

# **TSUNAMI DISASTER MANAGEMENT IN SRI LANKA**

*Dissertation submitted to the Jawaharlal Nehru University  
in partial fulfillment of the requirements  
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**MASTER OF PHILOSOPHY**

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### CERTIFICATE

Certified that this dissertation entitled "TSUNAMI DISASTER MANAGEMENT IN SRI LANKA", submitted by CHITRA MEENA, in partial fulfillment of the requirement for the award of the degree of MASTER OF PHILOSOPHY, has not been previously submitted for any other degree of this or any other university and is my own work.

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*Dedicated to...*

*...My parents*

## List of Abbreviations

ADB	:	Asian Development Bank
AGA	:	Assistant Government Agent
CNO	:	Center for National Operations
GA	:	Government Agent
GDP	:	Gross Domestic Product
INGO	:	International Non-Government Organisation
JBIC	:	Japan Bank of International Cooperation
JICA	:	Japan International Cooperation Agency
JVP	:	Janatha Vimukhti Peramuna (People's Liberation Front)
LTTE	:	Liberation Tigers of Tamil Eelam
MOF	:	Minister of Finantion
MOE	:	Minister of Education
NGO	:	Non-Government Organisation
PDS	:	Planning and Development Secretariat
RADA	:	Reconnection and Development Agency
STAART	:	Sri Lanka Tsunami Affected Areas Recovery and Takeoff Project
TAARP	:	Tsunami Affected Areas Rebuilding Project
TAFREN	:	Task Force for Rebuilding the Nation
THRU	:	Tsunami Housing Reconnection Unit
UN	:	United Nations
UNDP	:	United Nations Development Programme
UNHCR	:	United Nations High Commissioner for the refugees
UNIGEF	:	United Nations Children's Fund
WB	:	World Bank
WHO	:	World Health Organisation

### **Weigmls and Measures**

Bn	:	billion
Km	:	kilometer
Km <sup>2</sup>	:	square kilometer
m	:	meter
mn	:	million
Ru	:	Rupee

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However, I am individually responsible for any errors in this work.

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## Preface

Natural disasters have affected mankind the world over since time immemorial leaving behind a trail of fury and havoc of unimaginable proportions. Natural disaster such as flood, cyclone, drought and earthquake and tsunami has become a regular in our normal life. They are catastrophic events with multi-dimensional impact on pattern of life. This necessitates an effective disaster management mechanism that could provide immediate relief followed by future reconstruction and rehabilitation efforts. It calls for a multi-pronged approach at the national and local levels to reduce to the risks and vulnerability of the populace affected by disaster.

Convinced of the vulnerability of Sri Lanka to natural disaster and their devastating long-term impact on the poor, the UNDP has significantly helped the government of Sri Lanka to set up the National Disaster Management Center (NDMC). While the disaster management of relief and reconstruction under the same ministry is responsible for post disaster relief and rehabilitation, the NDMC is charged with the primary responsibility of strengthening the capability at all levels to respond to disaster effectively. This serves as the catalyst for planning and management at all levels. The activities are primarily funded by the various bilateral and multi-lateral donors, e.g., UNDP, UNICEF Government of Japan, DANIDA, etc. However, most of the aid received for the disaster is spent on structural reconstruction project with scant attention paid to non- structural measures based on indigenous knowledge of coping strategies.

This dissertation mainly focuses on the important natural disaster, tsunami in Sri Lanka. The study also focuses on the subsequent management activities undertaken to mitigate, minimize, and prevent, if possible, the havoc caused by this natural disaster.

This study adopts a historical and analytical method. It is based on primary and secondary sources. The primary sources would include: World Bank Reports, Asian Development Bank Reports, NDMC of Sri Lanka, government documents, UN official statements, relevant speeches, and UNDP, etc. Oceanography Department Report, statements of the tsunami warning system at the regional, national, and international levels have also been examined. The secondary sources are consisting of

books, articles of periodicals, newspapers, and reports. Internet sources have provided more information in the form of maps, diagrams and data tables.

As a Third World and developing country, Sri Lanka was paralysed by the tsunami that occurred on December 26, 2004. It was the most serious catastrophe in the country's history that created a worldwide display of sympathy for Sri Lanka. Due to a weak economy and a lack of relief and reconstruction resources, the Sri Lankan state was unable to fully compensate victims for the enormous losses caused by the tsunami. Fortunately, however, donations of government and private aid from all corners of the globe have poured in to Sri Lanka through innumerable organizations and individuals, enabling not only first aid, but also permanent reconstruction through the quick rebuilding of the devastated coastal regions and the successful repair of the psychological disorder.

Chapter 1 on "Natural Disaster: A Conceptual Discourse" comprises a conceptual framework for planning and management of natural disaster. The chapter begins with an analysis of the concept and meaning of disaster and the properties that differentiate it from an emergency. It tries to explore the human linkages in disaster and the need for an emphasis on vulnerability reduction as the key to disaster management. This chapter focuses on the meaning, definition and classification of tsunami in natural disasters and its causes and types. The chapter focuses on the management activities undertaken to mitigate, minimize the disaster.

Chapter-2, "Tsunami in Sri Lanka", this chapter focuses on the December 26, 2004 tsunami impact on Sri Lanka. The chapter focuses on the socio-economic, environment and physical infrastructure of damage by tsunami. The death total in the country stands at 35,322 persons with further 6,300 missing, and besides about 120,000 buildings were partially or totally destroyed, 29,700 fishing vessels lost, 92 schools destroyed and 90 damaged as well as 516,000 people displaced. The economic loss estimated by the government of Sri Lanka, is approximately US\$2.2 billion and it has reduced the GDP of Sri Lanka by 0.5-0.6% from the expected 6% growth which on the face of it looks comparatively very low. The chapter also focuses on the damage of physical infrastructures in the coastal region including roads, railway lines, water, electricity supplies and waste water treatment system. The chapter also focuses on the damage of the environment and ecosystem.

Chapter-3 "Role of Government and Non-government of Tsunami Disaster Management in Sri Lanka", it lays down the approach to disaster management plans

including needs assessment and guiding principles for a Post-tsunami reconstruction strategy. Further, it analyses the framework for a disaster management policy and institutions in Sri Lanka in the context of the country's peace process.

Chapter-4 "Conclusion" This chapter sums up the analysis and findings in all the previous chapters. It also assesses the nature of development and disaster management policies in Sri Lanka.

## **CHAPTER-1**

# **Natural Disaster: A Conceptual Discourse**

Natural disaster, in fact has existed alongside man as long as recorded history and presumably even longer. They have not discriminated between people and countries although; affecting some parts of the world more severely than others. This is, particularly true of developing countries where the effects of a disaster have been exacerbated by vulnerable socio-economic condition. These include steady population growth, higher incidence of poverty. Lack of adequate resource and absence of basic infrastructural facilities and disorganized institutional situation.

The inevitability of natural disaster and aforementioned conditions make disaster management a complex process requiring comprehensive planning and multicultural management. The foremost question that harts social scientists dealing with the issue of disaster management in modern times has been-is mankind despite the amazing scientific progress made still a spectator of the fury unleashed by disaster? This question brings to light varied inter-linkages between society, polity, economy and last and not the least environment all of which need to be carefully examined and explored in any research undertaken in this area.

### **1.1 Disaster: Concept and Meaning**

Disasters have occurred all though recorded history as early as 5,000 years ago. Natural, ecological disasters and hazards, affected the Mesopotamian communities. Evidence suggests that they acted collectively in the face of such natural hazards. The very existence and development of concentrated centers of population and cities were partly due to a need for collective defense against such disasters whether natural or attributable to human activity. The disturbances caused by such unfortunate experiences are said to have been relatively controlled, especially in the case of floods, earthquakes, tsunamis, and storms and similar phenomena. However, most of the humanity continues to bear an increasingly heavy burden of losses from such hazards.<sup>1</sup>

Although considerable efforts have been devoted to conceptualizing the term disaster, many divergent definitions appear in literature. Social scientists, politicians, environmentalists, geologists, relief workers, and journalists perceive disaster

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<sup>1</sup> Planning And Management of Disaster Reduction, Report by United Nations Centre for Human Settlements (UNCHS), Nairobi, 1990, p.1, Also see D. Alexander, Natural Disaster, Chapman and Hall, New York, 1993, pp.1-20.

differently.<sup>2</sup> Reasons for the lack of a commonly accepted definition are based on the complexity of natural events.

The term 'Disaster' owes its origin to the French word 'Berastre' which is the combination of two terms 'des' meaning bad or evil, and 'astre' meaning 'star': the combined expression is 'Bad or Evil Star'. In the earlier days, a disaster was considered to be a loss due to some unfavorable stars.

Disaster is associated with following features:

- 1) It disrupts normal pattern of life. Such disruption is usually severe and may also be sudden, unexpected, and widespread, and thus human beings remain in shock and trauma for a long period.
- 2) Human sufferings such as injury, loss of life, livelihood and property, increased hardship etc adversely affects health, physically as well as mentally.
- 3) Effects on social structure such as destruction or damage to infrastructure buildings, communication, and other essential services leading to disruption of life and scarcity of resources.
- 4) Community needs such as shelter, food, clothing, medical assistance and social care are also affected.
- 5) The magnitude of damage and destruction are often beyond the control of local authorities and they require external assistance to control the situation.
- 6) Return to normalcy is prolonged and it takes several years to completely overcome the damage caused.

A complete definition of disaster may be "an event, concentrated in time and space, which threatens a society, or a relatively self sufficient sub division of a society with major unwanted consequences, as a result of the collapse of precautions which had hitherto been culturally accepted as adequate" (Turner, 1976).

Science has not had much success in defining what it means by the term "disaster". Dictionaries use the words as "misfortune" or "calamity" implying that disaster implies that people must suffer (i.e., unless a cyclone or an earthquake. Kills people or damages property it is not a disaster). Since 1906, UNESCO has been listing "natural

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<sup>2</sup> Anders Wijkman and Llyod Timberlan, Natural Disaster: Act of God or Acts of Man International Institute for Environment and Development and the Swedish Red Cross, Geneva, 1984, p.18. Also see P.L. Abbott, Natural Disaster, William C. Brown Publisher, Dubuque, IA, 1996, pp.2 -8.

disasters” occurring each year earthquakes tsunami (large ocean waves), storm surges, and volcanic eruptions, et al. In 1969, it listed 759 disasters but named only 12 as destructive disasters suggesting others to be harmless. Other experts take almost a contrary view defining disasters only in terms of its impact upon people.<sup>3</sup>

The World Bank operational directive OD 8.50 Emergency Assistance Work System DC, 1989 defines disaster as an extraordinary event of limited duration or strictly speaking, a natural event causing serious disruption of the country’s economy. In order to provide a certain consistency, the Natural Hazard Research Group came up with the following definition of disaster in 1969. The elements of disaster included:

- 1) More than 11 million suffer damage;
- 2) More than 100 people dead, or
- 3) More than 100 people injured.

This definition had the effect of separating the disaster event, destruction, death, and injured, from the “Trigger Mechanisms” i.e. high velocity winds, earth shocks, lack of rain, excess, of water, volcanic eruption immuring lava and high tidal waves. This definition of disaster showed that most of the emphasis lay by geologists and climatologists was on the trigger mechanisms.<sup>4</sup>

The United Nations defines disaster as; “The occurrence of a sudden or major misfortune which disrupts the basic fabric and normal functioning of a society or community.”

In an Indian setting, natural disasters whatever are the kind, are seldom found to be stingy in respect of their impact and aftermath. Ravages wrought by them are invariably pervasive, populations whatever be the natural become victims, and settlements, human and other, are disrupted, buildings and structures are dismantled, often razed to the ground, mental frame is found reeling heavily; environment in its entirety thus becomes terribly. As mitigation and alleviation of miseries stand out to be necessary tasks in the wake of natural disasters, attention to medical care and needs often come as third in the order of priority, food and shelter having obviously higher precedence.<sup>5</sup>

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<sup>3</sup> Anders WijkMan, n.2, pp.18.

<sup>4</sup> Anders Walkman, n.2, pp.18-19.

<sup>5</sup>Indian Science, Congress Association Presidential Addresses, Prof. Delip Kumar Sinha, 1991, Indore, The Shaping of Indian Science Congress Association Presidential Addresses, 2003, vol.3: 1982-2003, pp.173-31.

Distinction between Hazard and Disaster: Hazards and disasters are closely related. “---A hazard is a natural event while the disaster is its consequence. A hazard is a perceived natural event which threatens both life and property --- a disaster is the realization of this hazard---.”(John Whittow, *Disaster*, 1980).

Pan-American Health Organization in its Scientific Publication No.575 in 2000 has described the difference very clearly, to quote: The term “disaster” usually refers to the natural event (e.g., a hurricane or earthquake) in combination with its damaging effects (e.g., the loss of life or destruction of buildings). “Hazard” refers to the natural event, and “vulnerability” to the susceptibility of a population or system (e.g., a hospital, water supply and sewage system, or aspects of infrastructure) to the effects of the hazard. The probability that a particular system or population will be affected by hazards is known as the “risk”.

### **1.2 Disaster: Nature and Cause**

The varied researches undertaken on natural disasters suggest the following nature and causes of disaster:

- Natural events result basically from interaction between the atmosphere, hydrosphere and lithosphere; i.e., they are geographical processes. Resource depletion and environmental decline change these interactions, which in turn, affect the frequency and magnitude of natural disaster.<sup>6</sup>
- Natural hazards are generated from the interaction between the natural events system and human use system. Earthquakes and tsunami would not be hazards if humans did not occupy active seismic zones. This means that natural hazards potentially threaten human society.<sup>7</sup>
- Natural disasters are interaction between natural hazards and their vulnerable conditions (socio-economic, cultural and political), which are usually created by human actions. Thus, the distinction between natural and man-made disaster is blurred by the tragic impact of the natural disaster that result from the human misuse of resources, inappropriate actions, and lack of foresight.<sup>8</sup>

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<sup>6</sup> Souhil EL – Masri and Graham Tipple, n.27, pp.1-2.

<sup>7</sup> Iam Burton n.12, P.9. Also see Report of The Swedish Red Cross, 1984, p.78. Also see Souhil EL Masri, n.27, pp.2.

<sup>8</sup> Iam Davis,Ed. *Disaster and the Small Dwelling*, Pergamem Press, Oxford, 1981, p.8. Also see Jawes Lewis, “Development, Vulnerability and Disaster Reduction”, in Andrenelle Awotona Ed., *Reconstruction after Disaster: Issues and Practices*, Ashgate Publishing Company, London, 1997, pp. 45-46. Also see Piers Blakie, et a, n.20, pp.8-12.



- Natural disaster causes tragic impact, which disrupts the established way of life. Some of impacts such as loss of life, destruction to buildings and infrastructure, and economic losses are quantifiable. Other losses such as loss of opportunities, changes in the community's culture, impact on the environment, and socio – economic problems are less easily measured.

The interrelated complicated nature of these aspects renders any manageable definition of natural disaster both as being contentious and difficult. However, the United Nations Center of Human Settlements (UNCHS) offers a holistic framework for natural disaster in terms of creation, effects, outcomes and responses.<sup>9</sup>

“As the interaction between natural hazards, generated in most cases from sudden and unexpected natural event, and vulnerable conditions causes severe losses to man and his environment (built and natural).”<sup>10</sup> These losses create and sometimes cause political disruption. Such a situation requires outside intervention both at the international and national levels in addition to individual and communal responses.<sup>11</sup>

The above definition (in keeping in line with social scientist's concern) for its adverse impact on society, economy, culture, polity, and environment represents a shift from focusing on the technical aspects of the physical phenomena (namely quantifiable impact on people and structures) to a wider perception, that the natural disaster are predominantly environmental, social, and development issues. The current trend highlights, the fact that the distinction between events based in nature and others is not clear.

As threats are becoming more and more complex and interrelated, the challenge is that of a better understanding of known natural hazards as also the changing and newly emerging threats as well as their complex interrelationships. This has led to the dominance of technical intervention focused on prediction of the hazard and on modifying its impacts. The intent of this kind of intervention has always aimed at ‘merely to get things back to normal as soon as possible’.<sup>12</sup> However, the role of the

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<sup>9</sup> UNDRO, Disaster Management Manual, May, 1991.

<sup>10</sup> United Nations Centre for Human Settlements (UNCHS), Reports, United Nations, New York, 1994, pp.3-10.

<sup>11</sup> Anders Wijkman, n.2, pp. 19.

<sup>12</sup> Mary B. Anderson, “A Reconceptualisation of the Linkages between Disaster and Development. Disaster: The International Journal of Disaster Studies and Practice, vol.9 (Harvard Supplement) 1985, pp.46-51. Also see Mary B. Anderson, “Vulnerability to Disaster and Sustainable Development: A

scientific community is perhaps moving beyond the scope of their disciplines towards greater cooperation among various disciplines. This necessitates an analysis of different perspectives of natural disaster and their management.

### **1.3 Categories of Disaster**

Disasters/hazards can be categorized into various kinds as either man made or natural. The natural disaster can be classified as:

- 1) Meteorological: storms (of various kinds), cold spells, cyclones, tidal waves, tornadoes, hurricanes, and droughts.
- 2) Topological (earth related): earthquakes, tsunamis, avalanches, landslides, and volcanic eruptions.
- 3) Water related (biological): communicable diseases.

The other categories under man – made disasters include:

- 1) Civil disturbances – riots and demonstrations;
- 2) Accidents – relating to transportation, building collapses, forest fires, chemical leaks, industrial accidents, oil spills, nuclear accidents, etc;
- 3) Refugees - due to partition for countries, wars and civil strife. (Ethnic and religious); and
- 4) Warfare – conventional, nuclear, biological, chemical, guerrilla warfare including terrorism. <sup>13</sup>

Natural hazards can also be categorized based on their five primordial origins (i.e., the five primary elements that constitute the universe-sky, air, fire, water and earth)

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General Framework for Assessing Vulnerability”, Prevention for Sustainable Development: Economic and Policy Issues, IDNDR and the World Bank, Washington D.C., 1995.

<sup>13</sup>Kalyan Biswas, Organization for Disaster management at city level, paper presented at Asian Disaster preparedness Center, Thailand, October 1997.

Table-1.1

**Primordial Origin of Natural Disasters**

Element	
Sky	Ionosphere-----Meteor, Cornet, Particle shower
	Stratosphere----- -Thunderstorm, Lighting
Air	Oceanic-----Surges
	Surface-----Gale, Storm, Cyclone, Tornado, Typhoon
Fire	Sub-terrene-----Gaseous fire
	Terrene-----Forest fire
Water	Rain, Ice-----Flood
	Show/Ice-----Piailstorm sleet
	Ocean-----Tidal waves
	Lack of water-----Drought
Earth	Core/Mantle-----Earthquake, Volcano
	Surface----- Landslides

Source: S. C. Bhatia, "Types of Hazards and their characteristics" proceedings of WCNHR, IOE, and WFOE, New Delhi, January, 1992.

The World Bank categorization of natural disasters includes two types:

- (1)Weather related events – winds, storms, floods, droughts, and forest fires, and
- (2)Geography related events – earthquakes, tsunami, volcanic eruptions and landslides.<sup>14</sup>

Categorization of disasters as natural and non-natural is also evident in the study available in the World Disaster Report-2000. The natural disasters as identified by the report include:

<sup>14</sup> This categorization is part of a World Bank study of 198 disasters related projects approved by the World Bank. Since 1980, of which 102 were for reconstruction and 96 for mitigation. Alcira Kreimer and Ray Gilbert, learning from the World Bank's Experience of Natural Disaster Related Assistances, the World Bank, Washington D.C. 1999, pp.1-10.

1. Avalanches / landslides
2. Droughts
3. Earthquakes
4. Epidemics
5. Tsunami
6. Extreme temperatures
7. Floods
8. Forest / scrub fires
9. Windstorms
10. Volcanoes
11. Other insect infestation

The non-natural disasters include:

1. Industrial / chemical
2. Transport
3. Miscellaneous accidents

**1.3.1 Earthquake:** Earthquake is the infestation—the most feared natural hazard as they occur without any recognizable warning, are unpredictable in space and time, and inflict heavy losses in less than a minute's duration.<sup>15</sup> A UNESCO study indicates that on an average, 10,000 people die each year from earthquake and losses amounting to billions of rupees.<sup>16</sup>

The continents and sea floor that cover the earth's surface are part of a worldwide system of plates that are in motion. These motions are very slow, only an inch or two per year. Earthquakes occur where the edges of plates run into one another. Such edges are called fault lines or fault. Sometimes the forces along fault can build-up over long periods of times so that when the rocks finally break, an earthquake occurs.

**1.3.2 Floods:** Floods occur when large volumes of water from heavy rainfall and / or river spill is not able to drain off quickly through normal channels and are the most frequent and most widespread natural disasters resulting in death, destruction,

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<sup>15</sup> R.K. Celley and T.N. Gupta, "Dimensions of Natural Disaster Management" in India, in Shelter, December. 13, 1999, pp.1.

<sup>16</sup> Ravi Shanker, "Seismic Activity in India", Shelter, p.14.

degradation and displacement. Whether sudden onset or slow development, floods take long to subside and they leave prolonged ill – effects.

Inadequate capacity of the banks of the river to contain high flows, river bank erosion, and silting of river beds, landslides leading to obstruction of flow and change in the river course, synchronization of floods in the main and tributary rivers, retardation of flow due to tidal and backwater effects, poor natural drainage, cyclones and storm surge and cloud burst, and flash floods.

**1.3.3 Cyclones:** Cyclones are characterized by very strong winds, torrential rains and associated floods that cause extensive damage to human lives and property in the coastal area. The damage is much more if cyclone strikes. The coast is affected at the time of high tide resulting in very substantial storm surge inundation the along coast.

