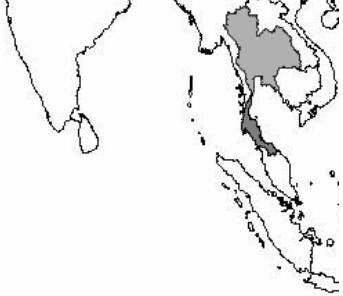




The Economic
Impact of the 26
December 2004
Earthquake &
Indian Ocean
Tsunami
in Thailand





I. Introduction

a) Background

A powerful earthquake of magnitude 9.5 in the Richter scale, with epicenter located just off the Northern part of the island of Sumatra, occurred in the early hours of 26 December 2004. It created a tsunami that expanded over the Indian Ocean and affected the coastal areas of many countries in Asia and Africa.

Estimates of the economic and social impact of the disaster were undertaken under the leadership of the World Bank in Indonesia¹, Sri Lanka², Maldives³, and India⁴. In Thailand, however, only individual sector assessments as well as preliminary global assessments of the macroeconomic impact were carried out by different government institutions, in some cases with assistance from international organizations⁵. Thus, no comprehensive assessment is available for the entire Thailand nation.

The Asian Disaster Preparedness Center (ADPC) undertook a comparative study of the economic impact of the tsunami in the entire region, with a view to identifying common vulnerabilities and risks whose solution may be best approached in a cooperative fashion and thus generating significant economies of scale for the countries.

As part of the regional study, ADPC first undertook the estimation of the total amount of damage and losses sustained by Thailand. This report describes the methodology, assumptions and results of such estimation.

b) Methodology and Authorship

In order to make ensure the validity and accuracy of results in the comprehensive estimation for Thailand, and their compatibility with the available assessment of the other countries, ADPC resorted to the use of a damage and loss assessment methodology developed originally by the United Nations' Economic Commission for Latin America and the Caribbean (ECLAC)⁶, which was also used – to a varying extent – in the national assessments undertaken under the leadership of the World Bank.

The ECLAC methodology enables the estimation of the replacement value of destroyed physical assets as well as the estimation of economic losses arising from the temporary

¹ See World Bank and BAPPENAS, *Indonesia: Preliminary Damage and Loss Assessment; The December 26, 2004 Natural Disaster*, Bangkok, January 2005.

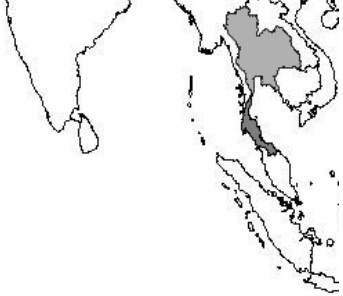
² See World Bank and Others, *Sri Lanka: 2005 Post-Tsunami Recovery Program, Preliminary Damage and Needs Assessment*, Colombo, January 2005.

³ See World Bank and Others, *Republic of the Maldives; Tsunami, Impact and Recovery*, February 2005.

⁴ See World Bank and Others, *India, Post-Tsunami Recovery Program; Preliminary Damage and Needs Assessment*, New Delhi, March 2005.

⁵ These references will be quoted separately in the appropriate chapters of this report.

⁶ See ECLAC, *Handbook for Estimating the Socio-Economic and Environmental Effects of Disasters, Four Volumes*, 2003.



absence of the assets. The resulting figures are subsequently used to estimate the impact of the disaster on the macro-economic performance of the country.

Original information used in the sectoral assessments undertaken by the Government of Thailand as well as by international organizations was collected. In addition, statistical data in regard to sectoral and global development was obtained. These data were processed using the aforementioned ECLAC methodology.

Reports were collected from, and/or interviews were held with, *inter alia*, the following official organizations:

- Bank of Thailand
- Ministry of Finance
- National Economic and Social Development Board (NESD)
- Department of Disaster Prevention and Mitigation (DDPM)
- Tourism Authority of Thailand (TAT)
- Ministry of Agriculture and Cooperatives (MOAC)
- Ministry of Education
- Airports of Thailand (AOT)
- Department of Highways
- Provincial Electricity Authority (PEA)
- Provincial Water Works Authority (PWA)
- World Bank
- Food and Agriculture Organization (FAO)
- World Health Organization (WHO)

For this analysis, as well as for the comparative regional study, ADPC engaged the services of international consultant Roberto Jovel, who led the development and recent updating of the ECLAC methodology. Mr. Jovel has been leading the simplification and adaptation of the methodology to the local conditions of the State of Gujarat, India, under a project financed by the World Bank and executed by ADPC. Mr. Jovel has also prepared this report. ADPC personnel assisted him in the collection and processing of information from primary and secondary sources.

II. The Social Sectors

a) Population Affected

The waves of the tsunami slammed the coastal areas of the Andaman Sea coastal provinces of Krabi, Trang, Phang Nga, Phuket, Ranong and Satun. Of these, Phang Nga was the hardest hit.

The number of deaths and injuries sustained in each province is listed in the following table, as prepared by the Department of Disaster Prevention and Mitigation (DDPM)⁷.

Table 2-1
Number of Deaths and Injuries Caused by the Tsunami

Province	Number of deaths*				Number of Injured
	Thai	Foreign	Unknown	Total	
Krabi	672	435	161	1,268	1,376
Trang	4	2		6	112
Phang Nga	2,654	2,229	997	5,880	5,597
Phuket	398	474	17	889	1,111
Ranong	162	6	4	172	246
Satun	6			6	15
Total	3,896	3,146	1,179	8,221	8,457

Source: Department of Disaster Prevention and Mitigation (DDPM)

* The number of missing persons has been added to the number of deaths

The above data reveals a very high proportion of foreign nationals that died in the disaster, no doubt due to the large amount of foreigners that visit the resorts and hotels located in the affected area. It is also worth noting that, due to the special characteristics of the disaster, many of the dead have not been identified or reclaimed by their relatives.

