



## TSUNAMI + 1 – an analysis of the response

### Introduction

On the 26<sup>th</sup> December (Boxing Day) 2004 the most powerful earthquake for over 40 years - measuring over 9.0 on the Richter Scale - struck off the coast of Sumatra, Indonesia. The nature of the movement along the fault line generated a massive tidal wave or tsunami. As the map (Fig.1) shows it travelled across the Indian Ocean killing approximately 275,000 people (many are still missing presumed dead). Therefore the tsunami has been described as a mega event (an RGE - regional geophysical event) - nothing of this scale had occurred over the last 300 years.

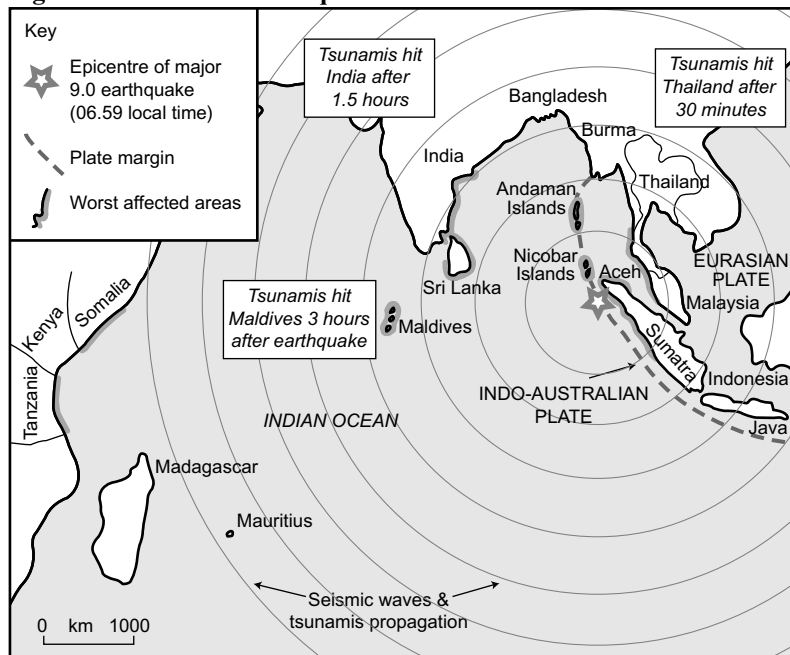
The sheer scale of this multi-national event which affected 10 countries posed a global challenge, both in responding to the emergency and in developing strategies for short-term rehabilitation and long-term recovery.

Table 1 highlights how the tsunami affected the people, environment and economies of 6 countries at very different levels of development. It shows how the impact varied, both between and within these countries. As a tsunami it has a disproportionate effect on people and economies along the crowded coastlines.

