

# DEVELOPMENT OF MARICULTURE IN INDONESIA

(Country Report)

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### I. Marine Aquaculture Products Demand, Trade and Market

Indonesia has 5,8 million km<sup>2</sup> of marine aquatic area, with 17,504 islands, 81,000 km of coastal line, and 217 million of population. National export of fisheries product in 2004 is 902,358,092 kg by value of USD 1,780 million (about 2.69% of total export), while national import of fisheries product in the same period is about 136,040,149 kg by value of USD 154 million (about 0,28% of total import). Export volume and value of fisheries product by commodity as seen on Table 1.

Table 1. Export volume and value of fisheries product by commodity in 2004

No	Commodity	Volume (Kg)	Value (USD)
1	Fresh, frozen, canned shrimp	139,450,184	887,127,117
2	Fresh tuna, frozen, canned	94,220,950	243,937,896
3	Other live, fresh, frozen, dried, canned	522,831,403	354,446,044
4	Fresh crab, frozen, canned	20,902,586	134,354,913
5	Frog leg	3,388,995	11,515,497
6	Dried jelly fish	4,598,934	4,994,686
7	Snail	1,886,462	2,762,606
8	Shrimp crisp	5,535,502	7,539,046
9	Fish oil	2,141,066	637,748
10	Dried seaweeds	51,010,828	25,296,399
11	Coral and shell	3,125,494	1,411,077
12	Pearl	1,711	5,866,158
13	Ornamental fish	3,516,060	15,809,284
14	Dried anchovy	3,202,761	18,571,267
15	Other product	46,545,156	66,563,069
	Total	902,358,092	1,780,832,807

Total production of capture fisheries is about 4,07 million ton/ year, and total production of aquaculture in 2004 as seen on Table 2 (about 26% of total production).

Table 2. Indonesian aquaculture production in 2004

No	Aquaculture system	Production (ton)
1	Marine based aquaculture	420,919
2	Coastal brackish water pond	559,612
3	Inland pond	286,182
4	Freshwater cage culture	53,695
5	Freshwater floating net	62,371
6	Rice field integrated farming	85,832
	Total	1,468,610

Contribution of mariculture for fisheries production in 2004 is about 420,919 ton (as seen on Table 3) or about 28,6 % of total aquaculture.

Table 3. Indonesian mariculture production by commodity in 2004

No	Commodity	Production (ton)
1	Grouper	6,552
2	Asian Seabass	1,748
3	Mussel	12,953
4	Seaweeds	397,964
5	Other	1,702
	Total	420,919

Almost all Indonesian mariculture products are produced for export demand. Grouper, asian seabas and other finfish, are commonly exported as live fish. They transport from the farm by means of shipping with sea water circulation. Seaweeds product for carrageenin extraction are exported as dried raw materials. In trading of this bulky product, involved several marketing mediator before trading by exporter.

The constrain of seaweeds marketing on farm level is transport cost from the site to the local buyer. They need a collector which is able to pay the yield in certain quantity and transport them efficiently to the bigger buyer. Some intermediate step are required for quality and price adjustment before ready to export. Exporter need the quality maximum with minimum price, but farmer need the highest price even with low quality. Intermediation make a conformity between them. Quality assurance for the market and reasonable optimum price for the farmer.

## II. Livelihood Opportunities Related to Mariculture Development.

According to a study, Indonesia was identified has 12,139,042 ha of available area for marine aquaculture (excluded coastal pond), but until 2004 the usage of area about 1,227.49 ha (0.01%). If the effective area (refer to receiving capacity) is about 10% of available area, so that the optimum area is about 1,2 million ha.

In physiographic point of view, Indonesian archipelago has characteristic tropical with various precipitation intensity. Western part of Indonesia have precipitation more than 2000 mm/y with longer rainy season, lower solar radiation. Eastern part of Indonesia rich with solar radiation, lower precipitation and shorter period of rainy season. So, the western part has higher suitability for agriculture and brackish water aquaculture, and eastern part for mariculture. The distribution of potential area for mariculture development and poverty distribution in Indonesia as seen on Table 4.

