CHAPTER 5

THE IMPACT OF SHRIMP FARMS

Environmental impact of shrimp farms on coastal ecosystem in Thailand causes a controversy over resources exploitation and conservation. However, discussion concerned usually based on theories or opinions rather than the hard fact. Scientific data are very essential for determining the actual impacts and for proper problem solving. The impact of shrimp farms in this study would focus on the change of landuse and coastal fishery production.

Impact on Landuse Change

Remotely sensed data of the study area during 1982-1992 were classified for measuring the temporal change in landuse. The method attempted to account for the annual rate of change (Table 5.1 and Fig. 5.1). To determine the area where shrimp farms took place, the image (showing locations) of shrimp farm was overlaid with the images of landuse categories in each years by using command OVERLAY in program IDRISI, and then using command AREA to calculate the amount of that area (Table 5.2).

Table 5.1 Rate of change in landuse and the amount changed of the study area between 1982-1992.

Categories	1982 (km^2)	1986 (km^2)	Annual rate of change 1982-1986	1988 (km^2)	Annual rate of change 1986-1988	1990 (km^2)	Annual rate of change 1988-1990	1992 (km^2)	Annual rate of change 1990-1992	Annual rate of change 1982-1992
Mangrove	190.34	172.32	-2.37%	84.11	-25.59%	63.4	-12.31%	63.23	-0.13%	-6.68%
Standing Tree	9.79	9.81	0.05%	12.95	16.00%	20.76	30.15%	27.94	17.29%	18.54%
Paddy Field	49.48	39.32	-5.13%	31.03	-10.54%	35.09	6.54%	39.52	6.31%	-2.01%
SW/MC	18.66	29.44	14.44%	12.99	-27.94%	14.45	5.62%	14.27	-0.62%	-2.35%
Shrimp Farm	16.57	29.98	20.23%	91.04	101.83%	121.31	16.62%	105.48	-6.52%	53.66%
Grassland	5.44	9.41	18.24%	5.74	-19.50%	0.79	-43.12%	2.39	101.27%	-5.61%
Unclassified	0.48	0.46	-1.04%	1.37	98.91%	0.8	-20.80%	0.64	-10.00%	3.33%
Mangrove cleared	-	-	-	51.22	-	28.18	-22.49%	32.63	7.90%	-

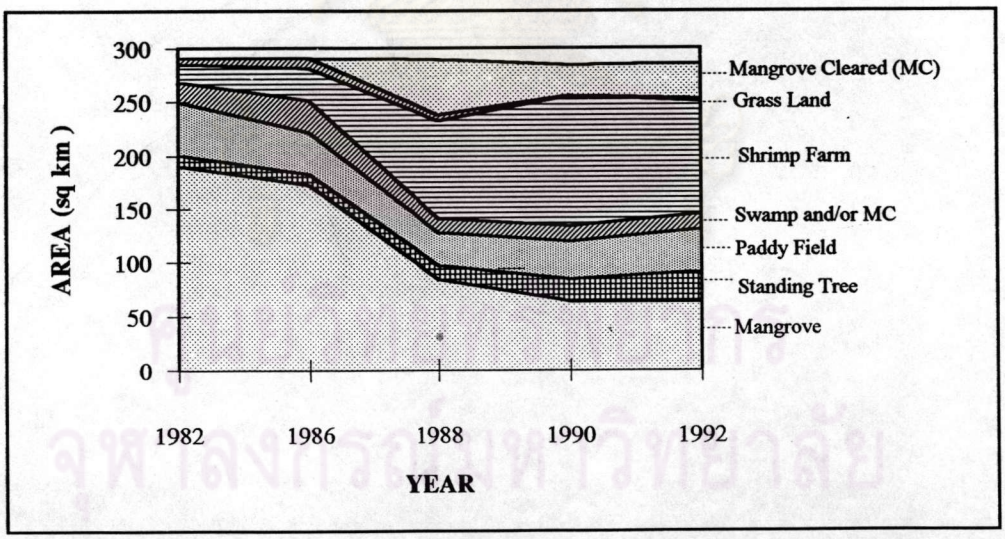

Figure 5.1 Change of landuse in the study area between 1982-1992.

