COASTAL AND MARICULTURE IN THAILAND

COUNTRY REVIEW/ANALYSIS

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Background

Thailand has coast line of 2,769.1 km in total, of which 1,874.7 km is facing the Thai gulf from Trad to Narathiwat province, and remaining 894.4 km. is facing Andaman sea from Satul to Trang province. Coastal and marine aquaculture in Thailand has long history date back to when mass seed production from hatchery of marine shrimp (Banana shrimp, *Peaeus merguiensis* and the Black Tiger shrimp, *P. monodon*) and Asian sea bass, *Lates calcarifer* had succeeded in around 1969 to 1976. Coastal and marine aquaculture had developed under administration of ministry of Agriculture, Department of Fisheries (DOF), Coastal Fisheries Research and Development Bureau which have 19 Coastal Fisheries Research and Development Centers (CFRDC) and 3 Coastal Aquaculture Research and Development Stations. Provincial Fisheries Office (PFO) of 24 Coastal Provinces also have duty of supporting development of Coastal aquaculture and enforcement of the fisheries law and regulation. The national fisheries development policy on aquaculture development are as follows :-

- Increase aquaculture production sufficiently for domestic consumption and export.
- Increase aquaculture production both in quantity and quality for domestic consumption and export.
- Accelerate research in support of commercial aquaculture industries to increase trade volume, quality standard, and reduce production cost.
- Development of sustainable marine shrimp culture system for domestic trade as well as for export.
- Development in production and marketing of ornamental fish and aquatic plants for export in order to raise the aquacultures income.

1. Marine aquaculture product demand, trade and markets

1.1 Analysis of marine aquaculture products demand, trade and markets trend locally and nationally

Demand for export, product demand, trade and markets: Foreign trade of fisheries commodity show by total quantity of 1,647,866 metric ton, total value of >4,377.8 million U$ in 2003**.** The major exports are fresh chilled or frozen marine shrimps 118,913 ton and fishes, 377,736 ton and their products. Marine shrimps (chilled or frozen) were exported to major clients' countries: USA, 62,861 ton and Japan, 22,363 ton. Marine fishes were exported to Malaysia,133,791 ton, Japan,105,088 ton, China,28,464 ton, Singapore,20,397 ton, Taiwan,13,194 ton and Korea Rep.,11,317 ton (CITC, 2003). Italy imported 27,723 metric ton of fresh chilled or frozen squids. Tuna is major fish to be exported; >326,402 metric ton both packed in air tight and non-air tight containers were needed in 2003 majority for USA, Australia, Canada, Japan and UK (Table 1. attached)

For import value of >1,162.8 million U$ with total volume of 1,095,059 ton were imported in 2003 mostly fresh chilled or frozen fish >950,000 ton (Table 2)from Indonesia, Japan, Taiwan, Korea Rep.,China and USA. The other major imported sea food were i.e. Fresh, frozen or salted mollusks from Malaysia, 18,255 ton; shrimps in non-air tight container from Indonesia and Malaysia,3,276 and 1,536 ton, respectively.

Table 2. Quantity of import sea food by selected country and commodity,2003 (Unit: Ton)

Country of Origin	Total	Live	Fresh chilled or Frozen			
		Fishes	Fishes	Shrimps	Crabs	Squids
Total Imports	*1,095,059*	*49*	*955,122*	*26,524*	*5,614*	*24,777*
Australia	10,444	-	1,042	172	-	-
Canada	6,528	-	1,907	1,847	2,433	-
China	24,696	1	17,598	1,522	53	432
EU country	16,252	-	13,325	648	249	379
Indonesia	262,861	4	252,436	1,529	-	4,367
India	11,364	-	5,730	4,304	23	1,169
Japan	107,423	5	100,007	309	63	1,219
Korea Rep.	40,536	-	30,368	151	72	1,178
Malaysia	34,525	31	6,645	2,403	14	654
Philippines	3,384	2	3,290	10	-	6
Singapore	1,109	1	963	-	-	-
Taiwan	123,124	1	122,026	11	-	281
USA	20,667	-	14,573	218	265	-
Veitnum	10,145	-	2, 679	1,440	43	2,164
Others	422,272	4	38,2533	11,960	2,399	12,937

Marine aquaculture for domestic markets: The main species to supply for domestic market is finfish, some small shrimps and mussel, mostly under food safety standards. Marine fishes are sent by truck or car to northern and north eastern Thailand. Shrimp, Fish and mollusk from farm sites along coastal line always transport fresh chilled or frozen products to Bangkok and other local destinations within 1-2 days. Goods will be sent directly to the market and to distributors which will be small cool storage or use ice boxes. Live fish and/or mollusks are preferred only by the restaurant.