The most destructive of weather systems, severe Tropical Cyclones (TC), bring worst disasters when they strike coasts in the preferred locations of the earth. Tropical Cyclones are intense low-pressure areas with fierce winds blowing in an anticlockwise manner in the Northern Hemisphere extending on an average 500–1000 km laterally (over the Indian seas) and on of surface 14-16 km vertically. They are classified according to wind speed in their circulation. In extreme cases, wind speeds of 320 km per hour gusting to 360 km per hour, rainfall 120 cm in 24 hours and storm surge of 13-14 meters have been recorded in association with tropical cyclones. Out of these three destructive elements, via, strong winds, heavy rainfall, and storm tide. The storm tide is responsible for 90% of the loss of life in the case of cyclone disasters.<sup>17</sup>

**1.3.4 Landslide:** Landslides are the most widespread and damaging particularly in hill areas due to high susceptibility to landslides of the Himalayan terrain. Large mass of snow or rock debris that moves rapidly downs a mountain slope sweeping and grinding everything in its path. An avalanche begins when a mass of material overcomes frictional resistance of the sloping surface, often after its foundation is lessened by rains, or is rapidly melted by warm and dry winds.

**1.3.5 Tsunami:** A tsunami is a natural phenomenon consisting of a series of waves generated in a body of water by an impulsive disturbance that vertically displaces the water column. Earthquakes, landslides, volcanic eruptions, explosions and even the impact of cosmic bodies, such as meteorites can generate tsunami. Tsunami can

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<sup>17</sup> G.S. Mandal, Cyclones: The Problem Size in Shelter, p.21.

savagely attack the coast-lines, causing devastating property damage and loss of life<sup>18</sup>

Tsunami is a Japanese word with the English translation, 'harbours wave'. Represented by two characters, the top character, 'tsu' means harbour, while the bottom character, 'nami' means 'wave'. In the past, tsunami was sometimes referred to as 'tidal waves' by the public and as 'seismic' sea waves' by the scientific community. The term 'tidal wave' is a misnomer. Although a tsunami impact upon a coastline is dependent upon the tidal level at the time a tsunami strikes, tsunami is unrelated to the tides. Tides result from the imbalanced, extraterrestrial, gravitational influences of the moon, sun, and planets. The term 'seismic' sea wave' is also misleading. Seismic implies an earthquake related generation mechanism, but a tsunami. Can also be caused by non-seismic events, such as landslide or meteorite impact.<sup>19</sup>

#### 1.3.5.1 Nature of Tsunami / Characteristics:

A tsunami travels outward from the source region as a series of waves. Although often referred to as "tidal waves", a tsunami. Does not look like the popular impression of "a normal wave only much bigger." Instead it looks rather like an endlessly onrushing tide which forces its way around and through any obstacle. Most of the damage is caused by the huge mass of water behind the initial wave front, as the height of the sea keeps raising fast and floods powerfully into the coastal area. The sheer weight of water is enough to pulverize objects in its path often reducing buildings to their foundations and scouring exposed ground to the bedrock. Large objects such as ships and boulders can be carried several miles inland before the tsunami subsides.

In open water, tsunami have extremely long periods (the time for the next wave takes to pass a point after the previous one, from minutes to hours and long wavelengths of up to several 100 kilometer (compared to the typical winds generated swell. one sees at a beach, which might be spawned by a far away storm and rhythmically roll in, one wave after another, with a period of about 10 seconds and a

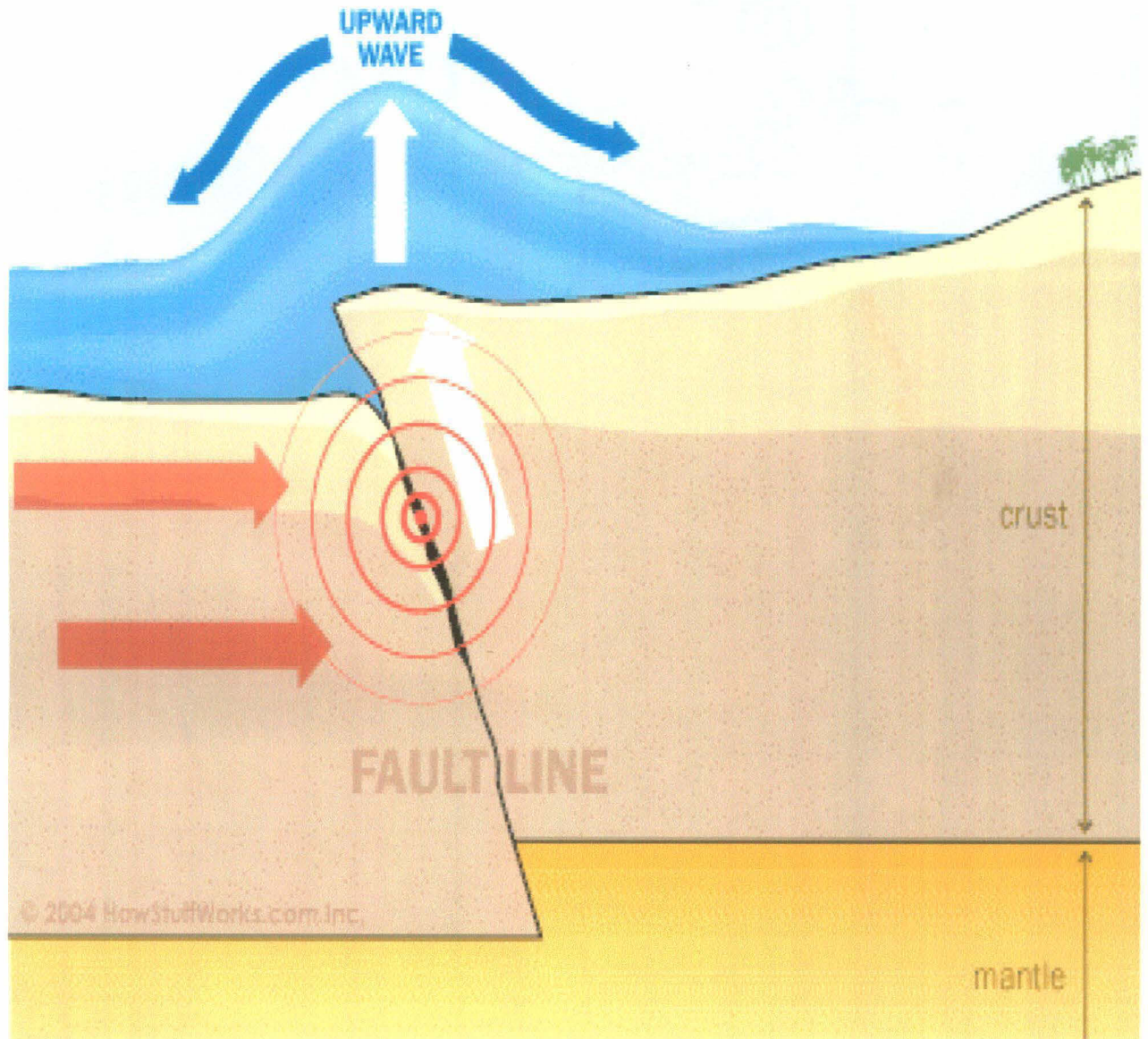
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<sup>18</sup> The Times of India, Chandigarh, Monday, 27<sup>th</sup> December 2004.<http://www.geophys.wasing.edu/.tsunami/general/physics.html>.<http://www.geophys.wasing.edu/tsunami/general/physics.html>.

<sup>19</sup> <http://www.geophys.wasing.edu/.tsunami/general/physics.html>,<http://www.geophys.wasing.edu/tsunami/general/physics.html>.

Figure – 1

### How Tsunamis Work: Tsunami genesis



wavelength of 150 meter) the actual height of a tsunami wave in open water is often less than one meter. This is often practically unnoticeable to people on ships. The energy of a tsunami passes through the entire water column to the seabed unlike surface waves, which typically reach only down to a depth of 10 meters or so.<sup>20</sup>

The wave travels across the ocean at speeds from 500 to 1000 km / hr. As the wave approaches land, the sea shallows and the wave no longer travels as quickly so it begins to 'pile-up'; the wave-front gets compressed becomes steeper and this gains amplitude of 30 meters or more. The steeping process is analogous to the cracking of a tapered whip. As wave goes down the whip from handle to tip, the same energy is deposited in the whip with fewer diameters; hence it moves violently towards the tip with gradual increase in amplitude.

Tsunamis have periods (the time for a single wave cycle) that may range from just a few minutes to as much as an hour or exceptionally more. At the shore, a tsunami can have a wide variety of expressions, depending on the size and period of the waves, the near shore bathymetry and shape of the coastline, the state of the tide and other factors. In some cases a tsunami may only induce a relatively benign flooding of low lying coastal areas, coming onshore similar to a rapidly rising tide. In other cases, it can come onshore as a bore, a vertical wall of turbulent water that can be very destructive. In most cases there is also a draw down of sea level preceding crests of the tsunami waves that results a receding of the shoreline, sometimes by a kilometer or more. Strong and unusual ocean currents may also accompany even small tsunami.<sup>21</sup>

Destruction from tsunami is the direct result of three factors: inundation, wave impact on structures, and erosion. Strong tsunami-induced currents have led to the erosion of foundations and the collapse of bridges and seawalls. Flotation and drag forces have moved houses and overturned railroad cars. Tsunami associated wave forces have demolished frame buildings and other structures. Considerable damage also is caused by the resultant floating debris, including boats and cars that become dangerous projectiles that may crash into buildings, piers and other vehicles. Ships and port facilities have been damaged by surge action caused by even weak tsunami. Fires resulting from oil spills or combustion from damaged ships in port, or from ruptured coastal oil storage and refinery facilities, can cause damage greater than that

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<sup>20</sup> S.M. Ramasamy, C.J. Sivakumar and Bhoop Singh (Eds.). "Geometrics in Tsunami", 1988, pp.1-8.

<sup>21</sup> Ibid.



inflicted directly by the tsunami. Other secondary damage can result from sewage and chemical pollution following the destruction. Damage of intake, discharge, and storing facilities can also present dangerous problems. Of increasing concern is the potential effect of tsunami draw down; when receding waters uncover cooling intakes associated with nuclear plants.

#### **1.3.5.2 Causes of Tsunami**

The tsunami, can be generated by any disturbance that rapidly displaces a large mass of water, such as an off shore earthquake, by a submarine landslide, and also occasionally by undersea volcanic activity. Most of oceanic tsunami (80% of all historical cases) is generated by shallow off shore earthquakes capable of transferring sufficient energy to the overlying water column (ITIC 2005). The rest are divided between landslide (9%), volcanic (6%), and up to 5 per cent as unidentified sources.<sup>22</sup> The tsunami consists of a series of large waves of extremely long wavelength usually generated by a violent, impulsive undersea disturbance, or activity near the coast, or in the ocean. When a sudden displacement of a large volume of water occurs, or if the sea floor is suddenly raised or dropped by an earthquake, big tsunami waves can be formed by forces of gravity.

##### **(A) Tsunami Generated by Earthquake**

Tsunami can be generated when the sea floor abruptly deforms and vertically displaces the overlying water. Tectonic earthquakes are a particular kind of earthquake that is associated with the earth's crustal deformation. When these earthquakes occur beneath the sea, the water above the deformed area is displaced from its equilibrium position. Waves are formed as the displaced water mass which acts under the influence of gravity, attempts to regain its equilibrium. When large areas of the sea floor elevate or subside, a tsunami can be created.

Large vertical movements of the earth's crust can occur at plate boundaries.<sup>23</sup> Plates interact along these boundaries called faults. Around the margins of the Pacific Ocean, for example, denser oceanic plate slips under lighter continental plate in a

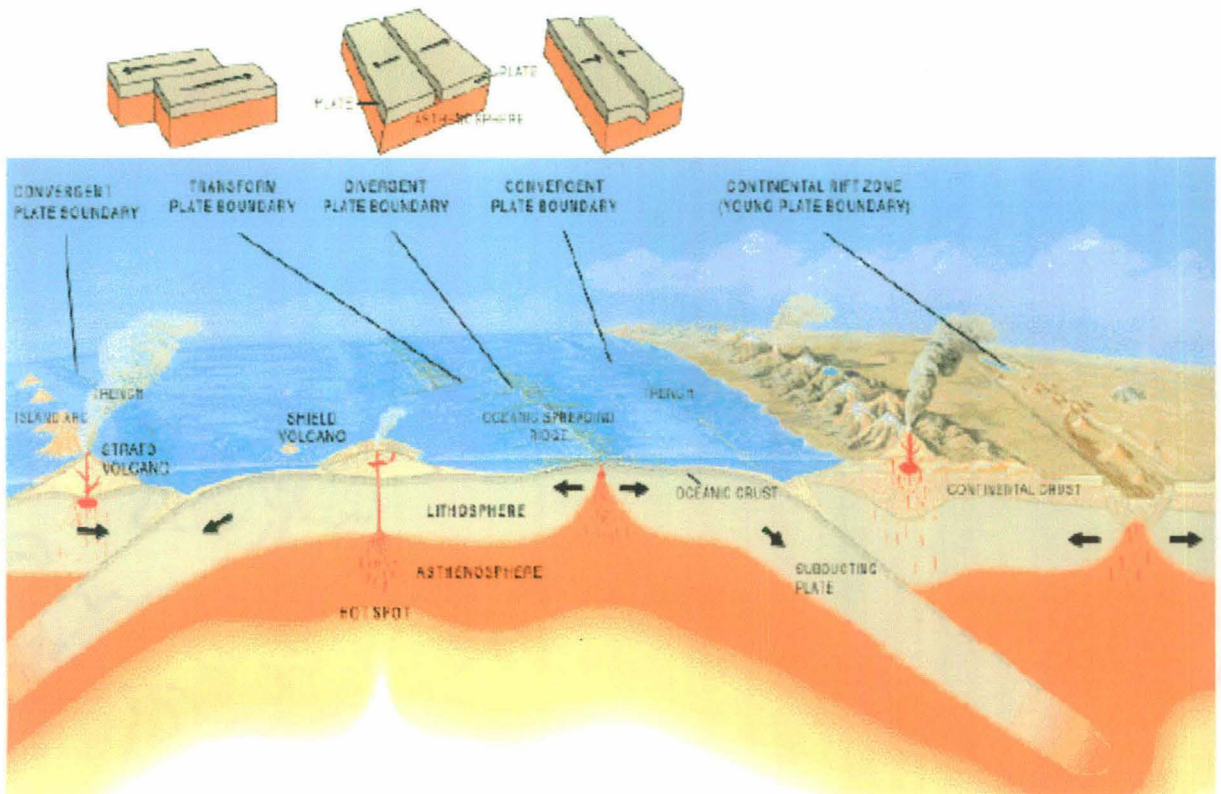
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<sup>22</sup> Manfred Domroes, "After the Tsunami in Sri Lanka Cresting Towered the Future", 2006, pp.41-45.

<sup>23</sup> The Plate Tectonic Theory is A Relatively New Scientific Concept Emerging from Continental Drift Theory. Also see J. Kious and RI Tilling (1996) This Dynamic Earth: The Story of Plate Tectonics, US Government Printing Office, Washington, D.C., 1996, pp.14-19.

Figure - 2

### Three types of Plate Boundaries – Transform, Convergent and Divergent



process known as subduction. Such Subduction earthquakes under the ocean are responsible for generating tsunami.

The continents and sea floor that cover the earth's surface are part of a worldwide system of plates that are in motion. These motions are very slow, only moving at the speed of an inch or two per year. Earthquakes occur where the edges of plates run into one another. Such edges are called fault lines or faults. Sometimes the forces along faults can build-up over long periods of time so that when the rocks finally break an earthquake occurs. Examples of features produced by forces released along plate edge faults are the Andes Mountains in South America (on land) and the Aleutian Trench near Alaska (under water). When powerful, rapid faulting occurs underneath or near the ocean, a large earthquake is produced and, possibly, a tsunami.

The deep ocean trenches off the coasts of Alaska, the Kuril Islands, Russia and South America are well known for their violent underwater earthquakes and the as the source area for destructive Pacific-wide tsunamis.

The tsunami generating process is more complicated than a sudden push against the column of ocean water. The earthquake's magnitude and depth in the region of tsunami generation, the amount of vertical motion of the sea floor, the velocity of such motion, whether there is coincident slumping of sediments and the efficiency with which energy is transferred from the earth's crust to ocean water, are all part of the generation mechanism.

**(B) Tsunami Generated by Landslides, Volcanic Eruptions, and Cosmic Collision.**

A tsunami can be generated by any disturbance that displaces a large water mass from its equilibrium position. In the case of earthquake-generated tsunami, the water column is disturbed by the uplift or subsidence of the sea floor. Submarine landslides, which often accompany large earthquakes, as well as collapses of volcanic edifices, can also disturb the overlying water column as sediment and rock slump down slope and are redistributed across the sea floor. Similarly, a violent submarine volcanic eruption can create an impulsive force that uplifts a water column and generates a tsunami. Conversely, submarine landslides and cosmic body impact; disturb the water from above, as momentum from falling debris is transferred to the water into which the debris falls. Generally speaking tsunami generated from these

mechanisms, unlike the Pacific wide tsunami caused by some earthquakes, dissipate quickly, and rarely affect coastline distant from the source area.<sup>24</sup>

Obviously not every earthquake generates a tsunami. Usually, it takes an earthquake with a Richter scale magnitude exceeding 7.5 to produce a destructive tsunami characterized by high local tsunami intensity (a function of maximum tsunami run-up). Therefore, the earthquake magnitude (M) is, in most of the occurred cases, an indicator determining the size of a tsunami. From 1975-2004, worldwide 325 earthquakes (USGS 2005) with a magnitude 7 and greater occurred. 282 (87%) of them were shallow earthquakes with a depth ranging from 0-33 km. 213 (75%) occurred in offshore regions directly related to the already mentioned sensitive subduction zones and can be described as tsunami generating earthquakes. But still, there are many uncertainties. An investigation of the dependence of tsunami intensity (on Soloviev-Imamura scale- 4/0/+5) on magnitudes (M, Richter scale) for the tsunami-genic earthquakes, that occurred in the Pacific region in the period 1901-2000, show a big scattering of the resulted tsunami intensity for earthquakes with the same magnitude. The observed statistical variation of tsunami generation creates the most serious problem for an operational tsunami warning system. For example, the severe tsunami in Papua New Guinea on July 17, 1998, was characterized by a tsunami intensity of + 3.3 (the largest in the period from 1991-2000), but “only” by a magnitude of 7.0<sup>25</sup>.

### **1.3.5.3 Mechanism: Tsunami Versus Wind Caused Waves**

The wind blown waves occur very seasonally and are distinctly differing from tsunami. The representative wave period and lengths are varying in different tsunamis. The contrast is quite evident. In deep sea water, the velocities of wind caused waves are about 17 mph for a 5 second wave, and about 70 mph for a 20 second wave.

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<sup>24</sup> <http://www.geophys.wasing.edu/tsunami/general/physics.html>. <http://www.geophys.wasing.edu/tsunami/general/physics.html>.

<sup>25</sup> Manfred Domroes, “After the Tsunami in Sri Lanka-Cresting Towered the Future”, 2006, pp.41-45.

Formula for calculating velocity of tsunami is:

$$V = \sqrt{gD}$$

(V=wave velocity of tsunami; g =acceleration due to gravity; D =depth of ocean water.)<sup>26</sup>

If the calculation is done for Pacific Ocean, then, D= 5,500m (18,040ft). As per the above formula, the velocity of tsunami comes to be 232m/sec (519 mph).

A typical tsunami hits the coast like a tidal wave, but it does not stop on the beach and keeps running inland. Tsunami waves have long wavelengths. The ocean basin topography often slows the range of tsunami waves, but they still move at freeway speeds. These are more dangerous on flatter than on steeper shores. Generally, the destructive power is assessed by the height of the waves, but the momentum of the waves is more important as their large masses are separated by ultra long wavelengths.

Related to the distance, three types of tsunami can be distinguished:

- (1) Ocean wide tsunami: It is capable of widespread destruction across the entire ocean. Also the term tale-tsunami or distant tsunami. is used for a tsunami originating from a distant source, generally more than 1,000 km away.
- (2) Paleo tsunami: They are tsunami occurring prior to historical record. Research is based on collection and analysis of tsunami deposits found in the coastal area. This is quite a new research field which will provide a significant amount of new information about past tsunami in order to improve the assessment of the tsunami hazard.
- (3) Regional tsunami: Tsunami that is capable of destruction in a particular geographic region, generally less than 1,000 km from its source (hypocenter of an earthquake), and can be further classified into local or regional tsunami, where the destructive effects are confined to coasts within 100 km or up to 1,000 km of the hypocenter respectively. A locally generated tsunami is very dangerous, because it reaches a nearby shore sometimes in less than 10 minutes. In this case, there is not sufficient time for any existing Tsunami Warning Center or for local authorities to issue a

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<sup>26</sup> S, L. Goel, "Management of Natural Disaster", 2005, pp.99.128.

proper warning? The majority of tsunami related casualties and property damage result from local tsunami. For people living near the coastline, the shaking of the ground should always be warning that a tsunami might be imminent. For tsunami from a more distant source, proper warning may be given.<sup>27</sup>

The tsunami risk is mainly a function of the following different factors; the nature and extent of the tsunami hazard, the vulnerability of facilities and people to damage; and the amount of development or number of people exposed to the hazard. A tsunami is a natural event that can alter the landscape and destroy human settlements, infrastructure, and economic activity. Communities may be vulnerable because of the location and quality of the built environment. The principal exposure will be people, building, and infrastructure located in the low-lying potential tsunami inundation area (tsunami laboratory 2005).

