Conflict in Fishery Resource Utilization: The Case of Light Luring Anchovy Fishery in Thailand

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Abstract. In late 1999 Artisanal Fisherman Association in Thailand requested the government to take actions in curbing destructive anchovy fishing gears. They believed that anchovy fishing was the main cause of fishery resource depletion in their fishing grounds. Main anchovy fishing gears were light luring falling net, purse seine, and scoop net. All of them are Juvenile bycatch varied from 1.72 – 30.37% of total catches depending on gear type, vessel size, fishing ground, fishing month, and fishing year. Economic losses of juvenile bycatch were $1 – 331/boat/trip. In Songkhla, the crisis problem area, economic losses from light luring falling net were as high as 0.42 – 7.64 times of the return from anchovy. The losses from light luring anchovy purse seine were 23 – 35% of the return from anchovy. The losses from light luring scoop net varied around 2 – 7%. Anchovy catch values in Thailand was $26 million in 1997. Value added from processing was $65 million, mainly from fish sauce. In spite of low value added, 59% of the catches were processed as boiled-dried/dried anchovy mainly for export. 44% of the anchovy value in the importing country were the trade margins, including tax, in importing country. Fishing cost was 20%. This cost estimation did not include the economic loss from juvenile bycatch. Processing and marketing costs in Thailand amounted to 19%. Profit margins for domestic fishermen, processors and traders added up to 17%. Thailand might have been exporting anchovy at an underpaid resource value. The relatively better return from anchovy had led to rapid increase in anchovy fishing effort. If fishing effort exceeded carrying capacity especially in habitats of juvenile economic species, it could lead to decrease in fishing income due to resource depletion not only for artisanal fishermen but anchovy fishermen as well. Recommendations were to determine optimum fishing effort in specific fishing grounds and control the effort. Where there had been overfishing, auction on fishing license and fee on anchovy fishing on the basis of economic loss could be introduced. Coastal community should take part in controlling anchovy fishing effort. Relocation of artisanal fishermen through training and support on initial investment in non-fishing sector was recommended.

Keywords: anchovy fishery, economic loss, market returns, and effort control.

1. THE PROBLEM

Anchovy fishery in Thailand had been increasing rapidly. In 1985 there were 1,400 anchovy fishing vessels and increased to 2,522 vessels in 1995. In 1999 according to Department of Fisheries there were 1,808 light luring anchovy fishing vessels. This number did not include light luring squid cast nets, which could easily be converted to anchovy fishing. Most of these fishing vessels were light luring. It was noticed that a number of 16 meter and lower trawlers and squid cast netters were also converted to anchovy fishing. Such conversion might have not been reported. The increase in anchovy fishing effort, using unusual small mesh size and light luring could have a negative impact on fishery resource abundance especially in the coastal fishing grounds.

Anchovy fishing areas expanded from the east of the Gulf of Thailand to the lower upper Gulf, the southern west, and recently to the Andaman Sea. The migration of the fleet led to a new source of income for those artisanal fishermen in the South who took part in anchovy processing and trading. Most of the catches in the South were boiled-dried, mainly for export to neighboring country. Nevertheless there were artisanal fishermen who did not involve in anchovy fishery, could not share the benefits from this development but suffered from the degraded fishery resources. They were artisanal fishermen who did not have alternative job opportunity but relied on coastal fishing. These artisanal fishermen, through Artisanal Fisherman Association in the South requested the government to take action in curbing the "destructive" light luring anchovy fishing. They claimed that the increasing in number of anchovy fishing vessels in their fishing grounds led to less fishery resource abundance in such areas thus lowered their incomes.

In response to the request, the government set up a committee to undertake studies on this problem during July - October 1999. This report was a part of the studies. The objectives of this report were to estimate the economic losses from the juvenile bycatch, review the cost and returns from anchovy fishing, review their impacts on socio-economic conditions of the artisanal fishermen, and give recommendations on measures to solve the conflict in fishery resource utilization.

