Response and Recovery in India after the December 2004 Great Sumatra Earthquake and Indian Ocean Tsunami

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The rescue and relief work undertaken in the Andaman and Nicobar islands and in mainland India after the 26 December 2004 Indian Ocean tsunami was massive. A number of new initiatives undertaken by the government and nongovernmental agencies were innovative and successful. Also, since the tsunami was not a typical disaster for India, it raised a number of new concerns related to reconstruction along the coast. [DOI: 10.1193/1.2206137]

INTRODUCTION

India is divided into states and union territories (UTs)—the states have their own elected local governments, while the UTs are directly governed by the union government at New Delhi. In India, the 2004 Great Sumatra earthquake and Indian Ocean tsunami caused extensive damage in the UT of the Andaman and Nicobar (A&N) islands situated in the Bay of Bengal, along the mainland coast in the states of Tamil Nadu and Kerala, and in the UT of Pondicherry. Damage was also sustained in the state of Andhra Pradesh along the eastern mainland coast, but it was moderate. The death toll in India was 10,273, and the number of missing persons was 5,832 (MHA 2005). Also, over 501 children became orphans, and about 10,260 livestock were lost. Of the total missing, 5,554 were from the A&N islands and were feared to be dead. The tsunami affected 2,260 km of the coastline along mainland India, besides all the Nicobar Islands and some of the Andaman Islands. However, as a percentage of the total population, the statistics from the Nicobar Islands indicate severe losses; as of 1 February 2005, of the total population of 42,068 on the Nicobar Islands, about 1,879 were dead, 5,640 were missing, and 26,616 were in relief camps. In India, about 2,750,000 people living in 1,089 villages were affected. About 172,000 dwelling units were destroyed, and about 63,000 boats were damaged. Of the six aboriginal tribes in the A&N islands—namely, the Andamanese, Onges, Jarawas, Sentinelese, Shompens, and Nicobaris—the Nicobaris suffered major losses, while the other five tribes were reported to be safe; 1,151 Nicobaris died, and another 5,580 were reported missing. The saline water ingress into agricultural land affected crops spread over about 200 km^2 of land area. The net economic setback in India is estimated at about Rs. 10,000 crores (~US $2.2 billion).

The most fatalities were in Tamil Nadu. The damage along the mainland coast was

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restricted mostly to a small strip of about 500–1,000 m. Thus there was a great deal of local support in search and rescue efforts and in relief efforts by the community living in the land adjoining the severely affected area. Also, in the early moments of the aftermath of the disaster, television broadcasts drew the attention of the country primarily to the areas adjoining Nagapattinam. Thus a large number of NGOs and other civil societies converged on the area; the latter are groups of people that form in the aftermath of a disaster but may not be registered under the national Act of Societies. A few NGOs (such as Abhiyaan and Yuva), which had been active after the 2001 Bhuj earthquake, also converged on the area affected by the tsunamis and offered services. For the above reasons, the relief work was more timely in the mainland and specifically around Nagapattinam. Immediate relief measures in terms of food and shelter were perhaps the most organized in Pondicherry and in Tamil Nadu. In Kerala, while the government appeared to be relatively slower in responding to immediate relief needs, the people of Kerala were far more resourceful in disaster response. This is in contrast to the approach in the A&N islands, where the affected people were evacuated from the affected islands and moved to relief camps in Port Blair, which was a very slow process.

The entire response effort undertaken in India should be seen as two distinct activities, namely, the effort in the A&N islands and the effort along the mainland coast of India. The former was driven by the central government alone, while the latter was primarily driven by the state governments. Understandably, the challenges and the success of the response efforts in the two regions varied distinctly, owing to proximity to the earthquake source, differences in topology, systems of governance, difficulties in accessing affected areas, and participation of civil societies.

EFFORTS BY THE GOVERNMENT OF INDIA

In the Indian government, natural disasters are handled by the Union Ministry of Home Affairs. The Indian Tri-Services (Indian Army, Indian Air Force, and Indian Navy) were pressed into service to provide emergency support. The Ministry of Home Affairs coordinated the responsibilities, the mobilization and dispatch of resources, and the logistics. The governments of the affected states and the administrations of the affected UTs delivered the relief material to the earthquake-affected areas with assistance from railways and helicopter services (MHA 2005).

The immediate relief was facilitated by the Government of India through the release of grants from the National Calamity Contingency Fund, which contributed Rs. 700 crores (US $156 million) to the affected states and UTs. The state grants consisted of Rs. 250 crores (US $56 million) to Tamil Nadu and Rs. 100 crores (US $22.2 million) each to Andhra Pradesh and Kerala. The UT grants consisted of Rs. 200 crores (US $44.4 million) to the A&N islands and Rs. 35 crores (US $7.8 million) to Pondicherry. To facilitate relief work, two regional logistics coordination centers (one at Kolkata and another at Chennai) and eight relief supply hubs (Bhuj, Ahmedabad, Bombay, Bhopal, Bangalore, Madras, Bhubaneswar, and Calcutta) were established in various parts of the country. In all, 881 relief camps were opened, and about 604,335 people were housed in them. There were 231 relief camps in Kerala, housing 171,491 people; 65 camps in Andhra Pradesh, housing 34,264 people; 48 camps in Pondicherry, housing 45,000

Figure 1. Government relief camp housed in the local school in Port Blair. This was one of the numerous camps set up in Port Blair to accommodate the affected people from the Nicobar Islands, who were moved to Port Blair (photo: G. Mondal).

people; 412 camps in Tamil Nadu, housing 309,379 people; and 125 camps in the A&N islands, housing 44,201 people (Figure 1). About 12,397 5-person tents and 2,318 10-person tents were used; most of the tents were used in the A&N islands. As of 1 March 2005, about 19,670 metric tons of relief material (including 17,500 metric tons to the A&N islands) were moved. All relief material was transported by the Indian Air Force, Indian Railways, and some State Road Transport Corporations to the affected areas free of cost, if the consignees were the relief commissioners or district magistrates and if the relief material had been donated.

In summary, there was an overwhelming response by the people of India to help those who were affected by the tsunami, and the entire postdisaster situation was managed with national resources. In fact, India even managed to offer limited assistance to Indonesia, Sri Lanka, and the Maldives.

