Recovery Process in Thailand after the 2004 Indian Ocean Tsunami

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ABSTRACT

The tsunami generated by the Sumatra earthquake on December 26, 2004 affected many countries around the Indian Ocean and Thailand also suffered severely from this event, i.e. 6 provinces along the Andaman coastline. More than 8,000 people perished or went missing, 4,500 houses were totally destroyed, and economic losses were estimated at more than 14 billion baht. Since it bore the brunt of the tidal wave at its peak, Phang Nga experienced the largest number of fatalities or missing (more than 65%) as well as property damage (about 50%). The Government was prominent in several short- and long-term measures following the disaster management cycle, including the development of a tsunami resilient community. This paper discusses several measures implemented by the government, private sectors, and international organizations.

1. INTRODUCTION

On the morning of December 26, 2004 a magnitude 9.3 earthquake struck off the Northwest coast of the Indonesian island of Sumatra, due to a complex slip on 2 faults (Koshimura and Takashima, 2005), where the oceanic portion of the Indian Plate slides under Sumatra, part of the Eurasian Plate. The earthquake deformed the ocean floor, pushing the overlying water up into a tsunami wave. The earthquake and resulting tsunami affected many countries in Southeast Asia and beyond, including Indonesia, Sri Lanka, India, Thailand, the Maldives, Somalia, Myanmar, Malaysia, the Seychelles and others (see **Fig. 1**). Records of fatalities and missing from the tsunami (UN, 2005) and the tsunami wave height surveyed by several experts (Tsuji et al., 2005; Yasuda et al., 2005; Harry Yeh, 2005; Matsutomi et al., 2004; Satake et al., 2005; Tsuji et al., 2006; Fujima et al., 2005 and NOAA, 2005) are shown in **Table 1**. The tsunami height peaked at the western side of Banda Ace, Indonesia, which thus explained the greatest number of fatalities and missing occurring in that area. Hardest hit, meanwhile, were the countries of Indonesia, Sri Lanka, India, and Thailand. The death toll up to the present has exceeded 300,000 people, representing a major disaster of monumental geographic and human proportions. Overall, an estimated 1,5 to 5 million people were directly or indirectly affected, while damage and destruction of infrastructure destroyed people's livelihoods and left many homeless without adequate water and healthcare facilities. In addition, the tsunami-affected communities can be categorized into three regions: the nearfield area along the Sumatra coastline, which accounts for approximately 73% of the total casualties, those at an intermediate distance (between 1,000-2,000 km) in Thailand, Myanmar, India, Sri Lanka, and the Maldives, and those in the farfield area, along the African coastline.

2. EFFECT ON THAILAND

Thailand suffered particularly serious effects from the 2004 Indian ocean Tsunami in 6 provinces along the Andaman coastline. Immediately after the event, the Thai-Japanese tsunami expert

