

Development Of Fishery Post-Harvest Technology In Indonesia

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Introduction

Indonesia is an archipelago comprising approximately 17,000 islands with a vast coastline extending some 36,600 km, and with abundant natural resources – all in an ideal climate.

The islands have a land area of over two million sq km and 5.8 million sq km of marine waters, 3.1 million sq km of which comprise archipelagic and territorial waters. The remaining 2.7 million sq km is in Indonesia's Exclusive Economic Zone (EEZ). About 775,000 sq km of marine waters are productive coastal areas of less than 200 metres deep.

Marine fish comprised 75.5% of the total fish production in 1987. Inland fisheries has shown considerable progress during the last five years and still has great potential for expansion (Table 1).

The population of Indonesia was about 175 million in 1988 and more than half is concentrated on a few islands of the west part of the country namely Java, Bali, Sumatra, Madura and Lombok.

Majority of fishermen can be found in the most densely populated areas, with localised coastal areas being over-exploited. The Indonesian fishing industry is generally dominated by small-scale operations, characterized by low technical inputs and low productivity. However the small-scale fisheries contribution to the national fish production is substantial, accounting for about 95% of the total fish production.

Marine fishing engaging 1.37 million fishermen mainly operating in the inshore waters, particularly along the coast of the densely populated areas. There are about 334,072 fishing boats, two third (222,233) of which are non-powered

boats while the rest are powered boats, the majority of which are less than 10 GT.

Thousands of fishermen fish in lakes, reservoirs, rivers and other open waters on a part-time basis combined with other agriculture activities. Indonesia has also inland and coastal ecosystem providing high potential resources for aquaculture. There are about 1.1 million fish farmers operating brackish-water ponds, fresh-water, paddy-cum-fish, cage and mariculture.

Fish has traditionally been the main source of animal protein in the Indonesian diet.

It was estimated that fish provides about 62% of the domestic animal protein supply. The average annual per capita consumption of fish has been demonstrating a general increase in recent years. However, the level varies from as little as 6 kg to about 35 kg per capita per year. High consumption rates are found in Kalimantan, Sulawesi, Maluku, Irian Jaya and Sumatra, with the average exceeding the national target of 18 kg per capita per year. The lowest rate is found in Java, Bali and Nusa Tenggara which is below 10 kg per capita per year.

Fisheries Resources

With 3.1 million sq km of archipelagic and territorial waters and 2.7 million sq km of EEZ, the country has great potential yield of marine living aquatic resources. This has been estimated to be 1.5 million mt in the archipelagic and territorial waters and 2.1 million mt in EEZ waters.

As in other tropical waters of South East Asia the marine fishery resources include many different species. There are over 22 popular demersal

fish species, 23 pelagic species, and over five different shrimp species. The remainder are classified as "others", in the national fishery statistics.

Evaluation of marine fisheries resources exploitation indicates that the level of exploitation in 1987 was still at a low level - estimated at about 30%. This means that a great deal of potential remains to be exploited, although the amount varies substantially from one area to another for each species. From the existing freshwater ponds, covering 54,082 ha, a production increase of 136,300 mt could be expected from semi or fully intensive culture technology beyond the existing production of 211,000 mt.

The areas of potential freshwater culture cover 180,000 ha and the yield here could be expected to reach some 675,000 mt. From areas of brackish water ponds ranging from 420,000 to 840,000 ha, production of 761,000 to 1,155,200 mt could be expected, if semi or fully intensive culture is applied.

Fisheries Production And Projected Expansion

During the fourth five-year development plan (1984-1988), fish production increased from 2,260,989 mt of total production in 1984, 76% of which being marine products, to 2,881,169 mt in 1988, an increase of approximately 6% each year on the preceeding year (Table 1).

Fish was estimated to provide about 60% of the domestic animal protein supply. The average

annual per capita consumption of fish has been demonstrating a general increase in recent years although the level is still below the national target of 18 kg per capita per year.