2. ECONOMIC LOSSES FROM JUVENILE BYCATCH

Department of Fisheries collected data on catch composition of different anchovy fishing gears in different fishing grounds and different times/years. Available from these data

were species, weight and length of juvenile bycatch. Length-weight relationship ($W_o = aL_O^b$) was employed to estimate weight of juvenile bycatch. The coefficients "a" and "b" were available from the previous studies of marine biologists from Department of Fisheries. Dividing the total weight of each species bycatch by individual fish weight, the number of bycatch (N_o) could be calculated. The number of survivals to the marketable size was calculated by $N_m = N_o e^{-Z\Delta t}$. Z was the fish mortality, natural and being fished as estimated by the fishery scientists. Δt was calculated from Von Bertalanffy relation, $L_t = L_\alpha(1- e^{-k\Delta t})$. From the length at marketable size (L_m), the weight at marketable size (W_m) was calculated using the length-weight relationship. The value of economic juvenile bycatch was estimated from the product of the estimated total weight of bycatch if allowed to grow to the marketable size ($N_m.W_m$) and the fish price.

The data on 1997/1998 catch composition were available for anchovy fishing in Songkhla , which was the critical problem area. Fishing gear in this area was mainly small light luring falling net. Fishing vessels were those migrated from the East and local vessels, which were mainly, converted small trawlers. In Table 1, economic losses were given for non-local fishing vessel and local fishing vessel (in two districts – Thepa and Jana). Non-local fishing vessels used a larger vessels thus had a higher catches. Catches of local vessels varied in the two districts but both were much lower than the catches of non-local vessels. Nevertheless the percentages of juvenile economic species bycatch were higher for the non-local vessels (17.81% compared to 8.34 and 16.58% for the local vessels). The economic loss of juvenile economic species was highest in case of Thepa local boat ($215/trip or 3.4 times of the return from anchovy), followed by non-local boat ($148/trip or 1.2 times of return from anchovy while the loss was least for Jana local boat ($54/trip or 1.8 times of return from anchovy).

When compared by season the loss was highest in September ($245/trip or 4.7 times of anchovy return). It was also high during June – August ($113-140/trip or 0.7 – 1.6 times of anchovy return). When compared by distance from shore, fishing boat within 5 miles from shore incurred a high loss of $331/trip or 7.6 times of anchovy return. The loss was lower for those boats fishing 5-10 and 10-15 miles from shore but increased again for those fishing 15 - 20 miles from shore and decreased for those fishing >20 miles from shore. (See Table 1.)

These losses were calculated to show the losses by type of vessels, season, and fishing distance from shore. The high loss in each case could be explained by the high ratio of juvenile bycatch including king mackerel and squid, which if left to grow to marketable size would yield high prices.

Beside the critical area in Songkhla, Department of Fisheries also collected the catch composition of anchovy fishing in the East, the Upper South, and the South. The data were available for different years depending on the development of anchovy fishery in those areas. Economic losses of juvenile bycatch were given in Table 2. The loss was highest in case of light luring falling net in the critical Songkhla area due to the high catch of king mackerel, the high price economic species. Light luring falling net in the other areas (the South in Satul, Phangnga and Phuket in 1998/99 and Pattani in 1996, the Upper South in Chumporn and Prachaub in 1998 and 1997) incurred much lower losses since their juvenile bycatch did not consist of high value juvenile species. Economic losses of juvenile bycatch were also calculated for different fishing gears by season and by distance from shore. Juvenile bycatch in most cases were sardinellas, mackerels, and trevallies. If there were bycatch of king mackerel and squid, economic losses would usually be high.

By season the percentage of losses were varied by the catch composition in each location. By distance from shore the losses were usually higher for those fishing closer to shore, except in case of light luring purse seines, which had the highest loss for those fishing more than 20 miles from shore. These were larger anchovy fishing vessels at an economic loss of $106 - $208/trip.