When the number of households and persons directly affected in their assets is considered, there exists a similar pattern as shown above, in that most affected were the provinces of Phang Nga, Krabi and Phuket, in descending order (See table 2-2 below)

⁷ See DDPM, *Loss Assessment by Tsunami and Earthquake from Provinces (Data as of June 10, 2005)*.

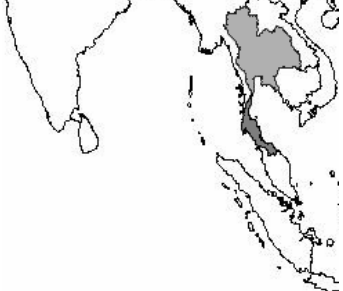


Table 2-2
Number of People Directly Affected by the Disaster

Province	Number of Directly Affected	
	Persons	Households
Krabi	15,812	2,759
Trang	1,302	1,123
Phang Nga	19,509	4,394
Phuket	13,065	2,616
Ranong	5,942	1,509
Satun	2,920	414
Total	58,550	12,815

Source: Department of Disaster Prevention and Mitigation (DDPM)

b) Housing

The waves of the tsunami destroyed or damaged many housing units, their associated domestic infrastructure, and the household goods and equipment contained therein. Many persons were forced to flee and were housed in temporary camps until the reconstruction and repairs can be effected.

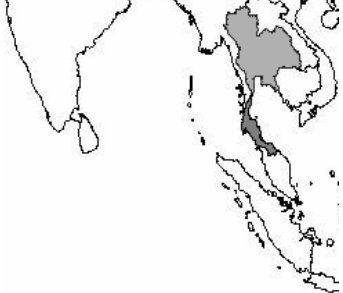
Estimates were made of the replacement value for the destroyed housing units, and of the repair cost for the damaged homes. Furthermore, the value of the associated tertiary infrastructure and of the household goods and equipment were also estimated. For this, prevailing construction and equipment costs were adopted and adjusted⁸.

Table 2-4
Estimated Damage to the Housing Sector

Province	Number of Housing Units*		Value of Damage, Million Baht			
	Destroyed	Damaged	Reconstruct	Repair	Household Goods	Total
Krabi	396	262	59.4	18.3	11.6	89.4
Trang	34	156	5.1	10.9	2.4	18.4
Phang Nga	1,904	604	333.2	51.3	92.3	476.8
Phuket	742	291	152.1	29.1	45.3	226.5
Ranong	224	111	33.6	7.8	6.2	47.6
Satun	2	80	0.3	5.6	0.9	6.7
Total	3,302	1,504	583.7	123.1	158.7	865.5

* Source of housing data: DDPM; Damage estimated made by Consultant.

⁸ The following average unit costs were adopted: Reconstruction, 150,000 Baht per home in Krabi, Trang, Ranong and Satun; 175,000 Baht in Phang Nga; and 205,000 in Phuket. Repair: 70,000 Baht in Krabi, Trang, Ranong and Satun; 100,000 in Phuket and 85,000 in Phang Nga. The percent value of household goods was 15% in Krabi, Trang, Ranong and Satun; 24% in Phang Nga, and 24% in Phuket.



The total value of damage to the housing sector has been estimated at 865 million Baht, as described in table 2-4 above.

c) Education

Schools located near the coastal areas sustained total or partial destruction as well as damage to their furniture, equipment and educational material. Classes were suspended for limited period of time, which will be recovered at the end of the school year. It was fortunate that the tsunami occurred during the weekend; otherwise the number of children directly affected would have been significantly higher.

According to the Ministry of Education, a total of 5 schools were fully destroyed, and 51 more were slightly damaged. The furniture, equipment and education materials were considerably destroyed. The estimated amount of damage is described in the following table.

Table 2-5
Estimation of Damage in the Education Sector

Province	Number of Schools		Damage, in million Baht		
	Destroyed	Damaged	Bldg	Furniture	Total
Krabi	1	11	44.6	0.5	45.1
Trang		3	2.6		2.6
Phang Nga	3	4	32.8	91.0	123.8
Phuket		5	77.3	33.4	110.7
Ranong	1	10	17.5	9.0	26.5
Satun		18	31.6		31.6
Total	5	19	206.3	133.9	340.2

Source: Ministry of Education

e) Health

Very limited damage was sustained by the health sector facilities, and they were able to provide the services that were required after the tsunami, and met the increased temporary workload. The sector incurred into post-tsunami expenses for the treatment of psychologically affected persons. It was estimated that a total of 115 million Baht was used to cover post-tsunami activities in the sector.

III. Productive Sectors

Damage and losses were sustained by the productive sectors of agriculture and livestock, fisheries and aquaculture, agro-industry, commerce and tourism.

a) Agriculture

The waves of the tsunami reached agricultural lands located near the coastline of the six affected Provinces. The standing crops were either washed away or negatively affected by the salt content of the water deposited in the soils. Some semi-permanent plantations – such as oil palms and coconut trees – were uprooted by the action of the waves, and will require re-planting. The surface area of each crop affected is given in Table 3-1.

Table 3-1
Agricultural Area Affected by Tsunami in Thailand

Province	Rice		Other Crops		Plantation	
	Area, Rai	Area, Hectares	Area, Rai	Area, Hectares	Area, Rai	Area, Hectares
Krabi	15	2.4	5	0.8	40	6.4
Trang	100	16.0	167	26.7	21	3.4
Phang Nga	37	5.9			8,369	1,339.0
Phuket	10	1.6			80	12.8
Ranong	184	29.4	11	1.8	1,430	228.8
Satun	122	19.5			387	61.9
Total	468	74.8	183	29.3	10,327	1,652.3

Source: Ministry of Agriculture and Cooperatives (MOAC) and FAO

The resulting impact on production includes the loss of the standing crops, as well as reductions in productivity the following two years, especially in the case of the most salt-sensitive crops and plantations. In addition, the cost of replanting oil palm plantations that were uprooted must be taken into consideration.