#### **1. 3.5.4 Tsunami Warning System: -**

In the wake of the devastating 1946 tsunami in Hawaii, Pacific Tsunami Warning System (PTWS) and National Oceanic and Atmospheric Administration (NOAA) were established in 1948 for the US and its territories at Ewe Beach, Hawaii. By 1965, it was an international system, with 26 nations as members.<sup>28</sup>

#### **(A) Tsunameter:**

The tsunameter pioneered at the NOAA lab is a system, a sophisticated pressure gauge set on the ocean floor that sends signals to a surface buoy, which in turn radios its findings to a satellite. The satellite then sends to the scientists, who must interpret it and decide if a warning should be sent out. If the Indian Ocean was outfitted with such deep-sea tsunameters, now deployed mostly in the northern Pacific Ocean the countless deaths might have been prevented.

In order to minimize the number of casualties and reduce the damage due to tsunami, three types of tsunami warning systems exist:

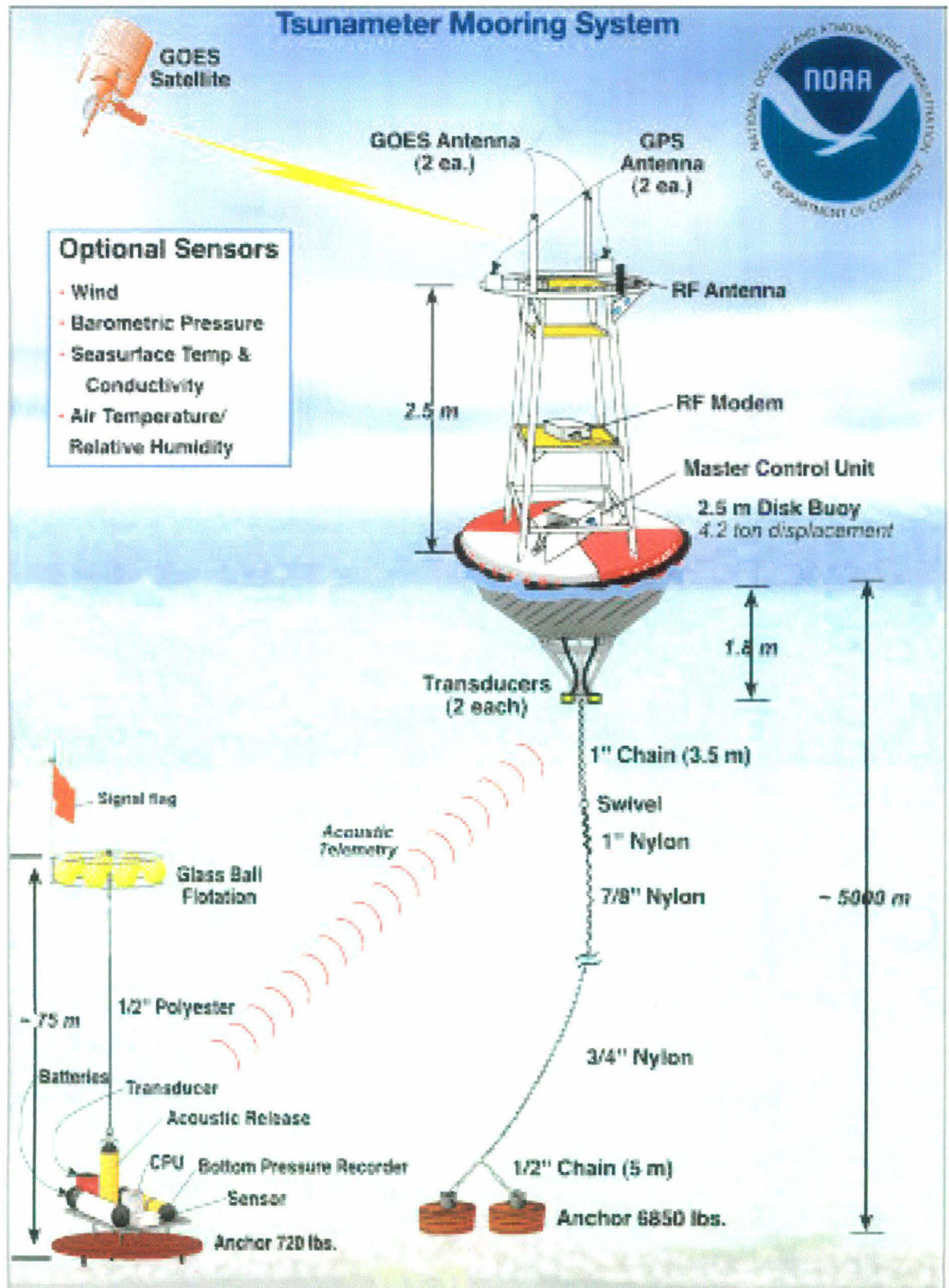
- (1) Pacific Tsunami Warning Center (on an international level);

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<sup>27</sup> Manfred Domroes, "After the Tsunami in Sri Lanka-Crestating Towored the Future", 2006, pp.34-59.

<sup>28</sup> Biswant Dash, "Tsunami Warning System", Economic and Political Weekly, vol.40, no.2, January 22, 2005, pp.269-71.

Figure - 3



- (2) Regional level system (5 system on regional level); and
- (3) Local system (Chile and Japan).

After 26 December, 2004 tsunami, the experts from the United Nations and Indian Ocean countries have agreed to set up an Indian Ocean tsunami warning system by the end of 2006 to prevent a repeat of the catastrophe. As a stopgap measure, Japan and the United States are to begin providing after the December 26, 2004 tsunami, to the experts from the United Nations alerts on seismic activity to the region starting from 1 April 2005 (UNESCO's Intergovernmental Oceanographic Commission).<sup>29</sup>

Objective of warning system: To detect, locate, and determine the magnitude of potentially tsunami-genci earthquake.

**(B) Working Principles**

- 1) Underwater earthquake detected by pressure sensor;
- 2) Acoustic transmission;
- 3) Data is processed;
- 4) Data transmitted to satellite;
- 5) An alert center broadcasts alert to the authorities and the media;
- 6) Population alerted.

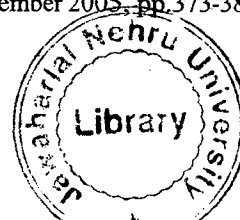
Seismic stations operated by PTWS and other sources provide earthquake information. If the location and magnitude of the earthquake seems to indicate generation of a tsunami, a warning is issued accordingly. Tsunami watch, warning and information bulletin issued by PTWS are disseminated to local, state, national, and international users as well as the media. These users, in turn, pass the information to the public, generally over radio, televisions, and SMS.

#### 1.4 Management of Natural Disasters

A natural disaster system cannot have merely technocratic approach but also has to involve a socio economic approach as well. Technology is not and cannot be a substitute for policy. There has to be a synergy between technology and policy. The problem is in operational vacuum due to ineffective policy formulation and inefficient implementation. Advocates of a mere technocratic approach to this issue should

<sup>29</sup> Harish J. Gupta, "Early Warning System for Oceanagenjng Disaster in Indian Ocean the Indian Initiative", Journal of Indian Ocean Studies, vol.12, no.3, December 2005, pp.373-382.

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realize that the primary role of science is to promote the cause of human well-being. Therefore, in any research on natural disaster management, scientists should also consider the issues of ethics, rights, and equity, long considered to be issues of concern for social scientists and relegated to the domain of social science. Fresh air in science can only be instilled with research from varied disciplines that fall within the ambit of social science. This would ensure that new technologies, the result of many scientific discoveries are used with caution.<sup>30</sup>

The necessity of a synergy between technology and policy should be effectively ensured in all the three key stages that a natural disaster entails.

1. Before a disaster: This is necessary to reduce the potential for human, material, or environmental losses caused by hazards, and to ensure that these losses are minimized when disaster strikes.
2. During a disaster: The synergy to ensure that needs and provisions of the victims are most to alleviate and minimize suffering.
3. After a disaster: The synergy helps achieve rapid and durable recovery, which does not reproduce the original vulnerable conditions.

Most research and efforts in policy formulation in the area of disaster management had focused on two stages viz., emergency relief period and post disaster rehabilitation. This bias occurs, as these two stages are the strongest in terms of high profile visibility, political support, and funding provision. Instead of allocation of funds before an event, and to reduce future disaster, action normally takes place after events have occurred. This situation is similar to that of preventive health care, where curative medicine is relatively well funded, while preventive medicine is not.<sup>31</sup>

Whilst emergency relief and rehabilitation are vital activities, successful disaster management planning must encompass the complete realm of activities and situations that occur before, during, and after disaster. The phase can be represented as a cycle or continuum, which if circumstances allow, reduces the negative effects of future disaster. These activities are implemented at specific times, with the length of any one period being dependent on the type of disaster. Therefore, one of the key issues in disaster management planning is the allocation of resources at all the stages

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<sup>30</sup> The Above Views are based on an Interview given by the noted Scientist M.S. Swami Nathan to Rajiv Mehrotra and telecast by Doordarshan on 26<sup>th</sup> December, 2001.

<sup>31</sup> UNCHS, n.1, pp.14-24. Also see ADB, n.44. pp 52-53.

of the disaster cycle, which optimizes the total effectiveness of disaster reduction activities.<sup>32</sup>

#### 1.4.1 Disaster Cycle

A disaster cycle consists of three stages:

- 1) **The disaster event / impact** – This refers to the ‘real time’ event of a hazard occurring and affecting elements at risk. The duration of the event will depend on the type of threat; sea floor may only occur for a matter of second during an earthquake while flooding may take place over a longer sustained period.<sup>33</sup>
- 2) **Recovery** – Recovery is used to describe the activities, which encompasses the three overlapping phases of emergency relief, rehabilitation, and reconstruction.

2.1 **Emergency relief** – Refers to the period immediately following the occurrence of a disaster, when steps are taken to meet the needs of the survivors in respect to shelter, water, food, and medical care. Activities undertaken during and immediately following a disaster include: immediate relief, search and rescue, evacuation, damage and needs assessment, and debris clearance.

2.2 **Rehabilitation**- Activities that are undertaken to support the victims return to normal life and reintegration into regular community function. Rehabilitation includes the provision of temporary public utilities and housing, as interim restoration measures both physical and psychological, to assist longer-term recovery.

2.3 **Reconstruction**- Good reconstruction attempts to return communities to improved pre-disaster functioning. It includes the replacement of buildings, infrastructure, and lifeline facilities, so that long term development prospects are enhanced rather than reproducing the same conditions which made an area or population vulnerable in the first place. Mitigation measures can effectively be incorporated into

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<sup>32</sup> ADB, n.44, pp.50-51, 66-68. Also See D.J. Oakly, “A National Disaster Preparedness Services.” Disaster: Protecting Vulnerable Communities, Thomas Telford, London, 1993, pp.270 – 281.

<sup>33</sup> ADB, n.44, pp.50-51, 54-55. Also see James Lewis, Development in Disaster Prove Places: Studies of Vulnerability, Intermediate Technology Publication, London, 1991, pp. 127- 31.

reconstruction, and there is generally openness to change, and improved safety following disaster an event.<sup>34</sup>

The transition from disaster recovery to risk reduction should necessarily incorporate development as it provides the link between disaster – related activities and national development. Its inclusion in the disaster cycle is intended to ensure, that the results of disaster are effectively reflected in future policies, in the interest of national progress. The measures could range from introducing improved and modernized building system and programmers; utilizing international disaster assistance to optimum effect, applying disaster experience in future research and development programmes, and using any other means appropriate to a particular situation. However, at the same time this linkage should be utilized to ensure that national development does not create further disaster problems or exacerbate existing ones.

**3) Risk Reduction Mitigation and preparedness** -Reducing the risk of disaster involves activities, which either reduce or modify the scale and intensity of the threat faced by improving the condition of elements at risk. Although the term ‘prevention’ is often used to embrace the wide diversity of measures to protect the person’s property, its use is not recommended, since it is misleading in its implicit suggestion that disasters are preventable. The use of ‘reduction’ to describe protective or preventive actions, which lessen the scale of disaster, is preferred. Even with effective preparedness and mitigation measures being in place, it is realistic to expect some level of damage from extreme natural forces. Risk reduction can take place in two ways:

3.1 Preparedness: The proactive process embraces measures, which enable governments, communities, and individuals to respond to disaster situations to cope with them effectively. Preparedness includes: the formulation of viable emergency plans, the development of warning system, the maintenance of inventories, and the training of personnel. It may also embrace search and rescue measures as well as evacuation plans for areas that may be at risk from a recurring disaster. Preparedness therefore, encompasses those measures taken before a disaster event,

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<sup>34</sup> ADB, n.44, pp.51-56. Also see D.J. Oakley, n.73, pp.270-281. Also see UNCHS, n.1, pp.14-24<sup>18</sup>

which are aimed at minimizing the loss of life, disruption of critical services, and damage when the disaster occurs. All preparedness planning needs to be supported by appropriate legislation with clear allocation of responsibilities and budgetary provisions. The preparedness segment of the disaster management cycle can be divided into the following sub-segments:

- a) Warning- The time or period when a hazard has been identified but is not yet threatening a particular area (e.g., notification that a cyclone exists but is a long distance away).
- b) Threat - The time or period when a hazard has been identified and is assessed as threatening a particular area (e.g. a cyclone is tracking towards particular area).
- c) Precaution- Action taken after receipt of warning to offset affects of disaster impact. Such action might include: closing offices, schools, etc, bringing emergency power generation to readiness, cutting crops to avoid total loss from high winds, and heavy rain, making safe boats and vehicles, taking household precautions such as storing emergency water supplies etc.<sup>35</sup>

3.2) Mitigation – Mitigation embraces all measures taken to reduce both the effect of the hazard itself, the vulnerable conditions to it, in order to reduce the scale of a future disaster. Therefore, mitigation activities can be focused on the hazard itself or the elements exposed to the threat. Examples of mitigation measures which are hazard specific include, modifying the occurrence of the hazard, e.g. water management in drought prone area, avoiding the hazard by setting people away from the hazard, and by strengthening structures to reduce damage when hazard occurs.<sup>36</sup>

In addition to these physical measures, mitigation should also be aimed at reducing the physical, economic and social vulnerability to threats, and the underlying causes for this vulnerability. An analysis of the disaster cycle is crucial not only for formulation of the theoretical perspective of disaster management but also for its crucial role in practical applications, namely training programmes, programs of public

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<sup>35</sup> D.J. Oakley, n.73, pp.270-281. Also see James Lewis, n.74, pp.147-150. Also see UNCHS, n.1, pp.14-24. Also see Disaster Prevention and Mitigation: A Compendium of Current Knowledge. Preparedness Aspect, vol. II, UNDRO, New York, 1984, pp.1-30.

<sup>36</sup> ADB, n.44, pp.52-53. Also see UNDRO, n.77, pp.1-30 Also see UNCHS, n.1, pp.14-24.

education and awareness, day to day disaster management activities, and maintaining government impact behind disaster management.<sup>37</sup> The disaster management cycle has to be set according to the development.

#### **1.4.2 Actors involved in the disaster management cycle**

An analysis of the disaster management cycle is dependent on the crucial role played by the various actors, namely, the government and the non – government organizations, involved in the process, during the different stages of the cycle. An effective and efficient disaster management system rests on certain commonalities that can be identified amongst actors:

- 1) An effective organization structure and mandate;
- 2) A series of effective policies to pursue objectives that are focused, realistic, and based on current information; and
- 3) A core group of people who need to be committed to the task, knowledgeable and possessing appropriate skills.<sup>38</sup>

**1.4.2.1 Government:** Governments are universally acknowledged as having the main responsibility for managing disasters. The main task of the government is to ensure, that the national resources, which are primarily under government control, are utilized (both before and after a disaster) in the best possible manner. The organizational structures needed for managing disasters are best founded on existing government structures. Local authorities and the project staff are the implementers at the community level of the development programmes of the government. This group actually coordinates most of the disaster preparedness and vulnerability reduction programmes of the government.

Though the national and regional policy planners formulate the instrumentalities for minimizing the disastrous effects, it is finally at the policy making level that the decisions are taken, as to when and how national disaster management programmes are to be developed. However, government action in this regard, for a variety of reasons ranging from corruption to red-tapism is not always the ideal. Government is therefore, made up of a variety of different groups with different agenda, views and responses and organized into various levels. These are the

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<sup>37</sup> ADB, n.44, Pp.53. Also see James Lewis, n.74, pp.145-158. Also see UNCHS, n.1, pp.1424. Also see Blakie Et. AL, n.20, pp.8-13, Also see Keith Smith, n.39, pp.45-50.

<sup>38</sup> ADB, n.44, pp. 66-69.

basic strategies on the basis of which governments create the desired organizational and social action in the event of a disaster:

- 1) Assisting individuals and organization to improve their capacity to achieve policy goals that is to protect lives and property within their own homes, workplaces, and communities.
- 2) Allocating resources, tasks, and time, to establish continuity in organizational structures and procedures across changing budget years, personal assignments, and administrative regions;
- 3) Establishing integrated patterns of communities to link individuals and organizations engaged in disaster reduction activities to one another, as well as to relevant clientele, and resources in the environment.

**1.4.2.2 Non-Government Organization (NGOs)** – The role of national and international NGOs in the realm of disaster management has undergone a sea change in recent decades, from primarily relief organizations to rehabilitation and reconstruction. Many NGOs activities can be perceived to be mitigation activities, contributing to further development of the local community, and thereby to an effective means of vulnerability reduction in the event of future disaster.

In recent years, various formal and non-formal organizations have played an increasingly important role in disaster reduction. Because of their significant links with grassroots development, these organizations have often performed as complimentary role with other established organizations. The role of schoolteachers, social welfare worker's, women's groups, and other socio-cultural organizations in disaster reduction should not be underestimated. Religious institutions and their structures have also been involved in a number of ways.

**1.4.2.3 Community organizations:** Disaster management is most effective at the community level, be it a city, towns and village. Human beings everywhere are organized at the community level to carry out collective tasks. Different social conditions in different societies might lead to a different order of priority, but in most cases the community level is a vital primary focus for the disaster management effort. Policy level support not only ensures the legitimacy of community programmes, but also enables integration of reduction measures into community development. Disaster management should not be approached in isolation. When it is being introduced at the community level, links should be made to the daily life of the community. The links between good environmental practices, safe location for houses and other buildings

and safe construction should be emphasized. Taking into account the particular hazard to which the community is exposed can do this.

The sequence of disaster planning can also be adopted at community level in a simplified manner by assessing their own risks and resources, and decide on local levels of protection. Local communities can plan simple disaster preparedness and mitigation measures, as well as practice their plans (such as local evacuation procedures). However, it is most effective when all aspects and sectors are considered in a holistic manner. If a multi hazard approach is followed, then the community can develop protection against potential hazards, and relate problems together to achieve a tactical primary list, seen within the broad context of development in its varied aspects.<sup>39</sup>

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<sup>39</sup> John Clark, *Democratizing Development: The Role of Voluntary Organization*, Kumarian Press, Connecticut, 1991, pp.29-32.

## **CHAPTER-2**

# **Tsunami in Sri lanka**



## 2.1 History of tsunami

Although tsunami occurs most frequently in the Pacific Ocean, it is known to occur anywhere. The major part of the tsunami for the whole historical period occurred in the Pacific Ocean (58 per cent) but they also appeared in all other seas and oceans, such as the Mediterranean Sea (25 percent) the Atlantic Ocean (12 percent), the Indian Ocean (5 percent), and many marginal seas (Lender and Lowell 2004).<sup>1</sup> The most powerful tsunami of an earthquake in the South China in history before 2004 was the result in 1782 that killed 40,000. The tsunami created by the 1883 explosion of Krakatoa is thought to have resulted in 36000 deaths. In 1775 in Lisbon earthquake killed over 100,000, in 1556, the earthquake in Shaanxi, China had an estimated death toll of 830,000 and the Great Kanto earthquake of 1920 has been the largest tsunami that has been the largest tsunami that has occurred in the Pacific Ocean ranges taking a toll of 200,000. The most distributive tsunami on earth has occurred as follows:

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<sup>1</sup> Most Destructive known earthquake on Record in the World, United States Geological Survey, 2004.

Table-2.1

**Most Destructive tsunami on the Earth**

<b>Year</b>	<b>Lost people</b>	<b>Location</b>
2004	3,00,000	Sumatra (Indonesia)
1755	60,000	Lisbon (Portugal)
1782	40,000	South China sea
1883	36,500	(Sunda Strait, Indonesia)
1707	30,000	Tokaido Nankaido (Japan)
1866	26,360	Sanriku (Japan)
1868	25,674	North Chile
1792	15,030	Kyushu Island (Japan)
1771	13486	Ryukya French (East China sea, Japan)
1976	8,000	Moroco gulf (Philippines)
1703	5233	Tokaido – Kashima (Japan)

Source- United States Geological Survey, 2004.

**2.2 Tsunami in South Asia**

Before the Sumatra tsunami that occurred on December 26, 2004 a total of 87 tsunami related disaster events were experienced between 1640 and 2005 in the Indian Ocean Region. Among them, four major historical events are well documented. On February 10, 1797 a tsunami developed after an earthquake with magnitude  $M > 8.0$  occurred in Western Sumatra. Padang town was flooded by powerful waves causing over 300 fatalities. On August 26, 1883 a strong earthquake (MZ 7.2)

occurred to the west of central Sumatra. A huge wave flooded the entire coast of Nias island. On November 24, 1833 a very strong earthquake ( $M = 8.8-9.2$ ) occurred at the south coast of Sumatra. A huge tidal wave flooded all southern parts of western Sumatra. On February 16, 1861 exceptionally strong earthquake ( $M > 8.2$ ) affected all the entire western coast of Sumatra.

