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The 2004 Indian Ocean Tsunami: Impact on and Rehabilitation of Fisheries and Aquaculture in Thailand

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This chapter is dedicated to the memory of Isabelle Attalli, a wonderful friend who, with her two children, was taken by the waters in Sri Lanka on that fateful day. Search for “Isabelle Attalli” in Google.

“My boat is everything. My life totally depends on it. When the tsunami came, it destroyed our boats and put an end to everything for all of us. But now we have the boats back and our livelihood as well. We can go fishing again.” (A fisher on Koh Lanta.)

1. Introduction

Southern Thailand, also known as Peninsular Thailand, lies between latitudes 50 and 110 N, and longitudes 980 and 1020 E. It covers an area of 7,153,917 ha and has over 2,705 km of shoreline, with the western coastline facing the Andaman Sea and the eastern coastline facing the Gulf of Thailand – see Figure 2. The result of the phenomenal growth of tourism and fishing is that much of the mangrove and beach forest along the coastal shores have been replaced by human-built infrastructures, such as aquaculture industries and tourist resorts (UNEP, 2005). As a consequence, the coastal areas of southern Thailand have become particularly vulnerable to natural disasters (Thanawood et al., 2006).

The earthquake that created the tsunami was the world’s fifth largest, with a magnitude of 9.15 to 9.3 on the Richter scale. It occurred at 00:58:53 (GMT) on Sunday, 26 December, 2004, with the epicenter, at a depth of 30km, just off the west coast of North Sumatra, Indonesia (Harinarayana & Hirata, 2005); see Figure 1. The sudden vertical rise of the seabed by several meters during the quake displaced massive volumes of water, resulting in a devastating tsunami. This seismic sea wave traveled thousands of kilometres across the Indian Ocean, and ravaged the Andaman coast of southern Thailand at 9.30 am local time.

The earthquake was the largest since the 1964 Alaska quake, and the fourth biggest this century. The tsunami that ensued was among the five largest recorded, as measured in tsunami magnitude – see Table 1. The waves that hit the Andaman coast were, in some places, as high as 20 metres. The Indian Ocean tsunami was the first in living memory to strike the shorelines of southern Thailand.

The tsunami caused extensive damage to life and property in six southern coastal provinces along the Andaman coast of Thailand (Figure 2). The people suffered a total of 5,395 deaths, 8,457 injured and 3,144 missing. The severely affected areas included 292 villages in 78 sub-

districts of 24 districts. In these areas, 20,537 households with a total population of 91,638 are considered to have been directly affected through loss of, or injury to, a family member (FAO-MOAC, 2005). Detailed tables for damage and effect on people, for number of deaths, injured and missing, and property damage (in THB), are provided by Srivichai et al. (2007).



Fig. 1. Indian Ocean earthquake propagation

Year	Location	Mt *
1837	Valdivia, Chile	9.3
1846	Aleutians	9.3
1960	Chile	9.4
1964	Alaska	9.1
2004	Sumatra, Indonesia	9.1

Table 1. The five greatest recorded tsunamis (Data source: Kohl et al., 2005.)

* Mt = tsunami magnitude



Fig. 2. Provinces affected by the tsunami

The most seriously affected sectors of the economy were tourism and coastal fisheries. Prior to the 2004 tsunami, the tourism and fishing industries provided most of the livelihoods in the affected areas along the Thai Andaman coast. The immediate result of the tsunami was the near destruction of the local economy. The economic disaster was such that it led to a 0.8% reduction in the Thai national gross domestic product (GDP) growth rate for the year 2005, compared to the rate that would have existed without the tsunami (Israngkura, 2005). We shall concern ourselves in this chapter to fishing, although a certain indirect interdependence existed (and exists) between tourism and fishing.

The catastrophe left hotels, resorts, shops, businesses, private houses, boats and vehicles in ruins, but the greatest number of victims were people living in 400 affected fishing villages. The rehabilitation happened faster in Thailand than other countries, partly because the waves hit one of the most important tourist areas, which rakes in a third of the country's total tourism income, so there was a commercial incentive to get everything back to normal as fast as possible. Also, because a third of the 8,562 people who died were foreign tourists ..., the crisis got a lot of attention ... from the first day. (Kerr, 2005.)

The tsunami caused major losses in the fishing industry and coastal aquaculture in terms of fishing boats and gear, culture ponds, cages and shrimp hatcheries. Seventy-four affected sub-districts and 386 villages reported losses for fisheries and aquaculture (DoF, 2005). The estimated damage, as reported by the Fisheries Rescue Coordination Centre on 10 January 2005, is summarized in Table 2.

Small fishing boats	3,714	Fish & shellfish cage farms	6,063
Large fishing boats	1,199	Shrimp farms	42
Ecotourism boats	554	Hatcheries	573
Public harbours & piers	83	Shellfish concession plots	17
Sets of fishing gear	47,063	(819 rai)	

Table 2. Damage (in units) caused by the tsunami (FAO-MOAC, 2005)

Damage to private jetties and piers for private boats or fishery-associated businesses, for example, ice plants, gas stations, fish landings, markets and others, has still to be assessed. The tsunami caused severe damage not only to fisher folk and aquaculturists, but also to fisher folk earning additional income from ecotourism. The total damage to fisheries and aquaculture is estimated at 343 M USD (FAO, 2005).

Fishing and aquaculture, although present, were marginal activities some 30 years ago. Fishing developed steadily and tourism grew exponentially in the years leading up to the tsunami. Of course, fishing (particularly artisanal) in Thailand has traditionally brought in much less money than tourism; the per capita and total household incomes of fishers are lower than the national averages. Within the fisheries sector, artisanal fishers as a group earn the lowest income (Silvestre et al. 2003). The livelihoods of many coastal fishery communities in Thailand were completely or partially destroyed by the tsunami. Economies at the community level were severely affected, which led to 19,968 already poor fishers to fall into even deeper poverty (Paton et al., 2007).

Note on units. Throughout this chapter a number of different units are used, and vary according to the source cited. The two monetary units are the Thai baht, written as THB and the US dollar, written as USD. They have not been converted one to the other, as the exchange rate rates varied greatly over the period of publication the various sources. For current and historical exchange rates, see Onanda, XE, National Bank of Thailand and other websites. Other units used are: ha (hectare), equivalent to 6.25 rai in Thailand.

Fishing is one of the oldest industries in Thailand and has contributed significantly to the development of the country – see Table 3 for a number of fishing industry indicators in Thailand and the Andaman provinces.

Fish production of Thailand (both Andaman Sea and Gulf of Thailand)	4 M mt	2005 population in the 6 Andaman Sea coast provinces	2.03 M
N° of Andaman fishery establishments	20,703	Proportion of fishers in Thai population (FAO, 2005)	1%
Total marine catch taken in the Andaman Sea (% of total national catch, in weight)	31.7%	N° of fishers (in Thailand) during peak season (Nov to March), of which:	47,000+
Thai GDP in 2005 (World Bank, 2006) - USD	1,766,000 M	- family members	30,000
Proportion of fisheries in GDP in 2005	2.5%	- employees	18,000
GPP for Andaman fisheries - USD	482.5 M	GPP of the 6 Andaman Provinces - USD	4,754.8 M
		Per capita GPP for Andaman (Panjarat, 2008) - USD	2,335

Table 3. Indicators relating to Thai fisheries (GPP = Gross Provincial Product)



Fig. 3. Damaged fishing boats and trawlers

2. Impact on fisheries

In contrast to the small impact on commercial fisheries, the Andaman coast tsunami significantly impacted small-scale and artisanal fisheries. These are generally subsistence fishermen. The main characteristics of such fishing households (FAO, 2004) are that they:

- use relatively small amounts of capital and energy;
- use small fishing vessels;
- undertake short fishing trips close to the shore;
- target a wide range of fish species;
- use multiple types of fishing gear;
- use a variety of fishing strategies to suit the natural availability of fish stocks or the seasonality of fish; and
- catch mainly for local consumption.

After the tsunami, these small-scale and artisanal fisheries suffered major losses in terms of damage to or loss of fishing boats and gear, and fishery resources. We summarize each of these here.

2.1 Damage to or loss of fishing boats

Some 5,431 fishing boats were either damaged or totally wrecked, of which 93% were small-scale and artisanal fishing craft and 7% commercial fishing ships.

Estimates indicate that 2,923 fisheries households were affected. Estimated damages to fisheries alone amounted to 16.6 M USD (DoF, 2005). See Table 4 and Figure 4.

