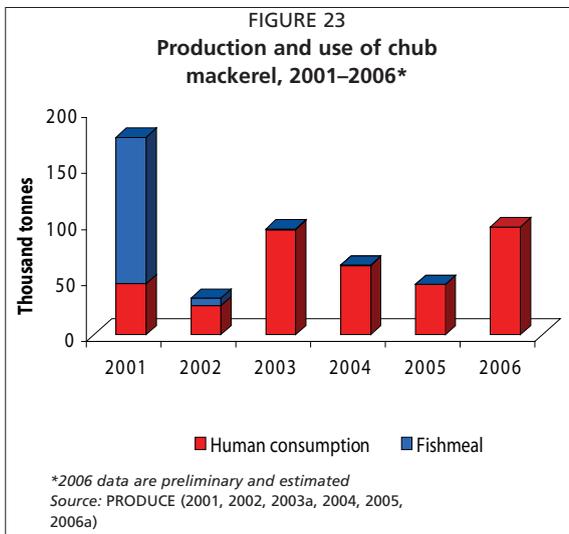


TABLE 24

Nutrient composition analysis of anchoveta

Component	Mean value
Proximate composition (%)	
Moisture	70.8
Crude lipid	8.2
Crude protein	19.1
Mineral salts	1.2
Energy (kcal/100 g)	185
Fatty acids (% of lipid)	
20:5n-3 Eicosapentaenoic acid (EPA)	18.7
22:6n-3 Docosahexaenoic acid (DHA)	9.2
Minerals (mg/100 g)	
Sodium	78
Potassium	241.4
Calcium	77.1
Magnesium	31.3
Iron	30.4

Source: ITP-IMARPE (1996)



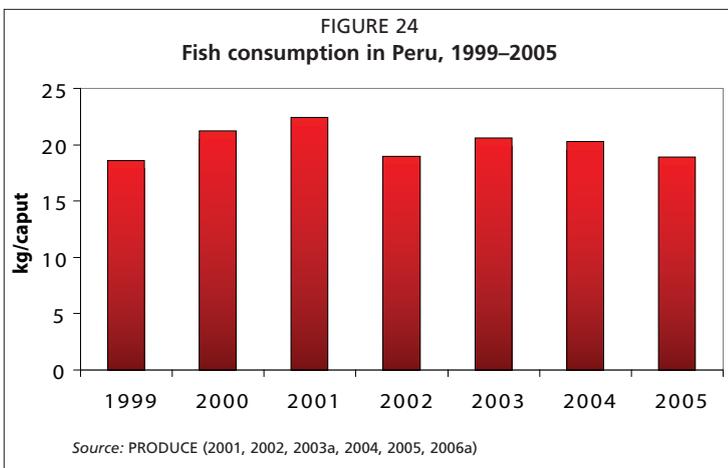
consumption; several presentations are already on the market;

- heavy salted and maturated anchovy fillets that are presented in vegetable or olive oil and packed in tin or glass containers; the product is traditional in some European countries and is made by means of a process of controlled maturation in a strong saline medium.

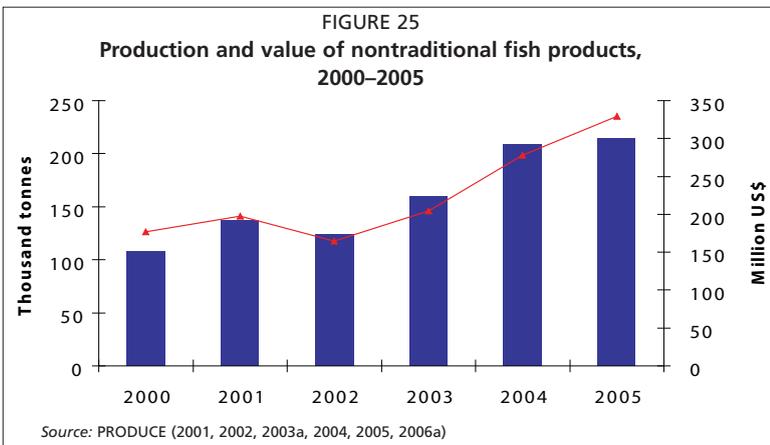
7.3.2 Frozen products

Frozen products include:

- surimi made from anchovy flesh that is subjected to successive washing cycles, refined and partially dehydrated. This product is an intermediate raw material used for manufacturing pasty products.