Estimates of the value of the standing annual and plantation crops that were destroyed by the tsunami were made based on the extent of the area affected (See table 3-1), and average unit yields and average unit prices taken from the agricultural statistics yearbook⁹. It was assumed that future production in these soils in 2005 would be diminished by 10% from their average values, due to the residual salt content. In the case of plantations, the value of damage and losses was estimated as the cost of replanting 18% of their affected area¹⁰; the value of standing production at the time of the disaster and a reduction of 10% in future production in 2005 and 2006 due to salinity; and the production that would not be obtained in two years until the replanted trees reach maturity.

⁹ See Office of Agricultural Information, *Agricultural Statistics of Thailand, 2003 and 2004*, Ministry of Agriculture and Co-operatives, Bangkok.

¹⁰ An average cost of replanting of US\$ 25,000 per hectare was assumed for these estimations.

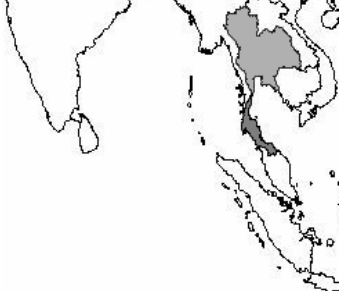


Table 3-2
Estimated Value of Damage and Losses in the Agriculture Sector
(Thousand Baht)

Type of Crop	Damage to Assets	Production Losses			Total Impact
		Standing Crop	Future Losses	Total	
<u>Plantation Crop</u>	<u>279,000</u>	<u>68,572</u>	<u>26,140</u>	<u>94,712</u>	<u>373,712</u>
Plantations	279,000	--	--	--	279,000
Production	--	68,572	26,140	94,712	94,712
<u>Annual Crops</u>	--	<u>2,468</u>	<u>247</u>	<u>2,715</u>	<u>2,715</u>
Rice		881	88	969	969
Other grains		1,587	159	1,746	1,746
Total	279,000	71,040	26,387	97,427	376,426

Source: Consultant's estimates based on official data

The resulting estimates indicate that the total impact of the tsunami on the agricultural sector of Thailand amount to 376.4 million Baht, or its equivalent of US\$ 9.65 million. Of said amount, 279 million Baht (76% of the total) represent damage to assets, and the remaining 94.7 million Baht (24%) are production losses.

The above estimates differ from initial figures given by several sources. In some cases, estimates of the value of compensation to be paid to affected farmers were used; in others, the affected themselves presented their alleged claims, which were understandably higher.

The above production losses are not significant in most cases. Exceptions are the loss in plantation production in Phang Nga province, which reaches about one-fifth of the annual output, and in Ranong, where the losses represent about 3 per cent of the annual crop output and 9% of plantation output. At the national level, the estimated losses represent a negligible fraction of total output for the sector.



b) Livestock

A number of cattle, goat and sheep, swine and chicken drowned as a direct result of the tsunami. Table 3-3 indicates the number of each category of livestock that were lost, and the estimated replacement value.

Table 3-3
Estimation of the value of damage to livestock
(Thousand Bath)

Province	Cattle		Goat & Sheep		Poultry		Swine		Total Damage
	Number	Value	Number	Value	Number	Value	Number	Value	
Krabi	7	95	107	214	208	16			325
Trang			36	42	47	1			43
Phang Nga	262	4,640	312	1,055	6,340	190	2,019	7,776	13,661
Phuket			20	21	816	81	86	201	304
Ranong	166	2,490	416	499	2,380	60			3,049
Satun	13	195	35	42	220	7			244
Total	448	7,420	926	1,873	10,011	354	2,105	7,978	17,626

Source: DDPM, 10 June 2005 Report, based on figures reported by MOAC.

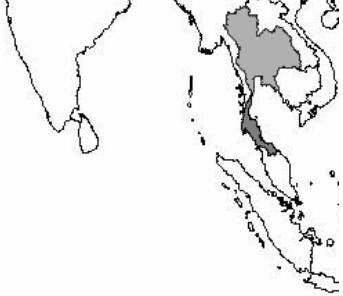
As reported, market replacement values were used in the above estimations, which are based in the number figures provided for in the joint FAO-MOAC report¹¹. Accordingly, the total amount of damage for the sector was 17.6 million Baht.

c) Fisheries and Aquaculture

The tsunami waves imposed heavy damage to the fishing boat and gear as well as in the infrastructure of aquaculture located in the Andaman Sea. The production of both sub-sectors will be correspondingly affected until the assets are replaced.

There are difficulties involved in the estimation of replacement values of the boats and fishing gear since no comprehensive registries are available. The number of boats and gears used in the estimation of damages only represents the number of units that the fishermen reported in order to obtain compensation from their authorities. Since compensation rates are low, some fishermen did not bother to report their loss of assets, and some large boats went also unreported because they have private insurance arrangements.

¹¹ See *Report of Joint FAO/MOAC Detailed Technical Damages and Needs Assessment Mission in Fisheries and Agriculture Sectors in Tsunami Affected Six Provinces in Thailand*, FAO and MOAC, February 2005, Bangkok.



For the estimation in the aquaculture sector, again the same difficulty arises in that the owners only reported their damage bearing in mind possible compensation by the authorities, and not all aquaculture facilities are duly registered with full information as to size and capacity.

Bearing those limitations in mind, order-of-magnitude estimates were made of damage to assets and losses of catch arising from the tsunami.

Table 3-5 presents the estimated number of boats and gear (including traps and nets) that were destroyed, damaged and sunken but retrievable, as given in the joint FAO-MOAC report, with more recent updates. Average unit replacement and repair values were obtained from local suppliers and marinas, in order to estimate the cost of replacement, repair or retrieval.