Province	Large boats		Small boats		USD value of all boat losses
	damaged	sunk	damaged	sunk	
Krabi	147	1	808	54	19,269
Phang-nga	322	124	754	46	915,546
Phuket	490	157	642	41	1,884,618
Ranong	204	13	414	27	12,331
Satun	35	6	552	49	20,520
Trang	1	-	648	-	-
Total	1,199	301	3,714	217	2,852,284

Table 4. N° of affected fishing boats (DoF, 2005)

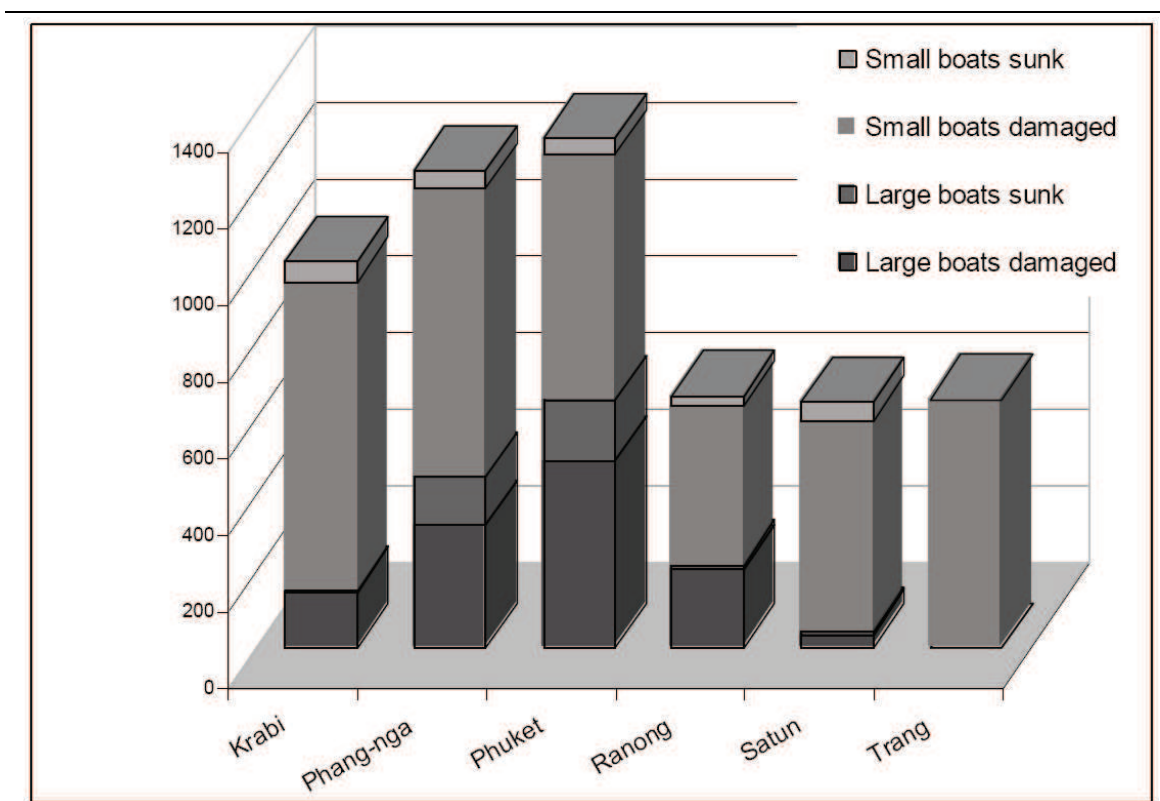


Fig. 4. N° of affected fishing boats (based on Table 4)

We took the figures provided by the DoF (2005), and calculated percentages, allowing a more balanced appreciation of the variations among the six provinces. These are given in

Table 5. Phuket and Phang-nga suffered the greatest losses for large boats, while small boat losses were largest in Krabi and Phang-nga.

Large boats						
Province	N° damaged	% damaged	N° sunk	% sunk	<i>damaged as</i> % of all boats	<i>sunk as</i> % of all boats
Phuket	490	41%	157	52%	33%	10%
Phang-nga	322	27%	124	41%	21%	8%
Ranong	204	17%	13	4%	14%	1%
Krabi	147	12%	1	0%	10%	0%
Satun	35	3%	6	2%	2%	0%
Trang	1	0%		0%	0%	0%
Total	1,199	100%	301	100%	80%	20%

Small boats						
Province	N° damaged	% damaged	N° sunk	% sunk	damaged as % of all boats	sunk as % of all boats
Phuket	642	17%	41	19%	16%	1%
Phang-nga	754	20%	46	21%	19%	1%
Ranong	414	11%	27	12%	11%	1%
Krabi	808	22%	54	25%	21%	1%
Satun	552	15%	49	23%	14%	1%
Trang	648	17%		0%	16%	0%
Total	3714	103%	217	100%	97%	6%

Table 5. Percentages (rounded) of large and small boats damaged and sunk (based on Table 4).

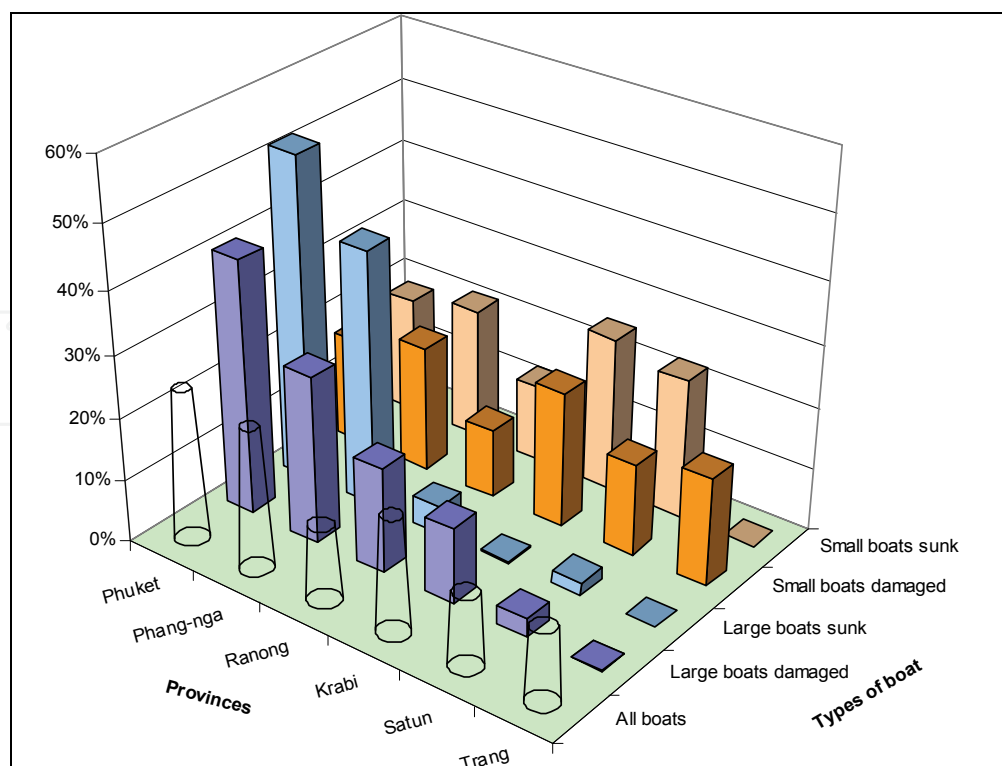


Fig. 5. Percentages of boats damaged and sunk (based on Table 5).

2.2 Damage to or loss of fishing gear

Loss of fishing gear is extremely difficult to assess. After the tsunami, for the purpose of assessing monetary loss, the vessel and the gear were assumed to have been lost together. Gear replacement is a lower-cost item, but compensation of which can help return fishing folk to their livelihood as fishers. It assumes that they are able to repair damaged vessels themselves. In such circumstances, gear provision is probably significantly less costly than expenses for boat repair.

2.3 Impact on fishery resources

From 1976 to 2003, the DoF monitored the implementation of measures to conserve marine resources during seasons of fish spawning and nursing young fish along the Andaman coast; the project covered 2,400 km² along the Andaman coast. Their aim was to identify study areas and periods in order to implement conservation measures for spawning and breeding of mature economic shallow-water fishes and marine shrimps. Surveys conducted by the DoF after implementation reported an abundance of marine fishes and shrimps in several study sites along the Andaman coast (DoF, 2005). Preliminary assessment, in early January 2005, of fishery resources of the Andaman coast indicated that those resources had, in some areas, declined by half after the tsunami (Bueno, 2005). It was also found that the price of marine animals dropped within three months after the tsunami, and then gradually climbed back to normal levels.

The DoF reported that the density of marine resources had decreased during the month following the tsunami. However, if only economic fish species were counted, the density around Phang-nga Bay and adjacent areas had decreased compared with a similar pre-tsunami period. In the two provinces of Trang and Satun, which were less severely hit by the tsunami, the catch increased (Office of Natural Resources and Environmental Policy and Planning, 2006). The marine fish catch off the west coast of Phang-nga and Phuket Provinces decreased after the tsunami struck (before 72.69 kg/hr; after 34.92 kg/hr). The juvenile fish catch increased after the tsunami struck; similar results were found in a fish larvae survey (Nootmorn, 2006).

An explanation for these differentials can be found in the physical effect of water movement. The tsunami waves caused a huge undercurrent with massive movement of water, disturbing sediments at the sea bottom and stirring a water mass rich in nutrients at the pycnocline level in the deep sea, bringing them up towards the continental shelf, a part of which was the Andaman coast. In this way, the tsunami moved great amounts of nutrients from the Sunda Trench and water mass from the deep sea up to fishery areas along the Andaman coast in Thailand. The food chain was thus impacted, with links from water movement through plankton and young marine animals to increased juvenile fish catch. Whanpetch et al. (2010) have shown that the patterns of temporal change in abundance and diversity of macrofaunal assemblages before and after the tsunami varied greatly from site to site, and that the degree of temporal changes in assemblage structure was not solely related to the magnitude of the tsunami disturbance. More importantly, the presence or absence of seagrass vegetation altered the patterns of temporal change in macrofaunal assemblages and recovery processes after a tsunami disturbance.