- anchovy burger, which consists of a cooked and frozen product that is manufactured from minced meat obtained from fresh anchovy;
- anchoricas, a product consisting of deep-fried boneless anchovy double fillets that are covered with corn flour, frozen, packed in polyethylene bags and stored at temperatures below -18 °C;



- anchovy block: whole or headed and gutted (HG) frozen anchovy in 5 kg blocks, to be used as raw material for product applications; and
- anchovy sausages (Figure 30), which are a sterilized product of long shelf life under room temperature that is based on anchovy surimi, has a high protein content and is similar to other traditional stuffed products.

7.3.3 Cured products

Cured products (Figures 31 and 32) include:

- wet salted anchovies, a product consisting of heavily salted anchovies that are vacuum packed, allowing a long shelf life under room temperature if stored under fresh and ventilated storage conditions; and
- boiled and dried anchovies, consisting of small-sized anchovies that are subjected

FIGURE 26
Anchoveta for fishmeal production
in Peru



FIGURE 27
Anchoveta landing in Peru



to a boiling and drying process which allows for a long shelf life at room temperature.

7.3.4 Other products

These include:

- fish protein concentrate (FPC) made from anchovy flesh that is subjected to a quick-cooking, decanting and drying process; FPC is generally used in the manufacture of cookies (Figure 33).
- fish oil for human consumption, obtained by processing high-quality fresh fish to obtain raw oil that is subjected to refining, deodorizing and stabilizing processes. The product contains high concentrations (around 30 percent) of EPA and DHA and is being tested as an ingredient in prepared fish products (Figure 34).

FIGURE 28
Anchoveta can filling



FIGURE 29
Anchoveta packed in flat cans ¼ club
(125 g)



FIGURE 30
Anchovy sausages



FIGURE 31
Heading and gutting operation



FIGURE 32
Boiling and drying process of anchoveta



FIGURE 33
Anchovy cookies



FIGURE 34
Fish oil produced from anchoveta



7.4 Exports of anchovy-based products

7.4.1 Canned anchovy

According to the report of the Office for Export Promotion of Peru (PROMPEX), exports of canned anchovies have experienced remarkable growth in 2006 (Figure 35), highlighting whole products presented mainly in tomato sauce and oil. The most important markets for these products are Colombia, the Dominican Republic and Haiti, followed by Bolivia, Panama and Spain, along with 17 other destinations. The placement of products in other developed countries as a substitute for similar types of products is expected in the future.

7.4.2 Anchoas (salted and maturated anchovy fillets)

The production of anchoas (a product based on anchoveta) is an industry that deserves to be highlighted because of its recent spectacular growth (Figure 36). According to statistics published by PROMPEX, the exports of salted and maturated anchovy fillets (vacuum packed and in metal containers) grew by 146 percent in 2006 compared with the previous year, mainly due to the lack of traditional raw materials in the markets of some of the European countries. For example, the landing of European anchovy

(*Engraulis encrasicolus*) in the Cantabric Sea has decreased, and this has resulted in the increased importation of anchos by countries like Spain, Italy and France. The most important markets for this product are Spain, Italy, Brazil and France. Other markets that have been important destinations for anchovy exports include Portugal, Germany and Chile.

8. CASE STUDY – CHIMBOTE FISHING PORT

Chimbote is the main fishing port of Peru and is located on the northwestern coast. This district is the capital of the province of Santa, Department of Ancash and is mainly important for its great fisheries wealth, where pelagic species like anchoveta are the basis for the most important fishing industry in the country.

Chimbote has an important source of electrical energy: the Hydroelectric Power Station of Del Pato Canyon and a steel plant that provided material for the building of a port in the 1950s which enabled the plant to market its products. This promoted the rapid growth of Chimbote, which grew from a fishing village of 4 342 inhabitants in 1940 to a town of 30 000 in 1956 and to a city of more than 300 000 people by 2000.

8.1 Landings

Other ports located in Santa province and under the influence of Chimbote are: Puerto de Santa, Coishco, El Dorado, Besique, Samanco, Los Chimus and Tortuga. Basic water, electrical and sewer services are found only in Coishco, with limited services or infrastructure also present in Los Chimus, Tortuga and Samanco (Table 25).