Table 5.2 Change of landuse to shrimp farm for each landuse category

(SF = Shrimp farm , SW/MC = Swamp and/or Mangrove cleared , MC = Mangrove Cleared)

Categories	Landuse'82 & SF'86		Landuse'86 & SF'88		Landuse'88 & SF'90		Landuse'90 & SF'92		Landuse'82 & SF'92	
	Area (km^2)	%	Area (km^2)	%	Area (km^2)	%	Area (km^2)	%	Area (km^2)	%
Mangrove	16.23	54.14%	53.16	58.39%	28.23	23.27%	12.33	11.69%	82.62	78.33%
Standing Tree	0.07	0.23%	0.02	0.02%	0.14	0.12%	0.67	0.64%	0.22	0.21%
Paddy Field	1.26	4.20%	3.37	3.70%	0.34	0.28%	1.17	1.11%	4.93	4.67%
SW/MC	4.14	13.81%	7.61	8.36%	0.79	0.65%	0.85	0.81%	7.09	6.72%
Shrimp Farm	8.25	27.52%	26.24	28.82%	71.96	59.32%	82.41	78.13%	10.31	9.77%
Grassland	0.03	0.10%	0.47	0.52%	0.27	0.22%	0.13	0.12%	0.12	0.11%
Unclassified	-		0.17	0.19%	0.36	0.30%	0.16	0.15%	0.19	0.18%
MC	-		-		19.22	15.84%	7.76	7.36%	-	
TOTAL	29.98	100%	91.04	100%	121.31	100%	105.48	100%	105.48	100%

Data from Table 5.1 and Fig. 5.1 show that tremendously expansion of shrimp farms began in 1986. Between 1986 and 1988, the rate of expansion increased to the level of 101.83%, five times of the rate during 1982-1986. During the same period of shrimp farms expansion, there was a 25.9 % decreased in mangrove which can be seen obviously (Table 5.2) that most of shrimp farms were located in the area used to be covered with mangrove. Clearly, this is the dominant factor of change in mangrove.

After 1988, rate of shrimp farm expansion decreased to 16.62 %, but in 1990, reversed to -6.52 %. This was because many shrimp farms faced with problem on water quality and disease of shrimp due to improper farm management. A number of farms have ceased their activities and left the land as unutilized area. Part of these areas might be classified as mangrove cleared area, hence causing the rate of mangrove cleared to increase after 1990 (7.90 %).

The area of standing tree had a constantly growth, from 0.05 % to 16.00 % to 30.15 % to 17.29 % for 1982-1986, 1986-1988, 1988-1990 and 1990-1992, respectively. From Table 5.2, only 0.22 km^2 of standing tree had been converted to

shrimp farms during 1982-1992 period. This mean that standing tree areas were scarcely used for shrimp farms.

For paddy field, the rate of change appeared to be decreased in the first period (1982-1988), but steadily increased later. The trend of change seem to have its own characteristic that depended on decision making of the land owner to be changed for cultivation or not. From 1982 to 1992, only 4.93 km^2 of paddy fields were used for shrimp farms (Table 5.2).

Grassland had also been converted to shrimp farms but for only 0.12 km^2 (Table5.2). After 1986, the change decreased by 19.50% and 43.12 % for 1986-1988 and 1988-1990, respectively. After 1990, a slight increased was observed from 0.79 km^2 to 2.39 km^2. Part of the additional area might be misclassified from paddy fields which had not be cultivated.

Mangrove cleared are the area where the mangrove had been cleared in preparation for shrimp farming. Change of this area depend on time when investors began their farming activities. Swamp was also showed this similar manner, it was regarded as wasteland which could be converted to shrimp farms.

To assess the major causes of mangrove destruction, the image of mangrove in 1982 was overlaid with the images of each landuse categories in 1992. The outcome indicated the portion of each activity which took place in mangrove area during 1982-1992 period (Table 5.3 and Fig 5.2). Obviously, most of the change resulted from the shrimp farms (65.00 %). If assumed also that half area of swamp and/or mangrove cleared would be converted to shrimp farms, mangrove depletion due to shrimp farms would rise to 74.12 %.