3. Coastal habitats

The coastal habitat and environment were impacted in various ways. In some coastal areas, coral reefs and seagrass beds were damaged or destroyed, greatly degrading fisheries

resources and thus fishers' livelihoods, both directly and indirectly. Both coral reefs and seagrass have been able to recover to a certain extent.

From a rapid assessment three weeks after the event, only about 13% of the coral reefs in the Andaman Sea were found to be severely damaged (>50% of corals destroyed), while almost 40% showed no measurable impact by the tsunami (DMCR, 2005; Brown, 2005; Wilkinson et al. 2006). A study on coral recruitment and recovery after the 2004 tsunami by Sawall et al. (2009) near the Phi Phi Islands (Krabi Province) and Phuket on the Andaman Sea found rapid recovery to be the norm, suggesting that the duration of disturbance, degree of sorting and hence stability of coral rubble is a key determinant of recruitment success. The tsunami-impacted coral reefs have now revived to a certain degree as a result of rehabilitation activities instituted by government agencies, private groups, communities and NGOs.

Seagrass shows a similar picture. Only some 5% of seagrass beds and 321.6 ha of mangrove forests were damaged or destroyed (Office of Natural Resources and Environmental Policy and Planning, 2006). A comparative analysis (Nakaoka et al., 2007) of seagrass biomass and coverage before and after the tsunami revealed that seagrass beds were severely affected by the tsunami. A broad-scale coastal census after the tsunami showed that the effects on seagrass beds were spatially variable; some seagrass beds disappeared completely, whereas others were only negligibly impacted (Department of Marine and Coastal Resources of Thailand, 2005). The Department of Marine and Coastal Resources studied and monitored seagrass beds destroyed by the tsunami, and revealed that the ecology of seagrass beds in all areas hit by the tsunami were able to survive and regain previous levels within a year without replanting.

From monitoring by the Office of Natural Resources and Environmental Policy and Planning (2006), it appears that local people were satisfied with the level of resilience of natural resources, such as mangrove forests, beach forests, seagrass beds and coral reefs. Local perception, gathered from personal interaction, is that the rehabilitation of coral reefs had been successful to a certain extent. People thus requested continued efforts to restore the natural resources back to the original state of abundance.

4. Impact on aquaculture

The Andaman coast of Thailand has significant amounts of coastal aquaculture based in and around mangrove areas, especially in the creeks and delta mouths. Several types of aquaculture were affected by the tsunami. We will review fish cages, shrimp ponds, hatcheries and shellfish.

4.1 Cage culture

Cage culture was one of the primary occupations for those living in the coastal communities devastated by the December 2004 tsunami. The typically fragile construction of cages made them particularly vulnerable to the tsunami attack, which resulted in the breakup of cages and escape of the stocks – see Figure 6. Some 5,568 cage culture farms, covering a total cage area of some 1,123,176 m², were reportedly affected by the tsunami impact, with a total of 15,802 cages damaged. The government estimated losses from aquaculture cages to be 20 M USD (DoF, 2005). Grouper and sea bass suffered the most, and Krabi and Phang-gna suffered the widest losses, in terms of variety of species; losses are summarized in Table 7.

Province	Fish cage farms	Shrimp ponds (ha)	Hatchery farms	Shellfish (ha)
Ranong	677	1.61	-	3.41
Phang-nga	3,008	16.88	180	64
Phuket	315	5.84	209	58.02
Krabi	389	18.24	-	4.86
Trang	243	-	144	0.84
Satun	966	-	40	-
Total	5,568	42.57	573	131.15

Table 6. Damage to aquaculture (source: DoF, 2005)



Fig. 6. Fish cages - Smashed and washed ashore

Cultured species	%age lost	Distribution among provinces					
		Ranong	Phang-gna	Phuket	Krabi	Trang	Satun
Grouper	37.7	x	x	x	x	x	x
Sea Bass	35.0	x	x	x	x	x	x
Red Snapper	11.8	x	x	x	x	x	x
Cobia	10.1		x		x		
Green mussel	4.4	x	x			x	
Oysters	0.7				x		
Lobster	0.3						x
Total	100.0						

Table 7. Cage aquaculture loss (source: Tanyaros et al., 2010)

4.2 Shrimp farms

Many shrimp farms exist on the Andaman coast, but little damage to shrimp farm operations have been reported, due to the smaller number of farms located near the coast, as compared with the Gulf of Thailand coast. The DoF (2005) reported that only 42.56 ha of shrimp ponds in four provinces were totally damaged by the tsunami. The most damaged farms were located in the immediate vicinity of the shore of low-lying land.

4.3 Fish hatcheries

Only one private grouper hatchery was reported to have been damaged, while the government stations were reported not to have incurred any significant damage.

4.4 Shrimp hatcheries

Destruction of shrimp hatcheries considerably reduced production. The six affected provinces are the main areas in Thailand for marine shrimp fry production. The 573 hatcheries damaged accounted for a 30% loss in seed production, which translates into 70,000 metric tons of cultured shrimp for only one crop (Bueno, 2005). It was estimated that it would take at least six months to get most of the hatcheries back into operation. The industry speculated that this would be an additional lost opportunity of more than 28 M USD and would inevitably lead to shrimp seed scarcity and higher prices. We have not been able to ascertain whether reality matched speculation.

Province	Fish cage farms	Shrimp ponds	Hatcheries	Shellfish farms	Total
Ranong	4,405,403	-	-	93,434	4,498,837
Phang-nga	3,994,861	391,744	3,215,205	N/A	7,601,810
Phuket	3,083,026	12,385	513,551	820,319	4,429,281
Krabi	3,187,173	176,641	-	-	3,363,814
Trang	10,760,56	-	N/A	8,462	1,084,518
Satun	4,604,375	-	N/A	385,898	4,990,273
Total (USD)	20,350,894	580,770	3,728,756	1,308,113	25,968,533

Table 8. Financial loss to coastal aquaculture (source: DoF, 2005)

4.5 Shellfish concessions

Shellfish consist principally of cockle beds, green mussels, oyster and land-based abalone operations, all of which suffered some damage.

5. Inequitable compensation distribution

Careful scrutiny of some of the figures from the DoF reveals wide discrepancies among the six provinces. As a general rule, compensation for farmers in high-loss provinces tended to be higher than for farmers in low-loss provinces. In other words, for similar type of loss, initially more well off fishers received more compensation than poorer fishers. Two examples are cage farms and boats.

5.1 Differential declared cage loss

From Table 9, we can see that some cage farms were estimated at a much greater USD loss in some provinces than in others. These differentials are illustrated in Figure 7.

Province	N° of fish cage farms	USD loss	Mean USD loss per farm
Ranong	677	4,405,403	6507
Phang-nga	3008	3,994,861	1328
Phuket	315	3,083,026	9787
Krabi	389	3,187,173	8193
Trang	243	10,760,56	4428
Satun	966	4,604,375	4766
Total	5568	20,350,894	3655

Table 9. Mean loss for fish cage farms.

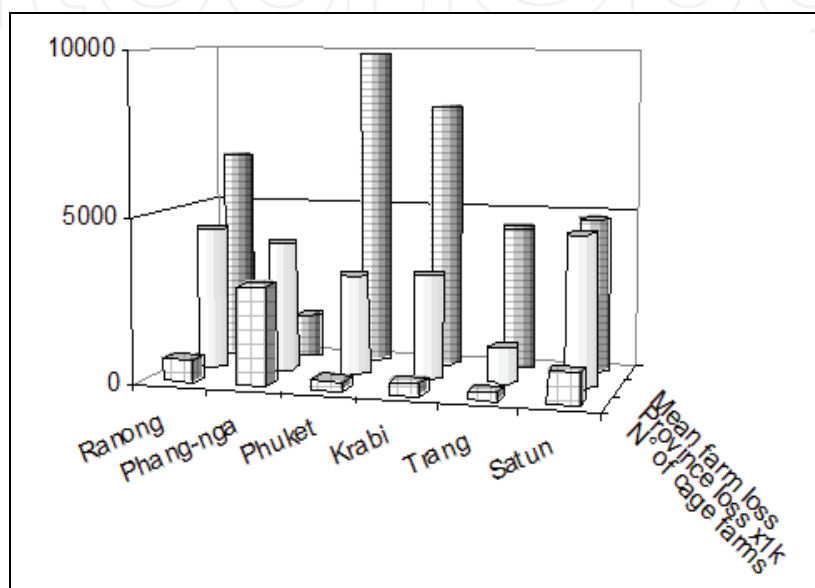


Fig. 7. Differences in declared loss for cage farms

Several factors may account for these differences. For example, farm size varies greatly across the provinces, and larger farms have more cages than smaller ones. Personal contacts with locals indicated too that many non-registered farms filed opportunistic claims for compensation. Additionally, this also illustrates the world-wide phenomenon of wealthier people having easier access to money. In the present case, Phuket fishers are generally better off than fishers from Phang-nga; thus they are better able to make claims, to make most use of the system, and to influence authorities (both legally and surreptitiously).