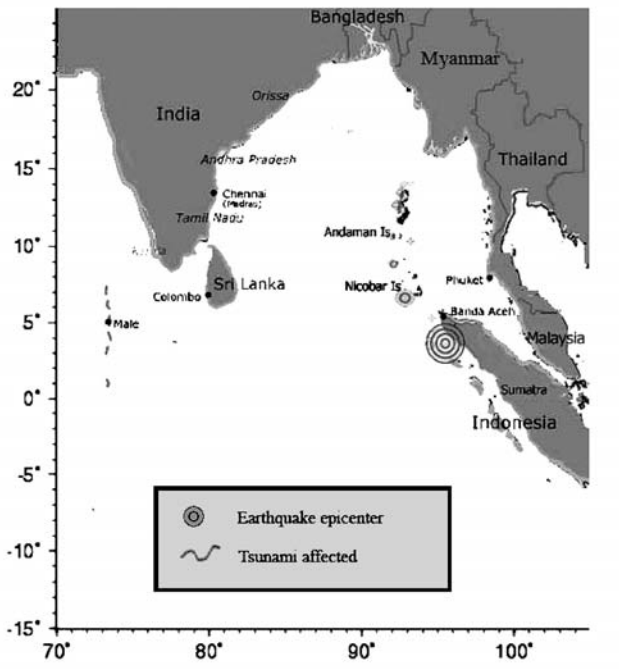


Fig. 1 Communities affected by the 2004 Indian Ocean Tsunami

KEY WORDS: Indian ocean Tsunami, recovery, warning, Thailand

Table 1. Fatalities & missing and actual heights of tsunami

Country	Total of fatalities and missing	Wave height (m.)
Indonesia	167,736	3 – 30
Sri Lanka	35,322	2.4 – 10
India	18,045	2.5 – 5.2
Maldives	108	0.6 – 3.4
Thailand	8,212	2.5 – 19.6
Myanmar	61	0.4 – 2.9
Malaysia	75	1.0 – 4.0
Somalia	289	5.5 – 9.5
Tanzania	13	0.35
Seychelles	2	1.39
Bangladesh	2	no data
Kenya	1	0.54

Table 2. Damage in case area and effect on people from the Indian Ocean tsunami

No.	Province	Devastated Area			House Damage		Affected families	
		District	Tambon	Village	Partly	Totally	Person	Household
1	Phang Nga	6	19	69	1,641	626	19,509	4,394
2	Krabi	5	22	112	1,343	357	15,812	2,759
3	Phuket	3	14	58	601	393	13,065	2,616
4	Ranong	3	10	47	111	255	5,942	1,509
5	Trang	4	13	51	156	33	1,302	1,123
6	Satun	4	17	70	69	102	2,920	414
Total		25	95	407	3,921	1,766	58,550	12,815

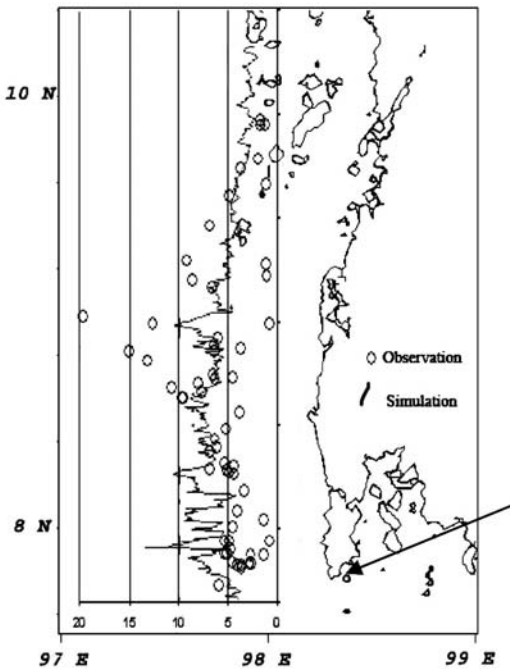


Fig. 2 Distribution of the tsunami height and result from simulation (Matsutomi et al., 2004; Satake et al., 2005; Tsuji et al., 2006 and Srivichai and Suphathid, 2007)