**Table 1 The impact of the tsunami.**

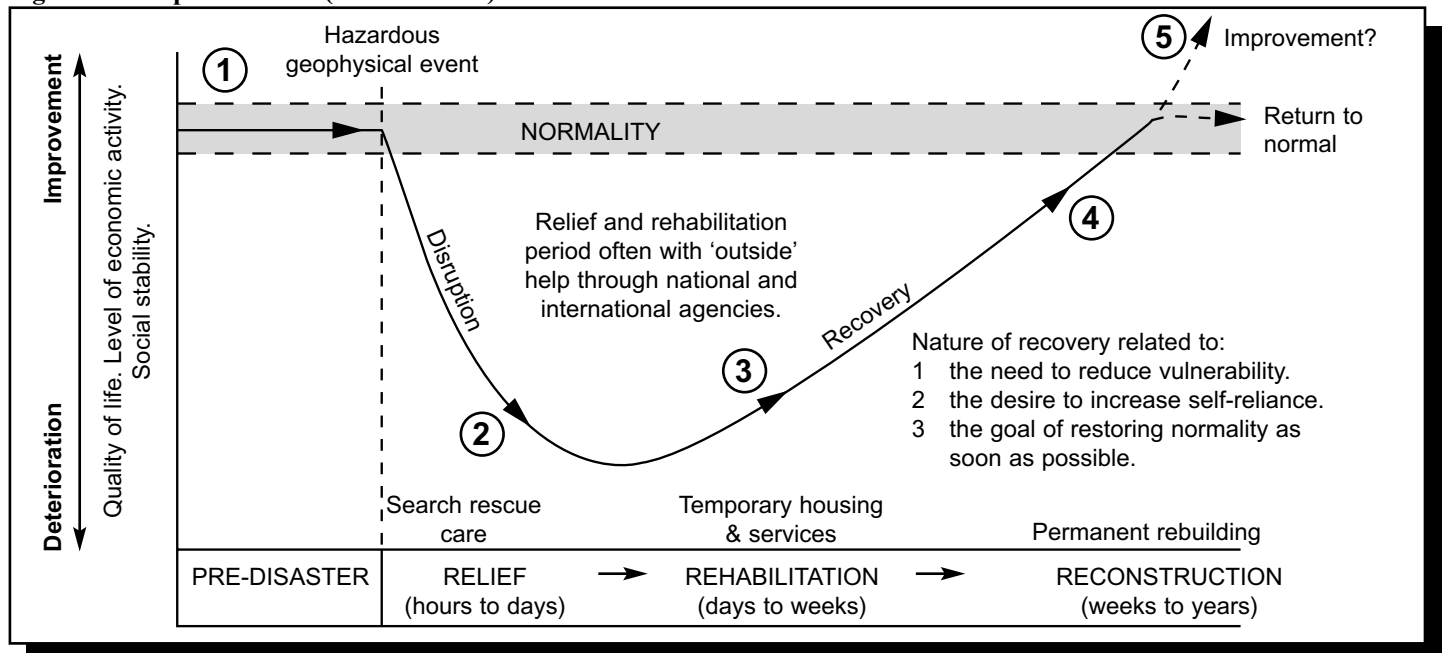
	Indonesia	Burma (Myanmar)	India	Maldives	Sri Lanka	Thailand
<b>Human Impact:</b>						
Deaths	169,000	81	10,750	81	31,000	5,300 (including 2248 foreign nationals)
Missing	150,000+	1	5,550	n/a	4,000	2,800
Homes damaged or destroyed		5000	15,000	15,000	100,000	60,000+
People displaced (some in relief camps)	600,000	10,000 - 15,000	140,000	11,500	500,000	300,000 (Burmese migrants a real problem)
Total Population	217,500,000	48,956,000	1,041,410,000	309,000	19,287,000	64,340,000
<b>Economic impact:</b>						
PC Income	\$3,043	\$676	\$3158	\$4180 - 62% of GDP lost	\$3530	\$6,402
Travel & tourism, economy employees	minimal	651,555	24,265,500	60,696	654,062	2,984,250
% of total employment	0.1% in Aceh	3.1%	5.5%	54.2%	7.8%	8.4%
2004 growth	0%	n/a	6.4%	5.5%	5%	6.1%
2005 growth forecast (post tsunami) - almost nil in Aceh		n/a	6-6.5%	5%	5.5%	5.5-6.5%
Tourism earnings (expected % GDP, 2005)	n/a	n/a	2%	42%	4.6%	5.4%
<b>Notes</b>	In Indonesia, Aceh province, a poor war-torn area, was affected	Note only limited information available	India is a NIC but area affected very poor	Tourist and native islands fared badly	Very widespread damage around most of coast	Only country where international tourists died - an extra problem

**Fig. 1 Indian Ocean: earthquake location and worst affected areas.**



- 1. Sumatra (Indonesia):** The northern province of Aceh was closest to the epicentre of the earthquake and was the worst affected area. Waves up to 12m swept 2km onshore killing at least 100,000 people. 80% of the province has been destroyed. The city of Banda Aceh was largely destroyed. Journalists described it as "stinking of death". Due to poor infrastructure and political instability, aid reached the region very slowly.
- 2. Sri Lanka:** An estimated 28,000 were killed, mostly on the eastern seaboard as a series of waves swept the beaches. Potential problems with Tamil-controlled northern areas exist - including floating land mines - and may slow government aid transfers. Government quickly announced that the disaster was beyond its ability to cope.
- 3. India:** The worst hit area was the remote coastline in the southern province of Tamil Nadu, which was hit by 10m high waves.
- 4. Thailand:** Southern Thailand holiday beaches were devastated by the tsunami and the majority of the deaths were amongst foreign tourists particularly from Scandinavia. Over 40 British people were killed. Phuket and Phang Nga were particularly badly hit.
- 5. Andaman and Nicobar Islands:** Unknown numbers of people - possibly in excess of 30,000 - were killed in these remote islands close to the epicentre of the earthquake. Rescuers found areas totally destroyed. Many parts of the islands could not be reached. Survivors reported to be without food and battling crocodiles washed onshore by the tsunamis.
- 6. Maldives:** Despite the inundation suffered by these low-level islands, only 81 deaths were confirmed and 68 of the 87 tourist resorts remained open.