Export of fisheries products increased from 84,601 mt valued at US\$259 million in 1985, to 228,658 mt valued at US\$832 million in 1989 - an average increase of about 25% by volume each year. Export commodities consist primarily of high-market value products, such as shrimp and tuna (Tables 2A and 2B).

The trade balance of fishery commodities increased from a value of US\$236 million in 1985 to US\$808 million in 1989 (Table 3).

Indonesia is now in the beginning of the third year of its fifth five-year development plan (1989-1993); the current plan is still geared towards increasing fishery production and export, providing employment opportunities, promoting income of fishermen and fishfarmers and increasing consumption of fish.

Fish production is projected to reach 3,765,700 mt in 1993, an average increase of about 6% per year (Table 4).

With an average increase of 11.42% in volume and of 16.33% in value per year, exports are projected to reach 291,400 mt at a value of US\$1,286 million in 1993 (Table 5).

Total consumption of fishery products is expected to reach 3,415,000 mt and consumption per capita to reach an estimated 17.71 kg per capita per year in 1993. This would be about 98% of the national target of 18 kg per capita per year.

Table 1. Fisheries production.

Sub-Sector	Unit : mt				
	1984	1985	1986	1987	1988
Marine Fishery	1,712,804	1,821,725	1,922,781	2,017,350	2,169,557
Inland Fishery	548,185	573,837	607,109	653,063	711,612
Total	2,260,989	2,395,562	2,529,890	2,670,413	2,881,169

Source : Directorate General of Fisheries, Indonesia.

Table 2A. Export volume of fisheries products.

Commodity	Unit : mt				
	1985	1986	1987	1988	1989
Shrimp	30,984	36,101	44,267	56,552	62,710
Tuna/Skip Jack	17,889	24,236	33,995	40,753	95,640
Aquatic Products	9,110	10,582	18,695	28,182	38,945
Froleg	2,802	3,752	3,076	3,814	4,729
Jelly Fish	1,875	4,762	3,372	4,181	6,184
Ornamental Fish	335	859	530	657	815
Etc	21,606	27,151	36,442	47,078	49,635
Total	84,601	107,443	140,377	181,218	228,658

Source : Directorate General of Fisheries, Indonesia.

Table 2B. Export value of fisheries products.

Commodity	Unit : 1,000 US\$				
	1985	1986	1987	1988	1989
Shrimp	202,729	284,875	352,435	500,312	556,662
Tuna/ Skip Jack	13,770	18,128	30,961	73,619	102,668
Aquatic Products	4,611	4,894	11,486	39,583	63,081
Froleg	6,571	13,139	8,939	17,995	16,723
Jelly Fish	2,716	7,869	7,370	16,453	8,669
Ornamental Fish	471	1,238	1,609	4,905	9,971
Etc	28,576	43,974	62,409	59,332	74,938
Total	259,444	374,117	475,209	712,199	832,712

Source : Directorate General of Fisheries, Indonesia.

With its abundance of potential fisheries resources Indonesia has an excellent opportunity to improve both productivity and production and to achieve economic returns through intensification and extension of ventures in fishery. The high market value of exported products such as tiger shrimp, tuna and skipjack is one of the main forces driving the effort to increase production.

Development Of Post-Harvest Technology

Of the total fish production, 60% is distributed fresh, and the rest as processed products (Table 6).

There are at least 4,271 traditional processing units engaged in salting/drying, steaming/cooking, smoking and fermentation. Also in operation are

Table 3. Trade balance of fishery commodities.

Unit : 1,000 US\$

Specification	1985	1986	1987	1988	1989
Export Value	259,444	374,117	475,209	840,959	840,959
Import Value	23,891	28,177	27,839	20,704	32,884 ^{x)}
Balance	235,553	345,940	447,370	697,627	808,075

^{x)} Tentative Data

Source : Directorate General. Of Fisheries, Indonesia.

Table 4. Projection of fish production.