Table 4. Poverty distribution and suitable mariculture area available in Indonesia

No	Province	Sum of poor (x1000)	% population	Available area for mariculture (ha)	Obtained in 2004 (ha)
1	Nangroe Aceh D	1,157.2	28.47	129,318	-
2	Sumatera Utara	1,800.1	14.93	99,642	0.24
3	Sumatera Barat	472.4	10.46	54,139	15.14
4	Riau	744.4	13.12	118,377	0.55
5	Jambi	325.1	12.45	290,205	-
6	Sumatera Selatan	1,379.3	20.92	614,834	-
7	Bengkulu	345.1	22.39	9,258	-
8	Lampung	1,561.7	22.22	388,351	0.51
9	Bangka-Belitung	91.8	9.07	255,175	9.95
10	DKI Jakarta	227.1	3.18	2,825	2.40
11	Jawa Barat	4,654.2	12.10	35,933	11.00
12	Jawa Tengah	6,843.8	21.11	1,134	-
13	D.I. Yogyakarta	616.2	19.14	0	-
14	Jawa Timur	7,312.5	20.08	31,937	30.00
15	Banten	779.2	8.58	60,768	9.28
16	B a l i	231.9	6.85	8,140	421.00
17	Nusa Tenggara Barat	1,031.6	25.38	139,523	251.00
18	Nusa Tenggara Timur	1,152.1	27.86	160,922	3.01
19	Kalimantan Barat	558.2	13.91	853,640	0.21
20	Kalimantan Tengah	194.1	10.44	659,754	-
21	Kalimantan Selatan	231.0	7.19	199,467	5.86
22	Kalimantan Timur	318.2	11.57	409,314	2.62

23	Sulawesi Utara	192.2	8.94	43,105	304.00
24	Gorontalo	486.3	21.69	65,836	0.27
25	Sulawesi Tengah	1,241.5	14.90	551,235	0.31
26	Sulawesi selatan	418.4	21.90	43,028	-
27	Sulawesi Tenggara	259.1	29.01	183,911	149.30
28	Maluku	397.6	32.13	1,065,983	9.85
29	Maluku Utara	107.8	12.42	429,154	0.18
30	Papua	966.8	38.69	5.234.074	0,8
	Total	36,146.9	16.66	12,139,042	1,227.49

The national poor population is about 36,14 million (16,66%), when the potential area obtained is about 0.01%. Is the mariculture able to reduce poverty? The government of Indonesia strive to provide the proof that the answer is optimistic yes.

The usage of potential area for mariculture year by year increase is about 19.4% since 2000 and the increment of farmer involved since 2000 is about 30.7% (as seen on Table 5). It is seem significant developed, but is still very low compared to the available area.

Table 5. The increment of area usage and farmer involved in mariculture sector

No	year	Sum of farmer (person)	Area obtained (ha)
1	2000	29,604	614
2	2001	39,800	713
3	2002	65,624	951
4	2003	67,735	981
5	2004	81,377	1,227
	increment	30.7 %	19.4%

Cultured species in Indonesian mariculture sector is still limited, and dominated for export oriented. The oldest one is seaweeds culture. This commodity have been exported since 1985 from several area. In 2004 exported dried seaweeds (*Eucheuma cottonii* or *Kapahycus alvarezii*) is about 400.000 ton, or they produced 3,2 million ton of harvested yield. The farming development was limited by recognized suitable area, information about value, culture technique, market, and capital. Available area for seaweeds culture is recognized after some identification by means of on site trial show the proof. Spatial and temporal variation of environmental condition is not always detectable by conventional analyses without experiment all over the year with certain seed and proper technique. The respond of cultured organism express the condition,

wherever and whenever the optimum production can be obtained. Some experience in developing of seaweeds as an alternative for poverty reduction had been demonstrated in several area of Indonesia. The steps should be followed:

1. It should be ensured that the target location is feasible for farming of commercial strain/ species with certain technique in commercial scale. It is recognized after on site trial.
2. For the introducing step the “candidate farmer” should be selected and they are not hard to work in coastal circumstance.
3. The seeds (initial stock) and other facilities supply to the farmer as a lend and they should pay back after harvest certain yield.
4. Supervising to the farmer continued until they produce marketable quality and quantity.
5. Connecting with “generous” trader or exporter

Government (by technical implementation unit) start to facilitate initial stock plantation in several region, in order to ensure the farmer that the initial stock is available and could be obtain with feasible price. Marine Aquaculture Development of Lombok have been built up multi strain stock plantation.

Other commodity is finfish (grouper). This commodity is hard to be developed for poverty alleviation. They are limited by technology, capital, and market information. After seeds was available in commercial hatchery in 1999, and commercial pellet feed available in 2003, the problem of seeds and feed supply can be ignored. The risk due to mortality and market are seemed as main problem. In 2004 they produced 6,552 ton. Un-successful examples of grouper development had been experienced in Indonesia. Many possible problems were faced in this great effort, i.e.:

1. Un-success to demonstrate the proper technique to diminish mortality rate due to pathogen or parasite
2. The rearing period is too long in order to obtain marketable size. About 10 month for tiger grouper, and 16 month for humpback grouper.
3. Trading as live fish is hard and risky and need big production scale
4. High capital investment is not so interesting to the investor

Pearl oyster is also one of established mariculture activity in Indonesia. Indonesian Pearl Culture Association, registered 39 members of pearl oyster company. Excluded association there is more than 100 small company or small holder conduct this culture. They are spread from Lampung (Sumatera), Madura (East Java), Bali, West Nusa Tenggara, Sulawesi, Maluku, Papua. Up to September 2005 they produce 3,800 kg pearl. The species available in Indonesia are: *Pinctada maxima*; *P. margaritifera*; *P. fucata*; *P. lentiginosa*; *Pteria penguin*. So far, the wild broodstock seem available to fulfil the hatchery.

Related to poverty alleviation, they employ plenty of labour, but not so socially secure. Security risk is one of big problems faced by the company. The rearing activity in open shore is hard to control. This problem indicate if there is no satisfy taken by the local community. Some wise action, which is able to involved the local community needed. Co-lateral collaboration by means of sharing activity and income generating have been trying. Business interdependency between local community and company should be created through mutual collaboration. In producing pearls there is several processed that could be fragmented independently. There are:

- (1) hatchery for producing spat;
- (2) nursery to grow up spat to be young survive oyster (5 cm shell length) for 6 month after stocking;
- (3) rearing to achieve adult oyster (10 cm length), that is ready for nucleus insertion.
- (4) insertion and incubation of inserted oyster to produce pearls.

The first part is conducted by governmental hatchery, which is able to supply with sufficient spat; second and third part are conducted the local community and supervised by the company or government. The last part is conducted by the company. The advantages to the company are: minimize labour hired; and community protect the company because of dependency. So far, the collaboration is still working.

### **III. Existing and Potential Mechanisms for Technology Transfer**

Indonesia has institutions for development centre which are spread from west to east part of the country. They are called **technical implementation unit**, which is part of Directorate General of Aquaculture. Such institutions are:

1. Center For Marine Aquaculture Development, Lampung (Sumatera)
2. Marine Aquaculture Development Center, Batam (Riau)
3. Marin Aquaculture Development Center, Ambon
4. Marin Aquaculture Development Center, Lombok (West Nusa Tenggara)
5. Center for Brackish Water Aquaculture Development Center, Jepara (Central Java)
6. Brackish Water Aquaculture Development Center Takalar (South Sulawesi)
7. Brackish Water Aquaculture Development Center, Situbondo (East Java)
8. Brackish water Aquaculture Development Center, Aceh

They have mission to conduct technology propagation/ extention, and develop applied technology. So they are facilitated with: commercial scale experiment facility (hatchery, nursery, and grow out facility) training facility, dormitory, and laboratory services as well.

