

Preliminary Report:

Impacts of the Tsunami on Fisheries, Aquaculture and Coastal Livelihoods (as of 1700 hrs, 03 January 2005), NACA, Bangkok

This is a very early report of the impacts on coastal livelihoods of the Indian Ocean tsunami. It will be constantly built up as more information is included, and made meaningful with subsequent analyses. The purpose of this assessment effort is to determine the needed resources and efforts to quickly restore shattered livelihoods in the stricken communities. This is a preliminary assessment which will be updated daily. While every effort is made to ensure the information is as accurate as possible, FAO does not accept responsibility for the accuracy of the contents.

We are sharing this report with concerned agencies, organizations, institutions, groups, who are requested to build onto it and exchange the results so that in the ultimate we come up with a sharper, more focused and comprehensive assessment. The assessment should then be -- in consultation with other like-minded organizations, governments, communities, and other stakeholders -- translated into priority needs. The needs will be addressed by projects designed to provide the best possible impact on restoring shattered livelihoods and rehabilitating affected communities as well as the sources or bases for their livelihoods that may also have been seriously damaged.

The information in here is from India, Indonesia, Malaysia, Myanmar, Sri Lanka and Thailand. Information from Myanmar is from media reports, and information from Bangladesh and Maldives are absent as we have not received or found specific information on these countries. Loss of lives and property are being reported as light in the mass media in these 3 countries, but we shall include damages to their coastal livelihoods bases subsequently.

This report now consists of two parts: Part I is a qualitative, quantitative and graphic report of damages and Part II is an example of developing an indicative level of funding to rehabilitate or restore the sources of livelihoods that have been damaged. The case draws from published reports and what we know of Aceh and North Sumatra (from our Asia-Pacific Marine Finfish R and D Network).

For a more useful document, a third section should include a more detailed resource needs including technical assistance (costed, even if voluntary), technical support services, and infrastructure. It will not include direct grants of cash to families. A fourth section may be a set of priorities as a basis for formulating projects. We welcome suggestions.

In short the report suggests a framework to progress this assessment into a comprehensive and useful document for planning rehabilitation activities.

The sources of information including photographs are mentioned in the text. As of 03 Jan 2005, we have put together the qualitative and quantitative information found in the subsequent pages. **Sih Yang Sim and Pedro B Bueno, NACA**

Part I. Damages

INDIA

1. Report by B.Vishnu Bhat . JD (Aqua) MPEDA

- **West Coast**
 - Kerala: total loss is estimated around Rs. 149 lakh, at least 14 shrimp hatcheries affected covering 4 districts (Kollam, Alleppey, Ernakulam, and Kannur). Most of these are small-scale hatcheries, but some may have employed a few local workers who are now livelihood being affected.
- **East Coast**
 - Tamil Nadu: total loss is estimated at around Rs. 627 lakh, which including a 120 ha of small-scale shrimp farms in Nagapattinam and Karaikal (Pondicherry) districts, and 11 hatcheries.
 - Thirumullaivasal: 3 seabass hatcheries are badly affected, and one seabass farm is totally submerged. Estimation of the damages cannot be carried out as the water level has not gone down (5 feet).
 - Madras: compound wall of the lobster fattening centre was totally damaged.
 - Qulachal, Cape Comarin, Velankanni, etc.: many fishing villages in these areas loss human life, fishing boats, shelters and other belongings.
- **Andhra Pradesh**
 - Fishermen along 1,000 km coastline here were the worst hit by tsunamis. The majority of 104 people killed in the state were fishermen.
 - According to officials 400 fish tanks were damaged. Fishermen lost some 2,000 fishing boats and 47,370 nets.
 - Unofficial estimated loss at Rs. 500 million. The trawlers, fishing equipment and fish stored for exports were all damaged at Visakhapatnam.
 - A majority of nearly 300,000 fishermen were rendered jobless and they are estimated to be losing Rs. 50 million a day. Fishing is a major trade activity in coastal Andhra. The state produces 200,000 tonnes of marine fish every year.
 - Aquaculture farms over 400 acres were also damaged. The state's seafood industry accounts for 25-30 percent of India total seafood exports.
 - (Source: <http://www.newkerala.com/news-daily/news/features.php?action=fullnews&id=51744>)

2. Initial report from the BOBP-IGO Director (Dr Y.Yadava)

The fisheries sector in Tamil Nadu, Andhra Pradesh and Andaman & Nicobar Islands has suffered major damages - some firm estimates would be available only in the next 7-10 days, when the areas become accessible. Worst hit places like Nagapattinam have been closed (both entry and exit) fearing epidemics. BOBP-IGO is closely monitoring the situation through its NGO network. Similar damages to coastal marine fisheries and community have taken place in Sri Lanka and to a lesser extent in the Maldives. The following photos were provided by Dr.Y.Yadava of the damaged fishing boats.