Table-2.2

### Tsunami in South Asia

Date	Location
1524	Near Dabhol, Maharashtra
02 April, 1762	Arakam Coast, Myanmar
16 June, 1819	Rann of kutch, Gujarat
31 Oct, 1847	Great Nicobar Island
31 Dec, 1881	Car Nicobar Island
26 Augt, 1883	Krakatoa volcanic eruption
28 Nove, 1843	Makran coast, Baluchistan

Source: United States Geological Survey, 2004.

#### 2.3 Tsunami on 26 December, 2004:

The tsunami that hit South East and South Asia on December 26<sup>th</sup> is clearly the biggest ever, in terms of the earthquake that triggered it as well as the extent of destruction it caused, in recent history. This according to the United States Geological Survey (USGS) is the fourth largest earthquake in the world since 1900 killing about 2,73,000 people worldwide and the largest since the 1964 earthquake in Prince William Sound, Alaska. The causative sea disturbance in recent value given by the USGS is 9.0- whose epicenter was off the west coast of northern Sumatra ( $3.3^{\circ}$  N,  $95.78^{\circ}$  E) and at 10 km depth.<sup>2</sup> The earthquake occurred at 00.59 hours Coordinated Universal Time (CUT) same as Greenwich Mean Time (GMT). The location is 250 km southeast from Banda Aceh, Sumatra, and 1260 km south southwest of Bangkok, and 1,605 km northwest of Jakarta. The magnitude 9.3 of the earthquake recorded on the Richter scale was located off the west coast of northern Sumatra. The Indian Ocean Tsunami (IOT) caused the death of over 2,70,000 people in 11 countries in Asia and Africa causing severe loss of

<sup>2</sup> Kostel Ken, Toni, Mary, "The Sound of a Disaster Rumble: Researches Track Underwater Noise Generated by December 26, Earthquake Lamont-Doherty Earth Observatory" July20, 2005.

Map - 1



socio-economic, environment and physical property.<sup>3</sup> I will focus in this research on the socio-economic environment and physical property losses in Sri Lanka after December, 2004 tsunami. This horrific tsunami ravaged the island's coastal regions leading to tremendous destruction and devastation of human life and property, severely affecting the environment and the economy, and at the same time exposed the fault lines in the disaster management system. So, there is an urgent need for tsunami relief management in the recent times, and it is important to focus on: providing temporary shelter to the victims, and meeting water and food supply needs, and also, supplementing that with basic health services by the foreign Governments, national governments and the NGOs.

### **2.3.1 Impact on Sri Lanka**

Sri Lanka was hit by the worst ever-natural disaster and national tragedy on December 26, 2004 when a horrific tsunami ravaged the island's coastal regions, leading to tremendous destruction and devastation of human life and property, as well as severely affecting the environment and economy. The extent of damage quickly reached a catastrophic level due to the tsunami's intensity (magnitude 9.3 on the Richter scale)<sup>4</sup> and the fact that Sri Lanka was unprepared for such a disaster because tsunami had been a completely unprecedented phenomenon for the Sri Lankan.

Moreover, Sri Lanka was regarded a "safe" country, free of any major natural hazards. A tsunami warning system that could have evacuated people on time was, therefore, believed unnecessary and hence not available in Sri Lanka. Incidentally, the tsunami originated off Sumatra two to three hours before reaching Sri Lanka. Radio news stations in Sri Lanka had promptly broadcast reports of the tsunami in Indonesia, yet no warning was given that the same tsunami might affect Sri Lanka.

The tsunami hit Sri Lanka on an extraordinary date, December 26, 2004, was coincidentally a day of leisure in three senses: not only was it an ordinary Sunday but was also a Buddhist "Poya" holiday, as well as the commercial holiday of "Boxing Day" and Christmas celebrations were still going on.<sup>5</sup>

Given these circumstances, most people were taking time off from work and many of them were enjoying the beaches, meeting relatives and friends on a rare long

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<sup>3</sup> Joint Needs Assessment, JBIC, ADB, World Bank, January 2005

<sup>4</sup> Mckee, Maggie, "Power of Tsunami Earthquake Heavily Underestimated", New Scientist, February 9, 2005.

<sup>5</sup> Hindu, Delhi, Monday, December 27<sup>th</sup> 2004.

weekend. Additionally, the beach resorts at all the popular tourist sites were packed with foreign tourists as it was peaking holiday season.

The tsunami swept over Sri Lanka during the day, between 9:15 and 14:30 local time. As can be imagined, many Sri Lankans were on the beaches enjoying the sun and sea when they suddenly observed a strange withdrawal of the sea and unexpected vista of the spectacular width of the coast. Such an event had never happened before; people humbly praised it as a wonder of nature and a miracle of God. Unaware of the tsunami and unprepared for such an event, people were not expecting any natural disaster, much less a tsunami. Very soon leisure radically turned into tragedy.

After the first tsunami wave arrived, many people were too panicked to be able to run away, losing their lives through drowning or being buried by the sea, but some people fortunately survived by retreating to trees and tall buildings to escape the deadly waves. The first wave was comparatively low and weak; the subsequent wave was the most severe, with a height up to 40 feet (approximately 12 meters), followed by four consecutive waves, all of them occurring within approximately five hours between morning and afternoon.

As a result of its tremendous force, the tsunami afflicted close to 1,100 kilometers of the total 1,583-kilometer coastline of Sri Lanka.<sup>6</sup> The powerful waves devastated the western, southern, eastern, and northern coasts, damaging the coastal belt by as much as 200 to 300 meters, and in exceptional cases by up to one or two kilometers inland, depending on the coastal configuration. The tsunami most severely struck the east, which was directly exposed to the tsunami waves off Sumatra and across the Indian Ocean.

### **1 Social Impact**

The tsunami struck a relatively thin but long (1,100 km) stretch of Sri Lanka's coastline from Jaffna in the north, the entire eastern and southern coasts, and part of the west coast. The worst affected by disaster were: Ampara, Batticaloa and Trincomalee in the East, Galle, Hambantota and Matara in the South; Jaffna, Mullaitivu and Kilinochchi in the North; and the Western district of Kalutara.<sup>7</sup>

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<sup>6</sup> <http://www.tsunami.org/new.htm>, [www.avsglos.co.uk/tsunami.htm](http://www.avsglos.co.uk/tsunami.htm)

<sup>7</sup> Ibid

Sri Lanka had been hard-hit in terms of socio-economic, infrastructure and environment assets. The social fabric of the tsunami-hit areas has been seriously affected by the number of human deaths 35,322 people (in 13 districts of 5 provinces) and approximately 6,300 were missing. Displaced persons estimate stands at 443,000 while the affected population is estimated at 1 million, out of a total population of approximately 19 million (5 percent).<sup>8</sup> Around 1, 00,000 people are still living in relief camps while the rest of the displaced persons have moved in with friends or relatives. The number of damaged houses is estimated to be around 160,000 of which more than 90,000 have been completely destroyed. Table-3 details the impact on the population.

Table-2.3

**Impact on the Population by the Tsunami**

District	Deaths	Displaced	Missing
Ampara	1,526	1,20,500	1895
Anuradhapura	03	200	09
Batticaloa	653	84,025	93
Colombo	13	33,000	75
Galle	640	12,000	1,000
Gampaha	05	15,475	67
Hambantota	667	5,000	345
Kalutara	69	13,000	41
Jaffna	2,640	48,729	125
Matara	671	1,000	384
Mullativue	300	15,000	784
Trincomalee	591	75,000	579
Vavuniya	0	450	47

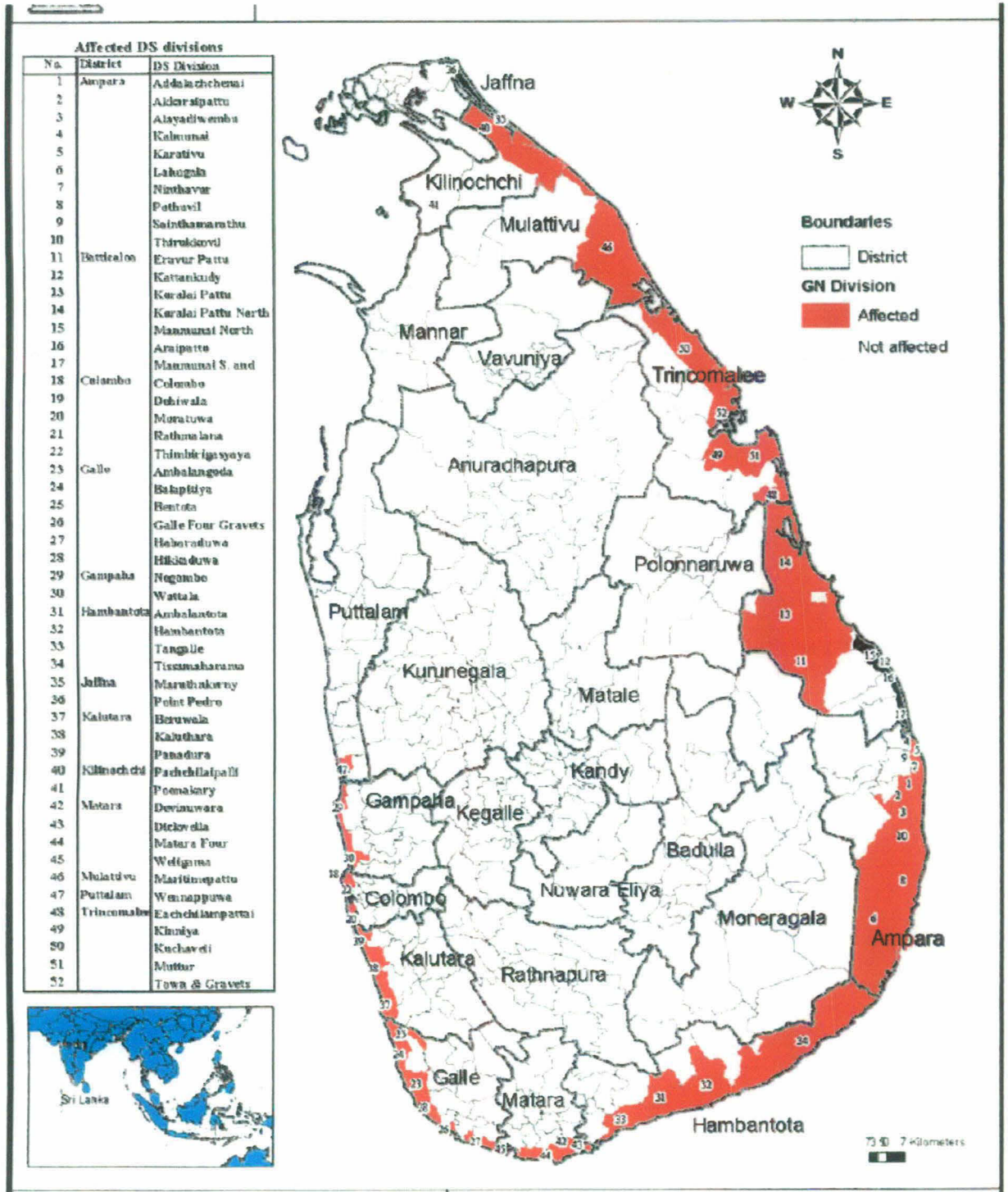
Source: The National Disaster Management Center and the Sri Lanka Police head Quarters.

The main victims were already vulnerable groups, such as child victims seen to be disproportionately high, probably because a higher proportion of women and girls were caught unaware in the houses on the Sunday morning when the tsunami

<sup>8</sup> Department of Census and Statistics Census of Tsunami Affected Areas January 25, 2005.

Map - 2

Tsunami affected DS Division of Srilanka





struck. Apart from the coastal communities, already comparatively poor in the Sri Lankan context, the tsunami has also in other ways compounded the already existing vulnerabilities. The North East is the region was worst affected by the tsunami. The percentage of the coastal population affected ranges from an estimated 35 percent in Kilinochi to 80 percent in Mullativu, and 78 percent in Amparai compared to the south districts of Galle, Matara and Hambantota with less than 20 percent of the coastal population affected, albeit with scattered pockets of severe damage.<sup>9</sup>

Children were the worst affected by the current Tsunami. According to UNICEF (January 13, 2005) based on information from 364 camps, about 900 children were left without parents. Of these, 44 are unaccompanied children (i.e., without parents and residing in an institution or with non-family care givers), and 858 children are residing with relatives but without parents. More than 3000 children have lost one parent.<sup>10</sup> When social assessments of all affected households were conducted, these figures can be expected to increase substantially. Orphans constitute a group which will require special protection immediately and continuing in the medium and long term. In the North East pre tsunami, there were already at least 2,500 children in 41 registered children's homes, and the exact number in over 50 non-registered institutional care facilities center is not available. As of yet there is no information available on whether any of these children's homes have been affected by the tsunami.

During the first days following the disaster, it was reported that approximately 193,000 housing units were fully or partially destroyed and around 160,000 families were displaced by the tsunami. They sought refuge with families and friends or in the approximately 800 welfare centers established in religious and public places, and in schools over the following days. Considering the scale of the disaster, relatively few families remained in the welfare centers.<sup>11</sup> Affected families had benefited from the traditionally strong family ties and social networks, to find host families willing to provide them shelter. While this provides better protection for females and other vulnerable household members, it can only be a temporary solution unless formalized and backed up by regular compensation to the host family. Some three weeks after the disaster, many people had started moving out of the temporary

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<sup>9</sup> Ibid

<sup>10</sup> Ibid

shelters. Some had started repairing their damaged houses or beginning to erect temporary shelters near their ruined houses. Several reports suggest, lack of security for women and children in camps, referring to cases of sexual harassment, rape, violence, and kidnapping of children. It is not possible to establish the number of actual incidents, as there exists a strong social/cultural reluctance to address these issues. Local women's groups stress the urgency of the issues, and confirm that it is seriously under-reported. International experience also shows that protection of women and children is frequently violated under disaster and conflict condition. Reports from camps further indicated, that lack of privacy for women and girls in connection with washing and changing clothes, breast-feeding children, and shortage of sanitation facilities adds to the exposure of the displaced women and girls.<sup>11</sup> In certain camps, recognition of these security problems had led to arrangements being made to keep women and men separate (which has the drawback that it splits families), but the level of domestic violence has also reportedly gone up in the aftermath of the disaster. Pregnant women in the camps lacked sufficient access to reproductive health care in view of the potential effects, which the psychological and physical strains will put on their maternal health. There is also a need to raise awareness in camps of the risks of sexually transmitted diseases, such as HIV/AIDS.<sup>12</sup>

## **2. Impacts on the Physical Infrastructure:**

In addition to the great loss of houses and other form of private property, a large number of public institutions like schools and hospitals were also either destroyed or damaged. Concerning commercial properties, many of the beach resort hotels were also badly affected by the tsunami. Two thirds of the major fishing harbors were also either destroyed or severely damaged.

The tsunami badly damaged physical infrastructure in the coastal regions, including roads, railway lines, telecommunications networks, water and electricity supply, and waste water treatment system. Most of the water wells that essentially serve as the water supply for the rural coastal population were filled with rubbish and rendered useless. Taking into account the severe physical degradation of the environment, the tsunami increased the physical hardships faced by all sections of the coastal societies creating a state of emergency among the tsunami victims.

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<sup>11</sup> Madhavi M Ariyabandu and Louise W Platt, Framework for Tsunami Relief and Rehabilitation-Focus on Sri Lanka, Prepared for USAID Bureaus for Asia and the Near East, May 2005.

<sup>12</sup> Ibid.

**(a) Hotels:** The tsunami that hit several countries in Asia and Africa resulted in extensive asset losses for the tourism sector (\$250 million) about \$200 million in damages to hotel rooms was sustained, and \$50 million in tourism related assets (souvenir shops, restaurants, and vehicles). Of a total of 242 registered hotels in the country 105 hotels were located in the tsunami-affected areas of which 50 hotels were partially damaged and 8 hotels were fully damaged. In terms of rooms, 3,500 out of the total 14,000 rooms in medium to large-scale hotels are currently not in operation. Some of these could be back in operation in a few weeks or a month time. In the small guesthouses about 1,200 rooms out of a total of 4,000 rooms have been affected. There are also indirect effects (such as loss of revenue, cash flow, etc.) on the economy which will have a multiplier effect on employment and other businesses that support tourism, and which are difficult to quantify at this point.<sup>13</sup>

**(b) Education:** The ocean waves that swept over the coastal areas of Sri Lanka on December 26, 2004 damaged 168 schools, 4 universities and 18 vocational and industrial training centers. About 80,000 students, 330 teachers, and 50 principals were directly affected by the tsunami. The total cost of the damage to the education capital stock, according to preliminary estimates is approximately LKR 2.3 billion. The major proportion of damage has been to primary and secondary schools, which account for over 90% of the institutions damaged and about 92% of the estimated cost. Buildings in about 59 schools have been completely destroyed.<sup>14</sup>

Further, according to the Ministry of Education (MOE), around 91 schools which have been destroyed or damaged and are located too close to the seashore, may have to be relocated and reconstructed. The damage to schools includes: school building, equipment, machinery and tools, furniture, books and other library resources, and consumable teaching materials such as: chemicals, chalk, and white board pens Universities have suffered damage to lecture halls, administration building, and hostels. Vocational training and technical education institutions have suffered and suffered damage to lecture halls, workshops, equipment, machinery and tools, and residential facilities

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<sup>13</sup> Damage to Restore Hotels is estimated at \$250 Million for the Registered Hotels.

<sup>14</sup> CPA Report on the Post-Tsunami Reconstruction of Sri Lanka, workshop, 20, January 2005, Colombo.

workshops, equipment, machinery and tools, and residential facilities present the detail: Table-2.4

### Summary of Damage to School and University of District by Tsunami

District	Number of Damaged schools	Number. of damaged universities	Estimated cost of damage (LKR Millions)
Hambantota	6	-	66
Matara	11	1	196
Galle	22	-	378
Kalutara	6	-	89
Gampaha	2	-	40
Batticaloa	33	1	409
Amparai	38	1	647
Tricomalee	27	-	285
Mllative	11	-	71
Jaffna	12	1	110
Total	168	4	2342

Source: Ministry of Education (MOE) and Ministry of Finance and Planning (MOE), 2005.

**(c) Housing:** The tsunami surge destroyed about 99,478 houses and damaged 46,292 (Sources: CNO: Note these numbers have fluctuated over the past two weeks). The damaged houses form about 13 percent of the housing stock of the coastal divisions of the affected districts. Most of the affected housing units were within 500 meters of the coast. The surge was recorded at 15 to 20 feet (5 to 6.5 Mt.) in most of the East, North East, and parts of the southern coast. Most of the places penetrated by the Tsunami had a land elevation of less then 2 to 3 meter above the mean sea level. On the south, and south east coast there were large tracts of the coastline, where there are sand dunes, which were not at all penetrated by the tsunami surge. The following chart

shows the housing stocks in the coastal belt and the total damage in housing by district. The worst affected areas were Amparai and Trincomalee where around 20% of the district with significant damage was: Batticaloa (19%), Matara (77%), Galle (4%), and Kalutara, and Hambantola (3% each). The impact on housing stocks in the Buttalam, Mullative, and Kilnochchi districts cannot be assessed as data were not available.<sup>15</sup> At the time of this assessment, figures on the numbers of temporary or permanent buildings affected are not available Table 2.5 presents on overview of houses destroyed or damaged by province and district as shows in Table-2.5

Table- 2.5

**Housing Destroyed or Damaged by Tsunami**

Province	District	Destroyed Houses	Damaged Houses
Northern	Jaffna	12,000	1,114
	Killinochchi	3,400	8056
	Mullaitivu	10,585	5,270
Eastern	Trincomalee	5,974	10,394
	Batticaloa	15,939	5,665
	Ampara	29,097	-
Southern	Hambantota	2,303	1,744
	Matara	7,188	5,659
	Galle	5,407	5,628
Western	Kalutara	3,100	3,668
	Colombo	4,170	2,521
	Gampaha	292	30772
N. Western	Puttalam	23	72
T Total		99,478	46,292

Source: Ministry of National Planning, 2005

**(d) Health:** The damage to the health sectors resulting from the tsunami is sizable in both terms of the curative and the preventive networks. The damage to the health infrastructure and health personnel is substantial creating a total breakdown of the health system in the affected districts.

The health physical infrastructure losses include at least 92 partially or fully damaged health institutions. These include: hospitals, drug stores, cold rooms, preventive health

<sup>15</sup> ADB, UN, WB (2005), Sri Lanka Assessment of Needs in the Affected Areas of North East Draft, n.51, pp13-244.

care offices, health staff accommodation facilities, and district health offices. In addition, a large number of vehicles (ambulances, Lorries, vans, double cabs and motor bikes), and majority of the medical equipment and office equipment in the affected areas were totally destroyed.<sup>16</sup> This damage was widespread among all affected districts as shown in Table-2.6

Table-2.6

**Health Infrastructure Damage in Districts Affected by Tsunami**

Province and district	Number of damaged Health institutions		Estimated damaged cost (LKR million)
	Fully damaged	Partially damaged	
North East province	-	-	-
Trincomalee	3	6	1,059.5
Mullative	6	0	462.0
Jaffna	0	4	17.0
Killinochchi	1	0	6.5
Batticaloa	9	10	1,268.0
Amparai	11	2	1,183.0
Southern province	-	-	-
Hambantta	0	5	22.5
Matara	2	5	230.5
Galle	10	8	1957.0
Western province	-	-	-
Kalutara	2	3	28.5
Colombo	0	5	22.5
Total	44	48	6,257.0

Source: Ministry of National Planning and Ministry of Health, 2005.