5.2 Differential declared boat loss

A similar situation existed for boats, although the great variation in boat sizes and types will account for some of the cross-province differences. It is clear from Table 10 and Figure 8 that, compared to the actual loss or damage (as a % of boats lost), the USD loss for all boats was estimated to be far greater proportionately in one province (Phuket) than in four other provinces (Ranong, Krabi, Satun, Trang). It is unclear what factors account for this huge discrepancy. It was probably a mix both of objective elements (such as boat size, Phuket may have had a greater proportion of larger, and thus more highly compensated, boats) and of human elements of the kind discussed above for cage farm loss. Even if Phuket did have a greater proportion of larger vessels, this does also reflect the relatively better off Phuket fisher.

Province	Total N° of boats	% of boats lost	USD loss for all boats	USD boat ² value	% of USD loss
Phuket	1330	24%	1,884,618	1417	66%
Phang-nga	1246	23%	915,546	735	32%
Ranong	658	12%	12,331	19	0%
Krabi	1010	19%	19,269	19	1%
Satun	642	12%	20,520	32	1%
Trang	649	12%	0	0	0%
Total	5,535	102%	2,852,284	515	100%

1. Includes all categories of boat lost

2. USD value per boat = total value / N° of boats

Table 10. Differences in boat value and loss

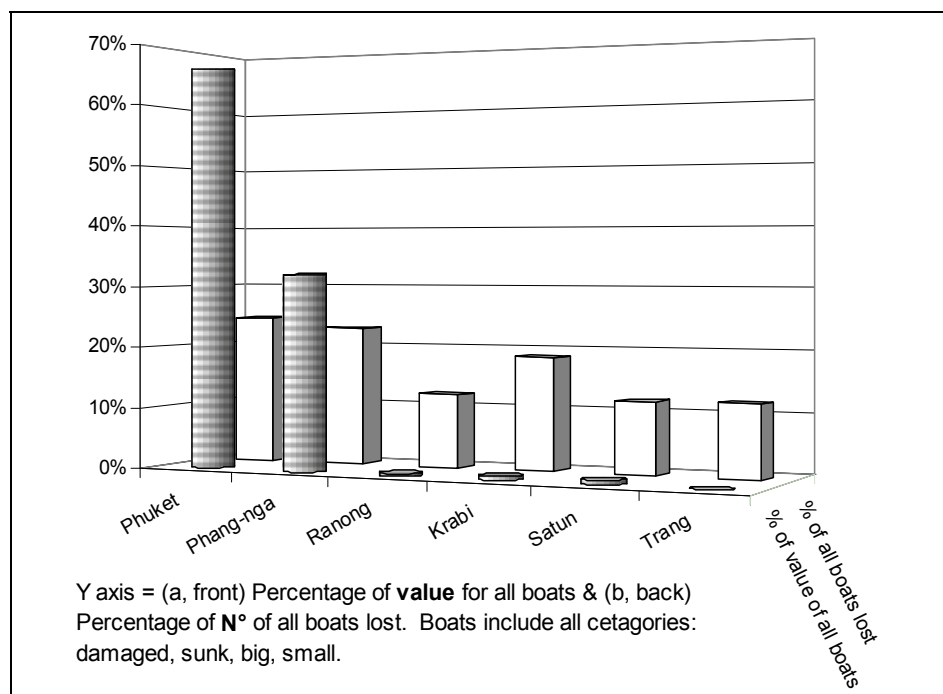


Fig. 8. Differences in boat value and loss, based on Table 10

These are examples of abstract data pointing up real-world enigmas. Compensation claims varied, from 'inaccurate' (at best) and fraudulent (at worst). This type of reporting of damage and loss was inevitable, given the greed element in human nature, and given the devastation inflicted at the time, with the ensuing social and economic disarray. Such data variation and the vagaries of such situations give an idea of the immense work undertaken to assess the loss and to calculate compensation. It can easily be argued that it is better for many to receive some form of quick compensation, even with fraud and corruption, than for fewer people to get delayed compensation, in the hope that less money will get into the wrong hands, but with inevitable hardship imposed on the really needy.

6. Post-rehabilitation

After the tsunami, several Thai government agencies, the private sector, NGOs and international organizations set up a wide range of projects for emergency assistance and

long term rehabilitation, in both fisheries and aquaculture sectors, with the aim of enhancing the quality of life for all victims. We have already seen that this effort was not equitably distributed, and below we note that the unequal sharing of compensation led to friction within and among communities.

6.1 Fisheries sector

A first step in the assistance plan was swiftly implemented by the DoF; its primary goal was to establish a Fisheries Rescue Centre (FRC). The centre coordinated and continues to coordinate the collection of damage and loss information from the six affected provinces for the Department of Fisheries. The detailed information is listed by village, and it was therefore possible to identify at sub-district and even village level where significant losses had been reported. This data set can therefore be used as an indicator to assist in identifying the most affected areas.

The second stage of the DoF emergency plan was to compensate the victims in cash for their losses or damaged boats, fishing gear and aquafarms. The aim of this DoF compensation programme was to assist victims to start up their fishing and aquafarming activities and to restore their livelihoods. The full Cabinet of the Thai Government approved a tsunami response budget of 5,252 M THB. Of this, 1,343 M THB was allocated to the DoF to assist 27,828 fishermen. This included the repair of 3,426 small fishing boats (under 10 metres in length) and 544 larger fishing boats (DoF, 2005).

Loss or damage claims that might be eligible for government compensation were registered at the Provincial Fishery Office, and in some cases at the district level if a fishery officer was present. Boat owners (as listed on boat registration records) were required to register the loss with the registering district or province within 15 days in the area where the vessel was affected or the registered home place of the vessel owner. The Provincial Fisheries Office (or District Fisheries Office) had to collate the documents and check for accuracy before sending to the Department of Fisheries within 120 days. Typical documentary evidence required for compensation was the vessel registration or permission to fish document (with date). Since the majority of vessels that were damaged or lost were in the small-scale category, very few actually had registration documents. In this case, alternative evidence of ownership was considered as supporting evidence. These included:

- Statement of ownership by the Provincial Fisheries Office (stating the boat is repairable or beyond repair);
- Document of guarantee from a fishers' association, farmers' group or fishery cooperative stating that the owner is a member;
- Sub-district headman's statement;
- Guarantee document from the village headman;
- Record in the fishery survey;

We will now survey the compensation according to type of article damaged. We include fishing vessels and fishing gear.

6.1.1 Compensation for fishing vessels

Several categories of loss were eligible for compensation:

- Support for the recovery of a vessel (i.e., re-floatation, or movement of the vessel, as many had been swept some distance inland above the high tide mark).
- Support for repairs to a damaged vessel.

- Compensation for loss or damage beyond repair.

Fishing vessel damage and loss was assisted by the government compensation package as shown in Table 11.

Type	Compensation per vessel	
	<10m	>10mm
Retrieval	10,000	25,000
Repair	20,000	70,000
Vessel lost	66,000	200,000

Table 11. Compensation (THB) package for fishing vessels, damaged and lost (Source: DoF, 2005)

6.1.2 Compensation for fishing gear loss

Fishing gear loss is extremely difficult to assess, unless the gear is assumed to have been associated with the vessel. In this case, the vessel and the gear are assumed to have been lost together. Small-scale artisanal gear may be reconstructed (such as fish and crab traps). Larger gear such as nets, require purchase. Loss of fishing gear was compensated at a relatively low rate (about 3,000 THB per case). Table 12 shows the government compensation for the loss of fishing gear.

Type	Unit	Total USD budget*	Max. USD compensation / victim		
			Retrieval	Repair	Replacement
Small fishing boat	3,426 boats	6,676,308	256	512	1,692
Large fishing boat	1,222 boats	7,050,000	641	1795	5,128
Bamboo trap (legal)	421 fishermen	107,949	-	-	256
Other traps	13,690 fishermen	3,510,256	-	-	256
Nets	1,871 fishermen	479,734	-	-	256
Total		17,824,247			

Table 12. DoF budget for emergency assistance for the fishery sector (DoF, 2005)

* Cost (or calculated loss). Actual compensation payment was less than this.

6.2 Aquaculture sector

Loss or damaged of aquaculture facility was compensated by the Royal Thai Government to assist the farmers to re-start their farming activities. Two broad targets for compensation were aquaculture holdings and fish cage culture operations.

6.2.1 Compensation for aquaculture holdings

Information regarding loss from aquaculture holdings does not appear to have been announced, however the document made available to the mission containing the dates of compensation also included rates for aquaculture. Compensation was payable in the case of:

- Loss of fish stocks 1,400 baht per rai (for a total area not exceeding 5 rai).
- Loss of shrimp and crabs 3,800 baht per rai (for a total area not exceeding 5 rai).