Juvenile bycatch of anchovy fishing varied from 1.72 % (falling net in Prajuab in October 1997, 5 – 10 miles from shore) to as high as 30.37% (falling net in Songkhla in May 1997/98) by weight. Catch composition varied. In term of economic loss, the loss could be as low as $1/trip in cases of falling net in Chumporn and Prajuab in 1997, falling net in Prajuab in October 1997 within 5 – 20 miles from shore, and scoop net in Cholburi in 1993. The highest economic loss was $331/trip in case of falling net in Songkhla within 5 miles from shore. Compare to the return from anchovy, the lowest loss ratio was 2% in case of falling net in Prajuab in August 1997 within 5 – 20 miles from shore. The loss could be as high as 7.6 times of return from anchovy in case of falling net in Songkhla within 5 miles from shore.

Table 1 Economic Loss from Juvenile Bycatch in Critical Fishing Area - Songkhla, 1997/1998

Fishing gear	Location	Year	Mth.	Distance from shore	Juvenile bycatch	King mackerel	Squid	Sardinellas	Mackerel	Trevallies	Economic loss	% of loss to returns
				(mile)	(% of total catches)						$/trip	
Falling net	Songkhla	1997/98	n.a.	10 - 25	17.81	0.04	0.34	11.76	0.55	0.47	148	118
Falling net	Thepa,SKL	1997/98	n.a.	5 - 25	8.34	0.15	0.59	4.39	0.03	0.54	215	342
Falling net	Jana,SKL	1997/98	n.a.	3 - 15	16.58	0.07	0.17	8.79	0.12	0.10	54	176
Falling net	Songkhla	1997/98	5	n.a.	30.37	0.00	0.01	22.91	0.66	0.30	65	44
Falling net	Songkhla	1997/98	6	n.a.	17.33	0.06	0.39	10.56	0.26	0.49	140	157
Falling net	Songkhla	1997/98	7	n.a.	13.62	0.04	0.42	8.03	0.35	0.23	129	117
Falling net	Songkhla	1997/98	8	n.a.	6.85	0.03	0.16	4.77	0.00	0.00	113	71
Falling net	Songkhla	1997/98	9	n.a.	14.57	0.19	0.26	6.39	0.61	1.71	245	469
Falling net	Songkhla	1997/98	10	n.a.	29.97	0.00	0.32	25.57	2.66	0.52	65	42
Falling net	Songkhla	1997/98	n.a.	<5	11.56	0.33	0.09	6.24	0.04	0.79	331	764
Falling net	Songkhla	1997/98	n.a.	5 - 10	16.70	0.04	0.47	8.61	0.70	1.09	71	122
Falling net	Songkhla	1997/98	n.a.	10 - 15	16.79	0.02	0.36	12.33	0.13	0.46	77	62
Falling net	Songkhla	1997/98	n.a.	15 - 20	14.72	0.11	0.33	9.46	0.25	0.31	241	274
Falling net	Songkhla	1997/98	n.a.	> 20	18.70	0.03	0.27	12.02	0.88	0.19	130	88

Source: Calculated from Tokrisna (1999), Pramokchutima(1998) and Pongthanapanich(1999).

Table 2 Economic Loss from Juvenile Bycatch by Fishing Gear, Location, Season and Distance from Shore