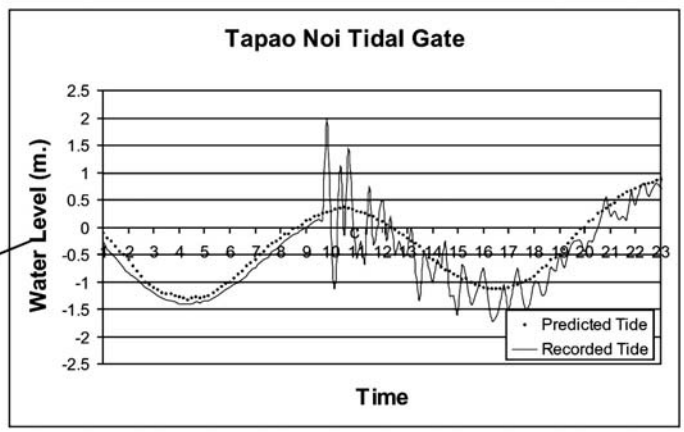


Fig. 3 Tidal record at Tapao Noi, Phuket

group made a detailed survey on tsunami behavior (Matsutomi et al., 2004; Satake et al., 2005 and Tsuji et al., 2006). The tsunami heights are shown in **Fig. 2**. Unfortunately, because the tsunami arrived at high tide, it rode on top of the elevated tidal level (Hydrographic Department Royal Thai Navy, 2006) in **Fig. 3** causing more severity. Due to the offshore bathymetry, the tsunami height varied by a factor of almost 3-4 times, with a maximum height of 19.6 m at Ban Tung Dap in Prathong island, 15 m at the popular Khao Lak resort area, and 5-6 m at the Patong beach in Phuket. Comparisons were also made with the numerical results, using non-linear shallow water equations (Srivichai and Supharatid, 2007) in the same figure, although this method was not effective for predicting the maximum wave height. One of the main contributions is the accuracy of bathymetric data near the shoreline (462.5 m. x 462.5 m.) The damaged areas, number of deaths or missing and property damage are summarized by the DDPM (Department of Disaster Prevention and Mitigation, 2005), DPT (Department of Public Works and Town & Country Planning, 2005) and the TEC (Tsunami Evaluation Coalition, 2005) in **Tables 2, 3** and **4**. As expected, many resorts in Kho Lak area, with its low-lying coastal plane, were severely damaged while several buildings with sliding glass door or windows facing the sea suffered little structural damage. This is because the tsunami force broke through all the openings. In addition, most of the engineering-designs used for reinforced concrete buildings with good foundations could withstand the wave attack. Because the wave height peaked at Phang Nga, this area experienced the largest number of fatalities or missing (more than 65%) as well as property damage (about 50%). A report from the Ministry of Public Health (Department of Mental Health, 2006) revealed that many people experienced very high strain after the tsunami attack and nearly 20,000 people visited clinics in the 2 year period after the event (see **Table 5**).

3. SHORT AND LONG TEEM RESPONSES

3.1 TSUNAMI PREPAREDNESS

The goal of tsunami preparedness is to plan for a response and several actions have been implemented by the Government and private sectors, with sixteen earthquake observation stations installed or improved nationwide by the TMD (Thai Meteorological Department) since 2005. This can improve the capability of the earthquake analysis and nationwide warning capability. At the

Table 3. Number of deaths, injured and missing

No.	Province	Deaths				Injured			Missing		
		Thai	Foreigner	Unidentified	Total	Thai	Foreigner	Total	Thai	Foreigner	Total
1	Phang Nga	1,389	2,114	722	4,225	4,344	1,253	5,597	1,352	303	1,655
2	Krabi	357	203	161	721	808	568	1,376	314	230	544
3	Phuket	151	111	17	279	591	520	1,111	245	363	608
4	Ranong	153	6		159	215	31	246	9		9
5	Trang	3	2		5	92	20	112	1		1
6	Satul	6			6	15		15			
Total		2,059	2,436	900	5,395	6,065	2,392	8,457	1,921	896	2,817

Table 4. Property damage

No.	Province	Property Damage, Baht			
		Fishery	Livestock	Agriculture	Established Business
1	Phang Nga	913,218,480	13,660,600	2,458,640	6,456,085,000
2	Krabi	191,696,520	325,240	342,880	2,683,651,800
3	Phuket	344,911,160	303,640	184,120	3,954,082,920
4	Ranong	170,738,000	3,049,120	636,080	830,000
5	Trang	14,980,000	43,400	1,838,680	6,600,000
6	Satun	119,393,720	243,600	1,165,000	-
Total		1,754,937,880	17,625,600	6,625,400	13,101,249,720

same time, two tidal stations (in Koh Miang, Phuket) were upgraded thanks to donations from USAID through the ADPC (Asian Disaster Preparedness Center). This will assure notification of the arrival of a tsunami 15 minutes before it attacks the main land coastline.

In term of community participation activities, a hazard map depicting some typically risk-prone areas, such as the Kamala beach (**Fig. 4**) and Khao Lak (**Fig. 5**) was developed, which will help enhance awareness among the people. Meanwhile, preparedness and evacuation plans were also made by the DDPM and one important event, the evacuation drill, was practised in several areas (see **Fig. 6**). In addition, the Government has constructed several siren towers within several coastal communities (see **Fig. 7**).