Fig. 2 The Response Curve (Park's Model).



The response curve is a model to chart the recovery process of an area post disaster, ranging from emergency relief through to short-term rehabilitation through to long-term recovery. Each hazard event, or in the case of a multi-national RGE such as the tsunami, each country, or even area within a country, will have a different curve.

### 1 Pre-disaster

**Stage 1 represents the state of the country** or area within it before the disaster. A number of factors are of key importance, in influencing the severity of impact:

- The physical nature of the area. Lowland coastal plains are especially vulnerable to coastal flooding, especially when they are unprotected by offshore coral reefs, and inshore mangrove plantations (many were removed for development).
- The impact of the hazard and its capacity to become a disaster is influenced by the state of development of the country - nearly all the countries hit by the tsunami were LEDCs, although India as a NIC has access to more capital and technology.
- The degree of sophistication of the infrastructure with many areas of high value coastal resort development, e.g. Phuket, Thailand.
- To manage hazard impacts the population density and the % of people living below the poverty line are also very important - for example much of the Sri Lankan coast was crowded (densities of 900 people per sq km), many of who lived at subsistence levels as fishermen and farmers.
- Additionally both the NE coast of Sri Lanka and Aceh province in Indonesia were war zones (Tamil Tigers and GAM respectively) which meant that many communities were in a distressed state.
- Pre-existing strategies for disaster mitigation pre-tsunami were also important. Bangladesh a multiple hazard zone, had many strategies for community preparedness for flood management although unlike in the Pacific Ocean nowhere had tsunami warning systems in place.

### 2 The impact of the disaster

**Physical** factors undoubtedly played a huge role in influencing the degree of damage and number of deaths with clear distance decay away from the epicentre. Aceh province was so badly hit by both mega earthquake **and** the tsunami wave which followed almost immediately afterwards. The coast was completely remodelled and the damage so widespread that even the coral reefs were totally destroyed as they were uplifted away from the sea by the earthquake. Equally, the low level of the coral atolls of the Maldives meant they actually overtopped by the tsunami waves causing much damage to both types of island, but especially those inhabited by local people.

Clearly the further away from the epicentre the more potential for communication networks to deliver warnings. Hence in Kenya, evacuation plans were possible but in the neighbouring LDC Somali Republic there were significant deaths even though the waves travelled 5000kms across the ocean as there was no warning.

Some areas such as the comparatively small island of Sri Lanka had disproportionately long stretches of coast affected with up to 3% of the total population affected (see Table 1).

In Thailand there were additional implications. The tsunami impacted on international holiday resorts such as Phuket with 40% of those killed or missing in Thailand being foreign nationals. Body identification proved a very complex emergency issue. This meant that a localised event developed a global dimension and undoubtedly increased the amount of aid donated (cf Kashmir).

### 3 Emergency Relief

Overall, the Oxfam Report states that the massive Emergency Relief effort was tremendously successful in virtually all areas, as there were minimal secondary deaths from starvation, disease epidemics or lack of clean water, even in the very isolated Andaman Islands. Equally children went back to school, almost immediately, although temporary schools had to be provided for 500,000 children by Unicef, with uniforms provided by Oxfam, the idea being to try and overcome trauma by returning normality to their lives.

However, just as the physical damage between and within countries varied, so too did the geographics of recovery. There was a differentiation in terms of response rates and the effectiveness of recovery programmes. How resistant communities were depended on the profiles of death, the topography, extent of damage and the timeliness and effectiveness of assistance from various institutional providers. Equally the cohesiveness of the community and access it had to social, economic and political resources play a crucial role in recovery activities.

For example in Thailand there was great success in the fishing community of Kohlanta but much slower progress in Phi-Phi. The biggest single problem faced in the emergency period was the breakdown of infrastructure and communications which meant that the multiplicity of NGOs and Government organisations lacked planes and boats to reach remote communities.