Fishing gear	Location	Year	Mth.	Distance from shore	Juvenile by catches	King mackerel	Squid	Sardinellas	Mackerel	Trevallies	Economic loss	% of loss to returns
				(mile)	(% of total catches)						$/trip	
Falling net	STL,PNG,PKT1/	1998/99	n.a.	n.a.	9.10	0.00	0.00	2.30	3.50	0.20	7	3
Falling net	CHP,PJB 2/	1998	n.a.	n.a.	17.60	0.00	0.00	5.38	3.81	2.33	9	9
Falling net	CHP,PJB 2/	1997	n.a.	n.a.	9.42	0.00	0.00	2.92	1.20	1.01	1	4
Falling net	Prajuab	1997	2	5 - 20	9.16	0.00	0.48	3.41	0.82	0.43	17	54
Falling net	Prajuab	1997	3	5 - 20	19.25	0.00	0.82	2.41	1.31	1.10	5	101
Falling net	Prajuab	1997	4	5 - 20	9.52	0.00	2.64	1.02	4.14	0.76	70	197
Falling net	Prajuab	1997	5	5 - 20	14.65	0.00	0.20	2.73	0.37	1.18	3	19
Falling net	Prajuab	1997	6	5 - 20	8.25	0.00	0.10	1.02	0.30	0.69	4	7
Falling net	Prajuab	1997	7	5 - 20	14.58	0.00	0.96	4.76	2.82	3.10	15	81
Falling net	Prajuab	1997	8	5 - 20	6.85	0.00	0.00	2.92	0.32	1.12	3	2
Falling net	Prajuab	1997	9	5 - 20	10.34	0.00	0.04	4.84	2.70	0.47	5	13
Falling net	Prajuab	1997	10	5 - 20	1.72	0.00	0.18	0.36	0.06	0.24	1	13
Falling net	Prajuab	1997	n.a.	5 - 10 3/	11.10	0.00	0.69	3.52	0.60	0.91	7	55
Falling net	Prajuab	1997	n.a.	10 - 15 3/	12.18	0.00	0.80	2.86	1.71	1.78	14	63
Falling net	Prajuab	1997	n.a.	15 - 20 3/	7.43	0.00	0.02	2.78	1.09	0.60	6	5
Falling net	Pattani	1997	n.a.	n.a.	6.58	0.00	0.00	5.78	0.26	0.31	11	6

Table 2 Economic Loss from Juvenile Bycatch by Fishing Gear, Location, Season and Distance fromn Shore (cont.)

Fishing gear	Location	Year	Mth.	Distance from shore	Juvenile bycatch	King mackerel	Squid	Sardinellas	Mackerel	Trevallies	Economic loss	% of loss to returns
				(mile)	(% of total catches)						$/trip	
Scoop net	Cholburi	1997	n.a.	n.a.	8.59	0.00	0.00	7.32	0.64	0.21	10	7
Scoop net	Cholburi	1993	n.a.	n.a.	3.38	0.00	0.00	1.20	1.13	0.51	1	2
Scoop net	Pattani	1996	n.a.	n.a.	8.50	0.00	0.00	6.76	0.94	0.58	11	6
Scoop net	Pattani	1993	n.a.	n.a.	8.28	0.00	0.00	5.31	1.85	0.36	12	5
Purse seine	Prajuab	1997	n.a.	5 - 10	29.14	0.00	0.24	16.05	6.39	3.41	174	35
Purse seine	Prajuab	1997	n.a.	10 - 15	28.29	0.00	0.08	15.17	6.12	3.15	106	23
Purse seine	Prajuab	1997	n.a.	15 - 20	17.66	0.00	0.30	10.02	5.19	0.77	153	28
Purse seine	Prajuab	1997	n.a.	> 20	20.93	0.00	0.31	12.01	4.96	1.17	208	32
Purse seine 4/	Rayong	1997	n.a.	n.a.	13.92	0.00	0.00	1.43	5.65	0.42	15	4
Purse seine 4/	CHP, PJB 2/	1992	n.a.	n.a.	6.03	0.00	0.00	1.61	2.22	0.10	8	2

Source: Calculated from data of Division of Marine Fisheries, Tokrisna (1999),Pramokchutima (1998) , and Pongthahapanich(1999).

Note: 1/ Satul, Phangnga, Phuket 2/ Chumporn, Prajuab 3/ The depth of fishing ground in meter 4/ Daytime, non-light luring

By type of fishing gear, daytime non-light luring purse seine incurred the lowest loss ratio (2 – 4%), followed by light luring scoop net (2 – 7%). Excluding Songkhla, the critical fishing ground; the loss in case of falling net varied from 2% to almost twice of the return from anchovy. Falling net in Songkhla incurred losses up to 42% to 7.6 times of the return from anchovy. Nighttime light luring purse seine had losses of 23 – 35% of the return from anchovy. Economic losses from anchovy fishing varied by fishing gear, location and season depending on the pattern of fishery resources in each fishing ground. The losses were usually high in cases of light luring falling net and purse seine.