Chimbote, although a main port, has some limitations. For example, the ice plants have insufficient capacity to meet demand, impacting the quality of the raw material, especially for direct human consumption. This port has two shipbuilders whose main activity is to repair the vessels of Chimbote and bordering districts. It also has factories

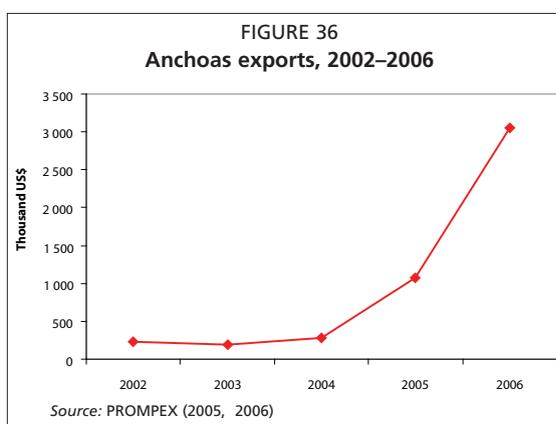
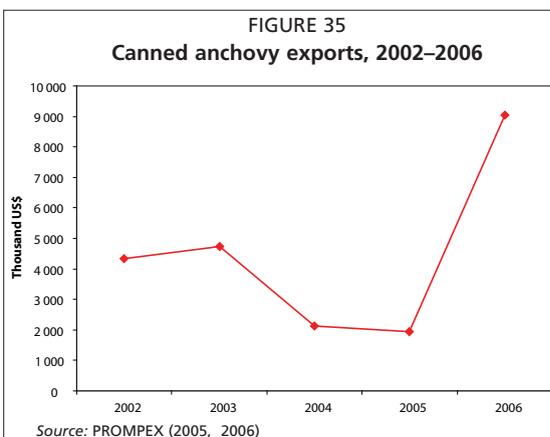


TABLE 25

Service and infrastructure in the area of Chimbote

	Basic services	Infrastructure
Puerto de Santa	–	–
Coishco	Water, electricity, sewer system	Handling room
Chimbote	Water, electricity, sewer system	Dock, storage room, ice producer, power generator, handling room
C. Atahualpa	–	–
El Dorado	–	–
Besique	–	–
Samanco	–	Dock
Los Chimus	Electricity	Dock, power generator, handling room
Tortuga	Water, electricity	Handling room

Source: PRODUCE (2001, 2002, 2003a, 2004, 2005, 2006a)

that manufacture spare parts for vessels. The mechanical workers do not have technical or university training, although the larger factories have better equipment and more qualified personnel. The input suppliers have specialized stores that sell nets and other fishing and security equipment for fishers. Some small suppliers offer basic supplies, while others operate as department stores.

Recent legislation is forcing vessel crews to have some level of qualification. There is a branch of the CEP-Paita and the Private University of San Pedro that offers training courses.

In 2005, this port accounted for around 14 percent of the national fish landings (1 326 799 tonnes) and provided 97.4 percent of landings (1 292 300 tonnes) to the production of fishmeal and 2.18 percent of landings (28 868 tonnes) to the production of canned fish.

Chimbote has an important industrial fishing fleet. In 2005, there were 302 registered vessels with a total hold capacity of 75 055 m³. As the fishmeal companies produce mainly standard-grade fishmeal, buyers of new vessels do not encourage the shipyards to equip the vessels with chilling equipment.

Another strategy that has been adopted by several of the big fishing companies is that of diversification. Having their own fleet allows them to fish in the open sea and to access various species that can be processed in their plants. In this way, when the catch diminishes in a fishing area or the area is declared a prohibited fishing area, the companies can get fish from other ports and/or other species can be caught. This global management of the fishing companies has encouraged the establishment of their main offices in Lima. For that reason, the strategic decisions relating to the industry and even the operational decisions take place in the capital.

The prevalence of use of fishery resources for processing into standard fishmeal does not encourage the shipbuilders to improve their vessels by incorporating refrigeration systems that would improve the quality of the protein contained in the fishmeal. However, the growing demand for “prime” fishmeal and its greater price stability have encouraged the conversion of some companies for prime fishmeal production. Currently, 42 percent of the fishmeal produced in Peru is prime fishmeal, yet in Chimbote only 15 percent of production is prime fishmeal. Prime production in the plants in Chimbote is low because the plants are older and require more investment so fishing groups have preferred to modernize their plants in ports other than Chimbote. Another reason is that the production of this type of fishmeal requires conversion of the fishing fleet to incorporate refrigeration systems, since the fish have to arrive at the plant with high indices of freshness and quality.

The fishmeal companies in Chimbote compete for the resource and for the international markets. The lack of property rights on the resource and the over-sized fishing fleet make competition for the resource very strong.

According to the Decreto Supremo N° 024-2006-PE, the payment for fishing rights for tonnes of extracted resource is equivalent to 0.25 percent of the freight on board (FOB) value of fishmeal, considering the average US\$ price for FOB/tonnes corresponding to the previous month. However, this valuation does not consider the environmental and social costs. Considering the current prices of fishmeal and fish oil and future projections for the markets for fishery products, an approach might be considered that takes into account the real cost of the resource.