1.1 Role of aquaculture versus fisheries as supply

Data from 13 years period since 1993, show that capture tended to decline, while the culture production had increased and only declined again in 2005 both of capture fisheries and culture production yield (Fig.1, Fig. 2). Average of 73.1% was from marine capture and 14.2% from mariculture (Table 1.). Therefore, main supply of sea foods were from capture fisheries than culture. Majority of coastal aquaculture are shrimp, fish and mollusk farming. Their production and number of farms are shown in Fig. 3 and Fig. 4.

In 2003, there were 34,977 shrimp farms wit total pond area of 512,620 rai (82,019.2 ha; 1 rai =1,600 m^2), with total yield of 330,725 ton, among them 194,909 ton from black tiger shrimp, 132,365 from white shrimp, 2,849 ton of banana shrimp, and 602 ton of other shrimps.

For finfish culture, there were 8,226 farms of which 1,073 pond operators, 7,153 cage operators within total area of 6,625 rai (1,019.23 ha, 1 ha = 6.5 rai), with total yield of 14,568 ton of which 12,229 ton were sea bass, 2,339 ton were groupers. The total yield of pond culture was 3,456 ton of which 3,102 ton were sea bass, 354 ton were groupers. For

cage culture total yield was 11,112 ton of which 9,127 ton were sea bass, 1,985 ton were groupers.

For mollusks culture, there were 5,935 farms within total area of 75,888 rai (11,676 ha), which 73.8% of the area for bloody cockle, 17.8% for green mussel and 8.4 % for oysters. Total yield of 357,944 ton, 67,359 ton from bloody cockle, 263,946 ton from green mussel and 26,639 ton from oysters (FITC,2003).

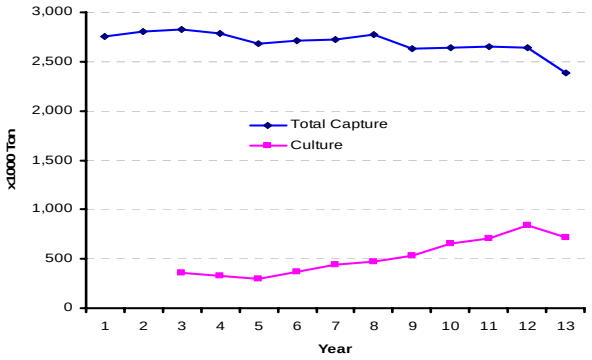

Fig. 1. Aquaculture versus captured fisheries from year 1993(1) to 2005(13) in Thailand (for year 2004 and 2005 were estimated values)