Anchovy fishermen did not take into account this economic loss from juvenile bycatch. The loss was the social cost in term of less fishery resource abundance. If fishing effort was still lower than the effort at maximum sustained yield, impact of such economic loss might not be severe. With overfishing and thus resource degradation, losses of juvenile economic species accelerated fishery resource depletion; thus worsening the fishing condition. If anchovy fishing effort kept on increasing beyond its carrying capacity, not only the other fishery resources would be depleted but the anchovy as well.

3. CATCH UTILIZATION

Fisheries Economics Division estimated that 59% of anchovy were processed as boiled-dried and dried fish mainly for export (45% export and 14% domestic consumption). The main markets were Malaysia and Sri Lanka. Recently tiny boiled-dried anchovy were exported to Japan and Taiwan. 39% were used in fish sauce processing (10% export and 29% domestic consumption). The other 2% were processed for other domestic consumption. From the total catches 55% were processed for exports, as boiled-dried/dried fish and fish sauce. The total catch value was nearly $26 million while their value added was estimated to be $65 million in 1997.

In the South where anchovy fishery had been rapidly developed, the landings would immediately be boiled-dried right on shore. A number of artisanal fishing families could earn income from anchovy processing and trading.. Table 3 indicated the income share from 1 kg of fresh anchovy. Domestic fishermen received 20% of its final value. One kg of boiled-dried fish needed 3.16 kg of fresh fish. Fishing cost, not including the economic loss was $0.12/kg of fresh anchovy. The fishermen received a profit of $0.05/kg or 8% of the final value. Processing cost was $0.03/kg or 5% of the final value. Processors got a profit of $0.02/kg or 3%. Domestic market cost was $0.08/kg or 14%. Profit to domestic traders was $0.04/kg or 6%. These added up to be 56% of the final value in the importing country. The income share in the importing country was 44% of which 4% was the import tax and 40% were distributed among the foreign traders.

Table 3 Income Share from Anchovy Fishery

Item	$/kg of fresh anchovy	% of final value
1. Fishing cost	0.12	20
2. Profit to fishermen	0.05	8
3. Processing cost	0.03	5
4. Profit to processors	0.02	3
5. Marketing cost	0.08	14
6. Profit to domestic traders	0.04	6
7. Marketing margin in importing country	0.27	44
8. Final value in importing country	0.61	100

Source: Calculated from the market chain study in Songkhla, Tokrisna (1999) and Tugsinavisutthi(1999)

The export market determined anchovy price in Thailand. The margin in the importing country was considerably high noticing that boiled-dried anchovy was a ready-made product commonly used in general cooking. Economic loss from by catches had never been taken into account in anchovy trading. Thailand might have been exporting anchovy at a price lower than the actual resource cost. Economic loss from bycatch had been estimated to be even greater than return from anchovy in many cases of anchovy fishery. Return from anchovy processing and trading was relatively high compared to the earning from anchovy fishing and other coastal fishing. Better prices in the export market induced more anchovy fishing effort. Once overfished, anchovy resources would be degraded. Destructive fishing gear introduced in vulnerable fishing ground could lead to severe impacts on fishery resource abundance.

In the earlier years, main fishing gear for anchovy was daytime non-light luring purse seine in the east. Catches

were mainly utilized as raw inputs for quality fish sauce processing. High price of boiled-dried anchovy in foreign market led to increase in anchovy fishing effort, initially in term of increasing number of large daytime purse seines. Development of light luring squid fishery led to improvement in anchovy fishing gear, the nighttime light luring purse seine, which was a highly destructive fishing gear. These were mainly large vessels of those large-scale fishermen. Due to high export demand, especially for the small anchovy (the smaller, the higher the price), trading volumes increased rapidly. Traders offered a loan for small-scale fishermen for investment in anchovy fishery. Light luring anchovy scoop net was adopted among small-scale fishermen in the East followed by light luring falling net, which was even more effective. Around mid 1990s scoop net were numerous in the East, catches decreased; thus fishing income. Anchovy fishing fleet invented light luring falling net and started migrating to new fishing grounds in the South. Trawl fishermen who had access to investment fund could easily convert trawl into light luring anchovy falling net and joined anchovy fishing fleet.