Table 5.3 Summarized causes of mangrove depletion in the study area

Mangrove area (km^2)			Activities in depletion area	Area (km^2)	%
1982	1992	Depletion			
190.34	63.23	**127.11**	Shrimp farm (SF)	82.62	65.00
			Mangrove cleared (MC)	18.61	14.64
			Standing tree (ST)	15.85	12.47
			Swamp and/or Mangrove cleared (SW/MC)	4.71	3.71
			Paddy field (PF)	4.54	3.57
			Grassland (GL)	0.61	0.48
			Unclassified	0.17	0.13
			TOTAL	**127.11**	**100.00**

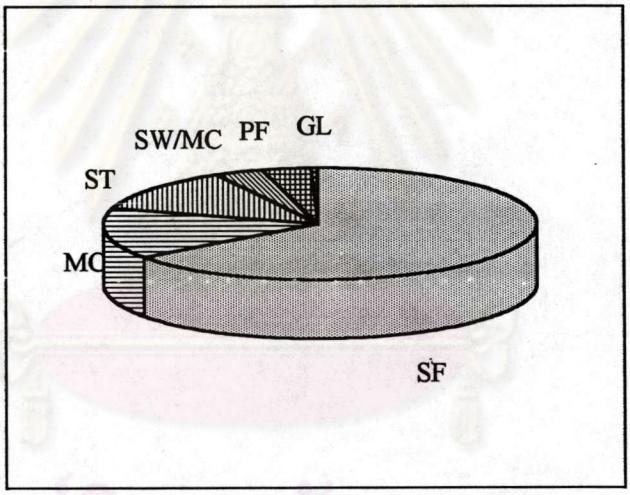

Figure 5.2 Portion of each activity in area of mangrove depletion

Discussion

Although the result showed that average annual rate of mangrove change was declining (6.68 %), it is difficult to expect that the trend would continue. Activity of shrimp farming relies on several external factors such as shrimp sale price which relates to consumption demand in the world market, environmental quality, feed price, disease and also the policy of the government. Therefore, to predict the future trend of each

landuse category is rather difficult. However, from a field survey at the study area in November, 1993 and January, 1994, it was noticed that a number of paddy fields have been converted to shrimp farms. If this pattern is still continued, the conflict of landuse between shrimp farming and rice cultivating from salt contamination, will be an increasingly serious problem in the future.

Conclusion

- The results point out that the rapid expansion of shrimp farms in the study area mainly take place in the area which used to be covered with mangrove.
- The large-scale destruction of mangrove in study area was primarily due to shrimp farms.

Impact on Coastal Fisheries Production

To assess the impact of mangrove depletion due to shrimp farming on coastal fisheries production, data from 'the landing place survey' between 1974-1991 was used to analyze the relationship between the production of the nearshore mangrove-dependent fisheries and the condition of mangrove area. Fish landing data was recorded by Fisheries Statistics Sub-division, Fisheries Department. Because there was no fish landing site at Khlung district, fisheries production captured around the study area (Khulng district) had to be transported to Muang and Lamsing district which is about 25 Nautical miles away.

The relationship was assessed based on 12 fish groups, 2 shrimp species and 1 specie of crab (Table 5.4). Ten groups of fishes were listed in Table 5.4, and another not on the list were one 'trash fish' and one 'other food fish'. Numerous studies of fish and prawn communities in mangrove of ASEAN countries confirmed that these selected aquatic animals associated with mangroves at least during some stages of their life history either as nursery grounds or feeding grounds. The number of registered fishing vessels operating in Chantaburi were also recorded by size, total gross tonnage, but fishing method was not classified by Amphoe. This information were plotted

together against the area of mangrove and fish landings to show their relationship (Fig. 5.3).