The artisanal fleet consists of vessels weighing from 0.5 to 2 tonnes, from 2 to 5 tonnes and from 5 to 30 tonnes (Table 26). This fleet includes vessels that, with appropriate equipment (e.g. boxes with ice), can be used to supply anchoveta for direct human consumption.

An estimate of the maximum and minimum landings of anchoveta for human consumption can be obtained for the artisanal fleet located in Chimbote (Table 27).

TABLE 26
Characteristic of artisanal vessels

	Artisanal vessels			Artisanal fishers		
	Less than 2 tonnes	2 to 5 tonnes	More than 5 tonnes	Shipped	Non-shipped	Processors
Puerto de Santa	32	1	1	100	100	0
Coishco	50	15	0	130	4	20
Chimbote	445	50	50	1 300	0	260
El Dorado	320	0	0	300	100	0
Besique	7	0	10	25	25	0
Samanco	35	7	8	240	5	10
Los Chimus	30	2	0	75	20	2
Tortuga	200	20	0	200	600	12
Total	1 119	95	69	2 370	854	304

Source: PRODUCE (2001, 2002, 2003a, 2003b, 2004, 2005, 2006a)

TABLE 27
Projections for the capture of anchoveta for direct human consumption

	Artisanal vessels			Capacity		x 100 days		Landing	Potential landing		With ice	
	< 2 tonnes	2 to 5 tonnes	> 5 tonnes	Min	Max	Min	Max	Actual	Min	Max	Min	Max
Puerto de Santa	32	1	1	23	99	2 300	9 900	31	2 269	9 869	1 134	4 934
Coishco	50	15	0	55	175	5 500	17 500	4 956	544	12 544	272	6 272
Chimbote	445	50	50	573	2 640	57 250	264 000	2 826	54 424	261 174	27 212	130 587
El Dorado	320	0	0	160	640	16 000	64 000	866	15 134	63 134	7 567	31 567
Besique	7	0	10	54	314	5 350	31 400	42	5 308	31 358	2 654	15 679
Samanco	35	7	8	72	345	7 150	34 500	66	7 085	34 435	3 542	17 217
Los Chimus	30	2	0	19	70	1 900	7 000	140	1 760	6 860	880	3 430
Tortuga	200	20	0	140	500	14 000	50 000	1 055	12 945	48 945	6 473	24 473
Total	1 119	95	69	1 095	4 783	109 450	478 300	9 982	99 468	468 318	49 734	234 159

According to the capacity of the artisanal vessels, the annual landings could range from 100 000 to 400 000 tonnes generated by 100 days of labour per year. At the current levels of landing, they only capture around 10 000 tonnes of fish, including Peruvian banded croaker (*Paralanchurus peruanus*), doublelined tonguesole (*Paraplagusia bilineata*), sand grunt (*Pomadasy s branickii*), silverside (*Odontotesthes regia*), humpback smooth-hound (*Mustelus whitneyi*), etc. To add a similar or larger quantity (>10 000 tonnes) of anchoveta for direct human consumption would require an additional hold capacity of between 40 000 and 200 000 m³ due to the reduction of the capacity caused by the installation of preservation systems on board. Over the short term, in terms of the capacity of the artisanal fleet in the port of Chimbote, a supply of up to 200 000 tonnes of anchovy for human consumption would be assured.

Chimbote had landings of anchovy for direct human consumption on the order of 8 777 tonnes during the months of January, February and March of 2007. The average selling price to the processing plants ranges from US\$80 to \$200 per tonne. Ice that is used to preserve the anchovies on board the vessel is obtained in Chimbote at US\$19.23 per tonne, although it is sometimes difficult to obtain.

8.2 Processing

Initially, canning companies in Chimbote produced fishmeal as a by-product. When world demand for fishmeal began to grow, dedicated fishmeal companies were installed, and now this industry is the most important fishing activity in the region.

The production of fishmeal is a continuous process that involves the separation of three components of the fish: solids, oil and liquids. Separation is achieved through various operations that involve cooking stages, pressing, drying and milling of fish. For this purpose, the anchovy is usually pumped together with water from the vessels through pipes into tanks or ponds. The pumped water is used as a means of transporting the fish and is treated by passing through a system that recovers the solids and fats and adds them to the production lines. Then the fish are transported to the cookers where, after a period of cooking, they are brought to the presses where the liquids are eliminated. One of the substances resulting is a pressed solid called “queque”, which is sent to a dryer that reduces the humidity to around 10 percent. The dry material is powdered and transformed into meal that is packed in polypropylene sacks ready for dispatch.