**Table 3-5
Estimated Damage to Assets to the Fishing Fleet in the Andaman Sea**

	Fishing Fleet					Fishing Gear			Damage Value Million Baht
	Number of boats				Damage Value, Million Baht	Number of		Damage Value, million Baht	
	Destroyed		Retrievable			Traps	Nets		
	Lg	Sm	Lg	Sm					
Krabi	147	804	1	54	158.5	725	347	22.0	180.5
Trang	1	648			58.8	412	182	12.9	71.7
Phang Nga	322	754	124	46	301.2	514	477	16.9	318.1
Phuket	490	642	157	41	390.5	463	491	15.4	405.9
Ranong	204	314	13	27	142.8	297	191	9.5	152.3
Satun	35	552	6	49	81.2	11700	183	350.2	431.4
Total	1199	3714	301	217	1133.1	14111	1871	426.8	1,559.9

In regard to the lost or damaged assets of the aquaculture sub-sector, estimates were made based on the number and average size of fish cages, shrimp ponds, hatcheries and shellfish facilities, as had been estimated in the joint FAO-MOAC report. The average value of these was estimated from different authorized sources, including FAO and the MOAC. Table 3-6 summarizes the estimated value of damage in this sub-sector.

The loss in catch that will occur until the fishing fleet is back into full operation, was estimated by comparing the relative size of the affected fleet with the size of the entire fishing fleet in the Andaman Sea, using data from FAO at its web site www.enaca.org. It was assumed for these estimations that the replacement and repair of commercial-size boats would require an average of 4 months, and that the corresponding for the case of artisan boats would be 2.5 months. This yielded an estimated catch loss of 3,751.8 million Baht, which represents just below 4% of the total annual fishery catch for the Andaman Sea.

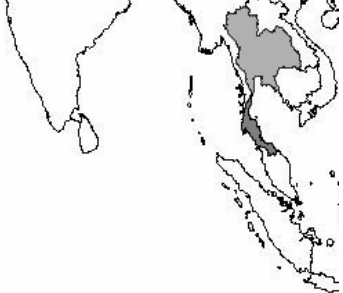


Table 3-6
Estimated Damage to Assets in the Aquaculture Sub-Sector
(Million Baht)

Province	Fish Cages	Shrimp Ponds	Shellfish	Hatcheries	Total Value
Krabi	124.3	9.7	1.9		135.9
Trang	42.0		0.3		42.3
Phang Nga	155.8	9.0	25.0	125.4	315.1
Phuket	120.2	3.1	32.0	20.0	175.4
Ranong	171.8	0.9	3.6		176.3
Satun	179.6		15.1		194.6
Total	793.7	22.6	77.9	145.4	1,039.6

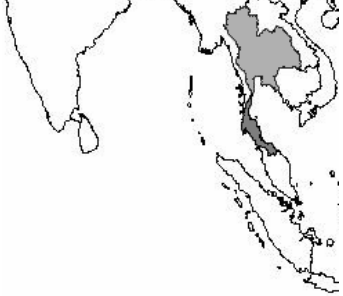
The estimation of production losses in aquaculture assumed that a period of 5 to 6 months would be required for full restoration of infrastructure and facilities. Average unit production values for each type of culture were used in combination with the surface area of destroyed or damaged assets to estimate the total value of lost production. A total value of 130.1 million Baht was estimated for the affected provinces, which represent slightly less than 1.5% of the national aquaculture production.

Thus, the total estimated impact of the tsunami in the fishery and aquaculture sector of the affected provinces is 6,481 million Baht, 40% of which (2,560 million) are damage to assets and the remaining 60% (3,882 million) are losses in production for the rest of the present year. See table 3-7 below.

Table 3-7
Summary of Estimated Damage and Losses
in the Fishery and Aquaculture Sector

	Impact, million Baht
Damage to assets	2,599.5
Production losses	3,881.9
Total impact	6,481.2

In this case again, the estimated value of impact for the fisheries and aquaculture sector differs from previous estimates. Reasons for such differences include, *inter alia*, the fact that more detailed estimates of aquaculture production were made on the basis of more recent information; the fact that an analysis of marine fishery production was included in the estimates using data for the Andaman Sea fleet and production.



d) Agro-Based Industry and Commerce

Due to the losses in primary production of agriculture and fishery, subsequent losses will occur in the processing industries and commerce that are the forward links of the production chain.

Based on a comparison of producer, wholesale and retail prices of the affected commodities¹², an order-of-magnitude estimate was made of the added value involved in these losses. These added-value figures were combined with the volumes of primary losses of the affected products, after discounting the volumes retained by producers for their own consumption, in order to arrive at losses in the agro-industrial processing and marketing sub-sectors.

¹² Prices were obtained from the MOAC's *Agricultural Statistics of Thailand for 2003*, as well as from the Bank of Thailand's *Domestic and World Prices of Certain Commodities* tables. Additional information on price level structure from nearby countries was also utilized.

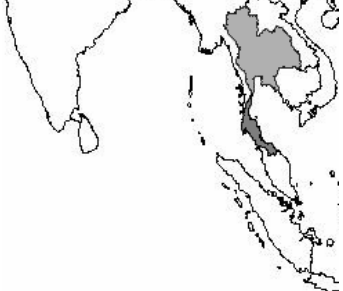


Table 3-8
Estimated Losses in Agro-Based Industry and Commerce

	Estimated Value of Loss, million Baht		
	Primary Production	Agro-Industry	Agro-Commerce
Rice	0.9	0.6	0.2
Other annual crops	1.2	0.2	0.1
Plantation crops	90.0	90.0	45.0
Fish	3,128.5	2,033.5	1,407.8
Shrimp	63.9	57.5	25.6
Total	3,284.5	2,181.8	1,478.7

These estimates yield a loss of 2,182 and 1,479 million Baht for the agro-related industry and commerce sub-sectors, respectively. It is to be noted that in previous damage and loss estimates, the impact on these sectors had not been included.

e) Tourism

In terms of tourism, the six affected provinces are of significance for Thailand as in 2004 they generated 17% of total tourism revenues in the entire nation. The affected area has a total of 1,130 hotels with a total of 40,272 rooms.