(The estimated cost of replacing damaged physical infrastructure (totally and fully damaged) has been estimated at approximately LKR 6.2 billion.)

**(e) Water Supply and Sanitation:** In the water and sanitation sector, tsunami disaster affected 14 districts in the Northern, Eastern and Southern Provinces, mostly in the

<sup>16</sup> CPA, Report on the Post-Tsunami Reconstruction of Sri Lanka Workshop, 20 January, 2005, Colombo.

areas where dependency on wells was high. Due to the water resources scarcity and water delivery system damaged by the conflict; most the tsunami-affected areas had suffered water shortage even before the tsunami.<sup>17</sup> Although the detailed surveys on water situation in the affected areas were being undertaken, it is estimated by salinity or high infiltration of seawater. Table-2.7 presents an overview of districts affected by tsunami.

Table-2.7

**Water Sanitation Sector Damage of Districts Affected by Tsunami (LKR mn)**

District	Damage to structure (Replacement cost)			Indirect Loss			Total Damage Cost
	Pipe System	Dug - well	Sanitation	Equip	w/s to camp	Survey	
Puttalam	-	0.4	.3	0.1	0.1	0.0	0.9
Gampaha	2.7	5.6	3.6	0.9	1.8	0.2	19.7
Colombo	6.5	79.3	50.8	12.6	25.2	2.4	170.7
Kalutara	1.3	59.0	37.7	9.3	18.7	1.8	127.9
Galle	30.2	102.8	65.8	16.3	32.6	3.2	50.9
Matara	39.2	136	87.8	21.7	43.6	4.2	332.4
Hambantota	15.2	43.8	28.0	2.9	13.9	1.3	109.2
Ampara	67.2	553.4	354.2	87.7	175.5	17	1255
Batticaloa	53.0	303.1	194	48.1	96.1	9.3	703.7
Trincomalee	104.8	113.6	72.7	18.0	36.0	3.5	348.7
Mulativ	-	201.3	128.9	31.9	63.8	6.2	432.1
Killnochchi	-	64.7	41.4	10.3	20.5	2.0	138.8
Jaffna	-	228.2	146.4	36.2	22.4	7.0	489.9
Total	319.3	1892	1211	300	600	58	4380.9

Source: The Ministry of Urban Development and Water Supply (MUDWS) and the Rural Water Supply and Sanitation Unit (RWSSU).

<sup>17</sup> The Ministry of Urban Development and Water Supply (MUDWS) and the Rural Water Supply and Sanitation Unit (RWSSU).

(f) **Power:** It appears that despite the unprecedented scale of loss of human life, the impact of the disaster on the power sector is rather limited and marginal. The total cost of damage to the assets owned by Ceylon Electricity Board (CEB) and Lanka Electricity Company Ltd. (LECO) according to the preliminary estimate, is approximately LKR 1.04 billion. The damage is largely confined to the medium and low voltage distribution lines and related transformers located in the coastal areas. The other infrastructure ancillaries such as; grid substations, major transmission lines, and power plants were not directly damaged by the tsunami.

About 48 Km of medium voltage distribution line (11 KV and 33 KV) and 405 Km of low voltage distribution line (4V0V and below) were destroyed and needed replacement.<sup>18</sup> About 70,000 sets of meters and service wires connected to households were also damaged, as the tsunami tidal waves washed away houses, distribution poles, and wires. 88 Sub-stations located in the distribution networks were also damaged as well. Table-2.8 presents an overview of the affected districts.

Table-2.8

**Power sector Damage of Affected District by Tsunami**

<b>District</b>	<b>Number of Consumers Affected</b>	<b>CEB (LKR millions)</b>	<b>LECO (LKR million)</b>	<b>Total loss (LKR million)</b>
Colombo	1,238	1.4	7.5	8.9
Kalutara	1,491	168.0	15.0	15.0
Galle	19,582	91.1	50.0	318.0
Matara	11,900	177.8	-	91.1
Hambantota	8,650	236.2	-	1.77.8
Amparai	13,500	121.7	-	236.2
Batticalloa	6,590	55.8	-	121.7
Trincomalee	6000	17.5	-	55.8
Jaffna	1300	-	-	17.5
Gampaha	91	-	0.5	0.5

Source: Center electricity Board (CEB) and Lanka Electricity Company Ltd. (LECO) 2005.

<sup>18</sup> According to CEB, the Number of Households which Need to Replace Meters and Service Wires is 62,542 out of 3,175,000, the Total Number of CEB Service Recipients as of October, 2005.



**(h) Roads and Railways:** Erosion damage occurred on sections of the coastal highway network completely washed away. A total length of approximately 800 kms of national road was of provincial and local government roads, Railways sections of track work, bridges, signaling and communications systems, building and some rolling stock were severely damaged on the 160 km long coastline between Colombo and Matara.

### **3 Impact on the environment**

Sri Lanka has a coastline of approximately 1,660 kilometers (the range reported is 1,585-1,730 km). The coastal zone is very diverse, and contains lagoons and estuaries, firming and offshore reefs, mangrove swamps, sea grass beds, salt marshes, beaches and spits, rocky shores, and dune systems. Sri Lanka's coastal zone contains very productive ecosystems that sustain a large proportion of the country's people, and flora and fauna.<sup>19</sup>

Sri Lanka's coastal belt covering the districts of Jaffna, Mullaitivu, Trincomalee, Batticaloa, Amparai, Hambantota, Matara, Galle, Kalutara, Colombo and Puttalam was severely affected by tsunami on December 26, 2004. The affected region in Sri Lanka harbors many key marine and coastal ecosystems such as coral reefs, mangroves, sea grass beds, coastal sand dunes, mudflats, salt marshes, backwaters and lagoons, environmentally sensitive areas declared as national parks and sanctuaries, which included a Ramsar wetland site, all of which plays a vital role in sustaining living natural resources on which many people in the affected region depend. The effect of the tsunami on these ecosystems had the potential to be very severe ecologically. In addition, the tsunami had created serious problems arising from adverse impacts to environmental capital or assets, which are ecosystems that provide society and economies with environmental goods and services.

**(a) Damage to the Coastline:** Although virtually the entire coastline of Sri Lanka has been affected by the tsunami, the impacted areas were severely damaged. The North East coastline appeared to have borne the brunt, with the affected areas reaching 2-3 km inland. Except in extremely small pockets, the tsunami had affected a much narrower strip in the Southern and Western coastlines, with the affected areas limited to approximately 500 meters or less, and at elevations below about 2.5 to 3 meters. The property damage on the North East coast line was very significant, with virtually

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<sup>19</sup> UNDAN Rapid Environmental Assessment in the Democratic Socialist Republic in Sri Lanka ,February 2005.

no area being spared. Yet there appears to be little visible impact on the fauna and flora in the affected zone.<sup>20</sup> Ground cover and smaller trees and shrubs had been removed by the tsunami while most of larger trees remained intact with little or no damage. It appeared that the extensive property damage to the North East coastline was due to the fact that it was not adequately protected by any natural barriers such as coral and granite reefs, mangroves, and sand dunes.<sup>20</sup> The situation in the southern and western coastline is different in that natural barriers had protected many areas and there was a visible difference in the level and extent of property destruction in the areas protected by natural barriers. Areas protected by mangroves and sand dunes had been left virtually unaffected with minor or no damage to housing. Bays in the entire affected areas had suffered devastating property damage, most likely as a result of a “funnel effect” created by the tsunami waters.

**(b) Impacts on protected areas in the coastal zone:** While there has been no documented loss of fauna in the protected areas affected by the tsunami, there have been significant impacts on flora and biodiversity. Extensive washing off of soils, as well as stress and dieback of flora was noted in the areas of seawater intrusion. The following protected areas were affected by the tsunami in varying degrees: Southern coast-Yala, Bundala, Hikkaduwa, Rocky Isles, Kalametiya, Nilwala, Rumassala and Kiralakelle; North East coast-Yala East, Lahugala, Pigeo Island, Chundikulam, Kokilayi, Sagamum, Little Sober Island Seruwila Allei, and Paraihivu Island, and Western coast-Wippattu. Some of these protected areas; in particular Yala East, Yala, Bundala, Kalametiya and Pigeon Island had suffered significant ecological damage, albeit in a relatively narrow strip. The greatest ecological impacts are on freshwater bodies and fishery breeding grounds in the protected areas, which have now been contaminated with saline water. The long term impacts or reversibility of this situation is unknown at this stage. There is also quite significant property damage in certain protected areas especially in Yala National Park and Hikkaduwa National Park, with some buildings being either completely or partially destroyed.<sup>21</sup>

**(c) Impacts on coral reefs:** The greatest extent of true coral reef is located in the Gulf of Mannar in the north-west, off the southern coast, and the eastern coast near

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<sup>20</sup> Staff Writer “Indian Ocean Tsunami Devastate Finherfolk” UK, Agricultural Biodiversity Coastline, December 26, 2004

<sup>21</sup> UNDAN Rapid Environmental Assessment in the Democratic Socialist Republic in Sri Lanka ,February 2005.

**Map - 3**  
**Satellite Image on January 2, 2004**  
**Tsunami impact in Sri Lanka**



December 26, 2004



January 1, 2004

Trincomalee. There are extensive areas of patch reefs at Bar Reef in the north, Great and Little Basses in the south, and off the eastern shores. There are fringing, patch and platform reefs elsewhere around the country, including sandstone/limestone and rocky reef habitats, covering in total about 680 square kilometers. Their diversity is high with as many as 190 species of hard corals and over 300 species of fish, including as many as 35 species of butterfly fish (Chaetodontidae).<sup>22</sup>

The coral reefs of Sri Lanka were far from pristine prior to the tsunami, since in many areas they had been all but destroyed by the mining of coral rock for making lime and cement. Also, reefs had been heavily exploited for living resources while management intervention was generally inadequate. Blast fishing and purse seining were continuing, even in reef areas designated for protection, such as the 1998 bleaching event, also had a profound effect on the western and southern coral reefs, while the damage was less on the eastern coast, and many areas had not recovered when the tsunami struck.

Surveys by NARA, IUCN, and others are continuing, or are awaiting improvements in the weather. As of mid- February, coral reefs had been surveyed at five sites in the south and southwest (Kapparatota-Weligama, Polhena, Unawatuna, Hikkaduwa and Rumassala), and at one site in the east (Dutch Bay, Trincomalee). The tsunami moved enormous boulders and section of reef, as well as thousands of tones of smaller fragments, sand and silt, which dislodge, abrade, crush and kill marine biota. There was also a powerful backwash carrying large quantities of waste, debris, soil, and organic matter. Despite all this, damage to reefs was very patchy, ranging from total destruction in some areas to almost no impact in others, reflecting a complex interaction among the recent history and condition of the reef, with the precise way the tsunami energy was delivered to that particular environment. Some smothering was observed from the land. Litter and debris was abundant. Much of the rubble formed after the mass mortality of corals in 1998 had shifted.

**(d) Debris disposal:** The extent of debris, particularly from destroyed buildings, requiring disposal was enormous. The disposal of the rubble and waste materials was proved to be a huge issue because of the sheer volume and associated costs. Emergency clearance efforts had resulted in haphazard disposal of rubble along roads, in open fields, into drainage ditches; low lying lands and waterways, including the

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<sup>22</sup> Synolaskis,C., 2005,Observation by the International Tsunami Survey Team in Sri Lanka: Science, vol.308,p.1595.

beaches. The practice of haphazard dumping of debris in inappropriate locations should stop immediately to prevent long term problems in flood control, clogging of waterways, and pollution of beaches.<sup>23</sup>

**(e) Surface and groundwater contamination:** All dug wells in the coastal zone in areas where the tsunami resulted in sea water coming into land were contaminated by the sea water which inundated most low lying areas as well as pollution due to wastewater and seepage from septic tanks that had been affected by the tsunami.<sup>24</sup> This was a serious public health concern since most local water sources had been contaminated. In addition, the pipe borne water supply system in the coastal areas affected by the tsunami and was largely out of service due to damage to the distribution network.

**(f) Mangroves:** Mangroves are a rapidly diminishing wetland types in Sri Lanka, consisting of less than 10,000 hectares of discontinuously distributed patches the coastline. The most extensive mangroves areas are in Puttalam district, with over 2,000 hectares. Batticaloa and Trincolmaee districts also extensive mangroves, each with over 1,000 hectares. Unfortunately, the inherent productivity of the tidal ecosystem combined with poor tenure arrangements in coastal environments has meant that mangroves are vulnerable to conversion by private investors, especially into prawn ponds. This has happened to a considerable degree in western Sri Lanka, where up to half of naturally occurring mangroves are said to have been lost, but the position is unclear in eastern parts of the country, where the war had inhibited other investment and monitoring.<sup>25</sup>

Although naturally mangroves are typically very resistant to water surges, and in many ways were apparently unaffected by the tsunami, there are limits to this resilience and in some areas large mangrove trees were uprooted and lay toppled far from the beach. Quantitative information on the extent of damage is not available, but only an indicative sample of the impacts of the tsunami upon a range of coastal ecosystems was available.

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<sup>23</sup> Series on Best Practice Guidelines (Sri Lanka), After the Tsunami Solid Waste Management, IUCN March 2005.

<sup>24</sup> UN DAN Rapid Environmental Assessment in the Democratic Socialist Republic in Sri Lanka, February 2005.

<sup>25</sup> Ibid

**(g) Sea Grass:** Sea grass beds constitute the most extensive coastal ecosystems in Sri Lanka. They occur along the open coast as well as within estuaries and lagoons (UNEP, WCMC, 2003). Very large beds exist around the north-western and southwestern coasts, and smaller sea grass beds are found on the leeward side of coral reefs elsewhere. Sea grass beds are important as feeding and breeding grounds for fish, as well as stabilizing submerged sand banks. Damage to sea grass beds was minor and was mostly due to shifting rubble; hardly any uprooting was observed. Severe beach erosion was observed both in the east and southwest, but was patchy in its occurrence.

**(h) Biodiversity and protected Areas:** Sri Lanka is the most biologically diverse country in Asia per unit area, and about half its native species are endemic. It lies on a major bird migration route and provides critical habitat to many migratory waterfowl. The island is also critical habitat for many internationally mobile species, including five species of endangered marine turtle (the loggerhead *Caretta caretta* olive, Rihy *Lepidochelys olivacea*, Hawkshill *Eretmochelys imbricata*, green *Chelonia Mydas*, and Leatherback *Dermochelys coriacea*). In part to preserve this rich biodiversity, Sri Lanka has officially declared 146 National Reserves of protected areas covering about 9,926 square kilometers, or 15.3 per cent of its land area; while forest reserves of 5,182 square Km and proposed forest reserves of 6,211 square km cover another 17.2 percent of the land area. However, much of the biodiversity is concentrated in the wet zone, which is poorly represented in the protected area system, with only one nature reserve, one National Park, and one wildlife sanctuary.<sup>26</sup>

At Yala and Bundala National Parks, vegetated coastal sand dunes completely stopped the tsunami, which was only able to enter where river outlets broke the dune line. At one outlet in Yale National parks, considerable damaged was done to park facilities (with a number of human deaths) as well as to forest and grassland, with many trees uprooted and the vegetation largely dead and brown. Two other sites in the park had damage up to 1.3 kilometers inland in flat areas. Less than 1 percent of the park area was affected by the tsunami in total. Natural recovery is expected as salt levels were reduced, assisted by high rainfall since the tsunami. Some damaged areas of the parks may be decolonized by alien invasive species such as prickly pears and the salt tolerant misquote. There has been an undocumented loss of fauna in the

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<sup>26</sup> Ibid

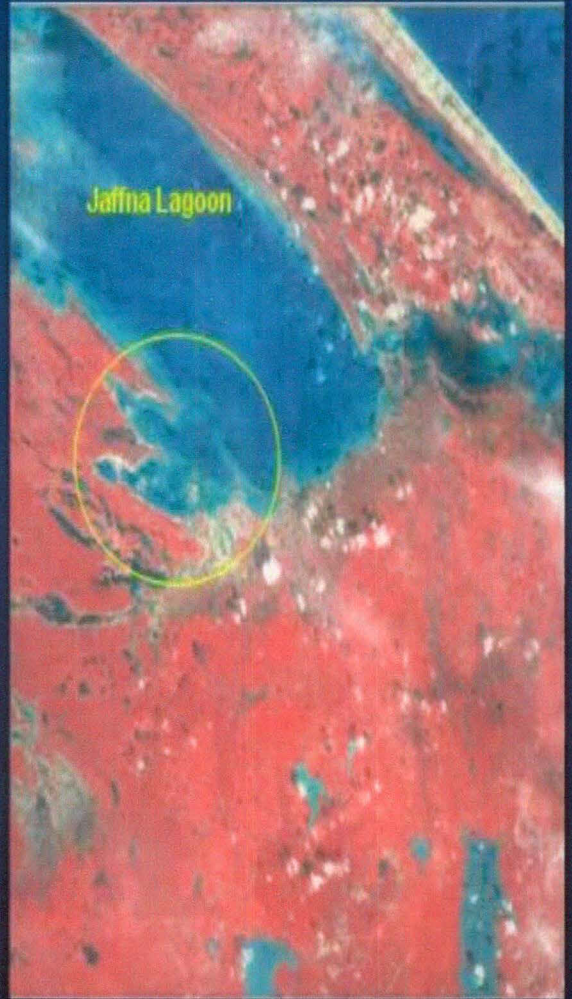
# Tsunami-2004

Pre and Post Tsunami Images showing part of Sri Lanka  
Jaffna Region



IRS-P6 AWiFS Image of 20-Feb-2004

IRS-P6 AWiFS Image of 01-Jan-05



protected areas affected by the tsunami, as most birds, and the larger mammals managed to avoid being caught in it, though dead mouse deer, monitory lizards and soft shelled terrapins have been reported from the south coast.

#### **4. Economic Impact**

The tsunami tidal waves on December 26, 2004 that hit several countries in Asia and Africa bordering the Indian Ocean had taken a heavy toll on Sri Lanka's coastal areas. The burden of the impact of the tsunami on the Sri Lankan economy was focused on the fishing and tourism sectors, in parts of the South and North East. In the areas hit, the tsunami devastated lives, social infrastructure, and economic foundations. The losses that had resulted from this disaster include; asset losses (direct damage), output losses (indirect damage), and fiscal costs (secondary effects).

Quantifying asset losses involves measuring the value of the stocks of buildings, equipment, inventory, and other property lost as a direct result of the tsunami. Measuring output losses involves estimating the value of the goods and services lost as a result of the asset losses and other disruption caused by the disaster. The fiscal costs measure the net additions to the fiscal deficit as a result, to revenue lost and additional expenditure incurred, as a result of the disaster.

Initial estimates placed the cost of asset losses at around \$1 billion (4.5 percent of GDP), with output losses in the most affected sectors of fishing and tourism estimated at \$330 million (or 1.5 percent of GDP), and fiscal costs for 2005 of 2 percent of GDP.<sup>27</sup> Because of the relatively small contribution of the fishing, and hotels and restaurants, sub sectors to overall GDP (3 percent), the impact of the tsunami will be limited to a reduction in GDP growth.

Although the sectors mostly affected by the tsunami do not constitute a large portion of the GDP and the affected provinces altogether only account for about 17.5 percent of GDP, the affected provinces constitute a large portion of the population (26 percent). Available poverty data for districts in the Southern Province affected by the tsunami show that between one-quarter to one-third of the population in these districts live below the poverty line.<sup>27</sup> This makes it evident that substantial shares of the population in the affected provinces have low per capita incomes. The tsunami disaster increases the vulnerability of this segment of the population, therefore making a case for channeling resources to address the needs of these vulnerable groups.

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<sup>27</sup> ADB, JBIC, World Bank, n.2, pp.2-7.



**(a) Asset Losses:** Preliminary estimates of total direct asset damage place losses at around \$1 billion (4.5m percent of GDP). Destruction of private assets in the affected districts is substantial, with losses estimated at around \$700 million. This figure includes losses in the fishing (\$97 million), and tourism industries (\$250 million) in terms of infrastructure and equipment. In housing, the asset losses amount to around \$306 to 341 million. In terms of some of the nature of the damages sustained by the private sector, preliminary estimates report that around 1,40,000 houses had been partly or fully damaged, over 19,000 private fishing vessels sustained damages, and about a quarter of hotels were affected (58 of the total 242 registered hotels have been fully or partly damaged).

Table-2.9

**Estimated Output and Asset Losses from Tsunami Disaster**

Sector	Asset Loss (\$ Mn)	Output Loss*
Housing	30-344	-
Roads	60	-
Water and Sanitation	42	-
Railways	15	-
Education	26	-
Health	60	-
Agriculture	3	-
Fisheries	97	200
Tourism	250	131
Power	10	-
Environment	10	-
Social Welfare	-	-
Excluded Items	90	-
Total in \$ Mn	960-1,007	331
Percent of GDP	4.4-4.6	1.5

Source: Government of Sri Lanka, 2005.