ROLE OF THE ARMED FORCES

While it was easy to access the affected coastline in mainland India, accessing the affected A&N islands was a challenge because (a) the A&N islands are Indian security zone areas for historical reasons, and (b) there are 572 islands spread over a 1,200-km area (in particular, the islands affected by the tsunami were themselves spread over 800 km). Hence, the Indian Tri-Services had a major role to play immediately after the event. In addition, the Indian Coast Guard and the Central Paramilitary Force were pressed into service.

The immediate tasks for the armed forces were (a) rescuing stranded persons and

evacuating them to safer places; (b) creating temporary shelter and relief camps; (c) disposing of dead bodies; (d) ensuring adequate supplies of food, water, and medicine; (e) restoring basic lifeline infrastructure (e.g., electrical power, water, and communications); and (f) ensuring the safety of the tribal population in the A&N islands. To achieve this, the armed forces launched Operation Sea Waves, in which the relief supplies were transported by naval ships in association with small local boats, since jetties were damaged and unfit for berthing heavy cargo ships. The Indian Air Force helicopters airdropped relief materials in remote areas. Two ships were also deployed in Tamil Nadu and Pondicherry for relief operations.

Rescue was a major effort; in all, over 28,734 people were rescued—9,284 in the A&N islands, 9,500 in Tamil Nadu (including 1,000 people stranded at the Vivekananda Memorial in Kanyakumari), and 9,950 in Kerala. About 647,000 people were moved to safer places—about 630,000 on the mainland and about 17,000 in the A&N islands. The effort in the A&N islands included a special intervention by the Ministry of Civil Aviation, Government of India, to operate 64 special flights from Port Blair (in the A&N islands) to mainland India from 27 December 2004 through 1 January 2005 to evacuate over 6,318 people, including tourists. This large-scale movement of people was made possible by the deployment of over 20,907 troops (8,300 from the Indian Army, 5,500 from the Indian Navy, 3,000 from the Indian Air Force, 2,000 from the Indian Coast Guard, and 2,107 from the Central Paramilitary Force). This movement involved 22 naval ships, 11 coast guard ships, 12 airplanes, and 17 helicopters.

The Central Paramilitary Force personnel were drawn from the Central Reserve Police Force (CRPF), Central Industrial Security Force (CISF), Indo-Tibetan Border Police (ITBP), Border Security Force (BSF), and Rapid Action Force (RAF). The CISF and ITBP personnel included specialized teams consisting of medical first responders. The Central Paramilitary Force conducted a range of activities including evacuation, search and rescue operations, road clearance, disposal of dead bodies, sanitation activities (e.g., applying bleach powder, DDT, and phenyl in relief camps), assisting the civil administration in distribution of relief material, and unloading and guarding relief material. In addition, these personnel provided rubberized inflatable boats, vehicles, and tents. The relief camps were set up to give temporary shelter and food to the affected persons. For the most part, public buildings (e.g., schools and colleges) and government offices were used as relief camps.

MEDICAL RELIEF

Immediately after the event, medical teams were sent to the states: 158 to Andhra Pradesh, 581 to Tamil Nadu, 233 to Kerala, and 87 to Pondicherry. The armed forces established 18 medical camps with more than 20 medical teams in the areas affected by the tsunamis. A 120-bed hospital was established onboard the INS Magar. All ships of the Indian Navy and Indian Coast Guard deployed for search and rescue were provided with medical facilities. About 114 doctors (including 32 physicians, 6 psychiatrists, 41 general duty medical officers, and 16 public health specialists), 104 nurses and paramedics (including fumigators), and 10 medical teams from the Indian Army and Indian Navy were deployed by the Indian Ministry of Health and Family Welfare. A number of teams

were constituted and kept on hand, including a team of psychiatrists in a number of medical institutions supported by the Government of India so that the team could be dispatched on short notice. A total of 27,537 people were attended to by the medical teams detailed by the Government of India. Emergency medicine worth Rs. 2 crores (US $444,000) was dispatched to the A&N islands, Kerala, and Pondicherry; and emergency medicine worth Rs. 1 crore (US $222,000) was dispatched to Tamil Nadu.

Liquid chlorine was administered in all open wells that were used for drinking water. Some of the wells had become filled with ocean water during the tsunamis; local health officers worked to restore these wells to a potable condition. There was an abundance of medicine in the relief material at different locations.

RESTORATION OF INFRASTRUCTURE

Andhra Pradesh and Kerala suffered relatively less damage to infrastructure, and hence the restoration of infrastructure was rapid. However, in Tamil Nadu and the UTs of the A&N islands and Pondicherry, the damage was extensive. Electrical power in the A&N islands was restored by 745 diesel generator sets, and arrangements were made to move other large generator sets into the islands. Engineering teams were sent to Tamil Nadu, Pondicherry, and the A&N islands to restore power.

The mainland area did not suffer a telecommunications crisis, because of redundancy available in cell phone services as well as land lines. Also, the damage extended only along a small coastal strip of land. However, the situation in the A&N islands was not so simple—there are not enough land line exchanges, and there is only one (government-owned) cell phone service provider. Hence, there were more difficulties owing to poor communications in the A&N islands, particularly in the islands south of Port Blair. The situation was aggravated because of the full or partial outage of power generation in many islands and the unavailability of technical personnel to restore the generation facilities. The administrators controlling the relief operations (including the armed forces) communicated via satellite phones. Ham radio and Immersat and VSAT phones were also used in the immediate aftermath of the earthquake and tsunamis.

The Central Institute of Coastal Engineering for Fishery (CICEF) in Bangalore assessed the damage to the fishing infrastructure and industry. Tamil Nadu, Kerala, and Pondicherry suffered damage to 37 fishing harbors and fish landing centers. In the A&N islands, 29 of the 49 jetties were functional, and 3 pontoons were added so as to berth ships.

In the immediate aftermath of the tsunami, the Indian Army sent 14 Bailey bridges to the A&N islands and installed one at Karaikal across a damaged masonry arch bridge, for early restoration of the transportation system and the facilitation of rescue and relief operations. The Indian Army also helped restore the ferry service in the Alleppy district in Kerala. The Indian Ministry of Road Transport and Highways reports suggested that about 162 km of the national highways, 462 km of state/district highways, 7 bridges, and 34 culverts were damaged in the affected areas.