Table 5.4 Summary of reports on fish and crustacean communities of mangrove

Species	Family	References
Fish		
Marine catfish (*Arius spp.*)	Arridae	2,7,9,10,11
Trevallie (*Caranx spp.*)	Carangidae	1,2,6,8,9,13
Anchovie (*Stolephorus spp.*)	Engraulidae	1,2,4,6,8,9,10
Mullet (*Liza spp.*)	Mugilidae	1,2,3,6,8,10,12,13
Snapper (*Lutjanus spp.*)	Lutjanidae	1,2,3,6,8,9,11,12,13
Barbel eel (*Plotosus spp.*)	Plotosidae	2,6,8,9,11,12,13
Crocker (*Johius spp.*)	Sciaenidae	1,2,5,6,9,10,11
Grouper (*Ephinephelus spp.*)	Serranidae	1,2,4,6,9,11,12,13
Sand whiting (*Sillago spp.*)	Sillaginidae	1,2,8,9,13
Barracuda (*Spnyraena spp.*)	Sphyraenidae	1,2,6,8,9,10,12,13
Crustacean		
Giant tiger prawn (*Penaeus monodon*)	Penaeidae	9
Bana shrimp shrimp (*P. merguiensis*)	Penaeidae	2,6,9
Mud crab (*Scylla serrata*)	Portunidae	6

Source : 1 = Martosewojo and Soedibjo, 1991
2 = Chong, Wee and Sasekumar, 1991
3 = Dolar, Alcala and Nuigue, 1991
4 = Low and Chou, 1994
5 = Yap, Sasekumar and Chong, 1994
6 = Sasekumar, Chong and Leh, 1991
7 = Singh and Sasekumar, 1994
8 = Leh and Sasekumar, 1991
9 = Suphap Monkolprasit, 1994
10 = Sasekumar *et al.*, 1994
11 = Low and Chou, 1991
12 = Dolar and Lepiten, 1991
13 = Burhanuddin, 1991