3. Additional Information from India private sector (late breaking)

Following are the damages of Tsunami:

Shrimp hatcheries: In Kovalam, Marakanam and Pondy belt, most of the hatcheries have lost their pump houses, fencing etc., The affected hatcheries are Best Aqua, Raj and a new unnamed hatchery. In Oceanic hatchery, surface bores and pump houses were mostly hit.

In Poompukar area, Amalgam, Spencers/Bismi hatcheries were severely affected with damages to motors and pumps. The above is the situation at the State of Tamil Nadu.

In Andhra Pradesh most of the hatcheries were not much affected except Thupilipalem in Nellore District where some damages have been reported with Geekay, Coastal and Royal hatcheries.

The hatcheries at Chirala, Bapatla, Kakinada and Vizag were unaffected.

Shrimp Farms: Farms at Cuddalore, Chidambaram, Sirkali were severely affected with collapsed bunds and damaged pumps. The damage is very severe in Bismi, Amalgam and Spencer Farm. M&M /Maruthi Aqua farms lost their total entire crop. Shrimp farms in Vellar estuaries (Chidambaram, sirkali) were heavily damaged from seawater inundation. Farms in Muthupet (Mangrove area) were also water logged. Sea based farms in Tharangampadi, Vedaranyam, Nagapattinam, Velankanni were severely hit by tsunami with their bunds obliterated and their equipment including motors and pumps destroyed.

Casualties: Mr. Vijayakumar, Technical Assistant at Muttukadu Hatchery of CIBA lost his life. Mr. Murugan, Farm Technician in Vedaranyam was also caught in Tsunami and expired.

Missing: Few seafood processing workers went for purchasing shrimp in Vedaranyam area had been missing. They were employed in Aswini Cold Storage, Chennai.

Capture Fisheries: Most of the fishing boats were broken, also crippling capture fisheries especially in Pazhayar, Poompugar and Vanagiri area. In this regard, shrimp broodstock collection would also stop, impacting adversely on the likelihood of having a crop in the next season. Sea catches will come down because of damages to fishing boats/vessels.

4. Other Related News - India

Poor fishermen get back to sea

SOWMYA AJI MEHU

TIMES NEWS NETWORK [SATURDAY, JANUARY 01, 2005 10:28:19 AM]

BANGALORE: Even as heart-rending stories of tsunami deaths and devastation are sweeping the South, poverty has forced Karnataka's fear-stricken fishermen back into the sea at the dawn of the New Year.

The 1.75 lakh fishermen, who live in hamlets along Karnataka's 356 km coastline, are among the poorest of the state's citizens. They lead a hand-to-mouth existence entirely dependent on the day's fishing.

Over the last six days, with the Karnataka administration issuing tsunami warnings, an alert all along the coastline and evacuating people from the beaches, fishing on the West coast has come to a near-total halt. "This is the fishing season. Any loss of fishing days means the fisherman loses the day's turnover," fisheries director H S Veerappa Gowda told TOI.

<http://timesofindia.indiatimes.com/articleshow/977629.cms>

Isolated Indian Fishing Villages on The Bay Of Bengal Hit Hard By the Recent Tsunami Face Monumental Task of Rebuilding Homes, Boats, Nets and Other Equipment and Caring for Those Who Lost Loved Ones

PONDICHERRY, India, Jan. 1 /PRNewswire/ -- An Indian non-governmental organization (NGO) that implements HIV/AIDS prevention, education and treatment programs in all 35 states of India and its Union Territories is using its medical expertise, its national network and its long-term presence in local villages to facilitate the distribution of relief supplies and to initiate reconstruction efforts, following the tsunami that devastated coastal regions of India on the Bay of Bengal.