Table 1. Outlay of post-earthquake rehabilitation funds by the Government of India

Description	Rs. in crores (US$ million)
Mainland India	
Immediate relief and response	
From Calamity Relief Fund and National Calamity Control Fund	760.61 (169.0)
From other ministries	101.21 (22.5)
Rehabilitation package for fishermen	1,184.84 (263.3)
Immediate repair of fishing harbors and landing sites	23.21 (5.2)
Construction of permanent houses	752.30 (167.2)
A&N islands	
Assistance	
From Calamity Relief Fund and National Calamity Control Fund	313.19 (69.6)
Covered under norms with relaxation of scale	215.65 (47.9)
Revival of economic activity	
Fishermen	15.01 (3.4)
Agriculture	239.54 (53.3)
Widows, disabled persons, and unmarried girls	8.60 (1.9)
Immediate restoration of administration and infrastructure	29.89 (6.7)

REHABILITATION PACKAGE

The Government of India announced a special rehabilitation package. The total financial outlay for the package is Rs. 3,644 crores (US $810 million) (Table 1).

About 10,000 temporary shelters were planned to be built with corrugated galvanized iron (CGI) sheets at 57 sites in the A&N islands for the affected tribal and nontribal population. The designs and detailed specifications were finalized, and hands-on training of engineering personnel was undertaken in all the islands. The required construction materials include an estimated 6,500 metric tons of CGI sheets, 3,431 metric tons of mild steel tubes, and 1,136 metric tons of cement. Construction equipment has been mobilized, and the construction of shelters is in progress. The initial target date for completion of these shelters, 15 April 2005, could not be met.

RESCUE AND RELIEF IN THE A&N ISLANDS

The A&N islands are situated about 1,400 km southeast of mainland India. The total population, according to the 2001 census, is about 356,152. Of these people, 288,000 have been affected by the earthquake and tsunami. Of the 572 islands, the number of inhabited islands is 37 (24 in the Andaman Islands and 13 in the Nicobar Islands). Of these inhabited islands, 15 were severely affected (2 in the Andaman Islands and 13 in the Nicobar Islands); 6 were fully evacuated, while relief operations were conducted in 8 of them.

The A&N islands are spread over a great arc of about 726 km along the general north-south direction. Among these, the North, Middle, and South Andaman islands are

Figure 2. An AN32 Indian Air Force transport aircraft, which carried relief material to Great Nicobar Island, is being used to carry affected people back to Port Blair (photo: C. Murty).

the largest and are almost completely connected by land. However, Little Andaman Island and all the Nicobar Islands are dispersed in the Andaman Sea at considerable distances. The main mode of public transportation among the islands is ships run by the Department of Shipping Services, A&N Administration. Thus access among the islands is relatively slow. The air connectivity among the islands is only skeletal. There are only four airstrips (at Diglipur in North Andaman Island, Port Blair in South Andaman Island, Carnic in Car Nicobar Island, and Campbell Bay in Great Nicobar Island) where aircraft can land, with the airstrip at Port Blair being the largest. These airstrips run a limited number of transport aircraft (such as the AN32 and IL76) that are primarily meant for the needs of the A&N Administration and for the emergency needs of civilians (Figure 2). Furthermore, there are very few locations where helicopters can land. There was significant damage to and collapsing of jetties/dry docks/seaport buildings in many islands, as well as damage to eight ships and the sinking of smaller vessels.

The rescue, relief, and rehabilitation activities in the A&N islands were constrained by various difficulties: (a) the collapse of jetty structures in many of the inhabited islands, which prevented the docking of fast and large ships that could carry relief material; (b) the limited number of small ships and barges that could dock directly on the shores instead of on jetties; (c) damage to the airstrips, due to earthquake shaking, and the inability of the airstrip pavement to carry heavy wheel loads, which prevented the landing of large aircraft like the IL76; (d) limited NGO participation, due to difficulties in accessing the islands; and (e) limited availability of civil infrastructure, heavy engi-

neering equipment, and vehicles for mass transportation of people and material for relief, because of relatively light development in the islands. In some instances, coordination between the field and headquarters at Port Blair and lack of accurate information from the various islands added to the delay in providing relief to the islands. The difficult working conditions and the severely reduced transportation infrastructure in the islands called for a focused effort to provide relief to the affected people.

To ensure coordination between the civil and the defense services, on 1 January 2005 an Integrated Relief Command (IRC) consisting of representatives from military and civil authorities was formed for handling the crisis. The IRC was charged with the following responsibilities: (a) mounting an integrated relief and rehabilitation effort with a special focus on the Nicobar group of islands and the aboriginal tribes and (b) making projections to the Ministry of Home Affairs of the personnel and material required from various ministries and government departments. The relief operations were conducted in three phases:

- Phase I: reconnaissance and assessment of damage, search and rescue, evacuation, and provision of immediate relief in the form of food and water
- Phase II: set up relief camps—provide shelter, medicine, and electricity; restore communication, water supply, and electricity
- Phase III: build up logistics for sustenance and initiate actions for early return to normalcy

The lieutenant governor of the A&N islands was the chairman of the IRC, and the commander-in-chief of the A&N Command, General B. S. Thakur, was the vice chairman, operations head, and spokesperson of the IRC. Interestingly, the A&N Command was the first in India in which the concept of integrated defense service had been implemented—with the army, navy, and air force reporting to the same commander-in-chief. One can imagine that this must certainly have been helpful in the crisis. The armed forces themselves received a major blow due to the tsunami. The air force residences in Car Nicobar were on the coastline and suffered massive damage. More than 100 air force personnel (including their family members) lost their lives. Fortunately, the operations area and the airstrip at Car Nicobar were not affected, and the operations were not hampered in that respect.

Initially, the instructions to the defense officers were to hand over the relief material to the civil authorities in the islands and not to get involved in its distribution to the affected population. After the formation of the IRC and in view of complaints of uneven distribution of relief, the armed forces posted 2 officers and 20 soldiers in each island just to keep an eye on the distribution of relief material; these personnel were to act as the eyes and ears of the government. A number of knowledgeable people expressed concern about the rather slow decision making by the civil authorities in the A&N islands. In fact, the decisions may have been slow because the islands do not have their own elected state government and are directly under the central government in New Delhi. Hence, with no local political leadership to demand action, the civil authorities may have been cautious and conservative, for fear of later being blamed for wrong decisions.