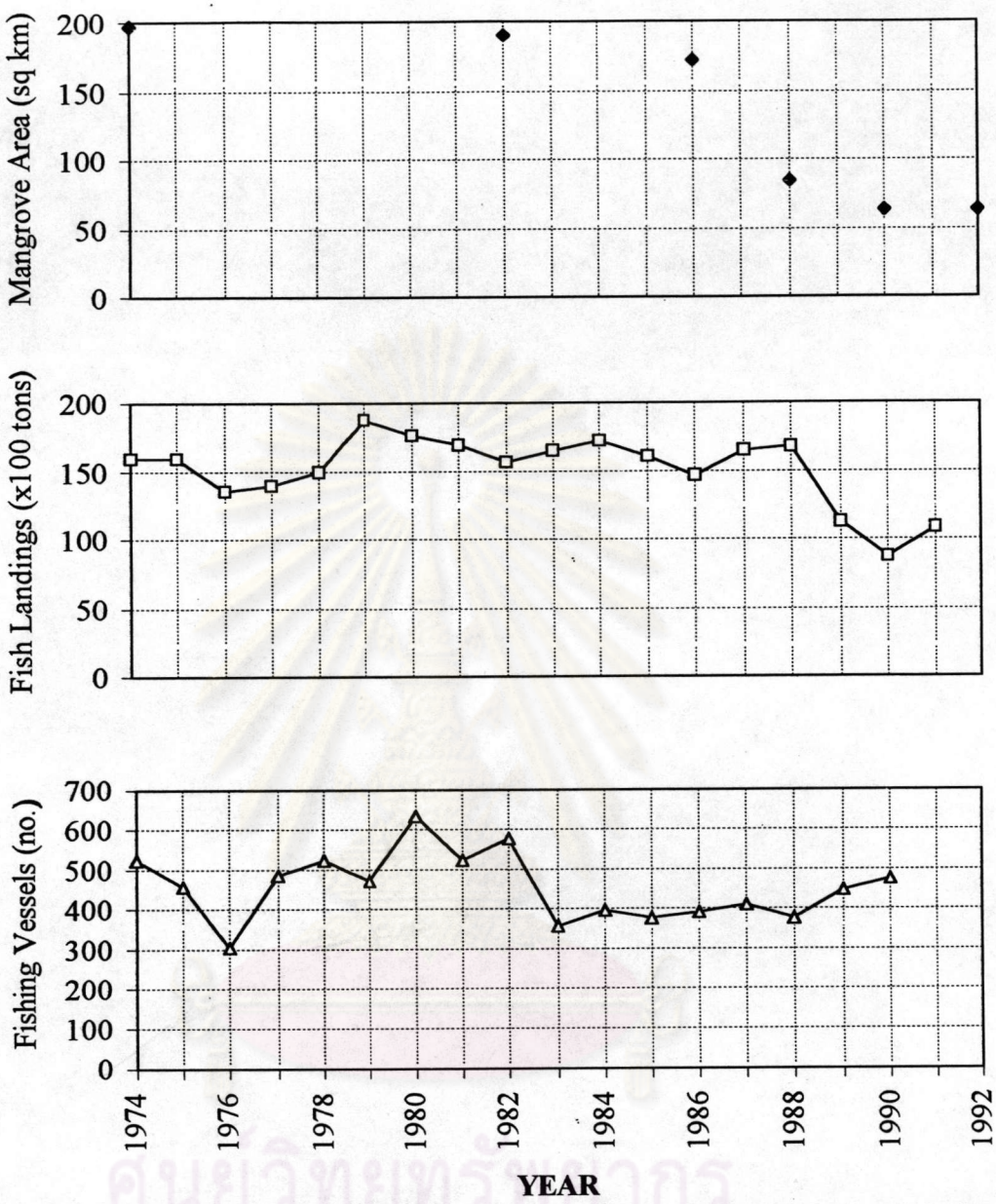

Figure 5.3 Fish landings, mangrove area and number of fishing vessels between 1974-1992.

Remark : Mangrove area in 1974 were recorded by Mangrove Management Sub-division, Sriracha Forestry Center, Forestry Department.

Analyzing of the relationship showed that obvious decreases of local fisheries production in 1989 occurred after the mangrove area had been reduced. Average of fisheries production decreased from 16,076.4 tons(1974-1988) to 10,281 tons(1989-1992) or declined 36.05 %. The amount of fish landing decreased, even though the number of fishing vessels increased. Calculating a value of decreasing amount of fish landing based on statistic of price and quantity of each specie from fisheries statistics sub-division, this amount is worth about 30,762,008 bath a year.

Discussion

There are at least two points of controversy in the analysis. Firstly, data of fish landings might include fisheries production from other areas, not only from Chantaburi. It was impossible to exclude this error due to recorded system. From Statistic of Fisheries Statistics Sub-division, during 1974-1990 the size of fishing vessels in Chantaburi were not exceed 25 meters in length.. With this size, fishermen might not be able to go too far from their villages since their vessels did not have special freezing room for preserving fishes in a longer trip. If they went to fish in a longer distant, they could land their captured production at the nearest landing sites, *i.e.* at Trat or Rayong provinces. Also, if they went to fish in further distant they had to face higher cost. In addition, if the captured production from longer distance were added to those landed at Muang or Lamsing site, and the quantity still declined, this would indicate that fisheries production in the study area had been in serious status.

Secondly, it might have other factors that can influence the decline of fisheries production such as, the problem of capturing aquatic animals over their rate of recruitment, called over fishing, or the problem of coastal water degradation. From evaluation of the Maximum Sustainable Yield (MSY) of Chantaburi (Muang and Lamsing) by Fox model (1974), the captured fisheries production was over than MSY (22,355.24 tons) since 1984. The production seem to be rather stable and even raised up in 1988 before rapid declines following a year of extensive mangrove depletion (Table 5.5). This circumstance expressed that destruction of mangrove might be highly affected the availability of fries, brood stock and also the near-shore food web, which

consequently affected to the production of mangrove-dependent species. For water quality problem, a large number of suspended solids from precious stone mining at Khao Saming district might have drained into Welu River, then finally affected nearshore primary productivity. However, analysis on impact of suspended solids can not be determined because water quality monitoring in Chantaburi has not been regularly taken.

Table 5.5 Total fisheries production and number of fishing vessels of Chantaburi.

Year	Total captured fisheries production (tons.)	Number of Vessels
1974	24,196	526
1975	23,682	455
1976	20,874	303
1977	20,381	487
1978	20,471	523
1979	25,887	473
1980	24,750	634
1981	25,638	523
1982	22,383	575
1983	23,234	359
1984	**23,983**	395
1985	21,176	377
1986	20,413	391
1987	24,623	409
1988	25,845	377
1989	17,113	450
1990	12,384	475
1991	14,772	-

Recommendation

- For future investigation, assessment and evaluation of the true consequences of shrimp farming activities based on scientific research are urgently needed to minimize damage to valuable ecosystems. Possible impacts of shrimp farms that should be emphasized are summarized as follow :

Fisheries production. To confirm the effect on production of mangrove-dependent species in other area where large-scale destruction of mangrove took place.