Among the hard-hit fishing communities in the Union Territory of Pondicherry (on the Bay of Bengal in Southeast India) the NGO, FXB India -- the national branch of the worldwide Association Francois-Xavier Bagnoud (FXB) that implements 87 HIV/AIDS programs in 18 countries -- is helping the local government to distribute food packets, drinking water, medicines, clothing and a support-in-cash in the villages of Kanagachettikulam, Periya Kalapet, Chinna Kalapet and Pillai Chawadi where FXB programs exist.

A quick survey of damage done by the tsunami showed that in these villages:

- * Nearly 500 houses have been totally destroyed in the havoc.
- * About 1,000 families have lost their belongings.
- * More than 2,000 people are absolutely homeless and displaced.
- * Nearly 250 mechanized boats (including outboard & in-board motor boats) and 280 country crafts (catamarans) are either fully or partially damaged and most of the fishing nets and other accessories were destroyed. Many of the fishermen estimate that it will take at least three months for them to venture into the sea again.

In the medium and long-term, there is an urgent need to:

- * Facilitate the reconstruction of houses,
- * Repair boats, catamarans and trawlers,
- * Repair or provide new nets,
- * Provide educational aids for school going-children and healthcare facilities especially for children.
- * Offer grief counseling, care and support for the victims of the tsunami.

Kerala fishermen devastated by tsunami

Fishing communities in Kerala districts, which were thrashed by the December 26 tsunami waves, are desperately trying to get things back to normal.

The fishing community living along the coastline is the worst affected by the tsunami disaster.

Battered by the tsunami waves, the once idyllic town of Allapad in Kollam district now resembles a ghost town.

Sea wrecks havoc

Eighty of the 160 people who died in Kerala are reported to be from Allapad. The fishermen who survived have fled the village. The whole town is tangle of torn fishing nets and broken boats.

"The water came and climbed over the coconut trees. That was the height of the waves, which washed away everything," said Shahzi, a fisherman.

"We are in a state of utter and complete depression. We have no home, no clothes and no livelihood. Where shall we go?" he asked.

"We are now scared to go into the sea and our families and government too are preventing us from going," said another fisherman.

<http://www.ndtv.com/template/template.asp?template=Tsunami&slug=Kerala+fishermen+devastated+by+tsunami&id=66183&callid=1&category=National>

<http://www.mcot.org/query.php?nid=33701>

Indian fishermen to stick by sea despite tsunami

The tsunami hit India's fishing community hardest as the southeastern coast is dotted with small fishing villages with poorly-constructed houses -- some made of brick and bad quality concrete -- and shacks located right on the beach.

Many of these were sitting ducks for the tsunami.

An initial estimate by authorities in Tamil Nadu state showed that around 85 percent of the nearly 700,000 people displaced in the state were fishermen or their families.

Most of the dead were women and children who could not scramble fast enough to escape the waves. About 100,000 fishermen homes and some 40,000 boats were badly damaged.

<http://www.alertnet.org/thenews/newsdesk/B200420.htm>

Relief work needs direction

By: Shradha Sukumaran

January 2, 2005

Tamil Nadu

Suyam has adopted three interior villages in Akkarapettai panchayat in Tamil Nadu's worst hit area Nagapattinam where 12,000 people have died. Muthuram points out that the area needs provisions for the kitchen systems that the relief workers are providing each family with.

Each catamaran costs Rs 10,000 to replace and fishnets between Rs 5,000-10,000. Suyam has toured Velankani, Kameshwaram and Meenawar colony and feel that victims need to cook their own food, build the boats themselves.

<http://web.mid-day.com/news/nation/2005/january/100672.htm>

INDONESIA

Information on estimated damages to fisheries, aquaculture and coastal livelihood in Northern Sumatra is still very limited due to poor accessibility to the area by fisheries officials. Indonesian contacts of NACA, with the Directorate General for Aquaculture, have informed NACA a team is in Sumatra. We are expected to receive more damage reports early January 2005.