A large number of flights (from Visakhapatnam, Bhubaneswar, Kolkata, Allahabad, Pune, Vadodara, and Chennai) were made by MI8, AN32, IL76, and IL78 aircraft, and a large number of ship voyages were made. On 26 December 2004 alone, there were eight air trips to the Nicobar Islands, in particular to Car Nicobar. However, since the population in the affected A&N islands was spread out within each island, it was not possible to deliver relief material to all people efficiently. Thus the approach adopted in the A&N islands was to evacuate people from the affected islands (in particular, Chowra, Trinket, Kondul, Pilomillow, Little Nicobar, Tillangchang, and Bompoka islands) and house them in relief camps in Port Blair. Thus aircraft and ships that carried relief material to the islands brought people back on the return trip.

HEALTH

On the morning of 27 December 2004, three doctors were sent from Port Blair to Car Nicobar by a defense aircraft, and by 9:00 P.M. that same day they re-established telemedicine links between Car Nicobar and Port Blair. Later, a number of doctors arrived at Port Blair from mainland India and were dispatched to the islands. Despite the fact that the health center facilities in the island suffered extensive damage, and about 14 paramedical personnel lost their lives, the morale of the health services appeared rather high. Of about 16 government doctors in the southern islands, three were traumatized by the event and were rested in the relief camps, while the other doctors continued to function. Similarly, of about 150 paramedics at Car Nicobar, only about 10% were in the relief camps for assistance; the other paramedics continued to discharge their responsibilities.

In the next phase, the Government of India deputed a group of 10 doctors to the A&N islands, but that number proved insufficient, so a larger contingent of medical professionals was sent. Most of the camps were in government-owned buildings. In most cases, the medical camps were housed in the same premises as the relief camps, for efficient medical attention (Figure 3). However, in some cases, the local residents refused to have medical facilities housed in buildings, as they feared that the buildings might collapse. In those cases, the medical camps were set up outdoors in makeshift tents (Figure 4).

The National Institute of Mental Health and Neuro-Sciences (NIMHANS) in Bangalore coordinated with other leading institutions in the country like the All India Institute of Medical Sciences (AIIMS) in New Delhi, the Post-Graduate Institute of Medical Education and Research (PGIMER) in Chandigarh, and the Central Institute of Psychiatry in Ranchi to form teams and attend to the psychosocial relief and rehabilitation work. These teams undertook outpatient services at the Port Blair relief camps. By 18 January 2005, about 1,850 severely disturbed disaster victims were given treatment.

The incidence of tuberculosis is high among the Onge tribe in Little Andaman Island. After the earthquake, to more readily seek support from the government infrastructure, this tribe moved closer to where the other A&N people were living. A need was felt to move the tribe away from the rest of the population, though, to prevent the spread of tuberculosis.

Figure 3. Medical support was incorporated into the relief camp in a Port Blair school building, for quicker and more efficient service (photo: H. Kaushik).

Epidemic Control

There was no report of any major epidemic. This was because three aspects related to epidemic control were addressed carefully in the relief work—health and hygiene, prevention and outbreak of vector-borne diseases, and vaccination.

The areas where the camps were set up were to be treated with bleach or disinfected. In the fortnight after the earthquake, this was not done in the A&N islands, due to a shortage of appropriate medical facilities and staff. To control malaria, DDT powder was sent in bags to the islands, but the spray pumps were not dispatched, because the local health centers were expected to have them. For instance, in Little Andaman Island, where the tsunami destroyed much of the built environment, the hospital building collapsed, and the DDT spraying pumps could not be recovered for a couple of days. Also, it was clear that drinking water must be safe and that good personal hygiene must be ensured. Hence, arrangements were made for trench latrines and proper disposal of human waste.

About 1.5 metric tons of malathion, 500 liters of fenthion and temephos, and 5,000 insecticide-treated bed nets were supplied to the A&N islands from Andhra Pradesh to prevent vector-borne diseases in the immediate aftermath of the earthquake. In areas affected by the earthquake and tsunami, the major concern was measles and vitamin A deficiency. However, the people in these areas were not routinely immunized for these diseases. Hence, there was a need for measles vaccination, vitamin A drops, and other immunizations. Some of the vaccine vials needed to be carried and stored in cold tem-

Figure 4. Temporary medical center in Kadamtala in Middle Andaman Island. This center was set up outside of and away from formally constructed buildings because the average person, fearing a possible earthquake, refused to go inside such buildings (photo: D. Rai).

peratures, but mobile iceboxes and cold storage facilities were not available. Also, the available medical staff was not adequate for administering these vaccinations. Only a few people could be vaccinated with the limited stock of vaccines available.

It is important to note that, although dead bodies do not spread disease, the government wanted to dispose of the bodies quickly. This was in part to improve morale, and in part because of that misconception about disease, and the government wanted to avoid any additional fears about epidemics. Some dead bodies that were severely decomposed were burned partially inside the premises of the buildings where they were found, and then a burial was conducted outside. In the A&N islands, kerosene was used to ignite the tsunami debris to burn dead bodies.

Law and Order

An important lesson learned during the post-earthquake rescue and relief effort was related to law and order. A number of agencies were pressed into service during the chaos after the earthquake, as is usually done after most natural and manmade disasters. These agencies include the CRPF, CISF, Indian Reserve Battalion (IRB) and Maharashtra Home Guard (MHG). These forces were extremely successful in restoring order. They participated in clearing debris, removing corpses, and distributing civil supplies in an orderly way. However, these efforts were also carried out by the local police.

By training, the police are not used to disposing of dead bodies. However, after the

tsunami, this was one of the tasks assigned to the police department. As a consequence, the police underwent significant trauma in conducting this duty. In some cases, their religious practices also constrained them. The identification of bodies was difficult under the circumstances, and only some of the bodies could be identified. In some instances, possible identification was written down for the official records. In some instances, photos were also taken for the records. Among the missing persons, only very few were found and recovered as corpses. The number of persons missing was large, particularly in the A&N islands. In the A&N islands, many of the officials and police were affected themselves in terms of losses in their own families, and some went away to calm the fears of their family members who were living in other areas. The officials who remained at their posts survived on rice and starch for over four days before the first round of relief supplies appeared in the islands.