Water quality. To determine the potential of soluble inorganic nutrients (nitrogen and phosphorus) released from shrimp farms which might cause nutrient enrichment and eutrophication.

To determine about the potential release of bioactive compounds (including pesticides and antibiotics) into the aquatic environment.

In addition, the analysis of reasonable costs of shrimp farms which would include the negative socio-economic consequences are necessary in determining the real cost and benefit of this business. Salinization of underground water and land due to salt-water intrusion which effected agricultural productivity, coastal erosion, acidification and reduction of biodiversity in the mangrove, these have to be taken into consideration in investment cost of shrimp farming.

- For management purposes, mangrove have been classified into three zones following the cabinet's decision in 1987 which was made without a base in scientific principles (Plate 5.1). Moreover, the uncertainty of the boundaries of each zone has led to wide expansion of shrimp farms in Preservation and Economic Zone A. Table 5.6 shows area and percent of shrimp farms located in each zone of the study area.

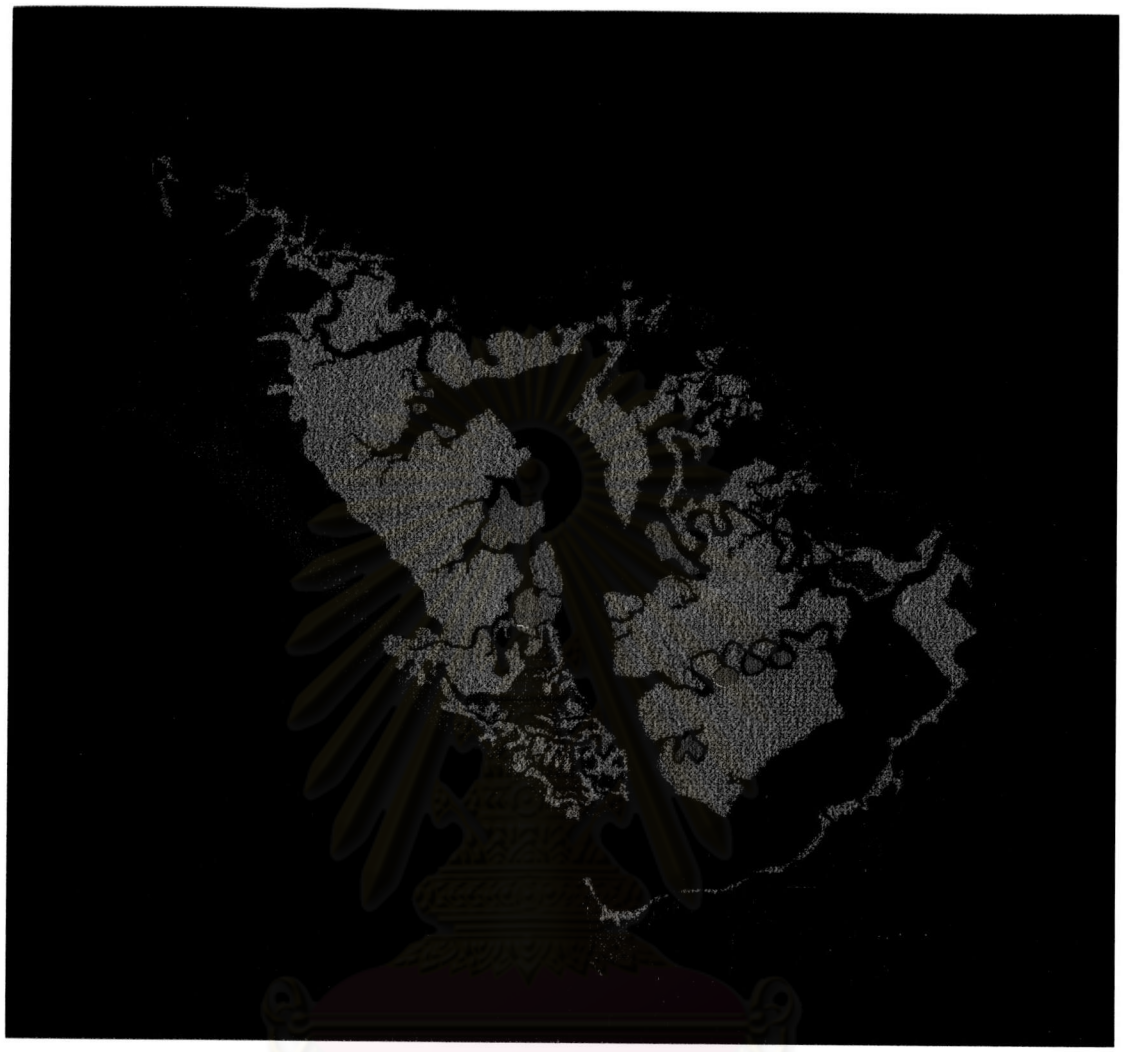

Plate 5.1 Legal status map of the study area

Table 5.6 Area (km^2) and percent of shrimp farms in each legal zones of the study area

Zone	1982		1986		1988		1990		1992	
	Area	%	Area	%	Area	%	Area	%	Area	%
Preservation Zone	0.16	1.40%	0.83	3.50%	2.85	4.35%	3.89	4.42%	3.25	4.30%
Economic Zone A	3.23	28.18%	7.16	30.16%	38.2	58.30%	57.24	65.00%	47.24	62.45%
Economic Zone B	8.07	70.42%	15.75	66.34%	24.47	37.35%	26.93	30.58%	25.15	33.25%

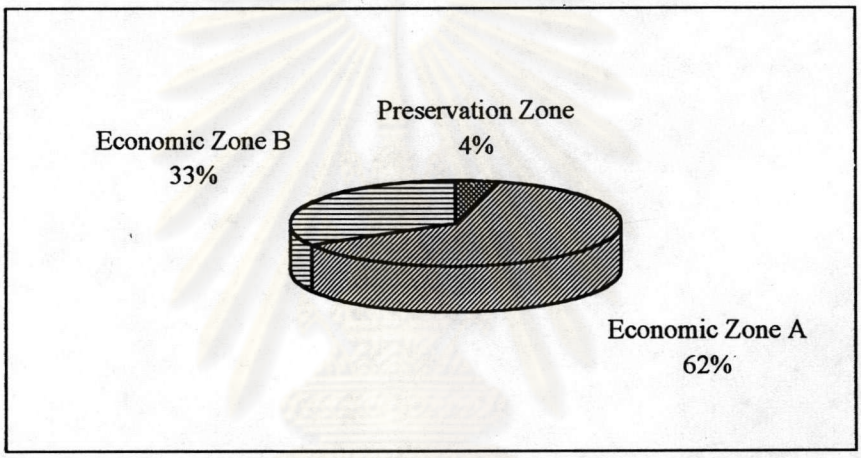

Figure 5.4 Percent of shrimp farms area in each legal zone in 1992