The technology transfer by these institution usually by means of:

- a) On the job training. The participants stay, learn, and work with the staff in charge for certain period depend on the subject and level
- b) Poster and leaflet publication
- c) Supervising on farm
- d) Pilot project, prototype, modelling

One of current training conducted in Marin aquaculture center Lombok is training on abalone culture for the vocational school (specific marine aquaculture) teacher from 7 provinces to accelerate the spat production.

#### **IV. Existing Major Mariculture Species and Farming Technology**

For mariculture development, Indonesia promote seaweeds, grouper, lobster, and abalone. Seaweeds (*Eucheuma spp.*) as one of established species, is recognized as a strategic commodity. It involve colossal people, apply simple technique, and short term revenue. The existing producer of seaweeds located at 7 provinces i.e. Sulawesi Utara, Sulawesi Tenggara, Sulawesi selatan, Jawa Timur, Bali, Nusa Tenggara Barat, Nusa Tenggara Timur. They apply floating method and off bottom method. The effective area produce 40 ton harvest per ha per month. Government strive to develop this commodity by means of co-lateral corporation with capital sources (banking) for credit distribution, company for marketing and processing, and coastal community as seaweeds producer.

The technology of grouper (tiger and humpback) aquaculture is established since 1999. The seeds from hatchery was available at Lampung, East Java, and Bali. Some company take apart to do this business since 2002, they are located at Lampung, Nusa Tenggara, Bali, Riau. The company located closed to the source of trash fish get advantage. The supply of feed supported by fisher folk with lower price and always fresh. The recent problem is the trading. Market of grouper (China) required live fish. High risk and costly for transportation decline the competitiveness of such product from Indonesia. Many disease occurred due to parasite and pathogen also discourage the development. Grouper culture which is introduce to small holders group by government in several province seems un-success. Problems identification show that the technical and non technical constrain occurred after implementation i.e. the grow out period is too long. The selected farmers were not able to spend long time without earning income. In many cases, the farmer is hard to find trash fish for feed with feasible price for certain period.

Lobster is one of mariculture commodity which is able to generate income within short period. Floating cage with 50 g adolescent lobster (*Panulirus spp*) feed with trash fish can reach 250 g within 6 months. The culture conducted by small holder located close to the source of wild seed. Capture of wild lobster need to be control to preserve broodstock by means of prohibit to catch lobster with size more than 50 g. This regulation ought to promote trading of culture product, and keep the availability of seed



in conserved area. Now lobster wild seeds size 2-3 cm are collected by fisherman using artificial aggregator (settling media) made of fibre sack or cotton cloth. During seasonal period the wild seeds attach the aggregator and easily to be collected. Collected juvenile then stock in concrete tank or floating net, feed with trash fish until the size obtained 5 cm. This way can create new opportunity business, especially for nursery step. This segment of business is under current experiment.

Abalone, especially tropical abalone (*Haliotis asinina*) now ready to develop. Current experiment show that the animal can live and grow up in floating cage, obtain marketable size (7 cm shell length) in 12 month, feed with *Gracilaria spp* and *Ulva spp.*, survival rate about 50%, FCR about 1:15. The technique to produce seed (spat) in hatchery is available, but there is no private hatchery built up to make sufficient spat available. Government would build up more hatchery for abalone seed supply. The abalone culture can be integrated with grouper or seaweeds culture.

Green mussel (*Perna viridis*) culture that is established around gulf of Jakarta have been produced 10,000 ton annually. They use bamboo stick to settle the spat. The problem is the potential pollution and toxic algae in the coastal waters due to urban environment. Indonesia government has concerned and transplanted the mussel spat to the less polluted area. Centre for mariculture development Lampung have been succeed to produce the spat in hatchery.