The liquid resulting from the process goes to a centrifuge that separates the solid residuals, which in turn are sent to be part of the queque from the press. The liquid continues on to another centrifuge where the oil is separated from the watery fraction that contains soluble solids with a high protein content. The raw oil can be sold directly or passed on to a plant to be semi-refined or refined. Alternatively the line water might go through an evaporation process to reduce the water and to recover the solids, which are recycled into the fishmeal circuit.

This constitutes the typical process. However, in the last 20 years technological changes have been made that allow the production of a type of meal (prime or special meal) with greater protein content. Prime meal is made by replacing the vapor cookers with direct cooking, allowing the fish to be cooked at a lower temperature so that the protein is not degraded. If the fish are landed fresh, the protein content is even higher. Fishmeal with higher protein content command higher prices, so there is an incentive for the production of this type of meal. Countries like Norway and Chile have specialized in the production of these product types.

A source of contamination in the fishmeal reduction process is the water pumping system. As previously mentioned, the fish are transported by pumping them together with water from the vessels to the storage tanks. Centrifugal pumps that require from 2 to 3 tonnes of water for 1 tonne of fish are currently used, although new technology has been incorporated by some companies whereby vacuum pneumatic pumps are used with smaller volume of water to fish ratios. Until recently, the excess water was pumped into the sea and contaminated the bay. Now it is recovered and incorporated into the production circuit.

Vapor emissions are a source of contamination that is still not efficiently combated by environmental regulations. The drying of solids produces vapor containing fine particles that are emitted out the chimneys. The traditional technology is to collect the fine particles through filtration. A technological alternative is to use dryers that are different from those used for direct drying (i.e. dryers of vapor or of overheated air) and allow the resulting vapor to be recovered and to generate energy.

Ancash is the location of the largest number of fishmeal plants (i.e. 47 of the nation's 126 plants), as well as the greatest installed production capacity (i.e. 2 937 of the 8 938 tonnes/hour of total capacity). Most of these plants are old, dating back to the 1960s and 1970s. Only 12 of these plants produce special meals.

The plants in Chimbote belong to two types of companies: (i) local companies and (ii) companies composed of fishing groups and having operations in different ports. The managers of the local companies operate the smallest and oldest plants, and their knowledge of the business is rather empiric. These plants operate with relatively obsolete technology and, as a consequence, they exert a negative impact on the environment. They depend mainly on private operators to supply the raw materials they need, the reason why the fish supply can be very irregular or onerous.

The plants operated by fishing groups are larger due to the investment in modernization that has been carried out in the last decade. These plants operate with more modern technology, although in comparison with the plants operated by these groups in other ports, the plants in Chimbote are the oldest. In 2005, Ancash accounted for 41 percent of the standard installed production capacity and only 19 percent of the capacity for prime meal production. In contrast, another important province, Ica, accounted for 10 percent of the production capacity for standard fishmeal and 21 percent of the production capacity for prime meal. In Chimbote, the plants of the fishing groups work with the most modern technologies, which minimizes harmful effects on the environment.

Whether fishmeal manufacturers belong to big fishing groups or are locally managed, collaborative mechanisms have not been developed to solve shared problems (such as the improvement of port infrastructure), as during the fishing season competition is ferocious in securing landings for their plants.

The advanced technology used to produce fishmeal highlights the importance of the suppliers of technology in the modernization of this industry. Most of the suppliers of capital goods for fishmeal plants are from Norway and Denmark, and more recently, Chile. However, these technologies have been adapted to the particular needs of Peru.

The suppliers of capital goods are usually located in Lima and can assist with the orders of the fishmeal plants located in different ports. The technical personnel of the supplier install the equipment in the plants. Although generic equipment is sold, it usually has to be adapted to the specific characteristics of the fish species utilized and the condition in which it is supplied. The fishmeal manufacturers are very conservative about the equipment that they use and usually do not adopt new technologies unless they have been tested in other plants. This reduces the uptake speed for technological development in fish processing.

There are not many equipment suppliers in Chimbote; however, extensive repair workshops for maintenance have been established. These shops are quite heterogeneous and they compete on the basis of speed and price. The biggest shops are the best equipped, and they are also subcontracted by the companies selling capital goods to work on the installation of new equipment. Due to the large number of old plants in Chimbote, the fishing companies have opted to modernize and enlarge the plants rather than build new ones.