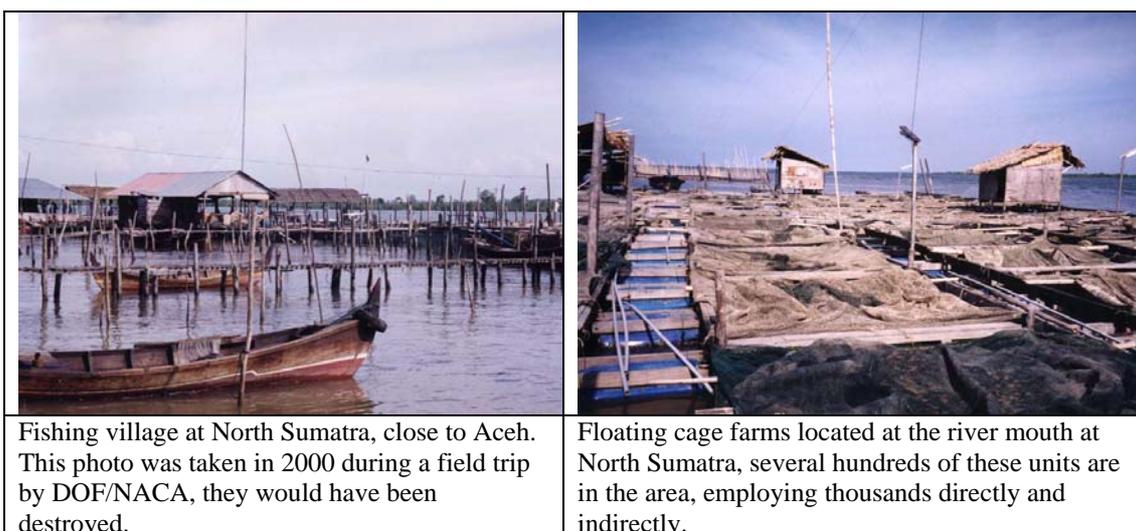
Early status report on the facility, Regional Centre for Brackishwater Aquaculture - Ujung Batee in Aceh said 20 houses destroyed, extensive damage to center, and 3 staff members or family members dead (*By Maya Sudjarwo, Director for International Cooperation, DGA, Indonesia*).

Potential damages:

The following information indicates potential losses based on published “pre-tsunami” information on the status of cage culture in the area:

North Sumatra – West Coast Region

The area available for marine fish farming was almost 400 ha, mostly in Central Tapanuli and Sibolga districts (Tapien Nauli Bay). In 1989, there were only 14 cage farms, but by 1994 the number had increased to 398 (Robert Napitupulu, 1998). Since the development of grouper hatchery production technology by the Research Centre for Mariculture-Gondol and other development centers (Lampung, Batam and Situbondo), grouper fingerlings from hatchery have become more readily available and abundant, which stimulated the rapid expansion of grouper farming in Indonesia from 2002. It is very likely that the number of farms in North Sumatra, by the date of the tsunami, was in excess of 1,000 farms. A cage unit (4 cages) usually employs 2 people. Many of the farms have more than 4 and up to 20 cage units.



Fishing village at North Sumatra, close to Aceh. This photo was taken in 2000 during a field trip by DOF/NACA, they would have been destroyed.

Floating cage farms located at the river mouth at North Sumatra, several hundreds of these units are in the area, employing thousands directly and indirectly.

Indonesia Aquaculture Statistics 2002, Directorate General of Aquaculture 2004

The number of aquaculture households by type of culture in Sumatra Province in 2002

Districts	Total	Marine culture	Brackishwater pond	Freshwater pond	Cage	Floating cage net	Paddy field
Nangro Aceh Darussalam	23,339	--	12,514	5,234	39	--	5,552
North Sumatra	34,689	447	1,633	10,969	329	992	20,319
West Sumatra	56,088	--	2	49,637	1,118	1,335	3,996
Riau	21,113	4,937	585	11,453	4,118	--	20
Jambi	15,758	--	820	11,914	1,243	1,508	273
South Sumatra	22,901	--	375	9,245	4,751	--	8,530
Banka Belitung	1,588	20	120	19	--	1,429	--
Bengkulu	3,193	--	66	703	46	--	2,378
Lampung	41,251	90	18,536	15,425	1,047	213	5,940
Total	219,920	5,494	34,651	114,599	12,691	5,477	47,008

Aquaculture areas and the number of aquaculture household and farmer in Sumatra Province for 2002

Districts	Number of fish farmers	Number of households	Aquaculture areas	
			Gross Area	Net Area
Nangro Aceh Darussalam	47,096	23,339	40,970	26,310
North Sumatra	82,694	34,689	26,051	23,065
West Sumatra	97,180	56,088	8,118	8,982
Riau	31,192	21,113	3,529	3,143
Jambi	24,936	15,758	3,075	2,543
South Sumatra	29,347	22,901	4,514	4,420
Banka Belitung	1,916	1,588	517	506
Bengkulu	6,690	3,193	1,610	1,534
Lampung	86,030	41,251	60,641	26,113
Total	407,081	219,920	149,025	96,616