For future management, delineation of areas or zoning is still required but it must established with scientific and social supports. Each zone should be separated by clear boundaries such as roads or waterways. The classification of each zone should depend on various factors, such as, physical factors (soil suitability, current landuse, infrastructure,etc.), and biological factors (structure of mangrove forest, biodiversity,etc.) and social factors (occupation and attitude of local people,etc.). In Economic zone B, government has to provide some facilities, such as, seawater irrigation systems, water treatment unit, necessary infrastructure, water monitoring system to attract investors from intruding into Preservation or Economic zone A and investors who have shrimp farms in the area where will be declared as Preservation or Economic zone A. Additionally, this zone must have strict enforcement power to

regulate discharge from shrimp farms through the enforcement of effluent standards, controls to prevent misuse of bioactive compounds and quality control measures for shrimp product in order to minimize the impact.

For the area to be re-zoned as Preservation Zone, replantation and strict control must be major activities. Some areas in Economic zone A which are serving for forest utilization should be rezoned as Preservation zone to prevent unnecessary use at present. Likewise, 543.7 km^2 of illegal shrimp farms in mangrove areas (from statistic of Forestry Department) should be taken back and re-zoned as Preservation zone. However, it should be emphasized that the recommendations in this report only intend to introduce the concept of solving impact of shrimp farms as ***re-zoning***. Details of this concept need further research information.