6.2.2 Compensation for fish cage culture operations

Compensation was payable in the cases of culture of fish in a cage, cement tanks or other (e.g., aquarium fish, frogs, soft-shelled turtle). The rate was 150 baht per square metre of

production up to an area not exceeding 80 square metres. The Thai government provided funding through the DoF of over 111.6 M THB to restore the cage farms on the coast of the Andaman Sea after the tsunami (DoF 2005). Excluded here are funds from the private sector, NGOs and philanthropic foundations.

Several types of assistance were provided from those organizations for the cage farmers, including provision of cash funds, materials for cage re-construction and fish seed. The money used to buy materials for cage re-construction and repair accounted for 28.1% of the funds provided; the purchase of seed, feed and chemicals for culture operation made up 15.8%. It was surprising to find that a substantial sum, 56.1% of the funds, was used for other purposes (Tanyaros et al., 2010). The loss of aquaculture operation systems was supported through emergency assistance from the government as illustrated in Table 13.

Type	N°of farmers	Total USD budget*	Max. repair & seed for restocking / farmer
Cage	27,828	1,4270,769	513 (cage & seed)
Shrimp pond	42	21,538	513 (pond & post larva)
Hatchery	573	293,846	513
Shellfish farm	80	40,770	-
Total	28,523	14,626,923	

Table 13. DoF budget for emergency assistance for the aquaculture sector (source: DoF, 2005). * Cost (or calculated loss). Actual compensation payment was less than this.

Anantasuk et al. (2008) reported that 69.7% of the main financial sources supporting the farmers in the effected areas came from government organizations, as listed in Table 14. Non-governmental organizations, at the Thai national and international levels, also played an important role in assisting the affected farmers. About 31.3% of the farmers received assistance, and each of those obtained 30,000 baht from these organizations. The DoF was the main body supporting aid to the farmers; more than half of the farmers received materials for cage re-construction, seeds, fishing gear, and boats. NGOs were also important bodies that furnished materials (Tanyaros et al., 2010). Table 15 gives the percentages of farmers who obtained materials from the DoF and various NGOs.

Level	Organisation	per farm
National	Department of Fisheries (DoF)	20,000
Local	Tambon Administrative Office (TAO)	2,000
Local	Education institutes (some farms only)	15,000

Table 14. Funding (THB) sources fish cage culture compensation

Target	Source %ages	
	DoF	NGOs
Material for cage construction	55.6	47.6
Seed	11.1	18.3
Fishing gear	31.1	13.4
Fishing boats	2.2	20.7
Totals	100%	100%
Proportion from each source	57.1%	42.9%

Table 15. Source of materials support (source : Anantasuk et al., 2008)

6.3 Public satisfaction regarding post-rehabilitation

Since the tsunami on 26 December 2004, government agencies, private organizations and civic groups have undertaken a large number of projects to rehabilitate the economy and improve the well-being of people in the six tsunami-affected provinces. The actions varied from short- to long-term measures.

Using Weight Average Index (WAI), Tanyaros et al. (2010) reported on the level of public satisfaction regarding post-tsunami rehabilitation. The results show that the mean satisfaction in regard to quality of housing and land tenure was at a high level (3.71; on a scale of 1 to 5). Other measures of satisfaction were at the middle level. However, the mean quality of all parameters for the post-rehabilitation period (three years post-tsunami) was significantly higher in comparison to that of the pre-rehabilitation period (one month post-tsunami).

Parameters related to aquaculture farms follow a similar pattern. During the post-rehabilitation period the mean level of satisfaction with equipment quality and seed and feed invested in aquaculture farms increased. Satisfaction with farm areas, growth rates, amount of product and revenue from farms also improved. These results indicate that the immediate and mid-term rehabilitation actions have generally been fairly successful. In comparison to the pre-rehabilitation period, most post-rehabilitation parameters related to livelihood, farm and culture operations improved - see Table 16. Farmer satisfaction with the rehabilitation programs was overall fairly high. However, the farmers need more effective support, both financial and non-financial. Building the capacity of farmers to help themselves is one of the best practices for sustainable support.

	Parameters	Rehab WAI		t
		Pre-	Post-	
Livelihood	house and land tenure	3.40	3.71	5.598**
	household consumer goods (basic necessities)	3.39	3.62	4.195**
	electricity & water	3.28	3.51	3.693**
	health care	3.39	3.58	3.427**
	education	3.39	3.64	4.933**
Farm	farm area	3.40	3.58	2.303*
	culture equipment	3.23	3.75	6.501**
	seed	3.24	3.65	4.606**
	feed	3.22	3.46	2.701**
	growth rate	3.27	3.41	1.995*
	amount of product	3.25	3.43	2.179*
	marketing	3.21	3.26	0.444ns
	price of cultured species	3.18	3.17	0.069ns
	revenue	3.23	3.42	0.266*

** = highly significant level (p<0.01); * = significant level (p<0.05); ns = not significant; (p>0.05)

Table 16. Farmer satisfaction related to livelihood and farms (Source: Tanyaros et al. 2010)

6.4 Constraints for rehabilitation in the fisheries sector

So far the picture appears to be a rather rosy one, with compensation appearing, at least in monetary terms, to have had much potential for good. However, on the ground, the results

of money compensation were far from desirable – due to both internal and external factors. Internal factors include greed and family structure; external include distribution methods. Here we outline each set of constraints and make suggestions as to how they may be alleviated, for the benefit of all and in such a manner as to avoid hardship on those who must give way to better, even best, practices.

7. Intra and inter-communal conflicts

The way in which compensation was given and monitored directly or indirectly caused serious problems, which in turn led to serious conflicts within communities and among communities in tsunami-affected areas.

One set of problems was related to the donation of fishing gear for tsunami victims by the government and private sectors; this encouraged an increase in the number of fishermen, sometimes beyond resource sustainable levels. This in turn generated conflicts between new and old fishermen; the old fishermen had well-tried fishing traditions and devices. In addition, this assistance was unequally distributed. For instance, some tsunami victims received a house, compensation packages, scholarships and children's allowances, fishing boats and gear, while others received little or none despite having lost their occupations and properties. Even worse, some tsunami victims who had never worked as fishermen were, incredulously, given fishing boats, which they then sold at great personal profit.

Another set of problems revolved round the migration of outside workers into the area, giving rise to social problems as well as improper use of the local natural resources. For example, outside workers caught protected aquatic animals. Thus, in addition to conflicts within and among local communities, conflict emerged between migrant workers and local communities (Department of Marine and Coastal Resources, 2005).

7.1 Illegal fishing

Fishing with trawlers and push nets still exists in several areas. Illegal fishing causes damage to marine life and benthos and also to coastal ecology. Before the great Indian Ocean tsunami, the status of fishery resources in the Andaman Sea was over-exploited. Many rehabilitation projects were introduced with the aim of enhancing the fishery resources of this area. However, illegal fishing is still practiced and constitutes a major obstacle to sustainable management of fishery resources. The government of Thailand has banned commercial operations in a near-shore (5km) zone in an attempt (a) to provide a nursing ground for aquatic animal, and (b) to reduce conflict with artisanal fisheries. In such cases, conflicts continue when trawlers encroach into these demarcated areas.

The DoF must play a significant pro-active role in controlling the use of non-destructive fishing gear by strict law enforcement. Allowing unfair and unsustainable competition for limited resources between artisanal and commercial sectors inevitably spawns human disputes and reduces fish spawning.

7.2 Management democratization

Fisheries experts now recognize that resource conflicts can be diminished and resources better managed when fishers and other resource stakeholders are more directly involved in management, and access rights are distributed more effectively and equitably. This is part of management democratization. The Thai government is increasingly committed to policies

and programmes of decentralization and community-based management and co-management (Pomeroy, 1995).

The DoF has formulated a fisheries development plan for small-scale fisheries, with a view to improving both livelihood and quality of life in the sector. The short-term objectives aim to upgrade the socio-economic status of the small-scale fisher, develop the coastal fishing ground to be more productive, and promote and develop the fishing occupation. The long-term objectives seek to allocate the existing resources to achieve most benefit, and lessen conflict between the small-scale and commercial fishers.

Several small-scale fisheries development projects have been implemented to meet the short-term objectives. These include construction of artificial reefs and provision of basic infra-structure for fishing and community activities, such as fish processing and fish landing, as well as institutional support, such as credit and fishery information. However, we are compelled to warn that government development programmes alone cannot achieve the long-term objectives as long as the fishing grounds are left as an open-access resource and the enforcement of fisheries regulations is ineffective.

7.3 Constraints and needs for continuing rehabilitation

Before the December 2006 tsunami, many aquaculturists faced an array of problems in aquaculture operation. After the three-year rehabilitation period, observations (Office of Natural Resources and Environmental Policy and Planning, 2006) indicated that most aquaculture farm became or were on the way to becoming viable - commercially and environmentally. However, a number obstacles still needed to be overcome three years after the tsunami, and many still remain today (five plus years later). We outline some of the obstacles here, as well as some possible ways through.

7.4 Culture operation

The main operational constraints for cage farmers lie in the high cost and shortage of seeds. The current seed supply is problematic because the trend of seed catching in the wild has gradually diminished over recent years. As a consequence, the price of grouper seed has increased three- to four-fold over the past few years. The grouper and snapper hatchery technique was poorly developed, while the production of sea bass fry from the DoF hatcheries met the demand because the technique of nursing the fry was well developed.