#### 4 Rehabilitation one year on

In this phase it is possible to see differential progress, for example between communities along the same coast as well as between countries. Many people report the almost indecent haste to get Phuket back to functioning as a premier tourist resort, at the expense of poor communities in Krabi or Khao Lak. So much depends on how well the sequence of aid was organised locally and how the providers worked with each other and the local communities.

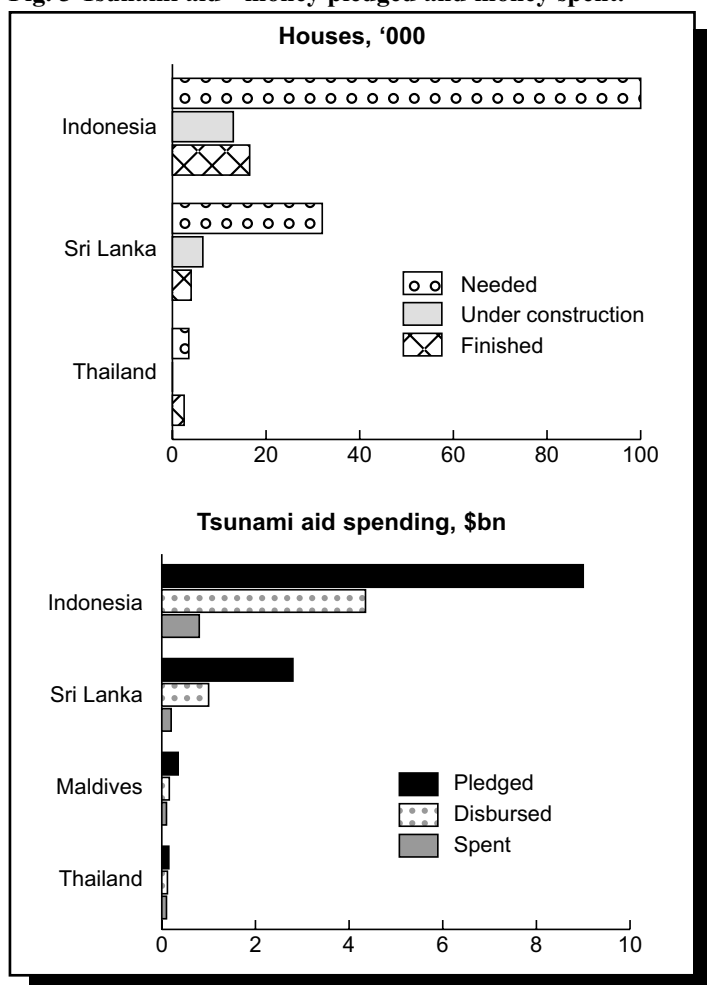
The one major success of the first year is the Cash for Work Programme. Over one million jobs were lost directly as a result of the tsunami, and 64,000 hectares of agricultural land were damaged or contaminated as a result of coastal flooding. Worst affected livelihoods were fishing, small-scale subsistence farming, tourism and labouring work. Cash for work schemes found work for survivors rebuilding boats, desalinating land and organising village communities as trade cooperatives, building, craftwork to encourage sustainable living.

So 60-70% of fishermen are back in business with many areas catching 70% of pre-tsunami levels.

There are however some major concerns, which have been raised:

- As Fig. 3 shows, in many countries including Indonesia and Sri Lanka, the two worst hit, there is a shortfall between money pledged and money received. Only around 10% has actually been spent on projects.
- Tensions between short-term and longer-term projects for which money needs to be set aside.
- Competition between charities and over emphasis on eye-catching projects such as sponsored logo fishing boats unsuitable for use!

Fig. 3 Tsunami aid - money pledged and money spent.