Assets were destroyed and damaged by the direct action of the tsunami, and hotel occupancy rates dropped considerable thereafter in the six affected provinces, generating significant losses to the sector.

The Tourism Authority of Thailand (TAT) reported at the end of January that some 328 hotels (24% of the total room capacity) in the affected provinces were either destroyed or damaged. The estimated replacement value of the hotel infrastructure, and of the furniture and other goods contained therein, as well as in other tourism-related commercial facilities (stalls, shops and restaurants)¹³, are summarized in the table below.

¹³ The figures of affected number of hotels and related commercial facilities are taken from the DDPM report titled *Loss Assessment by Tsunami and Earthquake from Provinces (Data as of June 10, 2005)*. Adjustments were made to unit values of damage, and to account for furniture and other goods within the affected facilities.

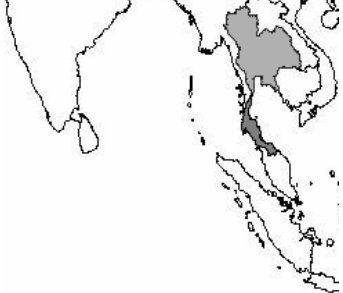


Table 3-9
Estimated replacement and repair value of tourism facilities in the affected area
(Million Baht)

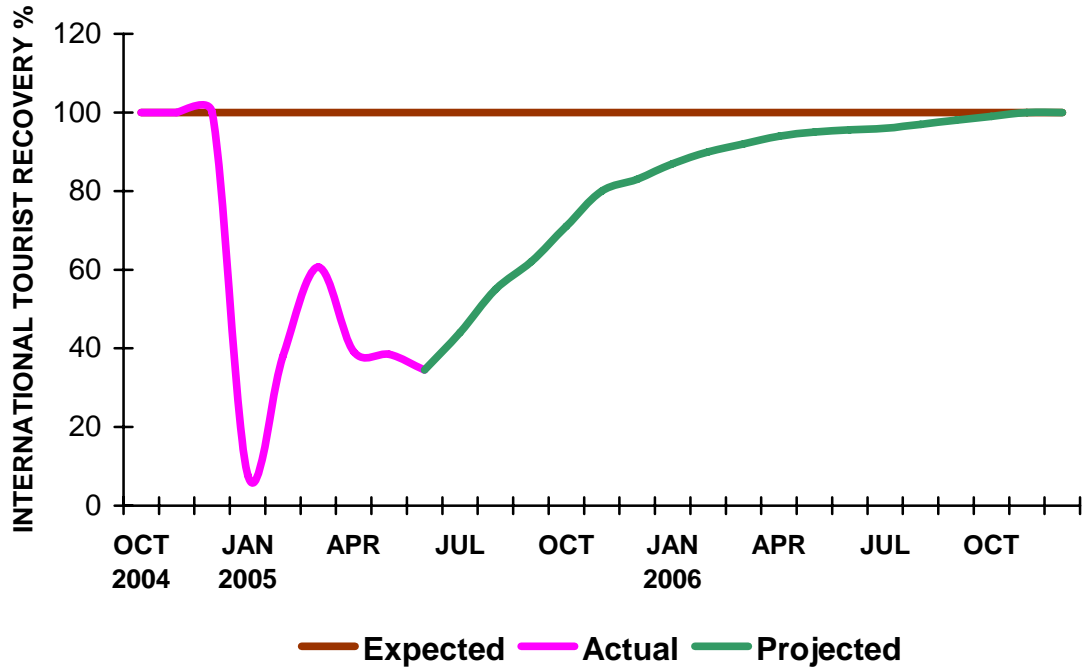
	Hotels and Resorts				Other Commerce				Total
	#	Bldgs	Goods	Damage	#	Bldgs	Goods	Damage	
Krabi	131	3,256.9	473.7	3,730.6	984	13.4	3.6	17.0	3,747.6
Trang	4	150.0	24.0	174.0	142	1.3	0.2	1.5	175.5
Phang Nga	93	5,953.0	340.2	6,283.1	858	20.4	4.9	25.3	6,616.1
Phuket	100	3,170.9	637.8	6,590.8	2,858	367.6	103.3	470.9	4,103.0
Ranong	2	4.4	0.6	5.0	62	0.8	0.2	1.0	6.1
Satun									
Total	328	12,535.2	1,597.8	14,132.6	4,904	403.5	112.2	515.7	14,648.3

Losses of revenue for the sector due to the drop in tourist arrivals, both international and domestic, were estimated on the basis of actual statistics through June 2005 and projections for the rest of the year and for 2006. Separate estimations were made for international and domestic tourism as they have behaved differently; international tourists are recovering at a slow pace, due to the uncertainty of available hotel facilities and remaining fear of the tsunami, while Thailand tourists are arriving in the affected areas with higher recovery rates.

Available data for the six affected provinces show that recovery of international tourist arrivals occurred at a relatively fast rate in the first quarter of 2005, and that recovery rates slowed down in the second quarter (See figure 3-1, where data on international arrival of tourists at Phuket International Airport are displayed). Domestic tourists arrivals, on the other hand, have recovered at faster and sustained rates. On the basis of the observed recovery trends, it was concluded that it would not be until the fourth quarter of 2006 when international tourism would achieve pre-disaster levels. For the analysis, the schedule of recovery indicated in table 3-10 was adopted.