One constraint is the high cost of trash fish, used as feed for the grouper, red snapper and cobia cage. Cost of trash fish is the single most expensive item, comprising more than 40% of the total production cost. Typically, trash fish from fishing operations are used as feed source, although in times of low catch, trash fish may be purchased for use as feed. Pellet feed is available only for sea bass, but not for grouper, red snapper and cobia cage culture.

Fish disease and mortality were the most common reported problems associated with cage culture. The problem of disease was experienced by all cage culturists.

7.5 Marketing

Three years after the tsunami, cage farmers in general were faced with fluctuating market situations. With an increasing number of cage culturists and rising demand for live fish, an excess in supply over demand developed. Marketing of live sea bass and grouper was also seriously affected. The local farmers found it difficult to compete with the prices set by the middlemen. The marketing problem appeared in Cobia culture when fish reached marketable size.

7.6 Technical support

The need for future support for sustainability in rehabilitated aquaculture farms on the coast of the Andaman Sea can be divided into three categories:

Providing seed for grow-out. As mentioned earlier, the problem of seed shortage had a major impact on the cage farms on the Andaman coast of Thailand, and occurred before the impact of the 2004 tsunami, especially in connection with the grouper seed. High demand for seed and high seed cost originated in the decline in wild seed. All cage farms in this area used the grouper and red snapper seed collected in the wild, whereas the sea bass seed was mainly bought from the DoF hatcheries. Therefore, the DoF government sector should pay attention to research and development of hatchery seed production techniques. As seedling resources are developed, fish seed holding centers will be needed. Each center should have the dual function of supplying low-cost fish seeds to cage farms, and undertaking nursery and quarantine work to ensure optimal survival rate of the fish seed.

Formulated feed development. In response to the limitations and problems associated with trash fish use for grouper and sea bass aquaculture, new and better practices are being developed. Foremost among these is the use of formulated feeds instead of trash fish. The economic benefit of using formulated feeds is that it is more cost-effective than trash fish. Because formulated feeds provide a nutritionally complete diet, fish grow faster and are healthier in comparison with fish that are fed trash fish. The Research Institute for Mariculture, Gondol, Indonesia, showed that grouper grew 75% faster when fed formulated pelleted feed, compared with grouper-fed trash fish (Sim et al. 2005). Formulated feeds also generate less pollution, since water stability is better and less of the feed is wasted. In turn, this provides a better environment for the fish, leading to a reduction in disease problems.

Disease control and prevention. From a study by Tanyaros et al (2010), it became clear that disease was a major factor affecting loss of production in cage farms. In order to diagnose the disease, fish samples needed to go to a laboratory. Fisher farmers would contact the DoF laboratory technician to take their specimen to the closest DoF fishery station, but some DoF technicians were slow to respond. Sometimes also the fish died before a DoF technician arrived. Subsequently, most cage farmers were not consistently helped by the government sector and turned to local wisdom from past experience rather than waiting for the government sector to respond. Today, cage farmers still need the public sector fish disease monitoring programs, so that measures can be implemented promptly if disease breaks out.

8. Lessons learned and opportunities for the future

Probably more time and detailed data are needed to provide sufficient distance to evaluate fully the whole rehabilitation effort. However, people cannot wait for that; they must live now. Thus, five years on, several promising opportunities present themselves. We provide a patchwork of lessons so far and opportunities to be seized now.

8.1 Creating supplementary income

The Community Development Office in affected provinces should provide fishers with additional skills to work in their communities in areas such as batik painting, home-stay tourism services and repairing fishing gear.

8.2 Training programmes

To facilitate the initiation of cage culture development, the creation of a core group of functional personnel should be an activity of high priority. This core group should provide the initial personnel capacity in handling farm management as well as the whole range of tasks of a production farm. It should also be capable of participating in the planning and the subsequent implementation of production and marketing programs.

8.3 Development of a marketing system

The marketing system and the basic essential supporting infrastructure both play a key role in the well-being of any fishery. The experience gained within the limited time spent in the field has clearly indicated that these aspects of the fishery industry need urgent review. In cases of failure and success, research should be conducted to establish and understand the underlying reasons. Thus, patterns will emerge and help to make future endeavours more effective. This should be carried out now as an ongoing activity.

8.4 Marketing statistics

A representative inventory of the basic information on the biological and economic aspects of cage farms should be kept to serve as a reliable source of data on which future development actions can be reliably based.

8.5 New marketing techniques – local branding

Techniques of marketing that have worked elsewhere should be implemented for Andaman fisheries. For example, local branding has proven extremely effective in many countries and localities attempting to sell their produce elsewhere and abroad. Such marketing techniques may be new to Andaman fishers and their cooperatives, but with care, they can be implemented relatively easily and inexpensively. One can easily imagine labels like “Phangnga Grouper” or “Trang Oysters”. Local branding for fish can also take advantage of local branding for tourism in the Andaman provinces. Secondary effects of local branding include greater pride and thus care by local fishers, greater sense of long-term goals, greater inter-village solidarity. One province has already begun to look seriously at local branding as a way of marketing its fish -- we invite you to guess to which province this quote refers:

The human geography of the province consists mainly of hundreds of settlements built around the coves and inlets that stretch along our coasts. ... fishing has been the foundation of the local economy and fishing continues to be one of our primary industries. Moreover, those picturesque fishing villages are also the main lure of the tourist trade - another primary industry. Our cultural geography is, likewise, constructed around fishing and the sea; ... fishing serves as a cultural self-identifier. (Bousquet, 2009.)

We provide the answer in Appendix A.

8.6 Financial support

Micro-credit arrangements/revolving funds. It is important to provide fish farmers with a low interest grant for revolving funds that they can borrow for their small business.

Improved compensation package. As mentioned earlier, the compensation package for cage farms is rather low compared to the loss, especially for the poorer farmers in some provinces. Compensation levels to replace essential livelihood inputs must be realistic. If people cannot replace their equipment, then assistance just is not effective

8.7 Greater coordination and communication

It is critical to establish coordination among all players. A lack of effective and comprehensive coordination and communication mechanisms has been the single biggest constraint on assistance. It is clear that assistance could have been faster and more effective with better coordination, and that greater input and participation from the fisher community could have facilitate more realistic and responsible decisions.

The benefits are increased when donors collaborate in complementary activities. Assistance could complement government policies and activities to rehabilitate the fisheries sector. Donors need guidance on what kind and how much assistance to provide, and who needs it. Sometimes, external donors have trouble engaging with local communities. Some kinds of assistance or distribution may not match actual need, or they may duplicate effort. Inappropriate assistance can be detrimental, and even cause community conflict. Communities should be fully involved in identifying priorities for assistance and in the selection of beneficiaries. Focused assistance is required to strengthen internal community coordination.

8.8 Need for a strategic approach

Mid-term and longer-term assistance to rehabilitate livelihoods should be carefully planned, based on assessments of actual need, not assumed needs. This means creating channels so that the views of the people affected are heard, and can be acted upon. It cannot be top-down planning; grass-roots initiative, involvement and coordination are essential.

8.9 Focus on self-help

Building the capacity of communities to help themselves is the only way to sustain support. Revolving funds and micro-credit arrangements are useful tools and an alternative to donations. Most farmers depend on loans, economic activities cannot generate enough income and the farmers need the revolving funds to subsidize their livelihood and maintain their farm. Therefore, good implementation and management of credit programs should be promoted.

8.10 Conflict management,

Communities can be strengthened by conflict management mechanisms that involve them directly. These might include the following:

- Independent local ombudsman can be appointed for small conflicts, as long as this respected local cultural norms.
- Local committees can be set up to look into larger conflicts, with possible input from research institutes.

8.11 Participatory methods

Innovative methods can be introduced, such as Companion Modeling, used successfully in other parts of Thailand (see Barnaud, 2007, for a remarkable example). The closely related technique of computerized role-play simulation has been effective with subsistence fishers (see Cleland et al., forthcoming). Methods such as these also provide greater knowledge about and more enlightened involvement in fishery dynamics and sustainability and thus lead to greater harmony among stakeholders.

Methods such as SWOT (Strengths, Weaknesses, Opportunities and Threats) might be applied to specific actions, and provide increased probability that assistance will have the desired effect.

8.12 Research

Of course, research is also a key to rehabilitation development. Rigg et al. (2005) put it well:

In addition to the spectacular, tragic and obvious destruction, the tsunami event has produced numerous socially transformative challenges and opportunities that necessitate longer-term research engagement.

Any rehabilitation action, short- or long-term, needs to be backed up with rigorous studies by independent researchers.

Local institutions and authorities are the best placed to understand and assist local communities. Enhancing local capacity to manage rehabilitation programs is essential to sustain them. Long-term support is needed beyond the funding horizons of most donors.

The question that arises in complex situations such as these is: How far will people, groups and governments act on the knowledge that is available and that is generated through research? The connection between knowledge and action is an uneasy one – for a discussion see Crookall and Thorngate (2009).

9. Conclusions

Finally, we need to heed these words.