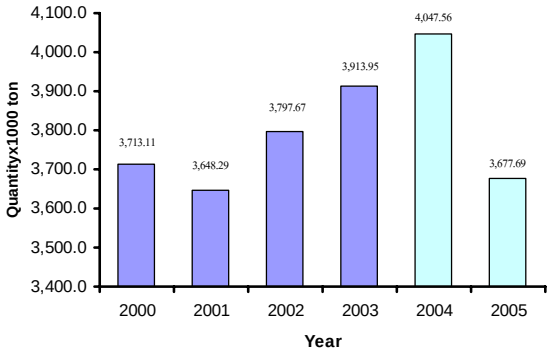

Fig. 2. Total production (x1000 ton) was rapidly declined in year 2005

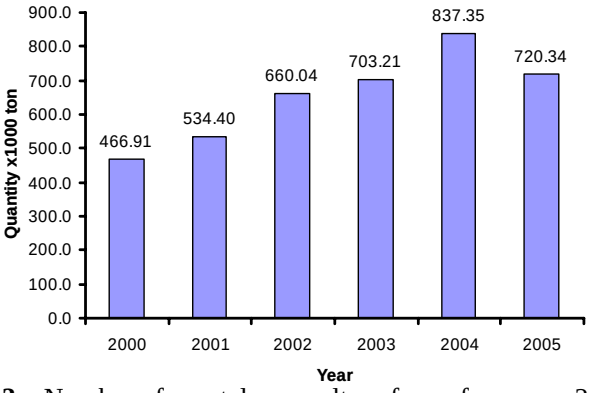

Fig. 3. Number of coastal aquaculture farms from year 2000-2005

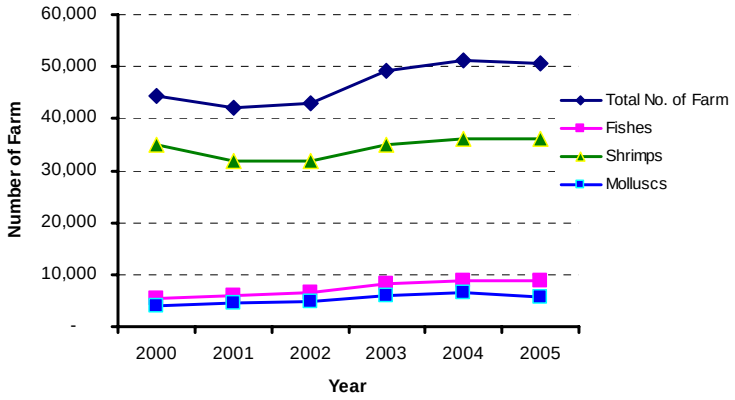

Fig. 4. Annual production (x1000 ton) from coastal aquaculture 2000 to 2005

1.3 The consumer trends, preferences, buying patterns

Thailand's two major clients Japan and USA, fresh chilled or frozen fishes and squids preferred by Japanese market same as shrimps for USA market. Seafood packed in air tight containers were accepted in both Japanese and USA market both for Tuna and others marine products but not for marine shrimps. On the other hand, the marine shrimps packed in non-air tight containers were preferred in both markets more preferred by American markets, also for Tuna in addition. The preserved or prepared fishes and other sea food were preferred also in both markets.

Table 2. Buyer preferences, analysis from 2 major clients of Thailand's marine products, Japan and USA

(Unit : ton)

Product	Japan			USA		
	Fishes	Shrimps	Others	Fishes	Shrimps	Others
Fresh chilled or frozen	105,088	22,363	31,323 (Squids)	10,132	62,861	5,711 (Squids)
Packed in air tight container	15,743 (Tuna) 116 (Sardine)	522	65,871(others) 171(Crabs) 142(Asari)	83,839 (Tuna) 3,768 (Sardine)	3,734	15,267 (others) 4,633 (Crabs) 2,642 (Asari)
Packed in non-air tight container	8,339 (Tuna) 6 (Sardine)	22,892	7,500 (Squids) 991 (Crabs) 331 (Asari)	24,222 (Tuna) 33 (Sardine)	65,568	159 (Squids) 92 (Crabs) 25 (Asari)
Prepared or Preserved	28,714	-	2,638(others)	11,902	-	2,251 (others)
Total	158,006 {24,082 (Tuna) 122 (Sardine)}	45,777	68,509 (others) 38,832 (Squids) 1,162 (Crabs) 473 (Asari)	133,896 {108,061(Tuna) 3,801 (Sardine)}	132,163	17,518 (others) 5,870 (Squids) 4,725 (Crabs) 2,667 (Asari)

(Source: modified from FITC, 2003)

1.4 The market chain organization, (i.e. trade flows/mark chains, particularly issues for smaller scattered producers), market trends and vulnerability

The sea food market chains in Thailand are divided into many routes, shrimps, fishes and others.

Market chain for marine shrimps in Thailand is rather complicated with hatcheries, nurseries, grow out farms, harvest/ partial harvest, and sail to domestic keep in cold storages, processing for export. Along the chain we have standard practice for hatcheries, nurseries and farms as GAP, and CoC. There are 24 Raw Materials Inspection Units for coastal shrimp farms for checking quality diseases and antibiotics residue of exporting shrimp. Aside from fresh chilled and frozen in many ways shrimp are also processed as steamed, cooked and pre cook in different packages/ containers. Factories/ cold storages have to develop for operation under international standard too.

Market chains for fishes and mollusks are more common than shrimps. Most of the finfish are from capture fisheries. The chain is started from fishermen, fish landing, middlemen/ collectors, cold storage/ice boxes then distribute to the market and to consumers. Mollusks harvesters will be transported to markets via distributor or direct, some will be processed, repack and sell.