**(b) Output Losses:** The impact of the tsunami on Sri Lanka's gross domestic product (GDP) is not as significant as the extent of asset losses, in the areas that were hit. It was estimated that around 2, 00,000 people (3 percent of the labor force) might have lost

their jobs as a result of the tsunami.<sup>29</sup> This included 100,000 in fisheries; 27,000 employed in tourism and tourism-related activities; and the rest in other informal sector activities. The estimated loss of output in 2005 and 2006 in the most affected sectors (fishing and tourism) totaled around 1.5 percent of GDP; but these sectors do not make up a significant portion of national GDP. The hotels and restaurants sub-sectors together with fisheries directly contribute about 3 percent of GDP. Other sectors which will also be negatively affected but to a much lesser extent, include telecommunications and transport. On the other hand, the construction sector, which makes up a substantial portion of GDP (7.2), will also be affected. Tsunami may likely only result in slowing down economic growth by up to 1 percentage point in 2005 (from 6 to 5 percent) Table-2.10 presents the details:

Table-2.10  
Selected Economic Indicators (2002-2005)

	Actual		Estimate	Pre-	Post -
	2002	2003	2004	Tsunami 2005	Tsunami 2005
Real GDP growth	4.0	5.9	5.2	6.0	5.0
Nominal GDP (Bn. Rs.)	1,583	1,760	1,988	2,297	2,297
Fish production (tons)	302,890	284,960	300,000	300,000	200,000
Tourist arrivals	393,171	500,642	565,000	600,00	425,000
Construction sector growth	-0.8	5.5	5.0	6.0	9.2
Inflation (CCPI annual average)					
	9.6	6.3	7.6	10.0-11.0	12.0

Source: Central Bank of Sri Lanka for historical data, January 25, 2005.

<sup>29</sup> Ibid

(c) **Fishing.** The December 2004 tsunami will worsen the outlook of the already volatile fishing industry in Sri Lanka. The disaster has affected about one-third (or around 1 million) of Sri Lanka's coastal population (totaling 3.2 million and the fishing industry provides (direct and indirect) employment to around 17,000 people. In addition to the negative impact on the livelihoods of fishermen due to their asset losses, demand for fish will also be limited in the first few months of 2005, and the price of fish is likely to remain depressed in this period. Fish production is expected to reach only 200,000 tons in 2005 (down from the earlier expected 300,000 tons), and to largely recover in 2006 with a production of 270,000 tons. However, since fishing only accounts for 2.4 percent of GDP, the contraction in the sector will not significantly slow down the overall economic growth.<sup>30</sup> The value of output loss for fishing in 2005 and 2006 is estimated at \$ 200 million. See Table-2.11 for details.

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<sup>30</sup> Central Bank of Sri Lanka, 2005. Recent Economic Development: Highlights of 2005, Prospects for 2006, November 2005.

Table-2.11

**Estimated Damages to the Fisheries sector from the Tsunami**

<b>District</b>	<b>Estimated Damaged to boats&amp; fishery harbors (L K R Million)</b>	<b>Estimated Damaged to Buildings (L K R million)</b>	<b>Total</b>	<b>Total US \$ million (L K R 104-5)</b>
Jaffna	994	88	1082	10.34
Mulaitive	11083	98	1201	11.48
Killinochchi	80	7	87	0.38
Trincomale	1559	138	1697	16.22
Batticaloa	648	58	706	6.75
Anpara	540	48	588	5.62
Hambantota	846	75	921	8.80
Matara	1256	111	1367	13.06
Galle	1273	113	1386	13.24
Kalutara	688	61	749	7.16
Colombq	25	2	27	0.26
Gampha	269	24	293	2.80
Putalam	15	1	16	0.15
Mannar	10	1	11	0.11
<b>Total</b>	<b>9306</b>	<b>825</b>	<b>10131</b>	<b>96.81</b>

Source: Central Bank of Sri Lanka. January 25, 2005.

(d) **Livelihoods, Poverty, and Gender:** Increased poverty is potentially the most important effect of this natural disaster. The macroeconomic impact of the tsunami is expected to be worse in Sri Lanka than in any other affected apart from the Maldives, but the macro-level of analysis conceals a much more sinister impact on the livelihoods of the poor. Fisheries, tourism, trade, agriculture and artisan, or cottage industries provided most of the livelihoods in the affected areas, and all have been severely impacted. The worst effects of the tsunami were experienced by people living in weakly constructed and unplanned settlements close to the shore women and children deprived of bread-winners, and those with marginal livelihoods such as cottage artisans. A large number of home-based production and income generating activities were destroyed, affecting

women in particular, and reducing family incomes. The catastrophe could drive around 250,000 more people below the poverty line, and these numbers could increase if concerns over basic needs are not properly and quickly addressed<sup>31</sup>

Fishing and related small-scale food processing industries were affected the most by the disaster. Of the country's 29,700 fishing boats, about two-thirds were destroyed or significantly damaged, along with outboard motors, ice storage units, fishing gear, and nets. Almost the entire fishing communities were dependent on these fleets.<sup>21</sup> Damage to the agriculture sector included: the destruction of standing crops and home gardens, washing away of tree crops, and entry of sea water to productive fields, which may render them unusable for many months. An estimated 27,000 jobs in the tourism industry were suspended by the tsunami, one-third in officially registered hotels and the rest in unregistered hotels and guesthouses.<sup>32</sup> Many small businesses and informal traders catering to the tourism industry (e.g., dive, souvenir, handicraft shops, and internet cafes) were damaged and are now facing sustained periods with far fewer customers. The main tourism season from January to March is likely to be lost entirely.

People suddenly impoverished by these impacts are likely to place unprecedented pressure on the environment. There are reports, for example, that unusually large numbers of nesting marine turtles have been killed for meat in Sri Lanka since the tsunami, as people strive to offset an under-supply of fish protein. The extent of such collateral damage will depend to a large extent on how the recovery process is managed. In the fisheries sector, the indiscriminate replacement of boats and fishing gear with new and high-quality equipment could easily result in overexploitation of the marine environment. Similarly, welfare, relief and reconstruction programmes, unless well managed, could lead to wasteful consumption. Poor targeting, over-design of facilities, and wasted investment will result in higher resource demand, depletion of natural resources, and the generation of wastes, all having direct and indirect impacts on the environment.

**(e) Tourism:** As the benefits of the cease-fire started to bear fruits for the tourism sector beginning in 2002, the tsunami has dampened these prospects for 2005 and to a lesser extent in 2006. Around 565,000 tourists visited Sri Lanka in 2004 and 600,000

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<sup>31</sup> Ibid

<sup>32</sup> Damage to Restore Hotels is estimated at \$250 Million for the Registered Hotels.

arrivals were expected in 2005 before the tsunami hit. Now tourist arrivals are projected to contract to around 425,000 in 2005, and recover in 2006 to 575,000. Around 40 percent of foreign guest night stays in Sri Lanka are spent near the beaches in the South and East coasts of the island, which were among the hardest hit by the tsunami.<sup>33</sup> Hotels and restaurants contribute about 1 percent of GDP, and the tourism industry employs around 1 percent of the labor force (130,000 jobs in 2004), both in direct and indirect employment. The tsunami is likely to result in reducing output in the sector by a total of \$131 million in 2005 and 2006, as may be seen in Table-2.12.

Table-2.12

**Tourism Statistics**

	2002	2003	2004	2005
Tourist arrivals	3,93,171	500,642	56,5000	400-500,000
Tourist guest night stays	3,989	4,700	5000	-
Room occupancy rate	43.1	53.2	59.5	51.8
Gross tourist receipts	23,724	31,209	38,420	34,000
Total employment	87,600	115,000	130,000	115,000
Direct	36,500	50,000	60,000	50,000
Indirect	51,100	65,000	70,000	65,000

Source: Central Bank of Sri Lanka, January 25, 2005.

**(f) Fiscal impact:** - According to the Ministry of Finance, the impact of the tsunami on revenues is expected to be marginal (0.3 percent of GDP). Revenues from Value Added Tax (VAT) and customs duty from increased imports in 2005 were expected to compensate for most of the revenue shortfalls from tourism and fisheries. Incremental tsunami related expenditures are estimated at Rs. 5 billion (over 2.2 percent of GDP) to be financed through extraordinary external assistance, including debt moratorium. Of this amount, Rs.1 billion will be additional recurrent cost and the rest will go the capital expenditures. This will result in the widening of the fiscal deficit from the budgeted 7.6 percent of GDP to 9.6 percent of GDP in 2005.<sup>34</sup> However, additional measures will be needed to achieve the pre-tsunami fiscal targets. The revenue and interest expenditure of the original budget were somewhat optimistic and may result

<sup>33</sup> Ibid.

<sup>34</sup> Central Bank of Sri Lanka, 2005, Annual Report 2004.

in a gap equivalent to 1.2 percent of the GDP. In addition, the budget was based on declining international oil gap equivalent to 1.2 percent of GDP. In addition, the budget was based on declining international oil prices, while oil prices have actually increased over 2004 levels. Therefore, the fiscal framework would need to be revised in light of these developments as may be seen in Table-2.13.

Table-2.13

**Post-Tsunami Central Government Fiscal Operations**  
(As a Percentage of GDP)

	Estimate 2004	Budget 2005	Post-tsunami 2006
Total expenditures and net lending	23.7	24.8	26.5
Current expenditures	19.2	18.5	18.5
Subsidies and transfers	4.9	4.0	4.5
Civil service wages and salaries	5.4	5.6	6.2
Interest payments	6.0	5.6	5.2
Capital expenditures and net lending	4.3	6.4	8.0
Total revenues	15.4	17.2	16.9
Tax	13.9	15.5	15.2
Current account balance	3.9	1.6	1.3
Budget deficit (w/ grants)	-8.2	-7.6	-9.6
External financing (w / grants)	1.8	2.5	5.7
Domestic financing	5.8	4.6	3.6
Public Debt	105.5		

Source: Ministry of Finance Estimates of Sri Lanka, 2005

**Chapter-3**  
**Role of Government and Non-**  
**government of Tsunami Disaster**  
**Management in Sri Lanka**



### 3.1 Disaster Management

Disaster Management consists of a wide range of measures both long-term and short term. They are designed to save lives and limit losses to minimum. It means a planned and systematic approach towards understanding and solving problems in the wake of disaster. The science of disaster management involves a systematic observation and analysis of a measures relating to disaster prevention, preparedness, mitigation, emergency response, rehabilitation, and reconstruction. The task involves making up a cycle of "Disaster Management Plan" to complete and command the whole of the management cycle, both in planning and operational terms. This command would seek man-environment equilibrium leading to the diminishing of risks from disaster management.<sup>1</sup>

The 'Disaster Management Plan' as discussed in detail in the first chapter can be categorized broadly under five organizing themes:

1. Hazard mitigation and protection;
2. 2-preparedness and emergency response;
3. Assessment and rehabilitation;
4. Recovery and reconstruction planning;<sup>2</sup>
5. Implementation and management.

However, disaster management needs very comprehensive planning, involving integrated pre-disaster and post-disaster activities. This also involves integrated and coordinated activities by both the government and the non-governmental organizations involved directly in the field as indirectly. For the establishment of an effective disaster management network, the blueprint as discussed in Chapter 1, could be followed by both the governmental as well as the non-governmental organizations involved in the field of disaster management.

This chapter presents a detailed analysis of the theoretical aspects of disaster management as a part of the disaster management cycle. The chapter explores the role of the government and non-governmental organizations in Sri Lanka, in the

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<sup>1</sup> D.P. Singh, n.3, p.257. Also see D.J. Oakley, n.2, pp.272-273. Also see Piers Bjelakis, Terry Cannon, Ian Davis and Ben Wisner, *At Risk: Natural Hazards, Peoples Vulnerability and Disaster*, Roulade, New York, 1994, pp.9-12. Also see Mary B. Anderson, "Vulnerability to Disaster and Sustainable Development: A General Framework for Assessing Vulnerability", in M. Munaringhe and C. Clarke, ed. *D. prevention for Sustainable Development: Economic and Policy Issues*, IDNDR and the World Bank, Washington D.C., 1995, pp.12-20.

<sup>2</sup> D.J. Oakley, n.2, pp.272-273. Also see *Disaster Mitigation in Asia and the Pacific*, Asia Development Bank, Manila, 1991, pp.33-35. Also see *Asian Development Bank*, Manila, 1991, pp.50-56.

background of theoretical underpinnings with specific reference to major tsunami discussed in the previous chapter, .It concludes with an analysis of the relationship between government and non-governmental organizations crucial for understanding of the development and disaster linkages.

Pre-disaster activities include:

1. Prevention
2. Preparedness
3. Mitigation

Post-disaster management

The post-disaster management phase is the most critical phase of disaster management with important bearings not only on society and economy at the local level, but also at the national level. The entire, sequence can broadly be divided into the following segments, each of which is discussed in detail subsequently

1. Emergency response
2. Assessment
3. Relief
4. Rehabilitation or resettlement
5. Reconstruction or development<sup>3</sup>

The following are the primary tasks involved in post disaster activity:

- . Devise exercises to test emergency response and relief plans, promote research on aspects of post disaster reconstructions and adopt effective strategies and guidelines;
- . Establish reliable communication, response and decision-making capabilities, at all levels;
- . Establish contingency plans, management and assistance for port disaster activities;
- . Strengthen scientific and engineering capacities;
- . Ensure that particular needs of women, children, persons with disabilities disaster vulnerable groups are considered in disaster related activities; and
- . Promote a cultural dimension in post disaster rehabilitation on process.<sup>4</sup>

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<sup>3</sup> N.K. Jain, n.17, p.22. Also see Asian Development Bank, n.6, pp.6-65. Also see UNCHS, n.3, pp.18-24.

<sup>4</sup> N.K. Jain, n.17, p.22. Also see Keith Smith, n.22, pp.40-50. Also see James Lewis, n.13, pp.40-60. Also see Asian Development Bank, Manila, 1991, pp.26-65. Also see UNCHS, n.3, pp.18-24.

### **3.1.1 Response of the Sri Lanka Government and the LTTE**

The then President Chandrika Kumaratunga appointed an apex body named National Relief Operation Unit (NROU) in December, 2004 to assist and facilitate relief work undertaken by government and non- government organization. The LTTE has formed its own task forces to co-ordinate the efforts in the areas under their control. The government and the LTTE also have forces in several districts with the NGOs, the Sri Lanka Monitoring Mission (SLMM), and other local organizations to co-ordinate efforts.

### **3.1.2 Response of other governments**

The response of other governments has been immediate and substantial. The Indian government sent several ships with equipment and supplies to Sri Lanka and was at work in Galle and surrounding areas. The US government sent warships with helicopters capable of ferrying supplies to unreal areas. The British Government had undertaken it overall co-ordination of the international efforts in Sri Lanka. Japan, the EU, Sweden, Pakistan, and Nepal among others have begun providing both financial and material help to Sri Lanka. Experts from all these countries arrived to help with the transporting, distributing and coordinating of relief efforts. Several mobile medical centers arrived, including an Indian ship with medical facilities.

**3.1.3 Response of Civil Society:** Many community groups and NGOs had been provided food, health supplies and services, water and other basic necessities to thousands of families throughout the country. Several NGOs also planed to continue supporting recovery programs. Sarvodaya, one of the largest national NGOs, was one of the first to deliver aid to the tsunami-affected people in many parts of the country, while the Tamil Rehabilitation Organization (TRO) provided emergency assistance to the people especially in the North and East. During the rehabilitation phase, Sarvodaya is planed on reconstruction 20,000 houses for those who lost their homes during the disaster. Other major NGOs active in relief and rehabilitation include SEWA Lanka, the Red Cross Society of Sri Lanka/ ICRC, as well as CARE and Save the children.

**3.1.4 Response of Private Sector:** The overwhelming human Asia tsunami initiated an outpoured of financial aid and other resources to the region from local, national, and international companies. Companies have provided assistance ranging from haloed to re-establish communication system to donated medicines, food, and money. Hundreds of private firms ranged from international sports conglomerates (such as the

International Cricket Council ), to global firms (included Daihatsu Motor Company, Dow Chemical, Nestle Corporation, Microsoft, Shanghai Banking Corporation (HSBC), Vodafone, Coca Cola, Shell Corporation, Exxon, and News Corporation) had donated million of dollars to assist Sri Lanka with its recovery activities. The media reports that some companies had established a network to coordinate their response to the disaster throughout the Asia region. In Sri Lanka, the network had assisted the Government in managed incoming relief supplies at the Colombo International Airport. Local companies in some cases not only contributed financial resources, but also administered relief centers that provided food to displaced people.

The Sri Lankan government launched an appeal to all friendly countries, the UN and relief agencies, through the Ministry of Foreign Affairs on 26 December 2004, seeking assistance in the immediate and medium term. In particular, relief and rehabilitation was needed in the following areas:

#### Immediate term-

1. Tents, blankets, linen etc.
2. Food (pre cooked or ready to eat meal packs)
3. Water purification tablets
4. Wheat flour, pulses, rice
5. Drugs: Paracetamol, antibiotics, dressing, suture material, disposable syringes
6. Intravenous infusions (saline and dextrose)
7. Portable generators

#### Medium term;

1. Housing and rehabilitation
2. Reconstruction of infrastructure

The Government has already implemented several measures in this regard:<sup>5</sup>

- . Provision of monthly livelihood allowance of Rupee 5000 per family (supported by the World Bank);
- . Cash grant and food basket worth Rupee 375 per person per week (supported by WFP);
- . Provision of Rupee 2500 to buy kitchen utensils;
- . Concession on electricity, water and telephone bills;

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<sup>5</sup> Government of Sri Lanka Post-Tsunami Reconstruction Recovery Strategy, May 2005.

- . Micro and SME credit on concessional terms (supported by ADB/JBIC);
- . Temporary housing (supported by UN Agencies and NGOs);
- . Grants for individual house construction (supported by the World Bank and the Government of Switzerland);

### 3.2 Needs Assessment

A provisional estimate of the overall cost of the reconstruction and rehabilitation plan in the affected areas is as follows:

Table 3.1

#### Investment Needs of the Post – Tsunami Reconstruction Strategy

Programme / Project	Required Investment (US \$ million)
Road Development	353
Rail Transport	313
Telecommunication	18
Water Supply and Sanitation	205
Electricity	115
Education	170
Health	100
Housing and Urban Development	400
Fisheries	200
Livelihood and Micro Financing	157
Tourism	58
Total	2,089

Source: ADB, World Bank, January 2005.

### 3.3 Donor Assistance for Post-Tsunami Rehabilitation and Reconstruction

The following table indicates the assistance pledged and committed by various donors, in terms of the need assessment done by the Department of National Planning, TAFREN, and joint study by ADB/WB/JBIC

Table-3.2

**Donor Assistance for Post-Tsunami Rehabilitation and Reconstruction  
Activities**

	<b>Donor Countries &amp; Agencies</b>	<b>Expected donor assistance</b>	<b>Remarks</b>
A.	Bilateral donors	661	
	France	104	Agreements will be concluded July
	Germany	81	Agreements will be concluded in July
	India	23	Negotiations underway to allocate US \$ 100 mn for modernization of Southern
	Italy	69	Three MOUs signed to use these funds
	Japan	181	Grant Aid Agreements signed for US \$ 81 mn. Minutes of Discussions were signed for the balance US \$ 10 mn
	Korea	35	Project Proposals have been submitted.
	USA	65	Agreements signed for US \$ 39 million
	Denmark	8	Agreement signed.
	China	18	
	UK		
	Switzerland	12	MOU signed.
	Canada	65	Negotiations underway
	Others		
B	Multilateral Agencies	631	
	ADB	157	Agreements signed
	World Bank	150	Agreements signed
	UN agencies	69	US \$ 6million has been committed for Strengthening of National to

			rural level capacities for Relief and Recovery. Proposals are being prepared to utilize the balance funds.
	WFP	25	Agreement signed.
	UNICEF	21	Agreement signed.
	IFAD	35	Negotiations will be held in June
	EU	75	US \$ 40 million will be concluded in June. Negotiations underway for using the balance funds
	Others	99	Negotiations underway
	Sub Total (a+b)	1,292	
C	NGO & INGs	853	These are Pledges made in the proposals. Remittances up to now amounts to US\$ 125 million.
	*Grand Total (a+ b+ c)	2,145	
	*Emergency relief not included		

Source: ADB, WB, JBIC, 2005.

### 3.4 Political Ramification of the Tsunami

The tsunami has caused a severe backlash in Sri Lanka's peace efforts, as well as the entire political scheme of the government. The international community has collected over three billion dollars in humanitarian aid to Sri Lanka. However, the distribution of this money had caused great political dissent. The then President Kumaratunga, along with many international observers, suggests that a plan to distribute tsunami aid to the Sri Lankan people be instituted.<sup>22</sup> This "joint mechanism" was to consist of advisors from multiple ethnic groups to distribute the aid needed to all Sri Lankan. Many viewed the tsunami as another possible opportunity to build peaceful relations between the two ethnic groups. Often, groups unify and ignore certain differences, when there is a great foreign threat or disaster.

<sup>22</sup> "Sri Lanka leader Gambles on Tsunami Aid", BBC World News, June 2005, [http://news.bbc.co.uk/go/pr/fr//1/hi/world/south\\_asia\\_4628125.stm](http://news.bbc.co.uk/go/pr/fr//1/hi/world/south_asia_4628125.stm).