... the havoc ostensibly wreaked by nature is often a reflection of the ways that humankind makes itself vulnerable to natural phenomena. And it is humankind that may have the best solution to these problems. ...

Yet two measures of critical importance, “vulnerability mapping” – identifying potential humanitarian crisis threats – and information sharing, are still fraught with conflicting interests, hampering the dialogue needed between scientists and policymakers. To make a real difference, natural and social scientists, policymakers and planners must work more closely to identify threats, Social anthropology and psychology have as much to contribute as engineering, agriculture, economics and medical assessments.

As was evident in the aftermath of Hurricane Katrina, the knowledge of social scientists about ways to engage local communities is often bypassed by the “experts.” ... Most governments say they “use” scientists; that they are in the room when it comes to policymaking. They may be in the room, but they are not at the table.

As the prospect that more complex and devastating humanitarian crises are on the rise, the dialogue between scientists and policymakers is needed more than ever. (Kent, 2010.)

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Appendix A: Local branding for Andaman fish

This appendix contains quotes about local branding, either in fisheries or in poor islands. Local branding for Andaman fish could give a sustainable boost to fisher livelihoods, on condition, of course, that the sustainability of fish is managed correctly.

On the Caribbean island of Tobago, a small group of local women have formed a loose **affiliation** to produce fruit preserves, jams and jellies, pepper sauce, herb seasonings, etc. under the **label** Taste of Tobago. They were assisted by the Caribbean Agriculture Research and Development Institute (CARDI) in food processing techniques and other support was provided by the Marketing Department of the Tobago House of Assembly. Their products have become **known** for their high quality, both locally and abroad, and recently won a European award.

Abdool and Carey 2004: Making All-Inclusives More Inclusive: A research project on the economic impact of the all-inclusive hotel sector in Tobago for the Travel Foundation.

Citizen groups are particularly demanding and active. Under this scenario, **fish farmers** become **actors** acknowledged for their efficient management of ecosystems. Its success is based on ... **local branding**. Fish farming benefits from **local** development plans, cultivates regional roots but must take considerable account of scrutiny ... of its practices and production conditions. Available at http://www.international.inra.fr/research/some_examples/possible_scenarios_for_french_fishing_2021

Local catch key to fisheries by Tim Bousquet

Our quote from Bousquet (2009) refers to a very different part of the world, but one where fishers have similar concerns. It is about Nova Scotia, Canada.

We can save Nova Scotia's fishing communities and the fish they depend on, by bringing the local food movement to the sea. On the one hand, Nova Scotia pretty much *is* fish. The human geography of the province consists mainly of hundreds of settlements built around the coves and inlets that stretch along our coasts. ... fishing has been the foundation of the local economy and fishing continues to be one of our primary industries. Moreover, those picturesque fishing villages are also the main lure of the tourist trade---another primary industry.

Our cultural geography is, likewise, constructed around fishing and the sea; from the ballads and songs about Nova Scotia to the decor of the student bars downtown, fishing serves as a cultural self-identifier.

February 26, 2009. From <http://www.thecoast.ca>

Appendix B: Fishers' stories

This appendix contains extensive extracts from a wonderful journal (Kerr, 2005), published about six months after the tsunami. They are provided here because they convey and illustrate the down-to-earth, real, **human side** of our rather abstract, statistical, factual, generalizations in our main article. (Our emphasis in bold.)

After the tsunami, a lot of NGOs, activists and professionals who'd cut their teeth on problems of urban poverty and housing suddenly found themselves plunging into the unfamiliar work of emergency relief and coastal village rehabilitation. The scale of the calamity meant that everyone's help was needed and **no time to be fussy about qualifications**. But as they got deeper into the work, a lot of these city folks found that the underlying forces at the seaside are not so different than those in the city after all. These fisher folk might have had better incomes and living environments than urban slum-dwellers, but **when the tsunami swept away their homes, families, friends, communities, boats and jobs, it left them poorer than anybody**. And like their urban cousins, **these battered fishing communities suddenly found themselves facing some of the same big, structural issues of land commercialization which push people out of the places they need to be to survive** - whether it be in the city or near the sea.

For these urban groups, the tsunami has been a development challenge on a gigantic scale. And some of the old techniques and organizing principles which have helped urban slum dwellers find solutions to serious problems of land tenure, housing and livelihood have come in quite handy in this dire, new seaside setting: techniques like network building, surveying, making space for people to come together and plan together, negotiating in blocks with government, model house exhibitions, using inaugurations ... to create alliances and showcase people's ideas.

Of course there's much need for help with rescue, medical aid, food, shelter and funds. But the **tsunami has shown that even badly traumatized disaster survivors can begin taking care of things** very early on, organizing themselves, coming together to talk, plan and work. Getting busy like this sets a healthy ball rolling which makes the long-term process of rehabilitation go much faster and better. Activity can be an excellent post-trauma therapy and one of the best antidotes to the helpless victim mind-set, which reduces formerly active people to passive recipients of what everyone else thinks they need.

The notion that disaster survivors need to be centrally involved in decisions about their own rehabilitation is not a radical new concept, but a lot of governments and aid organizations still don't get it. Disasters bring out a daddy-knows-best attitude in many of the best-intended state agencies and aid institutions.

There's no point waiting for the formal systems, with their bureaucracies and professionals, to solve the problems - the tsunami is too big, too sudden, too complex, too off-the-map for any of the conventional systems of governance to understand, much less deal with. So instead of waiting for the system to do what it can't do, it's possible for affected people to initiate things, find ways of resolving these huge problems in their own ways. The tsunami is proving that when this happens, people can show their societies ways of dealing with calamities and these **people-driven solutions can become part of the system**. Plus, **if the victims themselves, who know best what they need, are centrally involved in all aspects of relief and rehabilitation, there will be fewer aid mismatches, fewer conflicts, less waste**.

Natural disasters hit everyone in their path, rich or poor. But disaster relief and rehabilitation are seldom so democratic. The crisis in many disasters is that those with the right credentials get the aid coming through official channels, while those without don't: you need proof of residence to get a place in the relief camp, ..., title deeds to get housing compensation, registration certificates to get new boats, etc. In these ways, disaster aid can become an extension of the unbalanced power

structures which enriched some and impoverished and marginalized others in the first place. So another lesson in the Asian tsunami has been that the relief process must also target the untitled, the unregistered, the unlisted, ... and the undocumented, so they don't fall through the cracks. It may comfort some to think that land-grabbers are going to rot in hell for their sins against the poor, tsunami-battered fisher folk they are trying to dispossess. But in the here-and-now, imperiled communities need more than divine retribution to defend their turf and to convince a sometimes-greedy system that in fact, their villages, their livelihoods and their ways of life can co-exist quite nicely with development. They can only do that by developing pragmatic, workable solutions. And this involves gathering accurate information, preparing alternatives and using all the tools of networking, negotiation, good design, ecological sensitivity and persuasiveness to battle the powerful and unscrupulous commercial forces that are only too ready to use such catastrophes to eliminate obstacles in the way of their plans.

In Thailand, there was a lot of hand-wringing about overdevelopment and environmental destruction in tsunami-hit areas, and calls for more stringent shoreline planning regulations, ... But in southern Thailand, where tourism is law, **the greater threat** to tsunami-hit coastal communities comes not from environmental controls but **from economic forces**. In April, the government tabled a new bill that would create "special economic zones"... Then in June, the government's Designated Area for Sustainable Tourism Administration (DASTA) began drafting tourism development "blueprints" for several tsunami-hit areas, drawing more lines and readjusting land-use patterns **without consulting any local communities**, many of which were already exhausted from six months battling to keep their old land.

The alternative

Thailand's **embattled coastal fishing communities** with unclear tenure rights have also employed the strategy of reoccupying their former land and rebuilding as soon as possible, to **assert their rights** to the land, and to negotiate from a position of occupation. Especially in cases where powerful **business interests are making spurious ownership claims** to the villagers' land. And so far, in most of the cases, the reoccupation strategy has paid off, and the communities have been able to negotiate some kind of secure land rights, either through long-term lease, or land-purchase, land-sharing or relocation to nearby land.

The fishing villages along Thailand's Andaman coast have a long **history of being pushed around** in a titan's **game of money and power**. A lot of this land, especially in the worst affected province Phangnga, used to be public land. Despite being already occupied by long-established fishing villages, huge tracts of this land have been concessioned out over the past century for commercial exploitation, first to tin mining companies and later to shrimp farming interests. Now tourism is upping the pressure to chuck these perpetually vulnerable communities off their ancestral land. Many of the resorts where so many foreign tourists perished were built on land previously occupied by fishing communities. Those which survive have faced increasing threats of eviction. **The land status of most of the tsunami-hit communities is extremely precarious**. Some are on public land (under the control of many different ministries and government agencies and subject to many different policies), some are on national park land while others are on land being fought over by two owners or claimed by private businessmen. Though people have lived here for decades - even centuries - many have no title deeds or lease contracts, and therefore considered by some to be illegal squatters. Even within these villages, the tenure situation is a messy patchwork of murky tenure rights, conflicting claims of ownership, spurious land titles and criss-crossing land disputes.