Figure 3-1
Actual and Projected Recovery of International Tourist Arrival
At Phuket International Airport in 2005 and 2006



Data Source (Oct 2004 to June 2005): Immigration Bureau, Police Department

Table 3-10
Recovery Rates of International and Domestic Tourism in the Provinces Affected by the Tsunami, 2005 and 2006

	2005				2006			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
International	25	40	55	80	90	95	97	100
Thai	80	90	95	97	99	100	100	100

The number of tourists that would not use the resorts, hotels and other tourism-related facilities was estimated on the basis of the above indicated projections and of existing projections of tourism for the six affected provinces developed by the Tourism Authority of Thailand (TAT). In addition, the average expenditure of international and domestic tourists in the six provinces was estimated on the basis of available statistics, as 14,250 and 6,000 Baht per person, respectively.

Combining the above data it was possible to estimate that the reductions in tourism revenue for the six affected provinces – assuming that the hotel and resort infrastructure are fully restored ahead of the tourism demand – would amount to a total of 57,324 million Baht for 2005 and 2006, 89% of which would occur in the present year (See table 3-10).

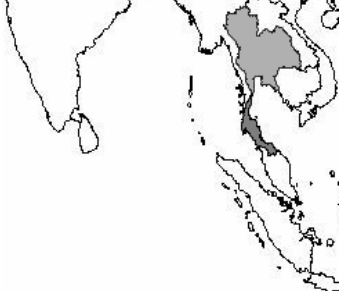


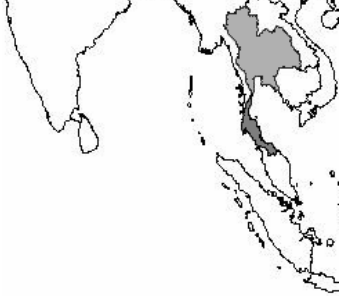
Table 3-11
Estimated Losses of Tourism Revenues in the Affected Provinces
during 2005 and 2006

	2005	2006
Expected, pre-Tsunami number of tourists		
International	7,000,000	7,500,000
Thai	4,500,000	5,000,000
Total	11,500,000	12,500,000
Projected post-Tsunami number of tourists		
International	3,500,000 (50%)	7,162,500 (95.5%)
Thai	4,072,500 (90.5%)	4,987,500 (99.75%)
Total	5,572,500	12,150,000
Projected reduction in number of tourists		
International	3,500,000	337,500
Thai	225,000	12,500
Total	3,725,000	350,000
Estimated loss of tourism expenditures, million Baht¹⁴		
International	49,875	4,809
Thai	2,565	75
Total	52,240	4,884

Therefore the total amount of damage and losses for the tourism sector, arising from the tsunami, is estimated as 71,972 million Baht. Of that amount, 20 per cent (14,648 million Baht) are damage and destruction of assets and the remaining 57,324 million are revenue losses. It is understood that a relatively high proportion of these amounts, especially that of assets, is insured; however, no factual information on the issue was made available.

The above results coincide with the pessimistic estimates included in previous analysis made by several government authorities (such as BOT and NESD). The above figures have been derived using data that covers the period from January to June, while previous estimates had been made with more limited data.

¹⁴ Using average expenditures of 14,250 and 6,000 Baht per international and Thai tourist, respectively.



IV. Infrastructure

Physical infrastructure and utility systems were destroyed or damaged by the tsunami in the six affected provinces. The estimations for both damage and associated losses are described below.

a) Electricity

A total of 69 electrical subsystems were affected. Their combined value of replacement and repair has been estimated as 172.5 million Baht¹⁵.

In the absence of detailed sales data for the affected provinces, an indirect procedure was used to estimate the value of the reduction in electricity sales that will arise from the absence of tourism. Thus, data from the estimated reduction in total tourists arrival was taken from the appropriate section of this report. A daily electricity use of 7.5 KWh per person was assumed for the estimations, based on the average national use of 1,621 KWh per person for Thailand¹⁶, and taking the upper bracket of consumption for the tourist areas. An average electricity rate of 2.5 Baht per KWh was adopted¹⁷. Thus, losses of revenue of 352.2 and 32.3 million Baht were estimated for 2005 and 2006, respectively, yielding a total revenue loss of 384.5 million Baht for the Provincial Electrical Authority (PEA). The latter represents less than 0.5% of PEA's annual electricity sales.¹⁸

b) Water Supply

Nineteen water supply systems were damaged in different components. It was estimated that their replacement or repair value was 24.0 million Baht¹⁹.

Since no detailed information was available in regard to drop in water sales, the same indirect procedure – as in the case of electricity – was used to estimate reduction of water sales due to the tsunami. A daily per capita consumption rate of 300 liters was adopted for the estimates, typical of the climate and upscale tourism environment. An average water rate of 2.1 Satang/liter was used²⁰. Losses of revenue were then estimated as 118.3 and 10.9 million Baht for 2005 and 2006, respectively, or a total revenue loss for the utility of 129.2 million Baht. This loss figure represents less than 2% of the value of total annual sales for PWA.

¹⁵ The value of damage to electrical subsystems was directly taken from the DDPM report titled *Loss Assessment by Tsunami and Earthquake from Provinces (Data as of June 10, 2005)*.

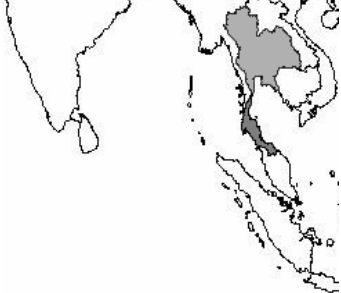
¹⁶ This information was taken from the web site www.nationmaster.com.

¹⁷ This information was taken from *Annual Report 2003, Provincial Electricity Authority, Bangkok, Thailand, 2004*.

¹⁸ A recent communication received from the Director of the Administration Department of PEA indicated that electricity sales for the first half of 2005 have dropped by 0.5%, in comparison to the previous year.

¹⁹ The value of damage to water supply systems was also taken from the DDPM report titled *Loss Assessment by Tsunami and Earthquake from Provinces (Data as of June 10, 2005)*.