RESCUE AND RELIEF IN TAMIL NADU

ADMINISTRATION

The government of Tamil Nadu rapidly provided relief to the affected people. While many saw this as a political move, the promptness of the government machinery on many fronts was rather exceptional. The Public Works Department cleared the rubble within five days of the event, even in difficult areas such as Nagapattinam and Kolachel, Melmannakudi. The chief minister of the state handpicked a senior bureaucrat as the officer on special duty to lead the government's post-tsunami effort. This officer made many quick decisions, even though some of them were not acceptable to the political leadership. Subsequently, since the volume of work involved was large, another relatively younger but experienced bureaucrat was brought from the state of Gujarat as another officer on special duty to help his senior officer to steer the government's efforts. The affected area in Tamil Nadu was divided into 11 zones, and 11 bureaucrats were chosen to head the relief effort in each of these zones. The bureaucrats chosen were ones who had a good record for delivering results and had experience in working with the state government's Department of Fisheries. Each of these zonal chiefs was supported by one officer from each of the concerned government departments (such as public works, health and sanitation, and fire). Also, one minister of the state government was assigned to each of these 11 zones, to provide support at the political level. Each zonal chief met with the zonal minister every day for the first few days; later, the chiefs' representatives met with the zonal minister while the chiefs attended to the issues in the field. The second officer on special duty subdivided the large coordination groups according to key items such as food and shelter. One coordinator was identified for each village.

An interesting highlight of the relief work was the formation of an NGO coordination center on 31 December 2004. It was formed because some affected areas were receiving more attention than others, and people from the less-affected areas protested. The Tamil Nadu government, however, did not have the wherewithal to handle this and needed help. So the state government sought help from the heads of three prominent NGOs that were experienced in disaster work, asking them to set up an NGO coordination center on the premises of the collector's office in Nagapattinam. These prominent NGOs—the South Indian Federation of Fishermen Societies (SIFFS) from Trivandrum,

Nav Nirmaan Abhiyaan from Bhuj, and ACCORD from Nilgiris—handled the NGO coordination center in rotation. The large number of volunteers working in these NGOs significantly helped in assessing needs, coordinating the solicitation of relief material (including specific items), and distributing the material. The other NGOs that participated in this center included well-established national and international NGOs, youth groups, and religious groups. Later, the NGO coordination center became a part of the mainstream relief work, because of the large quantity and type of relief material to be handled and the large number of NGOs participating in the relief work to be coordinated.

A large quantity of earth-moving equipment and joist crane booms (JCBs) was sent to Nagapattinam and Kanyakumari to remove obstacles and extricate dead bodies, and a helicopter was used to lift the dead bodies from Chinnavaikkal Island on the Cuddalore coast. Identification and disposal of dead bodies was given top priority. Almost 95% of the dead bodies were retrieved and disposed of either by cremation or burial. The number of deaths was well enumerated in the well-knit fishing community. However, in public places like the Velankanni Church, Nagapattinam Harbor, and Mandakadu pilgrim center, there were problems because visitors from across the country had been at these locations and were among the dead. The 11 zonal chiefs had magisterial powers and declared the missing persons dead after seven days, although this was not placed on record. Thus the number of missing persons was very small in Tamil Nadu, in contrast to the large number of missing persons in the A&N islands.

SPECIAL SITUATIONS LEADING TO HIGH CASUALTIES

The affected western coast of India in Kolachal (in the Kanyakumari district of Tamil Nadu) and Allapad (in the Kollam district of Kerala) has a peculiarity—there are shallow transportation canals between the coastal land area where fishermen live and the mainland inward from the coast. When the tsunami wave came in, women and children fled from the coast, but since the tsunami filled the entire land with water, it was not clear which part was treadable land and which was the canal. Kolachal and Allapad sustained high casualties because of this topography. After the wave receded, a number of bodies of women and children were recovered from these shallow canals.

The area adjoining Nagapattinam has relatively flat topography. It is also the mouth of the Cauvery River, implying that there a number of waterways that discharge the river's water into the Bay of Bengal. There is thus little high ground in the area for people to escape to. This topography is also considered the prime cause of the huge loss of life in the Nagapattinam area.

RELIEF

The chief minister of Tamil Nadu announced a compensation of Rs. 100,000 (US $2,200) to the family of every deceased person. The government also announced a relief package including items of general utility, temporary shelter, and permanent housing for affected families who lost their houses. The government distributed free notebooks, textbooks, and two sets of uniforms to children studying in government and government-

aided schools. The government also announced the opening of orphanages for children who had lost their parents. Adoptions were allowed, but under strict supervision.

The relief package was announced and distributed rapidly by the government. The relief material was maintained in makeshift storage spaces in the affected districts, to coordinate with the NGOs in facilitating the redistribution of relief material, and the task of receipt and distribution was handled by the government teams. Some instances of pilferage from the storage areas were reported. In view of this difficulty, some donor organizations successfully distributed food supplies without storing them.

When the distribution scaled up as the needs increased, the government invited NGOs to help in the management of the storage areas; the NGOs took over, maintained the storage spaces, and developed an inventory management system. Still, the relief was distributed by government teams. Volunteers from the NGOs involved in distribution came back with valuable information about the relief needs in the field. Sometimes, material did not reach the intended location because the back-end system was not available to guide the relief material to the destination. This also caused frustration for the volunteers involved. The government could have attempted the distribution of relief by NGO teams, with a government representative on each team.

An important point that emerged regarding relief was the fact that old clothes were typically not acceptable, particularly because the affected were mostly fishermen, a reasonably well-to-do community. There were problems in disposing of the old clothes that had been received from across the country. The government gave away the material to groups of people who make quilts for a living.

TEMPORARY SHELTERS

A race against time started when the chief minister of Tamil Nadu made a promise that everyone affected would have a temporary shelter by the prominent festival, Pongal, that was just 19 days away from the day the tsunami struck. Before making this promise, the government had neither a policy for how temporary shelters would be assigned to the affected persons nor the designs, material, or infrastructure for constructing them. This deadline also resulted in full powers being given to the 11 zonal chiefs. In Kanyakumari, the schools were initially used to house affected people, and this was not a concern because the schools close anyway for a fortnight that includes the Christmas and Pongal (14 January) festivals. But since schools traditionally open immediately after the Pongal festival, there was pressure to vacate the school buildings for the resumption of classes after the break. As the festival date came near, the daily wage laborers employed in the construction did not come to work, and the temporary shelters were ready only by 25 January 2005.

There was wide variation in the type of shelters. Some builders chose to make long sheds in the early efforts, and only a limited number of them were made as individual houses. But later this received significant criticism from the users, and then individual houses were made. According to the early estimates, about 35,000 shelters were required in Tamil Nadu, but as of mid-2005 only about 11,000 were built. When large sheds were made for people to occupy without adequate privacy, there was hesitation among the in-

tended users, and they did not occupy the shelters. In Tarangambadi village, there were 900 families, but only 550 shelters were built because the rest of the families' houses were intact. But there was a claim that, in many old houses, people were living as joint families and would now like to live as individual families, and they now needed 1,200 shelters.