The diversity and improvisation of many of the workshop employees has inhibited the demand for qualified personnel. The manpower becomes qualified through “on the job” experience. However, several small training centers have opened, and about seven years ago a branch of the Servicio Nacional de Adiestramiento en Trabajo Industrial (SENATI) opened up a center of industrial training of high prestige. There are three universities in Chimbote; of these, the University of the Santa offers careers in fishery engineering, while the Private University of San Pedro offers a technical degree for workers involved in fishing activities (crew and machinists). According to equipment suppliers, the engineers in charge of the fish processing plants are very good at handling the equipment and standard technology but lack knowledge of recent advances.

Chimbote is also the main port where the industry producing canned products for direct human consumption is located. More than 50 percent of the landings for the canned fish industry are in Chimbote, and in the Department of Ancash there are 37 plants with an installed capacity of 113 432 boxes per shift, which is 59 percent of the national capacity. Two of the country’s main fish processing companies, Southern Group and Hayduk, produce cans of anchoveta, among other products.

The manufacture of canned anchoveta starts with fresh anchoveta that is headed and gutted (HG), in type tube cut, and then packed in tin containers with different covering liquids that are selected according to the product line (oils, sauce, tomato cream, onion, smoky, etc.) being prepared. More specifically, the process involves the heading and

gutting of the fish and then washing them in cold water or 3 percent brine for a short bleeding period. The fish are then brined in a saturated solution for 25 to 30 minutes. Following immersion, the fish are then rinsed in cold water and placed in containers, which are then pre-cooked in a continuous or static cooker in order to reduce the moisture content of the fish and to give them an appropriate texture. The fish are dosed with the covering liquid (e.g. an oil or sauce), the air is evacuated from the can and the can is closed and sterilized. The cooled cans are appropriately coded and then packed for storage in dry and ventilated atmospheres.

8.3 Marketing

Most fishmeal (around 94 percent) is sold to international markets, and only a small part is directed to the local market to satisfy the demands of the poultry, livestock and aquaculture industries. The broker is the agent that serves as intermediary between the Peruvian company's fishmeal producers and the big traders that sell to Europe (mainly German) and Asia (mainly Chinese traders). This type of trade is typically controlled by the buyers.

In recent years, the production of special fishmeal has favoured direct sales. In the trading of this type of meal, the product is shipped directly in containers to the end users. In the case of prime meal produced in Chimbote, due to transportation difficulties, it usually has to be carried to Lima for its dispatch to Callao, making the process more expensive. However, the biggest fishmeal companies are taking advantage of their large production volumes to market their products directly. For example, some of them have established representation offices in the destination markets.

Another important actor in the fishmeal trade is the customs agency, which is in charge of the logistics and procedures for dispatch. The customs agencies have offices in Chimbote. Because they also assist other economic sectors, the main offices are in Lima. In the case of the big fishing groups, the contracts are made directly in Lima.

The certification companies play an important role in the trade process, because they certify the quality and quantity of the product that is going abroad. A recent achievement of the Peruvian producers is that the weights and quality of fishmeal reported at the departure point are respected. The certification companies have their main offices in Lima but maintain offices in Chimbote.

An important aspect of the fishmeal trade is the use of warrants offered by the warehouses that provide the fish processing companies with access to short-term bank credit to assist with working capital. The warehouses generally belong to or are affiliated with the main commercial banks, and they have facilities in Chimbote and other fishing ports where the fishmeal is stored until its dispatch. For the larger companies, the storage contracts are generally made directly in Lima.

The limited infrastructure in the port of Chimbote has become an obstacle to the modernization of the entire Peruvian fishing industry. The facilities are too small for the volume of fishmeal dispatched. In the months of higher productivity, it takes the ships one week from time of arrival to load and weigh anchor. These delays and their consequent costs are generally assumed by the buyer who hires the marine transport.

Other sectors in the country have shown a greater increase in exports than the fisheries sector, the sector's growth having occurred due to the higher current product prices. The sustained demand from aquaculture has pushed up the prices of fishmeal and fish oil. For years, the price of a tonne of fishmeal was above US\$500. In 2005, the price reached US\$600/tonne, and in 2006 it reached US\$1 000. For the same reason, the price of fish oil has more than doubled in the last 10 years. Peru once exported around 50 percent of its production; today almost all fish oil is exported.

The fishmeal is used as animal feed. It doesn't contain carbohydrates, but contains proteins with essential amino acids, minerals and fats having a high content of polyunsaturated fatty acids, especially EPA and DHA. Fishmeal is critical for

development and growth during the early ages of fish, birds, pigs and sheep. The main competitor to fishmeal (in particular that of standard quality meal) is soy meal, which has 44 percent protein compared to the 64 percent protein content of standard fishmeal and the 72 percent content of super prime.