²⁰ This is the rate charged to large businesses, according to the Provincial Waterworks Authority web site, at http://www.pwa.co.th/english/tariff_rates.htm.



c) Transport and Communications

The transport and communications infrastructure was destroyed and damaged, and revenues from their operations have dropped.

Main and rural roads, bridges and their ancillary drainage structures were destroyed and damaged to varying degrees; the value of such damage was taken from the DDPM report dated 10 June 2005, which draws from data from the relevant sector organizations, and was verified and supplemented with information received from the Highways Departments²¹. The international airports operated by Airports of Thailand (AOT) sustained minor infrastructure damage, but their revenues dropped in accordance with the reduced number of tourist arrivals and of landings by airplanes²². Damage to telecommunications facilities was limited²³.

No estimate of increased road transport costs was made, as no sufficient data was available. No estimate was made of lower revenues for the telecommunications sector, but they are expected to be low.

The total impact on the transport and communications sector was estimated as 632 million Baht, of which 289 million refer to damage to assets (46 per cent) and the remaining 343 million (54%) are losses of revenue. See table 4-1.

Table 4-1
Damage and Losses in the Transport and Communications Sector
(Million Baht)

	Damage	Losses	Total
<u>Transport</u>	<u>235.1</u>	<u>343.3</u>	<u>578.4</u>
Roads	186.9	...	186.9
Bridges	41.6		41.6
Drainage works	2.6		2.6
Airports	4.0	343.3	347.3
Telecommunications	53.6	...	53.6
Total	288.7	343.3	632.0

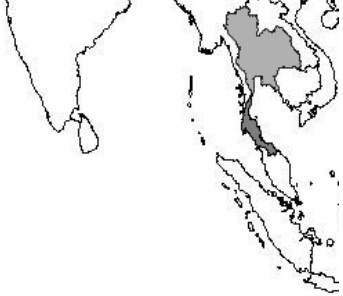
d) Other infrastructure

The DDPM June report lists damage to several types of miscellaneous physical infrastructure, including piers, dams and retaining walls, buildings and others. The total value of replacement or repair of these physical facilities was estimated as 593 million Baht.

²¹ Communications received from Department of Highways (28 July 2005) and from Department of Rural Roads (5 August 2005).

²² According to a communication from the Director, Budget Division, Planning Section, OAT, 3 August, 2005.

²³ The value of damage to telephone systems was directly taken from the DDPM report titled Loss Assessment by Tsunami and Earthquake from Provinces (Data as of June 10, 2005).



e) Summary

Results of the estimation of the impact of the tsunami on infrastructure, as described briefly before, indicate a total impact of 1,919 million Baht, of which 1,062 million (55 per cent) are damage to assets and 857 million refer to revenue losses (45%). The estimated figures are given in table 4-2 below.

Table 4-2
Summary of Damage and Losses in Infrastructure
(Million Baht)

	Damage	Losses	Total
Water Supply	24.0	129.2	153.2
Electricity	172.6	384.5	557.1
Transport and Communications	288.7	343.3	632.0
Other infrastructure	576.5	...	576.5
Total	1,061.6	857.0	1,918.6

IV. Summary of Disaster Impact

a) National Impact

An aggregation of the individual sector estimates presented in the preceding sections of the report indicates that the total impact (Measured in terms of the amount of damage and losses) caused by the tsunami in Thailand is 85,747 million Baht, or its equivalent of US\$ 2,199 million²⁴. This makes Thailand the second most affected country by the tsunami.

The magnitude of the disaster for the Thai economy can be visualized when comparing the total impact to the national GDP. Such comparison yields a value of 1.3 per cent. This implies that the impact of the disaster is not too great and that the national economy should be able to absorb it with relative ease.²⁵ Nevertheless, the economies of the local communities affected will be very significant, and will certainly require central government assistance for their recovery.

Total impact can be broken down into its components of damage and losses, as follows:

	Value, Million Baht	% of total impact
Damage	19,811	23.1
Losses	65,936	76.9

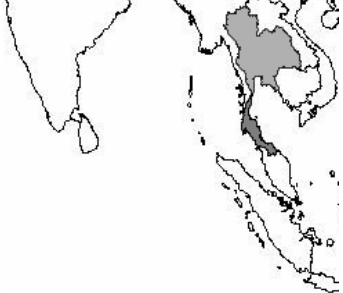
The distribution of total impact among its components in the case of Thailand makes the country a unique case in this disaster since losses exceed damage by a ratio of 3 to 1. This feature reveals the high vulnerability and exposure of productive activities in the affected region, with special reference to tourism as will be discussed later on.

In addition, the above figures are useful in that the amount of damage is representative of the value of lost or destroyed assets that must be replaced. And the amounts of losses are in fact reductions in production that will arise in 2005 and 2006 as a result of the disaster. The amount of damage represents 1.3% of the annual rate of capital formation for the country, and can be considered a cost of opportunity for normal socio-economic development, since financial resources will have to be assigned for the replacement of assets that were already in place, at much higher unit prices, and will thus prevent or defer the solution of other developmental needs. The amount of losses represents slightly less than 1% of gross domestic product and, when converted into value added, will provide an indication of the reduction of GDP that will result as an effect of the disaster.

Most damage and losses are to be sustained by the private sector. This is especially in the case of the large private enterprises of the tourism and fisheries sector that are usually well insured, and should be able to rebound with relative ease. However, there exist a large number of individuals that have lost both assets and livelihood, and who have no means of recovering

²⁴ A uniform exchange rate of 39 Baht/US\$ has been used throughout in this report, as the one that prevailed when the disaster occurred.

²⁵ International experience shows that when the impact/GDP ratio is above 8%, the magnitude can be considered moderate; and that when it exceeds 40%, the affected economy will face significant difficulties for recovery.



unless the government provides special assistance. Thus the government is expected to absorb part of the economic impact of the tsunami, through special budget assignments, in addition to the burden of meeting the cost of humanitarian assistance during the emergency stage and of collecting lower amounts of revenues due to the resulting reductions in economic activity.