3.2 TSUNAMI PREVENTION AND MITIGATION

The goal of tsunami prevention and mitigation is to minimize the effects of a disaster. Land use planning has been proposed to the government for the popular Phi Phi island and Patong beach. However, this measure could not be implemented due to strong protest from many local people. One success project was the developing of tsunami resistant community. This was done as a pilot project at Ban Bang Niang (Khao Lak) by the collaboration among Government and private sectors. Three main actions were made:

1) Evacuation system: The evacuation plan was developed for emergency situation by the DDPM and Tumbon Administrative Office. The evacuation route map was also constructed as shown in **Fig. 8**. There is 1 tsunami shelter (see **Fig. 9**) constructed in this area by friends in need (of "PA") Volunteer Foundation. The construction budget was supported by the Catholic Cardinal Council of Thailand. The local people can use this building for multi-purpose activities. In ordinary situation, it is used for recreation, local administrative office meeting,

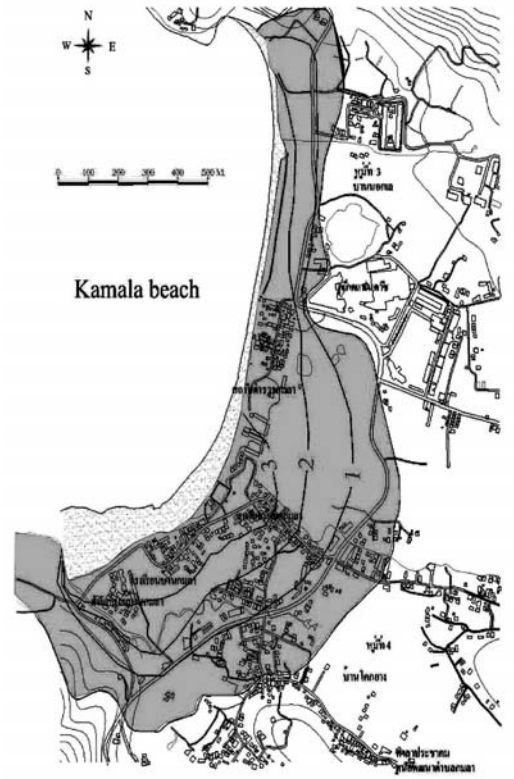


Fig. 4 Hazard map at the Kamala beach

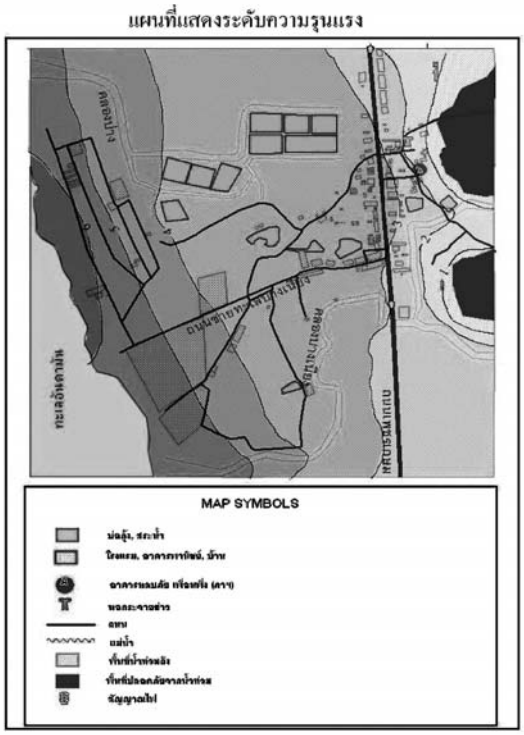


Fig. 5 Hazard map at the Kamala beach

a) Patong beach b) Khao Lak

Fig. 6 Evacuation drills

and Buddhism events while in the time of disasters, it is intended to reserve for temporary evacuators. Several basic needs for livelihood (food, medicine, clothes, etc.) are stocked in this building. Two evacuation drills are proposed to do each year. However, due to limited space of the building and also the remote location from the beach (1-2 km.), it is recommended that resorts & hotels (near the beach) should reserve the 3rd floor space for emergency evacuation.

2) Warning system : In this area, a dissemination tower (**Fig. 10**) was installed to receive warning information from the NDWC (National Disaster Warning Center, 2006). NDWC will receive the earthquake data from the Thai Meteorological Department (TMD) and International Networks for preliminary analysis and estimate the tsunami arrival time. NDWC will also receive tsunami information bulletin from the Pacific Tsunami Warning Center (PTWC) as well as the Japan Meteorological Agency (JMA). After careful judgment, the warning message will be sent to the related central government department, local government and the people via short messages, television, radio and fax. A direct communication line was also connected to many hotels and resorts (**Fig. 11**), which will allow each hotel or resort to disseminate the message to its guest and operate an emergency plan. Some hotels or resorts have reserved high-floor areas for evacuation. However, due to the lack of a tsunami evaluation system, many false alarms may occur. Therefore, the NDWC is very concerned about this and plans to install the 1st deep sea buoy (DART) near Nicobar island by the end of 2006.