Aquaculture Production by type of culture in Sumatra for 2002 (mt)

Districts	Total	Marine culture	Brackishwater pond	Freshwater pond	Cage	Floating cage net	Paddy field
Nangro Aceh Darussalam	27,449	--	22,292	2,764	180	--	2,213
North Sumatra	43,960	489	22,651	10,718	379	3,497	6,226
West Sumatra	27,922	--	--	17,141	4,562	4,401	1,818
Riau	26,491	7,095	1,050	15,974	2,362	--	10
Jambi	6,208	--	1,452	2,263	1,159	1,308	26
South Sumatra	35,703	--	14,377	11,368	5,769	--	4,189
Banka Belitung	315	77	121	115	--	2	--
Bengkulu	4,341	--	722	1,767	381	--	1,471
Lampung	34,122	136	23,610	8,934	130	299	1,013
Total	206,511	7,797	86,275	71,044	14,922	9,507	16,966

Aquaculture Production by type of culture in Sumatra for 2002 (Rp.1,000,000)

Districts	Total	Marine culture	Brackishwater pond	Freshwater pond	Cage	Floating cage net	Paddy field
Nangro Aceh Darussalam	481,016	--	403,478	39,825	1,888	--	35,825
North Sumatra	1,511,881	32,885	1,246,324	146,267	2,806	25,075	58,523
West Sumatra	322,214	--	--	230,904	38,607	33,022	19,681
Riau	676,382	426,436	46,139	179,087	24,630	--	90
Jambi	119,877	--	47,406	53,265	8,951	10,092	163
South Sumatra	1,075,889	--	909,258	126,452	370	--	39,809
Banka Belitung	13,745	6,713	6,005	1,012	--	15	--
Bengkulu	79,905	--	32,898	22,169	4,037	--	20,801
Lampung	1,023,659	14,230	895,868	101,560	909	1,803	9,289
Total	5,325,168	480,264	3,587,375	900,543	102,717	70,807	184,181

MALAYSIA

The northern states of west coast peninsular Malaysia are badly affected. About 5,200 fishers with estimated loss of RM 29.3 million; 155 fish farmers with estimated loss of RM23.9 million are affected. The government is giving RM 500 per family as initial help (*From the DG Fisheries, Malaysia*).

Floating cage farms at Tanjung Dawai (Penang) were very severely damaged, farmers lost everything, their cages smashed by the tsunami. Floating cage farms at the south of Bukit Tambun area were wracked, and estimated loss of around RM 10 million. At

Pulau Aman, some cages were damaged with loss of fish (*a report from Dr. Leong Tak Seng, Penang*).

The photos below show examples of facilities and structures that would have been washed away.



Floating cage farms in Kedah which grow various marine fish species located at the river mouth may already have been destroyed by the tsunami. These big scale operations employed hundreds of people from the local community.



Small fishing village which is by the river mouth in Kedah. The tsunami would have destroyed the houses, fishing boats and the coastal fishery resources.



Fishing ground for bivalves and floating cage farms (behind), in Penang providing livelihoods and income for many would all have been destroyed by the tsunami.



Dead groupers littering a Penang beach, most likely from aquaculture (because of their uniform size).
From a CNN website.

MYANMAR

Myanmar fishing village 'swept away' by killer tsunami

KHA PYAT THAUNG, Myanmar: A Myanmar seasonal fishing village of some 600 people was swept into the sea by killer tsunamis, leaving 17 dead and scores of families with nothing but shattered lives.

The village, 220 miles (352 kilometres) southwest of the capital Yangon in Ayeyarwaddy division, sprang up barely a month ago as families built bamboo and thatch huts for the post-monsoon fishing season.

The government has put the country's death toll at 53, with 21 still missing, 17 seaside fishing villages destroyed and some 778 people homeless.

Casualties were reported heaviest in Ayeyarwaddy and in southernmost Tanintharyi division which borders Thailand. Rakhine state in the west also reported casualties, with the Co Co islands off the coast particularly hard hit, the UN said.

There was particular concern about fishing communities and the ethnic Salone and Moken, commonly referred to as sea gypsies, a UN official told AFP.