Table 5-1
Summary of Economic Impact Caused by the Tsunami in Thailand
(Million Baht)

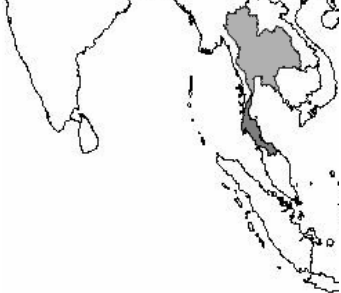
	Damage	Losses	Total
Social Sectors	1,206	115	1,321
Housing	866	..	866
Education	340	..	340
Health	...	115	115
Productive Sectors	17,544	64,965	82,510
Agriculture	279	97	376
Livestock	18	..	18
Fisheries	2,599	3,882	6,481
Industry	..	2,182	2,182
Commerce	..	1,479	1,479
Tourism	14,648	57,324	71,972
Infrastructure	1,062	857	1,919
Water Supply	24	129	153
Electricity	172	385	557
Transport and Communications	289	343	632
Other works	576	..	576
Total	19,811	65,936	85,747

b) Sectoral Impact

The breakdown of the economic impact among all affected sectors is shown in Table 5-1 above. There it may be observed that, in monetary terms, most affected were the productive sectors (97% of impact), followed by infrastructure and the social sectors. The most affected individual sectors were tourism (71,972 million Baht), followed by fisheries (6,481 million Baht), industry (2,181 million), commerce (1,479 million) and housing (866 million).

When damage to assets are considered, again the tourism sector is the most affected in view of the destruction of hotels and resorts (14,648 million Baht), followed by the fishery sector due to the destruction of boats and aquaculture facilities (2,599 million), and housing (866 million). The most affected individual sector in terms of production losses is that – again – of tourism, with losses of 57,324 million Baht; followed by fisheries (3,882 million) and industry (2,182 million). See table 5-1 again.

Therefore, the impact was heavily concentrated into the productive sectors and, more specifically, into the tourism sector. Distant runner-ups in terms of affectation were fisheries,



industry and commerce. As indicated before, this sectoral breakdown of damage and losses indicates the high vulnerability and exposure of the productive activities located in the affected region. This is very clearly the case of tourism activities, but of other sectors such as fisheries, and food-based industries and commerce as well.

c) Spatial Distribution of Impact

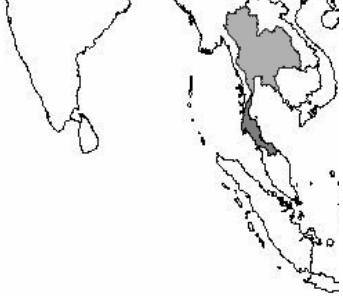
An examination of the spatial distribution of impact reveals that damage and losses were concentrated in Phuket, Krabi and Phang Nga, in order of decreasing importance, while the other three provinces sustained much lower impacts (See table 5-2 below).

Table 5-2
Summary of Impact in Affected Provinces
(Million Baht)

Province	GPP (2004)	Damage	Losses	Total Impact	Impact/GPP
Krabi	28,588	4,414	15,238	19,652	69
Trang	40,174	315	2,097	2,412	6
Phang Nga	20,281	8,523	5,249	13,772	68
Phuket	51,984	5,405	41,423	46,827	90
Ranong	11,570	483	1,393	1,876	16
Satun	19,794	672	546	1,218	6
Total	172,391	19,811	65,936	85,747	50

The true measure of the spatial distribution of impact can be visualized, however, when considering the magnitude of the disaster in each province, as indicated in the last column of table 5-2. For the entire affected region, the magnitude of the impact is equivalent to one half of the combined gross provincial product (GPP), a very high ratio that indicates that the affected area cannot easily overcome by itself the situation arising from the disaster. Thus, the need for central government assistance is evident, especially in the case of Phuket (where the magnitude equals to 90% of GPP), Krabi and Phang Nga (magnitude of around 70%).

While most of the impact falls in the private sector domain and there seems to be insurance involved, the recovery of the entire affected area will require some intervention by the government, as the livelihood of many persons belonging to the lower income strata has been compromised and there seems to exist a relatively high degree of under-insurance.



d) Impact on Economic Performance

On the basis of the estimated value of losses arising from the disaster, preliminary projections of the disaster impact on GDP growth have been made.

Before the disaster occurred, Thailand economic authorities expected that in 2005 GDP would grow at a rate of 6 per cent, down 0.1% from the previous year's rate. When the value added of the estimated losses for the disaster is subtracted from the forecasted GDP, a growth rate of 5.5% is obtained for 2005. That is to say, the losses caused exclusively by the disaster would result in a 0.5% reduction in economic growth for the country²⁶.

The above estimated reduction in GDP growth should be partially compensated by the positive impact of reconstruction and economic recovery efforts of the government and the private sector. In this regard it is understood that the government has made special budget appropriations to assist and compensate the affected persons and small and medium enterprises. It is also known that there is insurance involved in the large private sector enterprises. However, at the time in which this report was prepared, no comprehensive information was available concerning the rate of public sector disbursements made to date. In addition, there are some reports indicating that there was considerable underinsurance in the large enterprises, that insurance payments are slow in coming, and that there have been delays in replacing and repairing some public infrastructure in tourism areas. These facts would have a bearing on the final rate of investment for the current year, and may even result in the transferring of investment to 2006.

Once the actual figures are known in this regard, it will be possible to estimate the net effect of the disaster on economic growth for the country in 2005.

The impact of damage and losses caused by the disaster on the fiscal budget and on the balance of payments and trade can be derived from the estimates presented here, although it is expected to be limited.

²⁶ This does not take into consideration the reductions in economic growth that may be caused by rising international prices of oil.