4. COST AND RETURNS FROM ANCHOVY FISHERY

In Table 4 cost and returns of anchovy fishery by fishing gear, location and gear were given. For Songkhla falling net, during the last two years the investment in boat and equipment had been doubled. Fishing cost per kg increased. The higher net return was due to the better landing price. In case of Prajuab where anchovy fishery had been developed before Songkhla, in 1997 net revenue per kg was almost nil. The fishermen earned almost nothing from fishing. Their incomes were mainly from processing. In case of the earlier year (1993/94) light luring purse seine in Trad and Rayong in the East where anchovy fishery had been firstly developed, net revenue from fishing was little compared to processing income. Light luring scoop net in Cholburi in 1993/94 had a high cost per kg, thus loss from fishing. Due to scarcity, falling net – the more effective gear, was invented. Included in Table 4 were cost and returns from 1993/94 daytime non-light luring purse seine and scoop net. These fishing gears used to be in operation in the earlier years. Recently due to the scarcity, they were not profitable. The fishermen had to turn to more effective gear.

It was observed that for the same fishing gear in any location, returns were higher in the earlier years. As fishing effort increased, anchovy became less abundant. Cost of fishing would be higher. Profit was lower. The fishermen then invented a more effective fishing gear. Recently adaptation had been very fast. Fishing effort increased rapidly. Once anchovy fishery had been introduced to vulnerable fishing ground like Songkhla, the impact on fishery resource was noticeable, leading to conflict in fishery resource utilization between anchovy fishermen and the artisanal fishermen.

Noticing that cost of anchovy fishery did not take into account the social cost of economic loss from juvenile bycatch, the cost of fishing was underpaid. If this social cost had been taken into account, anchovy fishing cost would be higher; thus lower fishing incentive and the fishing effort. Fishery resources might not have been rapidly depleted.

5. SOCIAL IMPACT OF THE ANCHOVY FISHERY

Based on the data from Fisheries Economics Division, catches of artisanal fishery in 1996 decreased by 10.3% on the average. Nevertheless the catches in the South were worst than the average. In the critical areas, artisanal catches decreased by 20.5% Main catches in this area were mackerel, anchovy, mullet, king mackerel, trevallies, and banana shrimp. Catches in each group decreased due to fishery resource degradation.

Fishery resources in Thai fishing grounds had been degraded due to continuing overfishing. Fishermen tried to maintain their catches by adapting fishing gear and moving to new fishing ground. Anchovy fleet migrated from the East to the South. Small trawlers in the south were converted to light luring anchovy falling netters. Provided skill other than fishing and investment in non-fishing activities, a number of artisanal fishermen left for new occupations. Those artisanal fishermen who did not have any other alternative had to continue fishing in degraded resource conditions. During the economic crisis, situation was worse. A number of unemployed labors in coastal areas turned to fishing. Such additional fishing effort resulted in even lower fishing income.

While fishing was difficult for artisanal fishermen, in the areas where anchovy fishery was recently developed, like Songkhla, some of local fishermen benefited from anchovy fishery either by turning to anchovy fishing, processing, trading or all. Development of anchovy fishery and their relatively higher earnings was a contrast to poor and worsening artisanal fishery. A study by Laowapong(1999) reported that during 1986 - 1997 household fishing income in a village in Songkhla decreased by 77%.