3) Education and awareness : Tsunami materials were distributed to the local people, schoolteachers, students, and tourists. These include a book (Department of Disaster Prevention and Mitigation, 2005a) (**Fig. 12**), VCD (Department of Disaster Prevention and Mitigation, 2005b) (**Fig. 13**). In addition, a tsunami brochure (Friends in need (of "PA") Volunteer Foundation, 2005) was also distributed to tourists in both Thai and English languages (**Fig. 14**). There are also several seminars in the affected area to educate local people, including local government officials, about the tsunami. These are under the responsibility of the DDPM.

Fig. 7 Siren tower at the Patong beach

Fig. 8 Evacuation route map at Khao Lak

Fig. 9 Evacuation shelter at Khao Lak

Fig. 10 Dissemination tower at Ban Bang Niang

Fig. 11 Direct communication lines to hotels and resorts

Fig. 12 Tsunami materials (Book)

Fig. 13 Tsunami materials (VCD)

Table 5. Number of people using mental health clinics

No.	Province	No. of people	Matter		
			Mental	Confer	Health check
1	Krabi	3,617	839	1,966	1,312
2	Phang Nga	10,595	3,564	6,979	4,345
3	Phuket	2,600	634	2,052	995
4	Ranong	1,484	178	1,115	278
5	Satun	646	48	167	532
6	Trang	614	6	594	0
Total		19,556	5,269	12,873	7,462

3.3 EMERGENCY RESPONSE

The goal of the tsunami response involves striving to minimize the hazards created by disasters. A search and rescue team was established by the DDPM with assistance from Japan and many temporary homes were constructed by several private sector bodies (see **Figs. 15-16**). This includes aid for medicine (First aid treatment), clothes, food and water, including initial repairs to damaged infrastructure by the military and private agencies. Moreover many volunteers (Both Thais and foreigners) entered the damaged areas to work alongside the government officers. This includes the monitoring of secondary disasters such as polluted water, epidemic, etc.

3.4 TSUNAMI RECOVERY

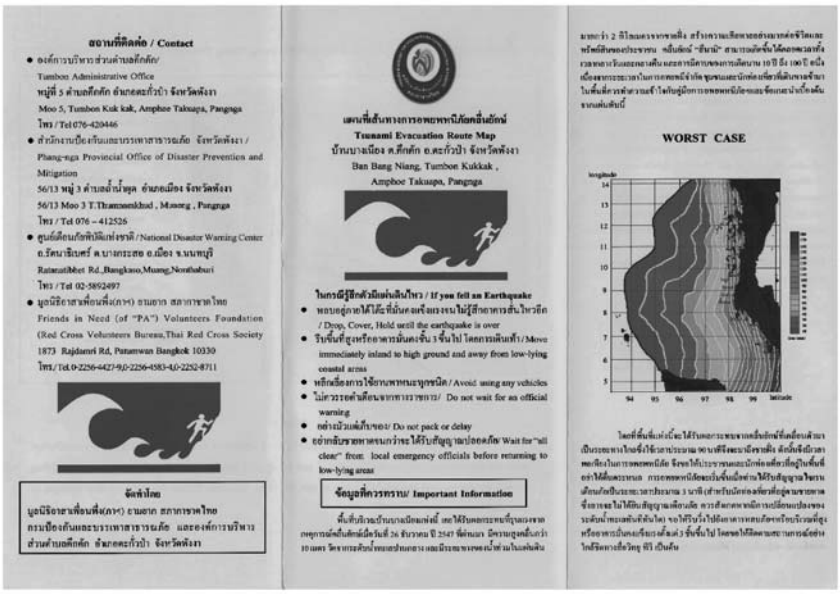
The goal of tsunami recovery involves returning the community toward a normal situation. The tsunami affected hundreds of fishing villages along the Andaman coast. It also destroyed the livelihood of more than 13,000 households, who were dependant on fisheries, and destroyed or seriously damaged over 4,500 fishing boats. The tsunami also seriously impacted on the natural environment, i.e. marine and national parks, coral reefs, and agricultural lands through salt-water intrusion. These impacts will have serious long-term consequences for tourism and fisheries, as well as the livelihood of many thousands of people. The government allocated a recovery budget for the damaged facilities according to sectors (Department of Disaster Prevention and Mitigation, 2005) as shown in **Table 5**. From **Table 6**, the largest amount is budget figure No. 04 (Loan from the Finance Ministry). This budget was reserved for supporting affected entrepreneurs and will be returned depending on the loan period. The 2nd largest budget amount was allocated to the Committee for Relief of the 6 Southern Tsunami Affected Provinces, who provided assistance through 13 groups of subcommittees (see **Table 7**). On average, 66% of the stated budgets have been used and the data is valid through September 30, 2005. It emerged that the largest budget (28%) was allocated for assistance to the 10 damaged government offices.