What the tsunami has done is to tear open and aggravate all these already difficult issues of land: who determines how it's supposed to be used and who has the right to use it.

For the affected communities and their supporters, the biggest and most difficult post-tsunami project has now become finding ways to resolve the overlapping “traditional” land rights of these fishing villages, and the so-called “legal” land rights of the speculators, developers and politicians. **Post-tsunami land grab resumes in earnest just a few weeks after the waves.** For a while after the tsunami, there was a lot of hand-wringing in the press about the ravaged coastal ecosystems even before the waves, vanishing mangroves, illegal resort building, banished indigenous peoples and unrestrained capitalism. This rhetoric wasn’t much help for Andaman villagers, however, who found that after a very brief lull, the assault on their land rights was resumed with even greater energy and viciousness than before. Of the 47 villages destroyed by the tsunami, at least 32 are now embroiled in serious land conflicts - about half of these in the province of Phangnga. In the village of Ban Nam Khem alone, more than 80 court cases over disputed land have been filed since the tsunami, mostly by wealthy capitalists.

In recent months, variations on the same story have played themselves out in 30 or 40 villages, as armed thugs, policemen, officials and perspiring lawyers try to prevent villagers from returning to their land. And it’s not only private land-owners. In other cases, local administrative bodies have conjured up bogus civic projects or newfangled zoning plans as a pretext for preventing villagers from rebuilding houses on the public land they have occupied for ages. Because both local and national politicians have been partners in - or beneficiaries of - schemes to commercialize the Andaman coastline, the **government’s role in managing these public lands is deeply compromised by conflicts of interest.** To these powerful interests, the tsunami has been like a prayer answered, since it literally wiped the coast clean of the last communities which stood in the way of their plans for resorts, hotels, golf courses and shrimp farms. As far as they’re concerned, these ruined villages are now open land! Senator Chirmsak Pinthong, on a recent tour of tsunami-hit areas to investigate land rights, put it this way: **“The developers have tried before to chase people away. Now the tsunami has done the job for them.”** Under Thai law, squatters can apply for legal title to a plot of land after 10 years of continuous occupation. In practice, few succeed and millions of people around the country continue to live on what is technically public land in a kind of legal limbo, without papers, without clear rights. Speculators exploit this ambiguity by using various “informal” means to get land purchase records back-dated or documents issued in their names, and then accusing villagers of encroaching. **Battles over land title are common, particularly where tourist dollars are at stake.**

But the **voices of the fisher folk who want to go back to their land have become very strong now.** Newspapers are filled with stories of small fishing communities fighting the fat cats to reclaim their land and rebuild their lives. Their land problems have also come out in a series of well-publicized meetings and large seminars organized by different ministries and civic groups in the aftermath of the tsunami. Behind the scenes, people’s groups and prominent figures have also been lobbying government advisors and officials, on these people’s behalf. In these ways, **the issue of land for these traditional coastal communities has become much more open.** There is now more information, more discussion, more awareness of the needs of these fishing communities among all the groups involved in tsunami rehabilitation. All this public discussion has helped to slow down the land grabbing (and the eviction of traditional fishing villages) considerably.

“Our most urgent need is to repair our boats and replace our lost fishing gear so we can earn a living again.” (Ahlee Charnnam, a fisher from Koh Poo, Krabi). ... The government’s compensation scheme promised fishermen [money] who lost registered boats Thousands of the lost boats were not registered, however. In these cases, Deputy Prime Minister Suwat Liptapanlop announced magnanimously that “fishermen whose unregistered boats or fishing equipment were destroyed ... will get compensation equivalent to 70% of the actual damage, even though they have no right to claim compensation.”

Either way, it was officials deciding who got compensation and who didn't, leaving plenty of room for **manipulation** and **palm-greasing**. By February, only a fraction of fishermen with registered boats had got the compensation, while others were still going through endless red-tape to verify their claims. Anyway, all the fishermen agreed the compensation was too little to buy new boats or even to repair damaged ones.

It didn't take long for fishermen in many different areas to come to the same conclusion: that there was **no point waiting around passively for state assistance**. Their clearest need was to get their boats fixed (or built new) as soon as possible so they could get start earning their living again. But how?

As Hat Thip, the community leader in Sang Kha-U village says, "All of us fishermen used to know how to repair and even build our boats. But in many communities nowadays, we just buy our boats, so our skills have gotten rusty." That's why the Community Planning Network, the Save the Andaman Network (SAN) and CODI decided to support several of these communities by securing donation funding and hiring some local skilled boat-builders to work with the communities, and teach them how to build boats. These networks encouraged fishing communities to identify their needs, draw up their own restoration plans and manage them as a group. Boat-building and boat-repair was item number one on most villages' list. Promoting activities like boat building was not only a strategy for reviving the spirit of self reliance, but also a means of building villagers' collective strength to tackle other problems in the future.

The first community boat yards were set up at Sang Kha-U (on Koh Lanta Island in Krabi) and at Batuputeh (on Koh Libong Island in Trang). Word spread quickly, and by early March, about 20 boat yards were in operation in tsunami-hit villages. The number grew after the first boat-building exchange was organized in March, in which a big group of fisher folk from 10 coastal villages in Krabi and Phangnga came to see the boat-yard at the Sang Kha-U community and to learn about how to repair boats.

All these **boat-yards are managed by committees of local fishermen**, who make their own rules about how to use the grant funds and set criteria for who gets new and repaired boats first. In Ban Nam Khem, the town which lost the most boats, the boat yard they set up at the Bang Muang relief camp began with only ten fishermen and a seed grant of 100,000 Baht (US\$ 2,500) from CODI. This wasn't enough for a full boat (which costs 130,000 Baht), but it allowed them to start building right in the middle of this big, busy, much-visited relief camp. Two boat-builders from Krabi were hired, whom the local fishermen assisted and learned from. Once visitors could see this clear, concrete self-help activity, the Bang Muang boat yard became an **attractive target for donations** (especially from Toyota and Cement Thai) which allowed the boat-building fund to grow rapidly. Like many other groups, the Bang Muang fishermen adopted a system where the fishermen repay half the cost of their new boat as soon as they start fishing again. This money goes back into the fund to finance more boats.

In the first of March, the fishermen at Baan Nam Khem launched the first batch of 15 new fishing boats they had built themselves (out of a target of 300 new boats!). ... Before putting out to sea, the men gathered at the boatyard to pray and have their boats blessed with colorful pieces of cloth tied around the prow for good fortune. By mid-May, 34 community boat yards had been set up in the six affected provinces and 700 boats had been repaired or built, with another 1,300 damaged boats yet to finish. There is still a long way to go, and many are still in dire need, but it's a considerable dent in the problem.

The boat yards have given fishing communities devastated by the tsunami another common point for building their **networks for mutual support**. Buoyed by the renewed **sense of community**, many villages are extending their work with community boat yards to start providing boat repair services to other villages and setting up new collective projects such as **community fish markets**, to cut out the middlemen. Many of the villages have also learned from each other that setting up

community savings groups can help them with low-interest loans - and wean them from extortionate loan sharks as well.

“My boat is everything. My life totally depends on it. When the tsunami came, it destroyed our boats and put an end to everything for all of us. But now we have the boats back and our livelihood as well. We can go fishing again.”

(A fisherman from Ban Hualam Village on Koh Lanta Island, whose community boat-building group has almost finished rebuilding the 70 boats that were destroyed by the tsunami.)

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The Tsunami Threat - Research and Technology

Edited by Nils-Axel Mörner

ISBN 978-953-307-552-5

Hard cover, 714 pages

Publisher InTech

Published online 29, January, 2011

Published in print edition January, 2011

Submarine earthquakes, submarine slides and impacts may set large water volumes in motion characterized by very long wavelengths and a very high speed of lateral displacement, when reaching shallower water the wave breaks in over land - often with disastrous effects. This natural phenomenon is known as a tsunami event. By December 26, 2004, an event in the Indian Ocean, this word suddenly became known to the public. The effects were indeed disastrous and 227,898 people were killed. Tsunami events are a natural part of the Earth's geophysical system. There have been numerous events in the past and they will continue to be a threat to humanity; even more so today, when the coastal zone is occupied by so much more human activity and many more people. Therefore, tsunamis pose a very serious threat to humanity. The only way for us to face this threat is by increased knowledge so that we can meet future events by efficient warning systems and aid organizations. This book offers extensive and new information on tsunamis; their origin, history, effects, monitoring, hazards assessment and proposed handling with respect to precaution. Only through knowledge do we know how to behave in a wise manner. This book should be a well of tsunami knowledge for a long time, we hope.

How to reference

In order to correctly reference this scholarly work, feel free to copy and paste the following:

Suwat Tanyaros and David Crookall (2011). The 2004 Indian Ocean Tsunami: Impact on and Rehabilitation of Fisheries and Aquaculture in Thailand, The Tsunami Threat - Research and Technology, Nils-Axel Mörner (Ed.), ISBN: 978-953-307-552-5, InTech, Available from: <http://www.intechopen.com/books/the-tsunami-threat-research-and-technology/the-2004-indian-ocean-tsunami-impact-on-and-rehabilitation-of-fisheries-and-aquaculture-in-thailand>

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