Table 4 Cost and Returns of Anchovy Fishery by Fishig Gear, Location and Year

Fishing gear	Falling net 1/	Falling net 2/	Falling net 2/	Purseine 2/	Scoop net 2/	NLL Purseine 2/	NLL Purseine 2/	NLL Scoop net 2/
Year	1999	1997	1997	1993/94	1993/94	1997	1993/94	1993/94
Location	Songkhla	Songkhla	Prajuab	Trad,Rayong	Cholburi	Chumporn	Chumporn,Surat	Rayong,Songkhla
	South	South	Upper South	East	East	Upper South	Upper South	East and South
Boat length (m.)	13	12	10	17	11	11	20	12
Boat and equipment ($/boat)	17,614	8,503	6,528	81,043	7,099	11,772	85,077	11,304
Fishing day/yr.	120	112	167	252	183	173	224	220
Catch (kg/day)	733	663	450	3,414	403	250	4,175	562
Return from anchovy($/day)	125.96	87.72	53.18	365.78	41.83	79.44	779.70	80.28
Fixed cost ($/day)	4.89	3.86	2.73	58.71	8.22	4.90	79.52	11.00
Variable cost ($/day)	83.00	64.12	50.42	270.95	74.16	74.16	361.14	57.09
Total cost ($/day)	87.90	67.98	53.15	329.66	82.37	79.06	440.65	68.09
Net revenue from fishing ($/day)	38.06	19.74	0.03	36.13	-40.55	0.39	339.05	12.19
Landing price ($/kg)	0.17	0.13	0.12	0.11	0.10	0.32	0.19	0.14
Fishing cost ($/kg)	0.12	0.10	0.12	0.10	0.20	0.32	0.11	0.12
Net return ($/kg)	0.05	0.03	0.0001	0.01	-0.10	0.0015	0.08	0.02
Annual net revenue from fishing ($/yr)	4,567	2,213	6	9,103	-7,436	67	76,109	2,685
Annual net return from processing ($/yr)	1,737	1,469	1,484	16,997	n.a.	854	18,515	2,445

Source:1/ Calculated from the interview survey, Tokrisna (1999)Tugsinavisutthi(1999) and Kao-ian(1999).

2/Calculated from the information and data from Fisheries Economic Division,Department of Fisheries and Tokrisna (1999).

Nevertheless anchovy fishery was but only one of the cause of fishery resource degradation. In Songkhla, light luring falling net was an accelerator on the difficulties of artisanal fishery. Economic crisis limited the other income earning activities in coastal zone leading to an increase in fishing effort and worsening the problems.

In vulnerable fishing grounds like Songkhla, rapid development in anchovy fishery should be careful to avoid the high loss from such development. Economic loss from juvenile bycatch could be kept low by using proper fishing gear and effort. Once overfished, anchovy catches will be lower. Fishermen struggling to improve fishing capability use more destructive fishing gear, depleting fishery stocks.

6. POLICY RECOMMENDATION

In order to avoid negative impact from anchovy fishery, the followings were recommended.

1. Determination on the optimal level of anchovy fishing effort in specific fishing grounds. Allowable number of vessel, vessels size, and fishing day should be determined. Such allowance could be varied by location depending on fishery resource condition, It was recommended that local fishermen participated in decision making in order to strengthen the compliance and lessen the costs on monitoring, control and surveillance.
2. There should effective control on fishing gear conversion to avoid unreported anchovy fishing.
3. Anchovy fishery should be registered.
4. In fishing ground where there had been overexploited, anchovy fishing effort should be strictly controlled. Fishing right should be prioritized to reduce the fishing effort.
5. Where anchovy fishing effort had to be decreased, auction on fishing right could be introduced.
6. Economic losses from anchovy fishing should be assessed and be employed as a basis on charging fishing fee to reflect the actual cost of such resource exploitation.
7. Vulnerable fishing ground should be identified. Anchovy fishery should not be allowed in these areas as to avoid a high loss of juvenile high price species.
8. Differentiated fee could be introduced as an incentive on “appropriate” fishing technology.
9. Providing job opportunity in non-fishing sector for artisanal fishermen as to reduce fishing effort in depleting fishery resources condition.

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