Apart from the budgets from the Government, recovery budgets from international organizations (Foreign countries, INGOs, CBOs, Community Associations, Charity groups) totaled approximately 3.2 billion Baht, with New Zealand making the largest donation through the UN families (UNDP). In addition, the top donations also came from the UN Children's Fund. USAID (USAID, 2005) also made a contribution to the Post-Tsunami Sustainable Coastal Livelihood Program, which was implemented in 5 villages of the Suk Samran district, Ranong province. The specific objectives of the program are to establish a set of principles & a coordinated approach to rehabilitation, to restart livelihoods with healthy coastal resources, to redesign damaged infrastructure, to establish capacity for planning and decision-making within the coastal zone, and to promote learning and share experience in the region.

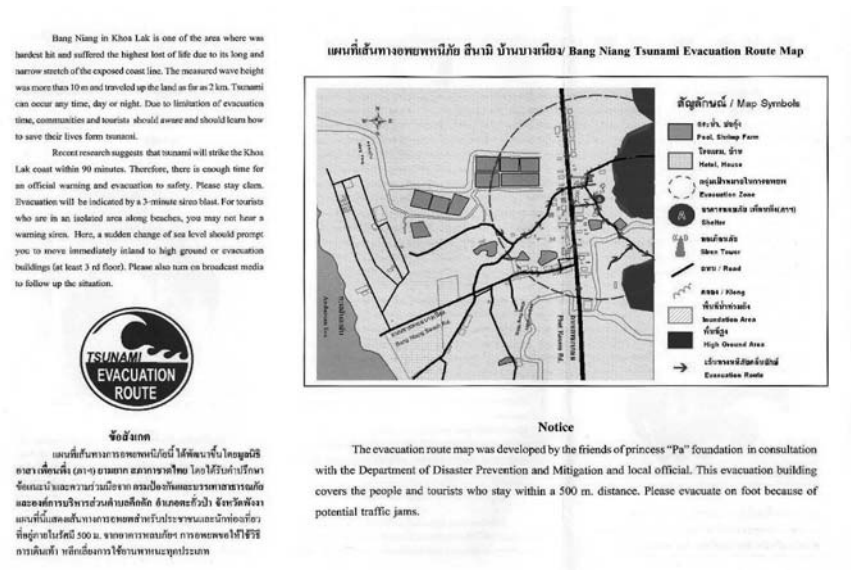
It can be concluded that the assistance from the Government and international organizations can be grouped into primary (short-term) and permanent (long-term) assistance. Primary assistance covers the supply of food, medicine, clothes (**Figs. 17-18**), search and rescue operations, damaged infrastructure reparation, and disaster victim identification (DVI), etc. For long-term assistance, this includes the construction of permanent houses and infrastruc-

Table 6. Total budgets supplied by the Thai Government

No	Sector	Budget (Baht)
1	Southern Disaster Victim Relief Fund, Office of the Prime Minister	968,879,079.10
	Provided to the committees of the Southern Disaster Victim Relief Center	385,243,670.00
	Provided to other Sectors	583,635,409.10
2	Central Budget (2005) for emergency use	8,391,066,379.00
	The Committee for Relief of the 6 Southern Tsunami Affected Provinces	6,553,150,739.00
	The Committee for the Tourism business promotion in the Andaman coastal areas	1,101,000,000.00
	The Committee for the Rehabilitation of the Natural Resources and the Environment in the devastated areas	723,310,640.00
	The Committee for the Installation of an Early Warning System	13,605,000.00
3	General financial support for the Local Administrative Committee	1,248,645,800.00
4	Loans from the Ministry of Finance	59,500,000,000.00
	Total	70,108,591,258.10



a) Front page



b) Back page

Fig. 14 Tsunami brochure

Table 7. Budgets for the subcommittees of the Committee for Relief of the 6 Southern Tsunami Affected Provinces