Unit : 1,000 mt

Sub-Sector	1989	1990	1991	1992	1993	Increase Rate Per Year %
Marine Fishery	2,293.1	2,426.8	2,566.6	2,714.4	2,867.0	5.74
Inland Fishery	714.8	757.8	802.9	848.8	898.7	5.89
Total	3,007.9	3,184.6	3,336.5	3,563.2	3,765.7	5.78

Source : Directorate General of Fisheries, Indonesia.

Table 5A. Export volume of fisheries products.

Unit : 1,000 mt

Commodity	1990	1991	1992	1993
Shrimp	65.1	72.3	80.3	89.2
Tuna/Skip Jack	44.8	50.0	55.2	60.4
Aquatic Products	29.2	33.1	37.0	40.9
Frogleg	6.3	6.9	7.6	9.3
Jelly Fish	10.2	11.6	13.0	14.4
Ornamental Fish	1.8	2.1	2.4	2.6
Etc	55.4	61.8	68.2	74.6
Total	221.8	237.8	263.7	291.4

Table 5B. Export value projection of fisheries products.

Commodity	Unit : US\$ million			
	1990	1991	1992	1993
Shrimp	625.0	730.2	859.2	1,016.9
Tuna/Skip Jack	44.8	50.0	55.2	60.3
Aquatic Products	17.5	19.9	22.2	24.5
Frogleg	19.5	21.4	23.6	25.7
Jelly Fish	17.3	19.7	22.1	24.5
Ornamental Fish	5.2	5.8	7.0	7.5
Etc.	94.2	105.2	115.9	126.8
Total	823.5	952.2	1,105.2	1,286.2

Source : Directorate General Of Fisheries, Indonesia.

Table 6. Treatment of fishery products.

Treatment	Unit : mt				
	1984	1985	1986	1987	1988
TOTAL	1,712,804	1,821,725	1,922,781	2,017,350	2,169,557
Fresh	853,647	878,607	928,944	1,061,060	1,188,406
TRADITIONAL					
Dried/Salted	561,493	636,556	665,298	626,887	667,373
Boiled	121,210	121,599	125,248	119,554	84,036
Paste	33,152	40,834	39,004	45,262	51,723
Fermented	10,536	9,599	15,095	7,706	6,619
Fish Sauce	118	564	969	2,005	1,145
Smoked	44,531	44,294	52,867	54,998	43,186
Others	16,113	17,389	19,568	17,412	16,439
MODERN					
Freezing	46,183	58,573	66,851	65,163	81,541
Canning	16,504	7,772	5,587	13,015	11,991
Fish Meal	9,317	6,001	3,350	4,288	17,096

Source: Directorate General Of Fisheries, Indonesia.

modern processing plants; they comprise 169 freezing (mainly shrimp) and 22 canning plants. The distribution of freezing and canning factories are as shown in Tables 7 and 8 respectively.

Both domestic and international markets seem to be bright for fishery products. As earlier mentioned, fisheries contributes over 60% of the total animal protein supply of the Indonesian diet. With a national growth rate of just 2% per year projected for the next few years, the domestic market will easily absorb the increase in fishery products.

Industrial processing has been accorded high priority for the export market. The main export commodities include shrimp, tuna/ skipjack, froglegs, ornamental fish, seaweed and jelly fish. By 1993 exports are projected to reach 290.4 thousand mt, up from 181.2 thousand mt in 1988, an increase of 11.42% per year, while values are projected to US\$1.3 billion in 1993. This would represent an average increase rate of 16.33% per year, from the 1988 value of US\$712.2 million.

The market for shrimp is primarily Japan, which accounted for 71.43% by volume in 1988. Other countries of destination in 1988 included Singapore (8.59%), Hongkong (4.27%), USA (3.05%), Netherlands (3.33%), Belgium and Luxemburg (2.78%) and France.