Fisherman Maung Maung, 36, told AFP he had been out to sea with seven other men on a trawler when they were caught by the wave and capsized.

"All our boats overturned but we managed to hold on and keep afloat until rescue arrived," he said.

http://www.channelnewsasia.com/stories/afp_asiapacific/view/125398/1/.html

SRI LANKA

The initial broad assessment of the Chairman of the NACA Governing Council who is the Director General of Fisheries Development was that their "fishery industry has been pushed back to its 1950 status".

No information is available yet on estimated damages on the affects of tsunamis to fisheries, aquaculture and coastal livelihood. Follow up with NACA Governing Council Chairman and TAC members is being conducted.

THAILAND

1. Director General Statement – Department of Fisheries, Thailand (Dec 30)

Six provinces facing the Andaman Sea which were hit hard by the tsunamis are Ranong, Phang-gna, Krabi, Phuket, Trang and Satun. The damages on fisheries and aquaculture are estimated at 1.753 billion baht. Some 2,818 fishing boats were either damaged or total wrecked. Some 27,409 floating cages for fish farming in these 6 provinces were damaged or totally lost. Details of damages and losses reported by DOF Thailand are listed below:

Fishing Boats – total number 2,818, lost of a total Baht 476 million

- Phuket: 981
- Phang-nga: 600

- Satun: 580
- Krabi: 401
- Trang: 176
- Ranong: 80

Floating cage Farms – total 27,409, lost of a total Baht 1.28 billion

- Phuket: 2,415 cages
- Krabi: 4,205
- Phang-nga: 6,000
- Satun: 7,167
- Trang: 394
- Ranong: 4,228
- Other areas: 3,000

The following photos, taken at various times before the tsunami likely destroyed them, illustrate the source of immediate livelihoods, direct and indirect employment opportunities in these rural communities that have been lost.



Small-scale floating cage farms in Krabi, this photo was taken in February 2004. This location is most likely to be one of the areas affected by tsunami, due to its proximity to the sea.



Happy fish farming lady in Krabi who liked to help small fishermen by buying their catches. Is she still capable of helping others? What kind of assistance does she need as well?



Floating cages in Satun close to the open sea, these small-scale farms would not have escaped



Small-scale fishermen in Satun area. Do they still have their boat? In the short and medium term

the destructive force of the tsunami.

would they have fish to catch?



This is one of the fishing village in Phang-nga bay area under TDH/DOF/NACA project, severely affected by the tidal wave. The community lost their fishing boats, and cages, and shelters have been damaged.



Small-scale floating cage farms in Phang-nga bay area which would surely been damaged by tsunamis.

2. TDH Project to Develop Seafarming Opportunities for fishers and coastal families: by Mr Alessandro Montaldi, Project Manager (Dec 27) **The project was provided technical assistance by NACA and DOF**

“The project office in Phang Nga was destroyed along with all equipment and documents. Nobody was harmed as it was a Sunday and none was working. The news we receive from the diving and boat industry is terrifying, with death tolls estimated by the thousands. We had just ended a week-long update survey by boat in Phang Nga and Phuket on mariculture activities, with so many changes and new features installed. Most are gone. At Sarasin bridge a Thai-Taiwanese farm and hatchery bred *Plectropomus* spp. from Taiwan has gone. Cages are broken and all the fish have escaped. Most small-scale fishermen in the inner Phang Nga Bay have lost boats, nets and cages, while a more devastating scenario can be seen along the ocean coast of Phang Nga and Ranong. Most villages swept away, Kao Lak completely destroyed with loads of corpses still floating offshore. All cages have gone in Satun and Trang, plus boats and gears. It is ground zero for tourism and seafarming. I decided in consensus with TDH headquarters to suspend the project for the moment and dedicate resources to the emergencies and first reconstruction of small-scale fisheries. We will try to do everything we can, even if the conditions now are still quite chaotic. Even today we had to run away two times from the shoreline based station and villages on false alarms of aftershocks waves. It is the greatest devastation ever for many Asian coastal communities and businesses. Please do something about that through NACA.”

3. Other Related News – Thailand

Plan to help fishing villages drawn up

According to an initial survey, altogether about 20,000 fishing families and 2,000 trawlers were affected by the tsunamis in Ranong, Phangnga, Phuket, Krabi, Trang

and Satun provinces.