Two dynamic markets are recognized, that of Asia, with a growing demand mainly in China, Thailand and Japan; and Europe, whose market has been affected by the restriction of the European Union (EU) on the use of fishmeal for ruminants.

In 1993, aquaculture used 16 percent of the fishmeal produced and 29 percent of the fish oil produced. In 2004, it used nearly 34 percent of the fishmeal (and was the most important user) and 56 percent of the fish oil, showing a greater increase in use than the traditional users of fishmeal (for livestock, pigs and birds).

8.3.1 Perspectives on the commercialization of fishery products

Approximately 5 percent of the market of animal feeds is fishmeal, 21 percent is soy meal and the remainder is meals derived from other sources. Increasing numbers of Asian countries are members of the World Trade Organization (WTO), a situation which will facilitate trade on the international markets for fishery products. There are also important changes which promote commerce, such as the labelling and traceability of products, which reflect the growing importance to consumers of the environmental and social impacts of fishing and farming. Since 25 November 2005, the labels on animal feeds sold in the EU must specify all the ingredients.

The price of fish oil has shown an even more dramatic change than that of fishmeal, due to its use in aquaculture, and very minor use in products for human health as a source of omega-3 fatty acids. The demand has doubled the price of fish oil since the early 1990s. Peru currently exports all its fish oil.

8.3.2 The Chinese market

Fish has been an important food source in China for more than 3 000 years. In 2002, China displaced Thailand as the primary producer of fishery products in the world, with an average industry growth rate of 10 percent since the 1990s. It is also the main buyer of fishmeal. In a little more than one decade, fishmeal imports have multiplied 4.5 times. Chinese aquaculture production is expected to reach 30 million tonnes in 2010, constituting 65 percent of China's total fish production (FAO, 2007).

The International Food Policy Research Institute (IFPRI) projected an annual growth of 2.6 percent for foodfish production coming from the aquaculture sector from 1997 to 2020 (FAO, 2007), although this may be an underestimate. The average rate of growth of the aquaculture sector in China has been high; 17.1 percent from 1980 to 1990 and 33.8 percent from 1990 to 2000 (FAO, 2005). In China in 1992, aquaculture contributed 55.5 percent of the total fish production and in 2002, its contribution rose to 79.8 percent. In 1992 the annual per capita consumption of aquaculture products was 7.1 kg and in 2002, increased to 21.8 kg, an average yearly growth of 11.9 percent.

Peru is the major fishmeal supplier for China. In 2005, Peru exported 1 049 000 tonnes of fishmeal to China, while in 2004, the volume of fishmeal exported was 810 638 tonnes. It is estimated that most of the fishmeal imported by China is used for aquaculture.

8.3.3 The European market

In Europe, fish and molluscs are also traditionally farmed. At the moment, population growth in Europe is slower than in Asia, and the consumption of fish is already high and unlikely to increase drastically, except in the countries of the former Soviet Union. In recent years, the volume of fishmeal used in Europe has decreased. The restriction on the use of fishmeal in foods for ruminants has not been fully compensated by the increased use by aquaculture.

Contrary to Asia where carp is the main species farmed, in Europe the main species farmed are the salmon and the trout. Together they represent 80 percent of the volume of European aquaculture production. During the 1980s and 1990s, the rate of growth of European aquaculture was below the world average, with the exception of Norway. Salmon aquaculture will only grow in the United Kingdom, Ireland and Norway, countries where there is a plan to expand the aquaculture sector that includes species other than salmon (FAO, 2005). The plan recognizes environmental restrictions as the main limitation.

In November 2000, France and Germany prohibited the importation of fishmeal in response to the bovine spongiform encephalopathy (BSE) epidemic. Due to the death of more than a hundred cows caused by this illness and concerns about possible human health impacts, the EU's restriction on the inclusion of fishmeal in ruminant diets remains in force.

During the last decades, the increase in food consumption in developing countries has been characterized by an increase in the protein and vegetable content of diets and a reduction in the basic cereals. These changes have been due mainly to the effects of rapid urbanization, as well as changes in the distribution of foods. In several developing countries, such as some countries in Latin America, the rapid expansion of supermarkets has increasingly catered to the needs of all classes.

Dietary habits are also changing in the developed countries, where the basic dietary necessities are available and consumers desire a wider variety of foods in their diets. The average consumer also increasingly worries about his health and diet, and fish is often considered beneficial. Fish, as with other foods, is being transformed into value-added products through novel processing technology. In addition to traditional preparations, advances in food science, together with the improvement of refrigeration and the use of microwave ovens, have led to the production of many "ready to eat" products that have boosted the overall growth of the fishery sector.