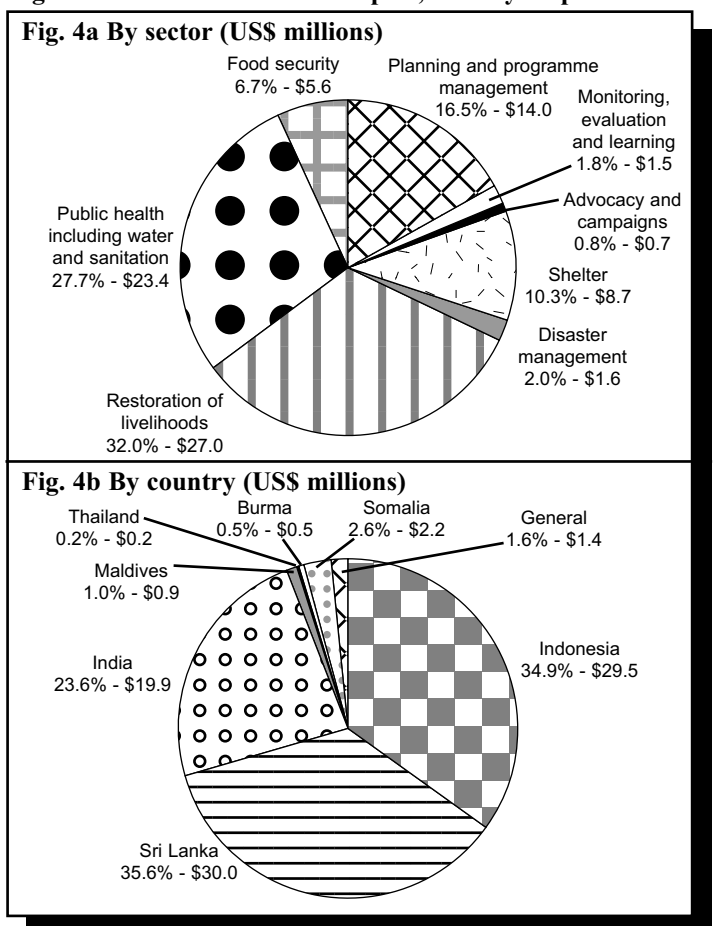


Progress on re-establishing infrastructure, public services and rebuilding housing has been very slow in comparison with restoration of livelihoods and provision of public health, water and sanitation (see Fig. 4). There are many barriers which prevent permanent rebuilding, but the greatest are problems related to land ownership. In Sri Lanka the authorities have planned a **buffer zone** to prevent rebuilding of fisherman's houses actually on the coast because of the risk. There are also arguments between local people and developers who have earmarked new land for up market hotels as part of Sri Lanka's tourist strategy for the future.

As Fig. 3 shows, Sri Lanka is experiencing the greatest problems in building new houses, with allegations of corruption centred on the differential progress in various villages. The sheer scale of the disaster with 2 million people homeless has meant that many people are housed in legionary barracks (50,000 in Indonesia) and transitional houses in Sri Lanka. Decisions as to where to rebuild raise issues of personal trauma and memories of lost family members.

Fig. 4b shows the differential spending by country. Whilst this is largely in proportion to the degree of damage, there are anomalies, based on political circumstances. Myanmar (Burma) has in general refused to acknowledge the impact of disaster and has only received limited aid from China. Equally the Maldives have repaired the tourist hotel islands but only allowed restricted aid to reach the separate islands where local people live. India, very conscious of its status as a NIC, has provided abundant government aid and actually denoted aid to other poorer countries. However because of their sensitive military status, foreign aid, except for emergencies, has not been permitted in the Andaman Islands. One good spin off in Aceh is that the war is now largely over, thus conflict proved less of a barrier to recovery than was first feared and in time this area may reach stage 5 of the model (Fig. 2).

Fig. 4 Where tsunami funds were spent, January - September 2005.



## 5 Recovery

In terms of mitigation, enormous progress has been made with the provision of a tsunami warning system.

### **The problem of no warning system for the Indian Ocean**

The Pacific Ocean already has the **Pacific Tsunami Warning Centre** based in Hawaii which co-ordinates warnings for the countries surrounding the Pacific Ocean basin. The Pacific Ocean is particularly prone to tsunami as it is bordered by the "Ring of Fire", a near continuous zone of earthquakes and volcanoes caused largely by the subduction of the Pacific Plate along destructive plate boundaries. Earthquakes are monitored and the risk of tsunami assessed before countries are warned of any potential tsunami threat. The Pacific Ocean accounts for 80% of tsunamis that occur and has several MEDC countries that are able to pay for such a system (USA, Japan). The Indian Ocean largely experiences seismic activity near Indonesia; the most significant previous tsunami was caused by the eruption of Krakatoa in 1883.