Committees	Budget (Baht)	Used (Baht)	% Used
01. The subcommittee for providing assistance to foreign tourists	191,174,662.02	75,458,517.79	39.47
02. The subcommittee for providing assistance to affected persons	810,608,008	770,681,008	95.07
03. The subcommittee for providing assistance to affected persons who were involved in the fishery business	821,082,500	515,494,405	62.78
04. The subcommittee for providing assistance to those laid-off	215,809,565	171,580,677.5	79.51
05. The subcommittee for providing assistance to small-scale business entrepreneurs	139,920,000	137,997,369.62	98.63
06. The subcommittee for providing assistance to large-scale business entrepreneurs*	37,808,184,000	37,808,184,000	100
07. The subcommittee for providing shelter for affected persons	101,820,000	83,560,000	82.07
08. The subcommittee for providing aid to affected students	389,659,750	371,247,750	95.27
09. The subcommittee for assisting the 10 damaged government offices	1,736,240,478.07	830,245,623.24	47.82
10. The subcommittee for providing compensation which had been paid by departments, and rehabilitation funds for 9 departments	1,041,711,945.28	704,187,452.91	67.6
11. The subcommittee for providing aid to affected civil servants	400,000,000	217,988,819	54.5
12. The subcommittee for establishing the relief database	5,500,000	993,750	18.07
13. The subcommittee for rehabilitation and reconstruction	289,008,000	153,537,357.80	53.13

* This budget was not controlled by the committee for the Relief of the 6 Southern Tsunami Affected Provinces

Fig. 15 Temporary house at Ban Ayokyu

Fig. 17 Donated material warehouse

Fig. 16 Temporary house at Khao Lak (Ban Bang Niang)

Fig. 18 Distribution of donated goods

Fig. 19 Construction of permanent houses (Ban Taleanok)

Fig. 21 Fishing boat construction

Fig. 20 Construction of school at Ban Nam Kem

Fig. 22 Handmade Basket and Bags of affected families

tures (**Figs. 19-20**), livelihood recovery of occupations and tourism business (**Figs. 21-22**), legal and services for poor and vulnerable people, the management of coral reefs and ecosystem, and environmental rehabilitation.

4. CONCLUSIONS

The sudden vertical displacement of the sea floor associated with a massive fault rupture and initiating a complex series of waves propagated across the entire Indian Ocean, resulting in the devastating tsunami of December 26, 2004. This was a world record tsunami in term of fatalities and the number of affected people. In Thailand, the tsunami affected residents and foreign tourists in 6 provinces along the Andaman coast (Phuket, Phang Nga, Ranong, Krabi, Trang, and Stun), with Phang Nga hardest hit due to the wave height peaking in that area. The situation was more severe, both because the waves arrived at high tide and the fact that the affected area was located in a relatively low-lying coastal plane, resulting in the serious destruction of many resorts. However, there were still many well-designed reinforced concrete buildings with good foundations capable of withstanding the wave attack. It also emerged that the non-linear shallow water equation underestimated the maximum wave height, which was a factor of the accuracy of the surrounding bathymetric data.

In term of short- and long-term responses, the Government was prominent in several measures following to the disaster management cycle including the developing of a tsunami resilience community. These include the tsunami preparedness (Installation of earthquake and tsunami monitoring instruments, construction of hazard maps, developing of preparedness and evacuation plans, conducting evacuation drills, and the construction of several siren towers in tsunami-risk prone communities), tsunami prevention and mitigation (Construction of evacuation route maps, evacuation shelters, and warning siren towers, bringing out tsunami books and VCDs), tsunami emergency response (Setting up the search and rescue team, construction of temporary homes, reparation of damaged infrastructure), and tsunami recovery (Construction of permanent homes, rehabilitating the environment, restarting healthy livelihoods, livelihood recovery of occupations and the tourism business.

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