As a result, many regard the natural disaster as a stepping-stone towards peace.<sup>6</sup> However, this does not accurately apply to Sri Lanka because the issue of aid distribution, and the peaceful experience that could be gained by a “joint mechanism”, has sparked violent opposition from other political groups. The Marxist People’s Liberation Front (JVP) launched their sternest opposition to the government agenda over this issue, refusing any cooperation with the Tamil people. The JVP is strongly opposed to the agenda, over the idea of giving aid to the ravaged Tamil people in the northeast. Despite the strong opposition from her coalition partner, President Kumaratunga had said in defense of the joint aid program, “The government may fall... I might lose the presidency, but those things are not of national interest unlike bringing lasting peace to the county”.<sup>7</sup> The JVP had effectively renounced the government over the issue of the aid program that was passed in late June 2005, leaving behind thirty-nine seats in the Parliament. The loss of these seats from her coalition had left President Kumaratunga’s political party as a minority in Parliament, making it all the more difficult to get her agenda pushed through.<sup>8</sup> In addition, the Muslims in Parliament felt that they were not adequately represented in the aid mechanism that primarily centered on the Sinhalese and the Tamils. According to analysts on Sri Lankan politics “Muslims feel they may be marginalized in that process while nationalists fear the tsunami-aid deal gives legitimacy to the Tamil tigers” demands for a separate homeland in the north and east.<sup>9</sup> The Muslims responded to their perceived lack of representation in the deal by deciding to withdraw all their Mahajana Eksath Peramuna Party (MEP) representatives from Parliament as well. The Buddhists too feeling underrepresented in the joint aid program, had left their seats in the government in protest and threatened violent attacks against the then regime. The Buddhists had allied themselves with the JVP and were violently protesting the aid deal. In less than ten days, seven political parties

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<sup>6</sup> Simon Gardner, “Aid Pact may Help Sri Lanka Peace, but Pitfalls Remain”, Reuters, June 27, 2005, <http://www.alertnet.org/thenews/newsdesk/SP71606.htm>.

<sup>7</sup> “President Vows Sri Lanka Aid Deal” BBC World News, June 2005, [http://news.bbc.co.uk/go/pr/fr/1/hi/world/south\\_asia/4511765.stm](http://news.bbc.co.uk/go/pr/fr/1/hi/world/south_asia/4511765.stm).

<sup>8</sup> “Sri Lanka Ruling Coalition Splits”, BBC World News, June 2005, [http://news.bbc.co.uk/go/pr/fr/1/hi/world/south\\_asia/4080564](http://news.bbc.co.uk/go/pr/fr/1/hi/world/south_asia/4080564).

<sup>9</sup> “Muslims Strike over Sri Lanka Aid”, BBC World News, June 2005, [http://news.bbc.co.uk/go/pr/fr/1/hi/world/south\\_asia/4626551.stm](http://news.bbc.co.uk/go/pr/fr/1/hi/world/south_asia/4626551.stm).



associated with these different ethnic groups had pulled out of President Kumaratunga's government in protest. The MEP still comprises an active militant wing that has been accused of carrying out politically targeted killings in a span of six months.<sup>10</sup>

The belief that the renegade Tamil Tiger, Colonel Karuna, was launching a series of political and civilian killings in June 2005 after siding with MEP only serves to further complicate the prevailing situation. According to Human Rights Watch, "while the perpetrators of the killings are not yet known, it is widely believed that they were carried out by forces loyal to Colonel Karuna, who broke away from the LTTE in March".<sup>11</sup> E. Kaushalyan, who was the political head of the LTTE, was murdered on February 8, 2005 along with several other tigers. Among these men were the former parliamentarian, C. Ariyanayagam, and a member of LTTE human rights body. These killings disrupt the now fragile ceasefire agreement and add yet another dangerous element to Sri Lanka's unstable atmosphere. There is now more strife among the Sinhalese People about how to act towards the Tamils than there is actual ethnic strife between the two groups. Current developments in the Sri Lankan conflict indicates struggle with a potentially violent future.

#### **3.4.1 The Tsunami and the Peace Process:**

When the tsunami hit Sri Lanka, it came at a time when the peace process was at low ebb. There was little dialogue between the two parties to the conflict killings which was increasing in number. The response to the tsunami was powerful: Tamils, Muslims, Sinhalese helped each other; Christians helped Hindus; Buddhist priests opened the temples to all. No one asked who belonged to which group. From the tragedy emerged the hope of a silver lining: that the tsunami could re-start the peace process. In the early stages of the relief and recovery effort, this belief was reinforced as the Government and the LTTE worked together to address immediate needs. Negotiation between the Government and LTTE Peace Secretariats began in January for the creation of a joint mechanism to oversee the recovery and reconstruction

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<sup>10</sup> Amnesty International 'Sri Lanka', Amnesty International  
<http://web.amnesty.org/report2005/lkasummary-eng>.

<sup>11</sup> Human Rights Watch, "Sri Lanka: killings Highlight Weaknesses in Ceasefire", Human Rights Watch, <http://hrw.org/english/docs/2005/02/11/slanla10162.htm>

process. By May, President Kumaratunga had put all her authority behind such an agreement. This led to the signing of the “Post-Tsunami Operational Management Structure (P-TOMS)”, between the Government of Sri Lanka’s Ministry for Relief Reconstruction and Reconciliation, and the Planning and Development Secretariat (PDS) of the LTTE.<sup>12</sup> P-TOMS provided a structure of three committees at the national, regional, and district levels to oversee the distribution of assistance and mandated the creation of a Regional Fund to finance recovery, and reconstruction projects that would be accessed by these committees. Committees would be made up of representatives of the Government, the LTTE, and the Muslim community.<sup>13</sup> P-TOMS would have been the first joint working system between the parties to the conflict since the collapse of the SIHRN in 2003. While it was clearly stated, that the responsibilities of these committees were limited to the tsunami affected coastal belt, it was anticipated that this mechanism could create an environment conducive to the revival of the mechanism and their willingness to put resources into the regional fund.<sup>30</sup> The constitutionality of the P-TOMS was immediately challenged in the Supreme Court. While it was deemed to be constitutional, certain elements were put on hold by the Supreme Court pending clarification, specifically the regional fund, and the location of the regional committee in Kilinochchi.

**3.5 The guiding principles of the needs assessment and recovery strategy are presented below.<sup>14</sup>**

- The allocation of domestic and international resources should be “strictly guided by the identified needs and local priorities”.
- The recovery strategy should strengthen the peace process and build confidence.

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<sup>12</sup> Ethirajan Anbarasan, “Sri Lanka Leader Gambles on Tsunami Aid”, BBC Tamil Service, June 27, 2005, [http://news.bbc.co.uk/2/hi/south\\_asia/4628125.stm](http://news.bbc.co.uk/2/hi/south_asia/4628125.stm)

<sup>13</sup> “Muslims Strike over Sri Lanka Aid”, BBC News, June 27, 2005 [http://news.bbc.co.uk/2/hi/south\\_asia/4626551.stm](http://news.bbc.co.uk/2/hi/south_asia/4626551.stm).

<sup>14</sup> These are derived from section ‘D. Guiding Principles of the needs Assessment and Recovery Strategy’. Preliminary Damage and Needs Assessment Prepared for the Sri Lanka 2005 Post-Tsunami Recovery Program by the Asian Development, the Japan Bank for International Cooperation and the World Bank (January 1-28, 2005), pp.7-9, and (February 12, 2005), pp.7-8.

- There should be no discrimination on the basis of political, religious, ethnic, and gender consideration.
- The reconstruction strategy should be sensitive to the impact on neighboring, but unaffected communities.
- The reconstruction activity should be designed and implemented at the lowest competent tier of government (subsidiary) to enable locally appropriate solutions, the engagement of sub-national structures, capacity building and the strengthening of different levels of government and civil society organizations.
- To secure the mid and long-term needs of the victims, solid consultation, local decision-making and full participation in reconstruction activities is essential
- Intervention should respect local religion, culture, structures and customs.
- There needs to be adequate communication and transparency in decision-making and implementation. . This refers to policies, entitlements and transparency, as well as to resource use, including 'zero tolerance for corruption'.
- Reconstruction should reduce future vulnerabilities to natural hazards by adopting a multi-hazard risk approach.
- Interventions need to be assessed with their impact on prospects for peace and conflict, on gender, on the environmental, and on government, and human rights.
- Revenues resulting from debt relief should demonstrably benefit the tsunami victims.
- Efforts need to be properly co-ordinate between all relevant stakeholders.

### **3.6 SECTOR STRATEGIES**

#### **3.6.1 Livelihood**

The overall strategy of the livelihood support is to advance. Tsunami affected communities must be brought out of dependency poverty as rapidly as possible by providing support to revive local economies and rebuild livelihoods. Since this can be achieved in the medium-term only, income support will be granted to those who are unable to work or for whom there is no work. Also, immediate income opportunities were to be offered through community and public works, which would in turn contribute for the local economic revival. The support meets immediate needs as well

as contributes to longer-term local and national development goals and aspirations. The following activities were the elements of the strategy:<sup>15</sup>

- Establish coordination and targeting framework, the Rapid Income Recovery Framework (RIRF) including a management information system at the community, divisional, district, and provincial level that enables communities to communicate their requirements, and gain access to assistance and services based on their needs and strengthen capacity at the District and Divisional level.
- Develop the capacity and mechanism for participatory and inclusive planning and implementation of local economic development, including the resolution of outstanding issues.
- Ensure the best possible targeting assistance to those in need.
- Ensure the adoption of best practice in cash transfer payments policy and systems including the integration of such practices into the social security system as a whole.
- Ensure that cash for work programme operates under the post tsunami Recovery maximizes opportunities for increased income and for those affected by the Tsunami.
- Support the development and implementation of holistic local economic development plans at the divisional level, to enable communities to gain access to financial services, business development services, skill training and rehabilitation of small infrastructure that meets their immediate construction and long-term development needs.
- Enable communities to identify and assess local economic opportunities, design and deliver community based skill training, and provide post-training services.
- Ensure the provision of private and public sector skills, training, and business development services providers with financial and technical assistance to enable them to increase their outreach and offer more relevant services in the affected districts.

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<sup>15</sup> Human Rights Commission/UNDP, 2005, People Consultation on Post-Tsunami Recovery, Preliminary draft.

- Develop and strengthen best practice standards of income livelihood protection and delivery of services.

It is estimated that over US\$ 125 million has been committed or partly committed by donors for Cash Transfer programmes, US\$ 40- US\$ 60 million For Work Programmes and a further US\$ 65 million for economic development services (total US\$ 250 mn). Capital for lending is sufficiently available through donors and financial institutions, including microfinance institutions. Donors who have committed finance include: USAID, GTZ, JBIC, SIDA, WB, ADB, IFAD, EU, Norway, etc. It is estimated that approximately US\$ 8 million will be additionally required by the Rapid Income Recovery Framework (Management Information System, Support Services, strengthened capacity at the District and Divisional level Administration), to ensure these funds are delivered in an efficient and effective manner over the three years, in which support to secure and develop livelihoods is expected to be required.

Delivery of Livelihood interventions will take place through many players to achieve the above status objectives. To ensure effective delivery the RIRF will identify local, divisional, district, and national committees operating in the tsunami affected areas, be suitably resourced and develop a Livelihoods Management Information System. A Program Management Unit and District Support Units will be formed to strengthen the management, coordination, and technical capacity at all levels, and assist in information gathering and dissemination under the direction of the Inter ministerial Steering Committee. Where coordination and management information systems already exist, these will be built upon and strengthened rather than setting up parallel mechanisms.

### **3.6.2 Water Supplies and Sanitation**

The major objective of the sector strategy is to provide sufficient and sustainable water supply and sanitation services to the affected areas. The following three actions were to be implemented:

Immediate need: The objective of is to provide adequate water supply and sanitation facilities to meet the immediate needs of the affected populations. The strategy includes temporary supply of safe water to transit camps, repair of damaged infrastructure and undertaking an assessment on situation of the existing water supply, and sanitation situation.

Immediate service restoration: This is to restore the services to the similar the level prior to the tsunami. This will be achieved through extensions and increasing the capacity of the existing schemes. Sanitation facilities in the resettlement areas will be improved through new installations. However the progress of the achievements will depend on the availability of firm resettlement plans.

Immediate service expansion: This is to achieve long-term ambition of meeting the needs of the Tsunami victims with the medium term planning horizon up to 10 years. The components of the strategy include improvement of the water resources and expansion of the schemes to meet the service requirements of the population in the restored/resettled areas and construction of new schemes in the areas where there is potential.

The need assessments revealed that the areas to which supply of water be provided should include, transit camps, new settlements, and newly developed commercial areas. The possible sources of water supply range from pipe bone schemes to protected dug well, depending on the demand and technical viability

Table-3.3

**Funding commitments by Donors for water supply (Rs. Million)**

District	Estimated project cost	Commitment
Gampaha	450	250
Colombo	358	138
Kalutara	913	684
Galle	3346	3146
Matara	1771	1514
Hambantota	2334	2104
Amapara	3515	2972
Batticaloa	930	730
Trincomalee	3726	3420
Killinochchi	1083	289
Millaitivu	864	664
Jaffna	866	606
Total	20096	16544

Source: Nation Water Supply and Drainage Board

### **3.6.3 Health**

The entire reconstruction of all damaged healthcare institutions including Arvada Centers and supply of medical equipment was to be carried out with financial assistance of international and local agencies. Healthcare waste management systems and other related infrastructure of the hospitals in principal towns will also be upgraded to ensure quality health services. The reconstruction activities and supply of equipment will be monitored by the committees chaired by Provincial Health Directors.

In order to ensure the successful completion of the programmes within the specified time frame, all donors have entered into agreements with contractors. In the case of supplying medical equipments, the donor is required to work in consultation with the Bio-Medical Engineering Services Unit of the Ministry of Health to avoid any conflict in policy. The Ministry of Health has appointed a committee of officials with experience in project monitoring to monitor the projects in the different districts. This committee will function under the direction of the Provincial Directors, Deputy Provincial Director Health Services (DPDHS), National Health Development (NHDC) and Health Development Committee (HDC), and will report to the Honorable Minister of Health on a regular basis.

Table: 3.4

**Donor Commitments and MOUs Signed**

District	Estimated Cost (Rs. Mn.)	Donor MOUs Signed	
		Cost (Rs. Mn.)	Donor
Trincomalee	1,090	1,090	India, Red Cross, UNFPA, Italian Civil Protection.
Batticaloa	1,268	1,268	Red Cross, UNICEF, MMB ORG., UNFPA, Celltel
Ampara	1,683	1,683	UNICEF, Red Cross, MMB ORG.
Killinochchi	6.5	6.5	Red Cross
Mullaitivu	462	462	UNICEF, Red Cross, MMB ORG.
Jaffna	17	17	Red Cross, UNFPA
Hambantota	22.5	22.5	Red Cross, UNFPA
Matara Galle	248	248	UNFPA, UNICEF, Italian Civil Protection, Red Cross, Celltel Intersos.
	1,990	1990	Germany, AES Kelanitissa, Caritas, Red Cross
Kalutara	28.5	28.5	Red Cross
Colombo	22.5	22.5	University of New Castle
<b>Total</b>	<b>6,338</b>	<b>6,338</b>	

Source: Ministry of Health of Sri Lanka 2006.

The total requirement for reconstruction and rehabilitation in the health sector is estimated at US\$ 68 million for the medium term and this amount has been committed by various donors such as the Indian Government, UNFPA, German Government, Red Cross, Italian Civil Protection etc.

**3.6.4 Education**

The fully and partially damaged schools and vocational training centers within the coastal buffer zone will be relocated in suitable places. The damaged schools and



vocational training centers located outside the buffer zone are expected to be repaired. Repairs to the damaged universities are to be undertaken using the allocations made available for 2005.

Table-3.5

**Funds Committed and Additional Funds Required**

<b>Schools / Institutes</b>	<b>Total Requirements (US \$ Million.)</b>	<b>Commitments - Received (US \$Million.)</b>	<b>Balance Fund Requirements (US \$ Million.)</b>
180 Schools	103	101	2
1981 IDP Schools	60	40	20
04 Universities	0.72	0.72	-
13 Vocational Centers	3.44	3.44	-
<b>Total</b>	<b>167.12</b>	<b>145.12</b>	<b>22</b>

Source: Ministry of Education website, March 2006.

For the relocation and reconstruction of damaged schools and the schools used as welfare camps, assistance was to be sought from local and foreign donor agencies. A number of 180 schools 198 schools used for welfare camps, 4 universities and 13 vocational institutions were be rehabilitated or reconstructed as the case may be. The requirement fund for this work US\$ 167 mn. and the donor assistance so far committed has amounted to US\$ 146 mn. Leaving a resource gap of US\$ 17 mn, Reconstruction and relocation of schools was to be implemented by the Ministry of Education and Provincial Education Ministries, and monitored through a National Monitoring Committee and Zonal Level Committees. A donor coordination committee will work with the participation of the key donors.

**3.6.5 Housing**

The main objective is to facilitate the reconstruction of the housing stock which has been destroyed by the tsunami disaster. The strategy adopted by the government was to establish a grant scheme, for fully and partially damaged houses outside buffer zone, and to build housing projects with donor assistance on lands allocated by the government for damaged and destroyed houses within the buffer zone. The requirement of funds for this purpose amounts to US \$ 22 million and US \$ 47million. For partially and fully damaged houses respectively. The partner arrangement for the

grant scheme includes: the Government of Sri Lanka, the International Development Association, and the Swiss Agency for Development Corporation.

Table 3.6

**Fund Requirements for the Grant Scheme**

	<b>Partially damaged houses</b>	<b>Fully damaged houses</b>
Grant amount	US \$ 1,000/ per house	US \$ 2,500/- per house
No. of housing units	21,858 houses	18,912 houses
Fund requirements	US \$ 22 million	US \$ 47 million

Source: Transitional Accommodation Programmer, Commissioner of Essential Services.

The grant scheme will be governed by a policy and guidelines agreed by the Consortium of Partners after extensive consultation with all stakeholders. Under the housing programme with donor assistance, a number of 53,127 houses were to be constructed. Several MOU have been signed to construct 31,891 houses and donor pledges have been made for the remainder.<sup>16</sup>

Table-3.7

**Pledges for the Donor – Built Housing Projects**

<b>Donor</b>	<b>No. Of Houses Pledged</b>	<b>No. Of Lands Allocated</b>
CARITAS	26,000	1,346
Red Cross	15,000	9,575
World Vision	10,000	1,935
Care International	6,800	1,715
International Lions Club	4,500	1,930
Tamil Rehab. Org.	1,500	738
SriLanka Co-Operative	1,400	769
Foreign Ministry	1,200	1,485
SOS Children's Village	1,143	880
TZUCHI Foundation	1,000	1,000
<b>Total</b>	<b>53,543</b>	<b>21,373</b>

Source: Ministry of Finance and Planning, 2005.

<sup>16</sup> RADA, December 2005.

### **3.6.6 Fisheries**

The strategy for reconstruction of the fisheries sector has been broken into 14 identified projects.<sup>17</sup> This mainly includes: repair of boats, supply of nets, replacement of fishing crafts, repair of fishery harbors and anchorages, supply of ice plants, providing assistance for training and research, cost conservation, livelihood support, and provision of setting up Tsunami early warning system. It has been planned to complete all the project activities within 18 months.

Total requirements for the reconstruction work in the fisheries sector is estimated at US\$ 201 million. Commitment so far by various donors and donor countries including China, Japan, ADB, Norway and IFAD has amounted to US\$ 95 million leaving a resource gap during the medium term amounting to US\$ 55 million.

### **3.6.7 Roads and Bridges**

The national road network in the coastal areas of the Northeast and Southern Provinces was severely damaged by the tsunami. In addition, extensive damage occurred to the provincial roads, and to the local government and municipal roads. Bridges and culverts were displaced and embankments eroded by the advancing and retreating tsunami. The main damage occurred to roads that were already in a greatly deteriorated state, due to lack of maintenance and damage during the conflict period. Further, on the east coast, flooding before and after the tsunami caused extensive damage to the coastal roads. It is not possible therefore to separate the value of road damage due to the three different mechanisms, i.e., conflicts, flooding, and the tsunami.

It was planned to undertake temporary repairs, which will to be consolidated by permanent repairs to embankments, drainage systems (including protection measures), and permanent bridges would replace that temporary bridges and bypass roads. There is then a need to bring the tsunami-affected national roads to a maintainable and uniform standard, including embankment and carriageway widening to 2 lanes, repairing pavements, drainage improvements, flood protection measures, culvert and bridge rehabilitations or replacements. In order to reap the

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<sup>17</sup> This includes: (a) Repairs of boats and engines, provision of fishing gear and accessories, replacement of boats and engines, (b) technical assistance to design better boats, (c) technical assistance to establish/ rehabilitate anchorages and small landing sites, (d) aquaculture development/ promotion and integrated coastal management, (e) rehabilitation of fishery associated institutional capabilities for better monitoring and coordination.

economic, commercial, and social benefits of rehabilitation the coastal main roads connecting provincial and local government roads were also be developed fully.

The post tsunami recovery in the roads and bridges sector will involve restraining to a continuous network of national roads, over 1000 km. long and stretching from Kalutara in the southwest to Jaffna in the north. These road rehabilitations will directly benefit the tsunami affected coastal communities by providing access to economic opportunities and good quality services, and by lowering transport costs and promoting local and regional development.

Table-3.8

**The Coast of Rehabilitation of the Roads**

<b>Roads and Bridges</b>	<b>Length (Km)</b>	<b>Approximate (US \$ Mn.)</b>
Southern National Roads and Bridges	464	92.0
Eastern National Roads and Bridges	323.3	126.0
Northern National Roads and Bridges	330.3	83.0
Provincial and Local Government Roads and Bridges in all districts.	1,480	39.0
<b>Total</b>	<b>1,266</b>	<b>340</b>

Source: STAART Project Office, March 2005

The total cost of rehabilitation has been estimated at US\$ 340 mn. of this US\$ 318 mn. had been committed by various donors including the ADB, World Bank, JBIC, JICA, and European commission, USAID, Saudi Arabia and Spain.

**3.6.8 Railway**

The railway tracks, signaling and communication system, and building infrastructure on the coastal railway line were severely damaged. Also some sections of railways tracks on Trincomalee and Batticaloa lines were partially damaged. In addition engines, carriages, Diesel Multiple Units were also destroyed. For the restoration and improvement of the railways the following strategies were to be adopted:

- The coastal railway line is one of the main corridors to enter the capital from the South. Re-recommencement of train services on this coastal railway line were to be given high priority.