2. Livelihood opportunities related to mariculture development

2.1 Information on coastal communities, poverty status, livelihoods, trends, vulnerability, identify key target communities

Coastal communities compose of fishermen and their families. The main operations fisheries are small scale and aquaculture i.e. gill netting, net cage culture, bloody cockle, mussel and oyster culture, aquatic animal collector etc. Species to culture always some fishes cough from traps and use of small trash fish from their own fishing as feed. Survey results from National Statistic Office and DOF (2000) on small fishery household (SFH) in fisheries commodity total of 50,732 household shown Songkhla had the biggest commodity with 6,175 household followed by Kribie Pang-nga and Nakorn sri thamaratt. The top income of SFH from Samut prakarn, with 4,736.4 U$ and the lowest income from Samut songkram with 1,829.5 U$/ household/ year (Table 3). Songkhla Lake fisheries communities in Songhkla, southern, Thailand is the example of good management with aquaculture, cage culture of sea bass, small scale shrimp culture, culture of green mussel and small fishing boat. Technical cooperation and services for good aquaculture practice by National Institute of coastal aquaculture, Institute of Coastal Aquatic Health Research and the FPO. The Coastal Fisheries Patrols are assigned for control laws and regulations along in Songkhla lake also.

According to Boonchuwong and Lawapong (1999), on the average, each farmer in the Andaman sea coast of southern Thailand owns four cages (4X4X4 m^3 each). The average production is 210 kg/cage (175 fish), the size ranging from 1.0-1.2 kg in a culture period of 9-12 months. The production cost is US$ 3.5/kg, of which 75% is accounted for the feed cost. Most farmers start to harvest fish after nine months of culture at a selling price of US$ 7.3/kg.

2.2 Markets and coastal community development linkages

Development of coastal community is necessary for sustainable management of coastal fisheries and aquaculture. Suitable roles of women in coastal fisheries and aquaculture are very important. Some season harvested is over supply for local market, they have to preserve and prepare for other products as shrimp paste, dried fish and mussel,

fish source etc. Fisheries Provincial Office in every coastal province does some training for preservation and fisheries products.

Table 3. Average income per year for small household in fisheries commodities (Unit : Baht)

No.	Province	Total Income	Maraine Fisheries				Other income (non fisheries)
			Capture Fisheries	Fiseries	Activities in Fisheries		
					Aquaculture	Processing	
1	Trad	106,017	87,463	3,632	3,107	525	14,922
2	Chantaburi	96,410	84,933	1,377	604	773	10,100
3	Rayong	102,195	75,484	1,685	1,122	563	25,026
4	Chonburi	140,864	122,428	3,735	2,391	1,344	14,701
5	Chachongsao	133,283	87,159	41,840	14,274	27,566	4,284
6	Samut-prakarn	189,454	164,132	4,203	4,107	96	21,119
7	Samut-sakorn	171,754	102,335	21,398	2,234	19,164	48,021
8	Samut-songkram	73,179	59,533	833	-	833	12,813
9	Ppetchaburi	100,061	91,425	87	22	65	8,549
10	Prajoub kiri khan	135,223	119,938	0	-	-	15,285
11	Chumporn	155,001	128,018	6,262	1,473	4,789	20,721
12	Surat thani	86,274	70,778	2,787	-	2,787	12,709
13	Nakorn srithamaraet	94,912	86,482	361	339	22	8,069
14	Songkhla	76,811	52,598	3,682	1,906	1,776	20,531
15	Pattani	96,277	89,426	0	-	-	6,851
16	Narathiwat	78,570	67,342	34	33	1	11,194
17	Ranong	92,627	77,039	3,175	318	2,857	12,413
18	Pang-nga	76,686	66,821	814	39	775	9,051
19	Phuket	103,987	72,121	610	203	407	31,256
20	Krabie	74,786	54,974	1,523	-	1,523	18,289
21	Trang	68,428	54,561	154	-	154	13,713
22	Satul	74,516	65,487	2,217	2,181	36	6,812
Total		**2,327,315**	**1,880,477**	**100,409**	**34,353**	**66,056**	**346,429**

Source : Survey for small household in fisheries commodities, by Office of National Statistics and Department of Fisheries (2000)

However, sustainable mariculture can be achieved with responsible application of well-defines mariculture practices and protocols with the use of indigenous species