The reasons for the quick expansion of ready to eat products include changes occurring in social patterns such as greater participation of women in the work force, less frequent meals at home, the general decrease in the average size of families and an increase in the number of single-person homes. This has led to the need for simple, easy to cook foods ready to eat. Another trend is the increased importance of fresh, chilled fish. Improvements in packaging, reduced cost of air freight and increased transportation efficiency have created new opportunities for the sale of fresh fish.

These trends are expected to continue in the foreseeable future. The United Nations considers that the rate of world population growth will slow, but that fertility rates will be higher in the developing countries, whose combined populations will increase to approximately 83 percent of the world population by 2030 (from 79 percent in 2005) (FAO, 2007).

By 2030, 57 percent of the population of the developing countries will likely live in urban areas, compared with 43 percent in 2005. Population growth, increased per capita income, and the urbanization and diversification of diets will create an additional demand that will perpetuate the trend towards greater use of animal products in the diet.

In terms of supply, it is expected that capture fisheries will not increase significantly in overall volume and that aquaculture will continue to expand. FAO (2005) conducted studies on the future of capture fisheries and aquaculture with projections to 2015 and to 2020 and a comparison of both projections with the projections made in *The State of World Fisheries and Aquaculture 2002 (SOFIA)* (FAO, 2003). FAO's comparative study in one scenario matches demand and supply with the relative prices of the substitutes and constant real price, and then in another scenario modifies prices to adjust the demand to the supply. The study concludes that:

- With regard to demand, it is expected that growth will be more limited than that of the last two decades. By 2015, 50 million tonnes of fish and additional products will be required.
- Human consumption will increase due to population growth, as well as increased incomes.
- Fishmeal demand will show a net annual increase of 1.1 percent until 2010 and a 0.5 percent annual increase from 2010 to 2015.
- It is anticipated that there will be reduced demand in developed countries, while demand will increase in developing countries. Also, the amount of pelagic and demersal fish will decrease and that of freshwater fish will increase.
- The difference between supply and high demand will result in an increase in prices. In conclusion, this study foresees a supply deficit.

Similarly in 2002, it was considered that by 2010, 50 percent of fishmeal production and 75 percent of fish oil production would be used by aquaculture. In all the scenarios, the price of fishmeal and oil will increase. This will increase even further if catches from capture fisheries do not increase and the demands of the aquaculture sector increase above projected rates.

8.4 Anchoveta and its contribution to world food supply

Annual global fish production during the decade 1996–2005 fluctuated between 118 and 142 million tonnes (capture fisheries, 88–95 million tonnes and aquaculture (excluding aquatic plants), 27–48 million tonnes), of which 21–27 percent was used for non-food purposes and the remaining 73–79 percent was consumed mainly as fresh, frozen and canned products. Over the last ten years, annual per capita foodfish supply remained more or less static, ranging between 15.3 and 16.6 kg (FAO, 2003, 2005, 2007).

Calculations made on future fish requirements to 2015 estimate a world demand of between 100 and 120 million tonnes. The difference between existing supply and future demand will have to be covered by aquaculture and the use of underutilized resources that can be adapted for direct human consumption.

Globally, of the four most important pelagic species used in reduction processes for fishmeal, the anchoveta could find acceptance in those parts of the world that consume a great variety of pelagic fish and that have established markets for similar species. Nevertheless, an important condition for acceptance would be that the anchoveta products should be low priced within the framework of regional and worldwide policies that include commercial development and the elimination of barriers related mainly to tariff rates.

Prices of fish for human consumption are expected to increase during 2005–2015 because current supplies will not meet the projected demand. Any significant increase in the acceptance of small pelagics for human consumption in countries with nutritionally deficient populations or low fish consumption might possibly be offset by a decrease in buying power as the forecast is for slight economic development. Consumption of small pelagic fish such as anchoveta could be promoted in developed countries based on knowledge of the physiological benefits derived from the consumption of this type of fish. In addition, if the price of demersal fish increases considerably due to limited supplies, consumers of white fish may change to cheaper alternatives, as is presently the case.

With the development of appropriate technologies for the conversion of the anchoveta and other small pelagics to processed foods, the challenge to fight hunger and malnutrition of millions of people worldwide can be met. Considering that most of the world's fish stocks are fully exploited or overexploited, any increase in the fish supply will have to come from increased aquaculture production and the more rational use of capture fisheries resources. This means that a part of the landings of

small pelagics that are used in fishmeal production will need to be redirected to direct human consumption.

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