At the time of the disaster no system existed for the Indian Ocean and this was largely due to the infrequency of tsunami events and the developing status of the surrounding countries.

The Boxing Day earthquake was detected and the threat it posed was recognised immediately by the Pacific Warning System but the personnel at the Centre did not know whom to contact in the countries under threat and knew that within 20 minutes of detecting the earthquake tsunami waves had probably already inundated Northern Indonesia. Information was received in Thailand an hour before the tsunami arrived but no action was taken due to the unusual nature of the information and the uncertainty of a real threat. Warnings were however given and heeded in Kenya, nearly 4000kms from the epicentre, and only one person was killed but not in Somalia where nearly 300 people died.

One example of how past knowledge can save lives was in the island of Simeulue. In 1907 an earthquake had caused a tsunami, which had killed thousands. This time when people felt the earthquake they ran to higher ground, and although there was damage, the population of 70,000 largely survived.

### **The new Indian Ocean Tsunami Warning System**

Following the disaster 27 countries bordering the Indian Ocean and UNESCO (United Nations Educational, Scientific and Cultural Organisation) are co-ordinating their efforts and resources to produce an Indian Ocean Tsunami Warning System. The system will combine hi-tech monitoring with educating coastal communities and is expected to cost £20 million pounds. A network of deep sea sensors, buoys and hi-tech communications will provide real time data to produce an assessment of risk and subsequent warnings to all partnership countries. Tide gauges will be part of the network but they can only confirm and measure the tsunami when it is already close to land. It will then be the responsibility of each country's National Warning Centre to disseminate the information to their populations. Inundation maps and tsunami modelling will allow for more vulnerable coastlines to be pinpointed.

Thailand hopes to be able to warn its population within 20 minutes of a tsunami by broadcasting on television, radio and by sending text messages to all mobile phones. They have also installed sirens and alarms on beaches which are controlled centrally not locally. The warnings will need to be combined with community preparedness.

## Conclusion

A number of important reports have been written concerning the management and relief for this mega event from United Nations, World Bank and Oxfam a leading multi-national charity. Issues raised include:

- The need to establish a world disaster fund, contributed to by most nations, so that the UN Disaster Emergency Committee has readily available funding to provide transport and emergency relief (UN).
- The need for mitigation strategies to be an integral part of pre disaster and recovery planning. In a very rare event is always difficult to persuade people it will ever happen again (World Bank).
- The protection of coastal areas, and relocation of new buildings away from the coast are therefore key long-term strategies in spite of local opposition.
- The need to establish a legal framework for land tenure, so that disputes about ownership are not a barrier to rehabilitation.
- To develop procedures which ensure that public works and buildings can take place so avoiding reconstruction delay and thousands of people in temporary homes.
- To ensure that all projects are equitable with technology appropriate to the local people and also empower these local people to play a full role in decision making post recovery, i.e. to ensure **sustainability** (described by Oxfam as **accountability to beneficiaries**).

## Bibliography

Developments DFID First quarter 2006  
 Post Tsunami Reconstruction and Tourism - Tourism Concern 2005  
 Oxfam Tsunami Accountability Report, Dec 2005, Oxfam  
 Geographical Journal 2005 - series of articles  
 Geography Review, Sept 2005, Asian tsunami the aftermath

## Useful websites

- [www.recover/anka.net](http://www.recover/anka.net)
- <http://ioc.unesco.org/indotsunami> - UNESCO - Tsunami warning system links
- [www.dfid.gov.uk/](http://www.dfid.gov.uk/) - Department for International Development
- [www.undp.org/tsunami/](http://www.undp.org/tsunami/) - Country by country reports on recovery
- [www.newscientist.com/channel/earth/tsunami](http://www.newscientist.com/channel/earth/tsunami) - Special report on the Asian tsunami

## Acknowledgements

This Factsheet was researched by Lucy Prentice with additional information from Sue Warn. Curriculum Press, Bank House, 105 King Street, Wellington, TF1 1NU. Tel. 01952 271318. Geopress Factsheets may be copied free of charge by teaching staff or students, provided that their school is a registered subscriber. No part of these Factsheets may be reproduced, stored in a retrieval system, or transmitted, in any other form or by any other means, without the prior permission of the publisher. ISSN 1351-5136