- Damaged rolling stock, communications and railway stations were to be rehabilitated.
- The old coastal railway line were also to be converted into a modern railway line, by providing additional rail track from Kalutara to Matara and development of selected railway stations as commercial centers, and development of railway stations as inter-modal transport centers.
- Implementation and monitoring mechanisms were to be arranged by the government and through private sector participation.
- With regards to financing, the ADB funds were to be made available to restore and improve the tsunami affected areas of the Sri Lankan Railway. These were to cover Colombo/Matara and the Eastern and northern lines. In addition improvement to the railway workshops was also included.

The cost of rehabilitation and improvements had been estimated at US \$ 185 million. Several donors had shown interest in meeting the costs. The proposed funding by the Indian Government for upgrading and double tracking of the Colombo/Matara rail track was intended to scientifically improve the operating speed of the railway and greatly assist in alleviating traffic congestions and extend the socio economic benefits across the country.

The total cost of rehabilitation has been estimated at US\$340 mn. of this, US\$ 318 mn. Has been committed by various donors including ADB, World Bank, JBIC, JICA, and European commission, USAID, Saudi Arabian and Spain.

### **3.6.9 Tourism**

The Sri Lanka Tourist Board had developed a strategy to restore both tangible and intangible tourism assets in the shortest possible time. This strategy included the following programmes and activities:

- The Marketing Recovery Program: Restoration of the Sri Lanka Tourism Brand (Us \$ 5.3 million).
- Tourism Resort Zoning Plan: 15 tourist towns, which were affected, had been identified for rehabilitation and reconstruction (US \$ 30 mn).
- Community Restoration Plan: Housing and infrastructure development will take place in the above 15 tourist towns in order to resettle the displaced communities (US \$ 15 mn).

- Incentive to hoteliers and tourism related enterprises: Import duty waiver for hotel refurbishment (US \$ 6.7 mn)  
Susahana loans up to Rs. 10 million, with no repayment in the first year.

The Monitoring mechanism was spelled as follows:

- The Ministry of Tourism and the Sri Lanka Tourist Board (SLTB) were to be the monitoring agencies for all future tourism development, including the Tourism Zones. Developers were to be encouraged to invest within these zones..
- All tourist establishments were required to possess a license issued by the SLTB to carry out tourism business.
- A report with development guidelines had already been published by the SLTB to assist developers to design their products.
- All project proposals were to be studied very carefully by the SLTB and only then approvals were to be given, provided they conformed to the guidelines set out by the SLTB.
- The government anticipates that the entire 53 large hotels damaged by the tsunami will be repaired by December 2007 (financed largely by the private sector). With respect to small hotels and guesthouses, recovery is more complex to measure recovery among the 240 known to-be damaged guesthouses.<sup>18</sup>

### 3.6.10 Environment

The major objective was to achieve environmentally sustainable post-tsunami reconstruction planning, through the establishment of a cross-sectional multi-stakeholder structure for coordinated planning that was based on a Strategic Environmental Assessment. The following key activities were to be implemented:

- Establishment of the multi-stakeholder planning platform to assist in policy review/formulation and preparation of sector plans;
- Establishment of an environmental helpdesk to provide guidance on environmental issues; and
- Conducting a strategic environmental assessment on the post-tsunami environmental issues. Detailed action plans per district and per sector will be

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<sup>18</sup> Minister of Tourism of Sri Lanka, October 2005.

devised based on the findings of the SEA and the Comprehensive Physical Damaged Assessment Survey conducted along the entire affected coastline.

The government of Netherlands had pledged support for the Strategic Environmental Assessment with a grant of one million Euros in the year 2005. In addition, the donor community in general had expressed willingness to provide support in the form of finances / expertise / other resources to selected actions / programmes. In the year 2006, funding in the form of euros 0.5 million grant would be enabled by the Government of Netherlands in order to continue with the actions/programmes that were commenced. The Memorandum of Understanding for the proposed Strategic Environmental Assessment to be signed between the GOSL and the Government of Netherlands was awaiting finalization at that time.

The key implementation agencies were to be: the Ministry of Environment and Natural Resources (MENR), Central Environmental Authority (CEA), and the Urban Development Authority (UDA). The proposed multi-stakeholder planning structure was to be chaired by the UDA and facilitated by the MENR. The planning platform was to strongly collaborate with the CEA for technical and operational direction. The other line agencies, NGOs, and business organizations were to be members of the multi-stakeholder planning structure, contributing towards their relevant sector performance. TAFREN was expected to link up with all key partners and provides support to the implementing agencies in the form of facilitation and co-ordination.

### **3.7 Disaster management policy and institutions in Sri Lanka: An overview**

Sri Lanka experiences frequent natural hazards in the form of droughts, floods, landslides, and cyclones, affecting millions of people over the years. Despite the tropical climate and heavy rainfall, the climatically differentiated 'dry-zone' in Sri Lanka is subject to periods of drought, while seasonal monsoons regularly bring about flash floods, river floods, and storm surges in certain parts of low-lying river basins. Eight of Sri Lanka's 25 districts are prone to landslides, the occurrences of which have increased in the recent years, and cyclonic storms and gale-force winds are also bound with monsoon activity or severe weather changes in the Bay of Bengal.<sup>19</sup> Sri Lanka's response focus has been oriented towards post-disaster activity with heavy

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<sup>19</sup> Ariyabandu M.M., Hazard Risk and Water Resource Management in Sri Lanka- an overview, ITDG South Asia.

emphasis on post-disaster relief and rehabilitation. Disaster preparedness and planning is given comparatively low priority.

Before the tsunami, disaster management came under the purview of the Ministry of Social Services (MoSS). The Department of Social Services (DSS) was responsible for the distribution of relief and rehabilitation programmes in coordination with the local government administration. Relief packages including food, money for shelter, and purchasing of destroyed kitchen and other implements are provided through the governmental network. The Secretaries of the 25 districts and 300 divisions report to the DSS in event of disaster, natural or man-made. The department also hands out forms of long-term assistance for those displaced or economically disabled.

Tabel-3.9

**Disaster and Its Impact 1996-2006**

Event	No. Of deaths	No. Of people affected	No. Of Houses Destroyed	Relief distribution in million (Rs)
Cyclone	30	22,431	65,707	224.90
Drought	0	7,479,147	0	1,176.14
Flood	285	2,230,098	28,607	714.46
Landslide	211	20,636	1,367	15.37
Tsunami	39,143	419,142	43,504	153.46

Source: National Disaster Management Centre (NDMC), Sri Lanka, 2006.

**3.7.1 WARNING FOR ACTION**

The government drafted a Disaster Counter Measures Act and the National Disaster Management Centre (NDMC) was formed in 1996. The NDMC was responsible for coordination of responses to natural disasters. However, awaiting the passing the Disaster Counter Measures Act, the NDMC had no legal backing and had struggled through changes, delays, and low prioritization on the parliamentary and policy agenda. The DSS too had struggled with poor coordination between agencies, insufficient financing and low capacity.

Efforts to incorporate disaster management into local planning and activities have been *ad hoc* and generally driven externally by development agencies. These have tended to focus on disaster response and developing plans with responsibilities for local governments. Such plans have sometimes gathered dust in the shelves, as



illustrated by the 2003 flood in the central town of Ratnapura. Although a disaster mitigation plan existed, it was not implemented prior to or in response to the flood. District level disaster management plans also existed for the coastal areas of Hambantota, Matara, Galle, and Kaluthara prior to the tsunami but similarly they had also not been implemented.<sup>20</sup>

Deaths numbering 35,322 is a high price to pay; yet in reality, it was the sheer scale and magnitude of the tsunami disaster that finally pushed the disaster management policy agenda quickly forward. After several legal battles and a decade long wait, the Disaster Management Act (the amended Disaster Counter Measures Act) was finally passed in May, 2005. The name change reflects the shift in emphasis of the new Act towards the preparedness for and response to the disaster. In this way, it is weaker in linking disaster management to development than the original draft. Following the passing of the Act, the Government set up the National Council for Disaster Management (NCDM) in October 2005 to “--- provide direction in disaster risk management in the county”. The NCDM is chaired by the President, with the Prime Minister as the Vice-Chair and consists of the Leader of the Opposition, twenty-nine Ministries (including Social Welfare, Rehabilitation & Reconstruction, Health, Science & Technology, Irrigation, Fisheries & Aquatic Resource etc.) and the Chief Ministers of every Provincial Council.<sup>21</sup> The Disaster Management Center (DMC) was also set up under the Presidential Secretariat, as the lead agency for disaster risk management in the country.

The placing of the newly created NCDM and the DMC under the Presidential Secretariat served to send a message out, that disaster management was being taken seriously. The presidential chair gave the institution power and influence, in contrast to the pre-existing NDMC housed under the MoSS.

“Towards a Safer Sri Lanka: Road Map for Disaster Risk Management”<sup>22</sup>, is a key Government policy document and was published by the Disaster Management Center under the Ministry of Disaster Management in December 2005. The Road Map

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<sup>20</sup> “Disaster Preparedness Plans, Disaster Risk Reduction and Management”, Janathakshana Puvath, Practical Action, Colombo, vol.1, n.4, 2005.

<sup>21</sup> The Provincial elected government representative bodies.

<sup>22</sup> Towards a Safer Sri Lanka: Road Map for Disaster risk Management, Disaster Management Center, Ministry of, Disaster Management, December 2005.

aims to provide an overall framework for disaster risk management in the country and is an effort, through the MoDM to unify the efforts of different agencies. The Road Map since organized around seven themes and priorities, activities and projects into short, medium, and long term.

The Road Map recognizes that the tsunami has highlighted the policy and institutional weakness on disaster risk management in the country. The document is not just about the tsunami. It is also far of filling the gaps, creating the social and political will to manage disaster risk, and the coordinate activities. It addresses some of the key gaps in the Disaster Management Act, particularly the Act's weakness in being largely focused on risk assessment and emergency response planning. However, one substantial gap is the lack of mention and link to social vulnerability. Vulnerability analysis is viewed only from a physical and hazard point of view without adequate analysis of gender etc.

### **3.7.2 Stop gap institutions set up following the tsunami**

The President set up the Center for National Operation (CNO) immediately after the tsunami, to facilitate and coordinate emergency rescue and recovery needs. At the end of January 2005, the CNO was replaced with the Task Force for Rebuilding the Nation (TAFREN), established on a Presidential directive. After the Presidential Elections in November 2005, the Reconstruction and Development Agency (RADA) was formed under the Presidential Secretariat to replace TAFREN. The CNO was followed by TAFREN and then RADA emerged as the key government-coordinating agency, and they were responsible for policy directives on emergency and reconstruction where as CNO and TAFREN focused specially on tsunami relief and recovery. *"The RADA mandate is to accelerate Reconstruction and Development activities in all parts of the country, functionally replacing all the Tsunami organizations," Ultimately, RADA will function as the single Government focal point (One-Stop-Shop- concept) responsible for all reconstruction and development activities relating to all natural and man-made disasters in post-Tsunami and post-conflict areas throughout the nation."*

### **3.7.3 Policy and institutional issues**

The Sri Lanka Disaster Management Act No. 13, 2005 passed a step forward but the passing of the Disaster Management Act with the policy and operational backing of the NCDM and DMC marked a milestone in the Sri Lankan disaster

management history.<sup>23</sup> Along with the road map now there exists a policy framework and institutional structure for disaster risk management for Sri Lanka. Nevertheless, by focusing on risk assessment and emergency response planning across departments, the Act is reactive and thereby weaker than the original draft. A key strength of the original Disaster Counter Measures Act was that, it identified and conceptually made the link between disasters and development, setting an agenda to make the incorporation of disaster mitigation planning mandatory in all government departments. In addition, it is yet to be seen how the different institutions (NCDM, DMC, the MoDM line ministries, local government bodies etc.), policies (the Disaster Management Act and the Road Map), and operational issues will work together.

#### **3.7.4 Lack of Clarity on Key Institutions' Roles:**

Since the Disaster Management Act was not amended to reflect institutional change, the MoDM is not a member of the NCDM set up under the Act. As no specific role was assigned to the NDMC or the DSS, the role they play in disaster management is not clear, although they continue to exist. While RADA has, spelt out a clear mandate for the future operations of rebuilding extended to post-conflict, as well as post tsunami, it is yet to be seen how RADA will integrate into the broader disaster management policy and institutional framework, as laid out in the Disaster Management Act or the Road Map.

#### **3.7.5 Tackling Top-Down Tendencies:**

The ministry of Provincial and Local Government is not represented in the NCDM, although they are required to prepare disaster management plans under Section 10 of the Act. Local government authorities that include Pradeshiya Sabas and Nargagra Sabas (the elected village and town councils) are the most decentralized bodies and could potentially play a major role in incorporating the concerns of the general public into a disaster sensitive development processes. However, the Ministry of Provincial and Local Government has no direct representation in the Council. Although the Chief Ministers of the Provincial Councils are in the NCDM, the Act provides no clarity on their role. Local government is mentioned in the Road Map, which clearly identifies Community-Based Disaster Risk Management as a policy theme, with the need for coordinating mechanism between provincial, district, divisional, and GN government divisions. This may mean that there is room for bitter

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<sup>23</sup> Sri Lanka Disaster Management Act no.13, 2005.

involvement of local government, which should in the long run strengthen local capacities to face future hazards.

According to the Disaster Act (Section 10 (1)) all government ministries, departments, and public corporations should prepare disaster management plans. The risk is that disaster management plans will not be incorporated into development plans, reflecting the conceptual failure to recognize disaster-development linkages. The Road Map actually talks about disaster- development linkages. However, it is not very clear whether the ministerial plans under Section 10 should be incorporated into their development plans or are to the separate disaster plans.

While the Disaster Management Act omits guidance on how to minimize overlapping, the later Road Map identified the MoDM as the institution to identify, and coordinate multi-stakeholder efforts over the next 10 years. The Road Map is seen to contain a disaster risk management framework for guiding a coordinated, national strategy.

The Road Map highlights the need to integrate recent early warning initiatives that have come about, as a response to the tsunami into a multi-hazard approach. Since the tsunami, the government has participated in the international coordination meetings for the development of a Tsunami Warning and Mitigation System for the Indian Ocean. The Road Map focuses on early warning strategy for frequent hazards like: floods, landslides, cyclones, and droughts, and in vulnerable areas. However, much of the strategy is on improving or putting in place scientific, technical, and institutional capacities on for example, meteorological observation and predication, seismic monitoring, and cyclone tracking. Community involvement is addressed under the Road Map's Community Based Disaster Risk Management policy theme; however the communities' role in the centrally managed EWS is not addressees with sufficient clarity. The reading of the policy implies a passive role for communities, which may have implications for capacity building at local levels.

**CHAPTER -4**  
**CONCLUSION**

The December 26, 2004, tsunami in the Indian Ocean in South-Asia has been one of the most unprecedented events in earthquake related nature disaster in the recent times. According to USGS it is the fourth largest earthquake in term of devastation caused. The under ocean earthquake responsible for this tsunami measured Mw 9.0 on the Richter scale. It resulted from the subduction of Indian plate below the Burmese plate and rupturing of 1,200 km long fault along the indo-Burmese plate.

It affected 11 countries in Asia, and Africa. It caused immense loss to life, 229,866 people lost, including 186,983 dead and 42,883 missing. Sri Lanka was the second most affected country after Indonesia. The tsunami completely ravaged the coastal region of the country and caused huge loss to life and property. It is one of the worst natural calamities in the recoded history of the island nation. The tsunami affected 1,100 km long coastline of the country particularly in the east, north and southern parts. The major brunt of the devastation has been borne by 13 districts of 5 provinces. It affected 1 million populations (5 percent of the total of 19 million populations); resulted in 35,322 deaths rendered 6,300 persons missing and displaced 4, 43,000 people in the country.

The tsunami substantially damaged the physical infrastructure including housing, education, health, water supply, power, communication etc. this completely paralyzed the Lankan economy and for a moment the life came to a grinding halt. In physical terms it destroyed more than 90000 houses and damaged around 1, 60,000 houses of which more than 90% were concentrated in the worst affected 13 districts of the 5 provinces. Likewise 168 schools, 4 universities and 18 vocational & industrial training centers in the education sector. 92 health institutions, water supply including pipelines, dug wells, equipment; water pumping machines, civil structures etc. and power supply line (11& 33 KV) and 405 km of low voltage distribution lines have been destroyed. In terms of cost the asset losses are estimated at around 1 billion US dollars. This is 4.5 percent of the GDP. The loss to the physical infrastructure has caused adverse impact on the employment front. An estimated 2 lakh people including 1 lakh fisherman, 27,000 people employment in tourism sectors were rendered unemployed.

Socially women, children and the people belonging to very low-income groups including daily wage earners, fisherman, casual workers etc. have been the hardest hit. In most of the families the bread earners have been washed away in the

tsunami leaving the families in complete disarray. The plight of the children is more horrifying, there are score of such families where the parent and guardians of the children have perished and the children have been rendered homeless. Their future is uncertain. They could be easy victims to forced labor, flesh trade, forced beggary etc. Apart from the physical and socio-economic infrastructure, Sri Lankan natural environment has also been adversely affected. The coastline along the north-east suffered intensive damage where the tsunami waves reached 2-3 km's inside the coast. This was mainly due to absence of natural barriers such as corals, mangroves etc. Further, fertile soil has been intensively washed away; fresh water bodies and fishery breeding grounds have been contaminated with saline water in protected areas. The Sri Lankan Government has announced several measures to rehabilitate and reconstruct the tsunami-ravaged areas. These include short term, medium term and long term measures. The government is also pruning its institutional framework in the light of the deficiencies witnessed during the tsunami. For this a comprehensive document entitled "Towards a Safer Sri Lanka: Road Map for Disaster Risk Management" has been brought out by the government. Sector-wise allocation of funds has been done to restore the basic infrastructure and the socio economic fabric. How effective will it be is yet to be seen.

There are however several problems that pose a severe impediment in the rehabilitation process. The ongoing conflict with the LTTE is a severe drain on the resources of the country. The government needs to arrive at an understanding with the LTTE so that there is no barrier in the ongoing rehabilitation programme. The institutional mechanism developed by the government needs to focus on proactive rather than reactive approach in combating disasters. Disaster Management plans have to be long term plans rather than *ad hoc* plan. A natural disaster system cannot have merely technocratic approach but also has to involve a socio economic approach as well. Technology is not and cannot be a substitute for policy. There has to be a synergy between technology and policy. The problem is in operational vacuum due to ineffective policy formulation and inefficient implementation. Advocates of a mere technocratic approach to this issue should realize that the primary role of science is to promote the cause of human well being. Therefore, in any research on natural disaster management, scientists should also consider the issues of ethics, rights, and equity, long considered to be issues of concern for social scientists and relegated to the domain of social science. Fresh air in science can only be instilled with research from

varied disciplines that fall within the ambit of social science. This would ensure that new technologies, the result of many scientific discoveries are used with caution.

The necessity of a synergy between technology and policy should be effectively ensured in all the three key stages that a natural disaster entails, before a disaster: This is necessary to reduce the potential for human, material, or environmental losses caused by hazards, and to ensure that these losses are minimized when disaster strikes.

Most research and efforts in policy formulation in the area of disaster management had focused on two stages viz., emergency relief period and post disaster rehabilitation. This bias occurs, as these two stages are the strongest in terms of high profile visibility, political support, and funding provision. Instead of allocation of funds before an event, and to reduce future disaster, action normally takes place after events have occurred. This situation is similar to that of preventive health care, where curative medicine is relatively well funded, while preventive medicine is not.

Whilst emergency relief and rehabilitation are vital activities, successful disaster management planning must encompass the complete realm of activities and situations that occur before, during, and after disaster. The phase can be represented as a cycle or continuum, which if circumstances allow, reduces the negative effects of future disaster. These activities are implemented at specific times, with the length of any one period being dependent on the type of disaster. Therefore, one of the key issues in disaster management planning is the allocation of resources at all the stages of the disaster cycle, which optimizes the total effectiveness of disaster reduction activities.

There is also need to have effective strategy to protect the coastal ecology. The tsunami disaster has clearly brought to light the fact that wherever there were mangroves along the coast the impact of the incoming tsunami waves were minimal. To illustrate, at Yala and Bundala National Parks, vegetated coastal sand dunes completely stopped the tsunami, which was only able to enter where river outlets broke the dune line Hence restoration of coastal ecology should be taken on a priority basis.

The most vulnerable groups including women, children, aged etc. need to be given special treatment and adequate protection. Special programmes need to be developed for their development and progress. Care needs to taken of the destitute children who have lost their parents. Government should take upon itself their



responsibility so that their future is secured and they do not become victims of atrocities.

The countries of Indian Ocean Rim including Sri Lanka must enter into a dialogue on collective installation of Tsunami Early Warning System in the region on the lines of the group of 26 countries who are a part of the Pacific Ocean Tsunami Early Warning System. This dialogue should also include the sharing of information, technology, expert groups etc. on various aspects of Disaster Management.

The disaster management plans should be time bound with a human face and total participation of the affected people. It should not be imposed upon them. They must be consulted with regard to their rehabilitation. The *Gujarat Disaster Management Model* could be a guiding model in which the people were consulted through meetings at the village level. The developmental Plans were circulated among the people, they were asked to record their objections and only after through consultations were the plans implemented Also the various stages of the rehabilitation schemes should be time bound to be completed in the stipulated time. Undue delay in their implementation can cause further hardship to the already affected people. It will also raise the overall cost of rehabilitation, which would be a drain on the country's limited resources.

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