3. Existing and potential mechanisms for technology transfer

3.1 Existing mechanisms for technology transfer and propose alternative mechanisms for effective dissemination of R&D to farmers and other stakeholders

Technology of mariculture had been transferred in Thailand through many channels, first discussion/ meeting in small group or seminar which can do any time at the CFRDC of DOF along coastal provinces. Then, we have training which divided into 1) Training for trainers, technician and fisheries officers, in order to be good trainers. 2) Training for farmers and other stakeholders which composes of lecture, workshop, demonstration and practicum in laboratory or on farm including study tours to real sites. DOF also have website: www: fisheries.go.th; every FPO and CFRDC have their own website which farmers and other interest stakeholders can gain knowledge and ask the questions, etc.

3.2 Present training activities and likely future requirements

Training : Training for farmers/other interest parties: Annually training courses for fisheries technology transfer are setup for fish farmers about 25,000 inds. These courses included basic techniques and practical for aquaculture provinces. Including inland aquaculture The training curricular included:-

- Aquaculture: culturing of economic important fishes including ornamental fishes, pound culture, cages culture, etc.
- Breeding and nursing of aquatics species
- Homemade formulated diet for fish culture
- Diseases and prophylactic
- Preserved and processing of aquatic species etc.

Aside from these training courses, DOF is setting the demonstration sited in selection fisheries communities, set mobile clinic which including technical assistance for farmers help solving the problems, water analysis, diseases diagnostic etc. Training for technicians and government officers (training for trainers) for update knowledge of officers and technicians (trainers) which will assist farmers to be developed their farmers to standard GAP and COC and other measures

Seminar: Special seminar for selected aquatic animal for selected group as Babylon snail culture, selected grouper and crown fishes breeding and culturing etc.

Food safety for fisheries production program : This program was set for promotion of clean sea food and their productions for domestic and export. Many training programs entrain to this concept has been trained to government officers, farmers and other stakeholders.

Developing information technology (IT): IT for fisheries is needed, continually information system arrangements, compilation and usage of information data and services in IT for stakeholders, farmers and general public.

4. Existing major mariculture species and farming technologies

Coastal aquaculture fisheries are shrimp culture, fish culture and shellfish culture.

4.1 Status of farming of selected species

Marine finfish farming in Thailand had begun about 4-5 decades ago along the coastal area. The two predominant groups are groupers and sea bass. They are culturing in

both eastern ponds and coastal cages. Most of the sea bass cultured are located in estuarine areas, but almost groupers are cultured in cages located in more marine water. The bays or coastal enclosed areas protected from wave and strong wind are preferred.

Grouper culture has been proven to be commercially viable, depending on export market in the region. The price for living fish weighing 1.2-1.5 kg is US$ 9-10 each or US$ 7-8/kg since 1990's and not swing too much until now.

Most fish farmers' culture grouper in floating net cages in sheltered coast areas protected from strong winds and waves, with salinity ranging from 12 to 30 ppt

Due to unreliable and limited hatchery production, majority of the grouper seeds stock are obtained from the wild. Grouper fry at the size of 1.0-2.5 cm are usually collected from the coastal areas of Songkhla and Pattanee Provinces from October to March. There fry are reared up to the size of 7-10 cm prior to stocking in grow-out cages. Majority of these seedstrocks were exported to other countries. Seedstocks of sizes longer than 10 cm are collected using traps and the fish are stocked in grow-out cages directly without nursing. Fish farmers prefer this type of seed to the reared fry because grow-out period and better survival. The fish produced from cage culture is steadily increasing its future appears to be promising.

Fry and fingerling Production of finfishes :

The demand of live marine finfish as groupers and bass for consumption had increased. To produce marine fish seeds we have to understand their reproductive biology and physiology of each species.

Table 4. Production yields from grouper culture and their food used in weight (mt)

Year	Sea bass / Feed		Groupers / Feed		Total F
	Weight	FCR=7.5	Weight	FCR=5.5	
1999	6,056	54,120	1,143	7,339	61,459
2000	7,752	70,040	1,312	8,299	78,339
2001	8,003	72,750	1,443	9,507	82,257
2002	11,032	105,100	1,170	7,794	112,894

mt = metric ton

The use of destructive fishing methods have destroyed the habitats on which reef-associated species depend for shelter and food.
Restriction of development in grouper culture can listed as follows:
- Live feed production should have high efficiency
- Steady supply of live feeds makes commercial-scale culture of difficult marine finfish species possible (enhancing live food farmer)
- Strong government support for the industry and research
- Seed supply center in the country and region.
- Good cooperation of fisheries organization + information network + market chair + Research laboratory (Fisheries Institution/ University integration)
- Government policies plan for hatchery-reared seeds to restock overexploited Coastal fisheries have to be continue.