The following broad observations are based on a survey of some of the temporary shelters along the East Coast Road from Madras to Nagapattinam:

- Location: in Tarangambadi, the temporary shelters built were about 350 m from the coast—instead of the minimum 500 m from the coast, as had been specified by the coastal regulation zone (CRZ) requirement. This was a relaxation of the rules by the government.
- Land level: the land identified for the temporary shelters was usually a low-lying area. Also, the floor level of the temporary shelters was same as the outside ground level, except in the shelters constructed in front of the collector's office in Nagapattinam, where at least about 0.15 m of elevation was provided for the floor level (Figure 5). Two problems arise from this: during rains, water is likely to enter the shelters; and the kitchen water, which is an everyday menace, is also likely to enter the shelters.
- Safety of the roof during high winds and fire: the light roofing adopted in most shelters is simply nailed from the top side alone. In the event of high winds, the roof can be ripped off. The nails could have been replaced with nuts and bolts. Some of the shelters made by the NGOs had a thatch roof. Even though this type of roof is common, the government objected to the use of thatch. The government's objection was said to be because, just five months before the tsunami, a major fire tragedy took place in the town of Kumbakonam in Tamil Nadu, and the fire was attributed to the use of thatch roofing.
- Kitchen space: the kitchen is expected to be outside the shelters. However, the space left between two rows of sheds of the temporary shelters was often small, about 1.8–2.4 m. This may imply that the walkway between the rows of sheds will be clogged during the cooking hours.
- Ventilation: the sheds of the row housing (particularly the gable-type sheds) do not have adequate ventilation. In some sheds, the last two units have ventilation because the gable end is left open. In some cases, the space above the lintel and the eave level of the sloped roof is kept open on the front side of the sheds. But since the roof is higher on the back side, the hot air does not escape.
- Garbage disposal: a garbage collection system was absent in most places where temporary shelters were made.
- Use of toilets: the toilets built along with the temporary shelters were of the flush type with a septic tank. But due to lack of training in the use of such toilets, the toilets were not being flushed after use, and this deterred their further use. Many people preferred to relieve themselves in the open. This will remain a concern even when permanent shelters are made.

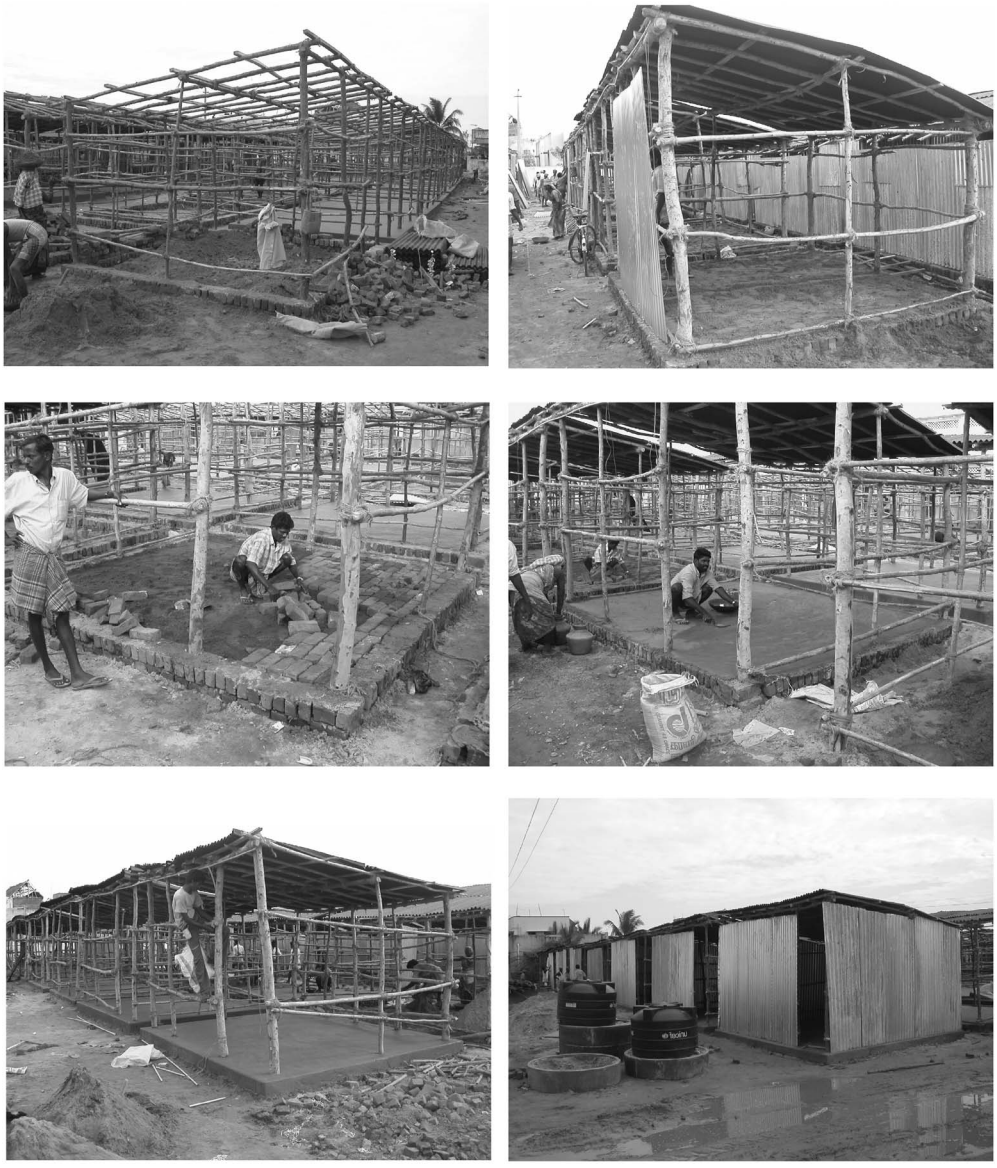


Figure 5. Government-built temporary shelters near the district collector's office in Nagapattinam demonstrated the rigor of formal construction. Such formalism was absent in other temporary shelters built by the government and by other agencies (photo: C. Murty).