The main species marketed include:

- Tiger Shrimp (*Penaeus monodon*)
- White Shrimp (*Penaeus merguensis*)
- Pink Shrimp (*Metapenaeus* spp.)
- Flower shrimp (*Metapenaeopsis* spp.)
- Kuruma Ebi (*Penaeus japonicus*)
- Freshwater Shrimp (*Macrobrachium rosenbergii*)
- Lobster (*Panulirus* spp.)

Shrimps are presented to the market either alive, fresh, frozen, canned or dried. Product forms include: headless shell-on, head-on, peeled and deveined, peeled and undeveined, individually frozen, blocked frozen according to the requirements of the intended market.

Species of tuna and skipjack include big-eye (*Thunnus obesus*), albacore (*Thunnus alalunga*), yellowfin tuna (*Thunnus albacares*), bluefin (*Thunnus thynnus*), and skipjack (*Katsuwonus pelamis*). These are marketed in fresh, frozen, canned or dried form for domestic use and for export.

In addition to shrimp and tuna/skipjack other fishery commodities with potential economic importance include froglegs, seaweed, jellyfish, ornamental fish etc (Table 9).

Measures In Promoting Post-Harvest Technology Development

Since the enactment of the Foreign and Domestic Capital Investment Laws, the development of industrial fisheries in Indonesia has progressed significantly, particularly in the establishment of integrated fishing industries.

The fishing industry is dominated by small-scale operations, a situation which has led to imbalanced utilization of fishery resources between western and eastern waters of the archipelago. This has been the basis for a recent policy decision to develop both small and large-scale fisheries simultaneously. In order to synchronize the development of both small-scale and export-orientated industrial fisheries, a "nucleus estate and small holder system" (NES) has been formulated in which the large-scale operation serves as the nucleus company. Remarkable progress has been made, particularly in shrimp industry development and also in the achievements of the tuna/skipjack fisheries under the NES set-up.

In an attempt to enhance competitive capacity in the international market efforts have been directed to, among other goals, reduction of production cost of commercially important species, improvement of the quality of fishery export commodities and further diversification of both export commodities and export markets. In order to maintain high quality exported products, a mandatory programme of inspection and quality control compliance has been adopted, and is sup-

Table 7. Number of cold storage and capacity in provinces.

Province	No. of Cold Storage	Capacity (mt)
Aceh	2	850
North Sumatera	16	7,835
Riau	5	5,130
South Sumatera	6	1,670
Bengkulu	1	25
Lampung	1	*N.A.
DKI Jakarta	20	5,780
West Java	7	*N.A.
Central Java	10	2,170
East Java	36	4,900
Bali	7	900
NTB	1	120
NTT	1	100
East Kalimantan	7	1,420
Central Kalimantan	1	100
South Kalimantan	4	800
West Kalimantan	4	500
North Sulawesi	2	350
South Sulawesi	15	2,290
Southeast Sulawesi	2	500
Maluku	13	1,870
Irian Jaya	8	2,900

*N.A. - Figures not available.

Table 8. Number of canning factories in each province.

Province	Canning Factories
North Sumatera	2
Central Java	1
East Java	10
Bali	4
West Kalimantan	1
North Sulawesi	2
Irian Jaya	1
Southeast Sulawesi	1
Total	22

Table 9. Fish and fishery products.