Hatcheries which produce groupers are 5 main government's hatcheries and 2 private hatcheries in Rayong province. For the government hatcheries are listed:

Southern: 1.National Institute of Coastal Aquaculture (NICA), Songkgla Province
Epinephelus coicoides , E. malabaricus,
2.Krabie Coastal Fisheries Research and Development Center, Krabie
Epinephelus coicoides, E. lanceolatus, E. fuscogustatus
3.Satul CFRDC, Satul
Epinephelus coicoides, E. malabaricus,

Easthen : 1. Rayong CFRDC, Rayong Province *Cromileptes altivelis,*
2. Tradd Coastal Aquaculture Station, Tradd Province *Plectopomus leopadus*

Cobia, The Black King Fish *Rachycentron canadum* are produced at Phuket and Satul CFRDC since 2004, and Rayong CFRDC in 2005.
Future prospects for finfish R & D : 1)Development of close recycle culture system for fish hatcheries and nurseries, 2) Education and training for more knowledge and experience are needed, 3) Enhance to set network co-operation among fish culturists (the whole cycle) as organization using IT.

The grouper culture system involves a series of farms specialized in one of the several areas

1. Hatcheries produce fertilized eggs.
   - Broodstock ponds (outdoor)
   - induced spawning
   - natural spawning

   ↓
2. Fertilized eggs → fry farm
   - nursing indoor (raised to 3 cm. TL)
   - nursing outdoor

   ↓
3. Fingerling farms → till 7 – 9 cm. TL

   ↓
4. Grow out farm → market size (600 – 700 g.)
   - pond culture 10 – 14 m.
   - cage culture 8 – 10 m. from 6 cm.

4.2 Priorities for development and research

Development and researches focus on shrimps, finfish and mollusks which trend should be on :- 1) Development of suitable feeds for each species (each stage of life too), 2) try to change traditional destructive culture methods as feeding with small fresh fish by train fish farmers to use formulated feeds, 3) Diseases prevention and prophylactic, 4) Enhancing all aquatics farms follow the rules for Good Aquaculture Practicing (GAP) and later on environmental friendly under Code of Conduct (CoC) in order to have sustainable aquaculture in Thailand and the region.

4.3 Identification of better management practices for existing farming species and systems, to mitigate environmental impacts

DOF in Thailand had involved for Good Aquaculture Practicing (GAP) and Code of Conduct (CoC) for all shrimp farming since 2003. These programs will also apply to other aquatic animal farming. The CoC will be mitigated the environmental impacts as the results of apply environmental friendly practices. Laws and regulations for environment were strengthening. Youth and children are learn to watch their environmental atmosphere in order to manage it in correct way and use them as long as possible.

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Appendix Table 1. Fisheries production from coastal aquaculture in quantity by sub-sector, 1993-2005

Year/Types	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Culture	**2,752.49**	**2,804.43**	**2,827.45**	**2,786.13**	**2,679.48**	**2,708.97**	**2,725.20**	**2,773.68**	**2,631.70**	**2,643.73**	**2,651.22**	**2,645.11**	**2,386.65**
Fishes	2,349.82	2,341.19	2,401.46	2,322.07	2,231.78	2,232.62	2,243.43	2,216.27	2,222.05	2,267.66	2,290.15	2,267.04	2,065.83
Shrimps	119.01	123.01	131.97	134.48	126.34	96.64	86.72	87.81	88.86	85.6	84.7	86.05	74.86
Crabs	47.02	50.93	52.35	52.76	50.99	57.94	55.44	58.12	50.27	42.12	43.63	52.14	40.48
Molluscs	67.76	58.66	51.54	73.14	54.33	68.85	80.63	94.18	55.86	34.23	55.09	50.06	45.25
Others	168.88	230.55	190.13	203.68	216.04	252.92	258.98	317.3	214.66	214.12	177.65	189.82	160.23

Source: CITC (2003)