- Shelters across the highway: some temporary shelters were built too close to the East Coast Highway (the main national highway traveled by high-speed vehicles). Sometimes, the shelters were built on the west side of this north-south highway (Figure 6). This can be dangerous, because fishermen do not have a safe way of crossing the highway to reach its east side (i.e., the shore side across the road, where they do most of their work).
- Construction material: a number of temporary shelters were built of flat asbestos sheets and corrugated jute-bitumen sheets (Figure 7). The former is known to be a health hazard, and the latter renders the units very hot in the typical tropical weather conditions of Tamil Nadu. There is a need to specify beforehand the acceptable and unacceptable materials for postdisaster construction.

MEDIA AND INTERNET TECHNOLOGIES

The disaster caused by the tsunami along the coastline of Tamil Nadu was varied. The public perception of the disaster was based primarily on the images shown on TV. TV played an important role in communicating the level of disaster not only to the public, but also to the government. It was mentioned that the uplinking facility was better at Nagapattinam than at Kanyakumari, which may have led to more focus on Nagapattinam initially.

The Internet also proved to be an effective communication tool. SIFFS maintained a web site (www.tsunami2004-india.org) and posted the emergency requirements as the needs arose. This was a very successful strategy for enabling donors from around the world to get valuable information. Also, SIFFS coordinated and developed an NGO database system. Such a system became very useful in Nagapattinam because the number of NGOs participating in the relief work was large (as many as 430), which required the registration of NGOs in different sectors of relief work—unlike other areas, where fewer NGOs participated.

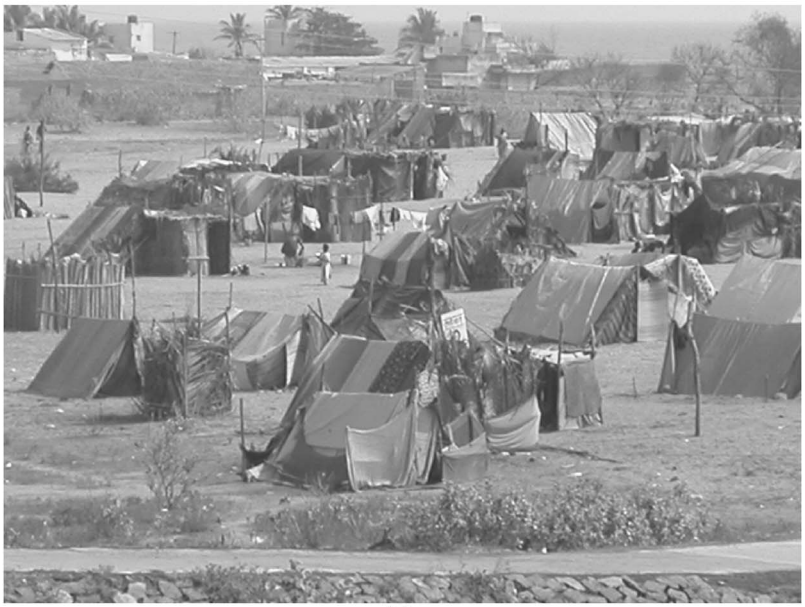
ROLE OF CIVIL SOCIETIES

A number of civil societies made donations in cash and in kind, and they put in volunteer time. The NGO coordination center at Nagapattinam played the role of a buffer between the government and the civil societies.

KANYAKUMARI VERSUS NAGAPATTINAM

In the Kanyakumari district, Christians are in the majority. In the early days, the government response was weak, but the church communities played a critical role. The parish took control, and the immediate relief was offered by the local Christian community—they started camps, operated kitchens, and coordinated relief material. Kanyakumari is a relatively well-developed district, with a good number of marriage halls and churches that could house people as well as provide sanitation facilities for them. Initially, about 90 camps were started, but this total was later reduced to 60 camps—about 45 run by the diocese and 15 by SIFFS. The church community in Kanyakumari district had a good amount of infrastructure that was essential in managing

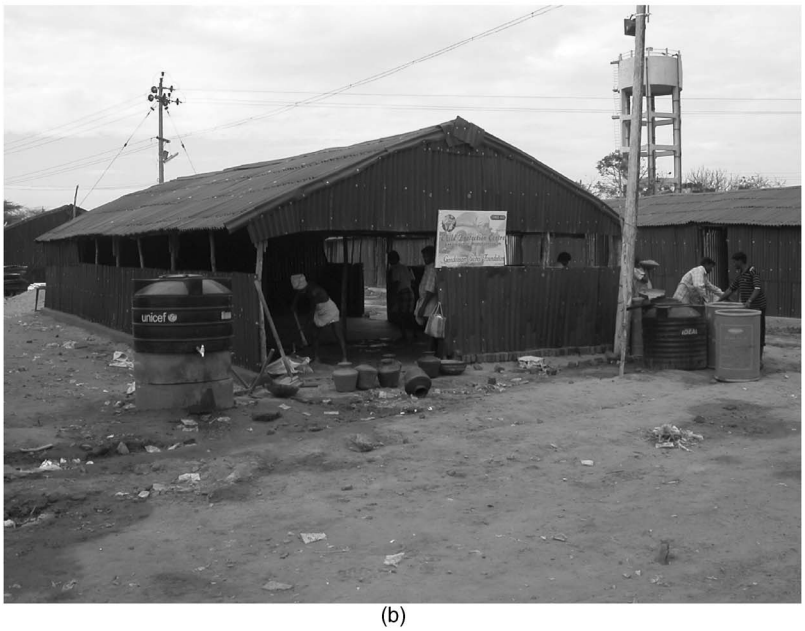
(a)



(b)

Figure 6. Temporary shelters south of Madras City along the East Coast Highway, which runs parallel to the coast. (a) Housing units of jute-bitumen corrugated sheets constructed on the wrong side of the highway remained unoccupied, because of the hazard of crossing the road while coming from and going to the coast. (b) Fisherman pegged their own informal tents to live on the other side of the highway, which was on the same side as the ocean (photos: C. Murty).

(a)



(b)

Figure 7. Temporary shelters in Nagapattinam town: (a) asbestos sheet units were donated by the Confederation of Indian Industries, and (b) jute-bitumen sheet units were donated by an NGO (photos: C. Murty).

camps. For example, the members of this community had megaphones for announcements during their usual church activities. These came in handy for organizing large groups of tsunami-affected people.