Hamron Mukhura, of the Friends of the Andaman group, said several of the affected fishing communities have received zero assistance so far due to communication and transport problems, while some are not even listed for help.

“The tsunamis have inflicted so much destruction and left fishermen, whose very lives depended on their fishing trawlers, with nothing,” he said.

http://www.bangkokpost.com/News/02Jan2005_news06.php

Part II. Magnitude of Funding Required for Rehabilitation

As mentioned above, this section provides an example of assessing and determining the level of funding required to rehabilitate destroyed sources of livelihoods. The first example is on cage structures which are a production unit, the second is on hatcheries which are support facilities.

Indicative cost of re-establishing facilities for livelihoods

The attached costs and return estimates for cages and small-scale multipurpose hatcheries can be used to estimate the direct costs to restore or set up in new coastal areas cages and hatcheries (Annex 1 and 2) .

We are using this case below as an example of estimating losses and estimating the level of funding needed to restore what has been lost.

Based on the statistics from Indonesia, the first table below shows the number of fishfarming households, their production level and the value of the production.

Synthesis of Coastal Aquaculture* Statistics Based on Directorate General for Aquaculture Official Statistics for 2002

Districts	Household Number	Production (mt)	Income (Rp. 1,000,000)
Aceh	18,066	24,505	439,303
North Sumatra	23,391	32,863	1,362,807
Total	41,457	57,368	1,802,110

* “Coastal aquaculture” includes marine culture, brackishwater pond culture, floating cages, and paddy field for small-scale integrated aquaculture.

This table assumes a severity of damage of 50% in Aceh and 30% in North Sumatra. This assumption (needless to say should have to be “ground-truthed” gives a picture of how many fishfarming households were affected and the loss in production volume and its value.

Calculation of Coastal Aquaculture Livelihood Impact by Tsunamis (based on an assumed level of severity)

Districts	Assumed damage	Households affected	Production loss (mt)	Income loss (US\$)*
Aceh	50%	9,033	12,253	24,405,778
North Sumatra	30%	7,017	9,859	45,426,889
Total		16,050	22,112	69,832,667

* US\$1 = Rupiah 9,000

The data from published sources give the following information:

a. Cost of rehabilitating production cages:

The total floating cage production for these two areas is 3,497 (mt). It is common for a small-scale floating cage farm to produce around 300-400 kg (average 350 kg) of fish from a 3x3x3m net cage. Thus to produce 3,497 mt of fish requires a total of around 10,000 net cages.

The assumed severity of damage would yield a total of 4,000 net cages (40%) destroyed. To rehabilitate these damaged cages a total of 1,000s unit floating cages is needed (i.e. 1 unit = 4 cages). A unit of floating cage farm requires US\$ 24,000 or US\$ 6,000 per cage. For 1,000 units a total of US\$6 million is needed.

This is a rough but illustrative estimation but it should be pointed out that the US\$6 million in this calculation is only the capital investment. Operating expenses are not included. Annex 1 - Small-scale floating cage farm model -- gives the details of operating costs. The model is based on the production of groupers (a high value food fish). Should if lower value, low input species such as milkfish, seabass, or tilapia are the targets, operating expenses would be lower.

b. Cost of establishing support facilities i.e. hatcheries:

The seed requirement of 4,000 cages is 1 million fingerlings, which is required to produce 350 kg of fish (500 gram apiece) per cage per year at an estimated survival rate of around 70%.

Produce 1 million grouper fingerlings will require a total of about 40 small-scale hatcheries with an annual production of 25,000 fingerlings each. Annex 2 shows a small-scale hatchery economic model.

The total investment (both capital and operating expenses) for each small-scale hatchery is around US\$5,000. Thus, building or rebuilding 40 small-scale hatcheries would need US\$ 200,000 is needed.

Small scale hatcheries in Indonesia obtain fertilized eggs from government hatcheries, which were not affected. They hatch and rear the fertilized eggs for eventual sale to growers. A hatchery is therefore a livelihood activity by itself for a household.

All these calculations are rough estimations. And it may not be necessary for all of the cage farms to produce high value food fish species such as grouper. It would be

urgent to produce a lot of low-cost fish, should the tsunami wave also destroyed the corals and breeding grounds of the usual wild species that the fishers used to catch. For food security other species such as milkfish and tilapia may be good alternatives. For these low value species investment are lower and culture systems other than cages can be used, for example earthen ponds.