Existing resources	Species	Treatment	Form	Countries of destination
Shrimp				
Tiger	<i>Penaeus monodon</i>	Fresh/chilled	Raw/cooked	Japan
White	<i>Penaeus merguensis</i>	Frozen	Head on shell on	Singapore
		IQF	Headless shell on	HongKong
Pink	<i>Metapenaeus</i> spp.	Canned	Peeled & deveined	USA
Flower	<i>Metapenaeopsis</i> spp.	Dried	Peeled & undeveined	Europe
Kuruma	<i>Penaeus japonicus</i>	Live	Butterfly	Australia
Freshwaters	<i>Macrobrachium rosenbergii</i>			
Lobster	<i>Panulirus</i> spp.		Dry packed	
Tuna				
Big eye	<i>Thunnus obesus</i>	Fresh	Whole	Thailand
Albacore	<i>T. alalunga</i>	Frozen	Gutted	Japan
Yellowfin	<i>T. albacares</i>	Canned	Chunks in brine	USA
Bluefin	<i>T. thynnus</i>	Dried	Chunks in oil	Singapore
Skipjack	<i>Katsuwonus pelamis</i>		Solid in brine	
			Solid in oil	
			Tuna in dressing sauce	
Froglegs				
Bullfrog	<i>Rana catesbiana</i>	Live	Froglegs	Singapore
Stone frog	<i>Rana macrodon</i>	Frozen		France
Green frog	<i>Rana rana</i>	IQF		Benelux Korea
Sardine				
Balinese sardine	<i>Sardinella longiceps</i>	Canned	Solid in tomato sauce	
		Fish meal	Solid in oil	
			Solid in oil	
Seaweed				
Brown	<i>Sargassum</i> spp.	Dried		Japan
Red	<i>Eucheuma spinosum</i> <i>Gelidium</i> spp. <i>Gracilaria</i> spp. <i>Hypnea</i> spp.	Agar		
Anchovies				
		Chilled dried		Japan
		Dried unsalted/ dried salted	Whole	Singapore
Jelly fish				
		Dried		HongKong
Others				
Grouper		Fresh	Whole	
Red snapper		Frozen	Fillet	
Pomfret		Live	Wet packed	
Crab		Canned	Dry packed	
Sand goby		Dried		
Snail		Canned		Europe
		Frozen		

ported by certification procedure. The certifications required are as follows:

1. A Good Manufacturing Practices Certificate (GMP) required by the processing plant.
2. A Certificate of Competence required by the Plant Quality Control Supervisor.
3. A Certificate of Quality required for exported products.

To facilitate the implementation of such a programme the Government has provided infrastructure, institutions and qualified personnel in sanitary and hygienic inspection and quality control in an effort to improve the post-harvest activities such as handling, processing, packaging, storage, transportation and distribution. Measures include the

1. Establishment of 26 provincial quality control laboratories to carry out evaluation and supervision of provincial laboratories.
2. Establishment of a reference laboratory to carry out evaluation and supervision of the provincial laboratories.
3. Establishment of cold storage chains and ice plants at landing areas.
4. Provision of training for fish inspectors, analysts, plant supervisors and those dealing with inspection and quality control of fish and fishery products, including fishermen and fish farmers.

To carry out the mandatory inspection, the Directorate General of Fisheries conducts periodic routine plant sanitary and hygienic inspection of all major processing and cold storage facilities.

Many conditions favour expansion of Indonesia's fisheries. Resource availability is good. Market prospects - domestic as well as foreign - are bright. Production is projected to reach 3,765,700 mt in 1993 and export value to reach US\$1,286 million. In anticipation of this expansion, the development of Indonesia fishing

industry is now taking an integrated activities approach. The goal is to maximize the utilization of the nation's huge fisheries resources without destroying the stock, and to minimize post-harvest losses.

Discussion

Asked whether there were any processing plants producing agar from *Gelidium* sp. in Indonesia and about the method of production in use, Dr. Wiryanti replied that the industry is small-scale with minimal production, and added that there is no culture production of the seaweed in Indonesia.

During the paper presentation, Dr. Wiryanti had mentioned that Europe disallowed the importation of canned sardines made from non-cold water species. Noting that the main market for canned sardines from Indonesia is Europe, Dr. Wiryanti who was asked what happened to the surplus, responded that Indonesia continues to export canned sardines to Europe through a third country.

On the topic of the tuna catch in Indonesia, Dr Wiryanti was asked whether there were any landings in the province of Aceh. She replied that previously, landings had not been significant but that they are gaining importance and that a landing port is now being established in that province.

Dr Wiryanti explained that the nucleus estate and small holder system (NES) was geared towards synchronizing the development of both small-scale and large-scale industries. Under this system, remarkable progress has been achieved, especially in the shrimp industry.