In the Kanyakumari district, many former fishermen, who now lived in cities, helped by providing immediate support to the fishing community, which was the most affected. Elsewhere, such a strong relation did not exist between the people inland and the fishermen. Two weeks after the tsunami, a new district collector was posted at Kanyakumari, and, as the government response improved, the churches withdrew from relief work.

MEDICAL SYSTEM

No major outbreak of any epidemic was reported from any of the affected areas. There were bottlenecks, though. First, the paramedic support was very weak. In the town of Velankanni, there were a couple of suicides by men, who were away fishing at the time of the tsunami and realized upon their return that they had lost their families. Trauma patients were handled by the paramedics, who did not have enough experience in treating mental conditions. As a consequence, the patients also did not take seriously the medical help that was administered. Second, prescription medicine was being dumped at camp sites. Furthermore, in the early aftermath, a number of quack doctors were giving intravenous injections. A separate coordination cell at the district collector's office in Nagapattinam was set up for coordinating medicine. Third, the lack of adequate exposure to the Kanyakumari district also meant less medical help for the region. In this district, a large number of the affected people sustained spinal cord injuries.

INSTITUTIONALIZING THE CONCEPT OF THE RESOURCE CENTER

Usually, in the aftermath of disasters in India, when assistance pours in, various state governments jump in and adopt individual villages. The government sends a donor to a village to attend to the needs of that village. The donor in turn is free to bring its own facilitators and technical support. This model is driven by the fact that governments are more comfortable in dealing with the corporate world. The NGO coordination center at Nagapattinam was based on just the opposite concept—the government finds the facilitator first, who in turn coordinates with the various groups (donors and technical personnel) and provides for the needs of the villages. The latter is arguably the better model, as was convincingly demonstrated by the smooth functioning of the NGO coordination center.

That center has successfully demonstrated the concept and structure of a resource center. Disaster mitigation efforts involve a number of specialties, and NGOs with backgrounds in these specialties are required to successfully complete the postdisaster management effort. For instance, the removal of dead bodies is an activity that is not performed by many NGOs; it is often conducted by the Rashtriya Swayamsevak Sangh (RSS) and Muslim youth groups. SIFFS specializes in matters pertaining to fishermen; hence, for the tsunami disaster, it was appropriate to have SIFFS as one of the NGOs offering coordination and thereby leadership to the resource center.

In general, the government attended meetings organized by the NGO coordination

center and answered questions. But the government officers did not ask the NGO coordination center what the center required. In the future, it may be worthwhile to institutionalize the NGO coordination centers with the recognition of the government. This will raise trust among the various stakeholders in the process of disaster management. At each NGO coordination center, the NGOs of the region could be given the mandate to organize themselves and coordinate disaster relief work. During times when there is no emergency, the center could prepare checklists of critical items and issues to be addressed in the aftermath of different disasters, and it could develop linkages and coordination with the civil societies. The center could be pressed into service in the immediate aftermath of a disaster.

Just as a good example was seen during the reconstruction after the 2001 Bhuj earthquake, there was another good example during the relief phase after the 2004 event. In 2001, the government of Gujarat put in place a village-level system with the help of proactive NGOs in the region. This system was called SETU—a bridge between the people (beneficiaries) and the government (the facilitator) in undertaking effective reconstruction and rehabilitation for the people affected in the 2001 Bhuj earthquake (Murty et al. 2005). It consisted of an NGO setup that was a slow negotiator of change between the people and the government. That system was effective and ideally suited for slow negotiations. But after the 2004 tsunami, a two-way link mechanism was required for undertaking relief work on a fast track and for doing so at the regional level, because the time available for response was shorter and there were many players—government officers, affected people, donors, NGOs, civil societies, and the corporate sector. Hence, the NGO coordination center was put in place. It acted as a guard-cum-volunteer, scouting for shortfalls in meeting the needs of the affected people and matching their needs with the wishes of donors.

SOCIAL RECOVERY

Fishermen and their dependents were the hardest hit due to the lack of warning, lack of buyers for the fish, loss of boats, and loss of huts. Dead fish were seen floating the next day at Visakhapatnam, in the port and fishing harbor. The business of fishermen was constrained by the damage to fishing nets and other fishing-related equipment. The affected coast of India has two fishing communities: the Pattinavars along the Bay of Bengal and the Mukkuvas along the Kanyakumari area, and fishing is the only livelihood of these communities. Thus they cannot easily abandon fishing. This is in contrast to the Indonesian fishermen, who have a parallel profession in agriculture. The loss of family and property caused trauma to the fishermen, and they did not resume fishing. Their livelihood was severely affected. The immediate need for food was fulfilled by the government's relief package. But the loss of the fishing equipment was a bottleneck. In cases where the equipment was in order, the families were concerned about other issues, and this prevented the fishermen from going back to the high seas. In general, the number of damaged boats was smaller than the number of damaged nets. This was because typically a fishing net needs to remain wet in the water, but after the tsunami the nets were washed ashore and remained dry for days. They became brittle and were rendered useless (Figure 8).

The government of Tamil Nadu gave livelihood restoration compensation to the fishermen. The initially announced compensation package, totaling Rs. 20 crores (US $4.4 million), included the following provisions:

- Replacement of 10,000 gill nets for motorized boats at Rs. 20,000 (US $440) per unit
- Replacement of 20,000 gill nets for wooden boats at Rs. 10,000 (US $220) per unit
- Repair/rebuilding of 10,000 motorized boats at Rs. 15,000 (US $330) per unit
- Repair/rebuilding of 20,000 wooden boats at Rs. 5,000 (US $110) per unit

However, the compensation was later enhanced and eventually totaled over Rs. 450 crores (US $10 million). But there was one problem. The government had stopped the registration of fishermen about five years earlier, and of course there had been an increase in the number of fishermen since then. Thus the official list of people who were to receive compensation was not acceptable. Furthermore, in Tamil Nadu there is a shortage of people who can repair boats. Some of the needed repair people came from Kerala to help, because there was less repair work for them to do in Kerala and Andhra Pradesh (Figure 9). But even they did not stay for long.

Concerns of Fishermen from Kancheepuram District in Tamil Nadu

The Kancheepuram district, which is north of the most-affected area along the eastern coast, was moderately affected by the tsunami. Fishermen from this district were concerned about a number of issues:

- The fishermen would like to keep a shorefront house, even if the government gives them land on high ground, because they need such a house for cleaning and preparing the fish and storing and clearing the net. They want the shorefront house to remain their personal property and not become public property, because women need a personal room/house to rest in the afternoon on the shorefront. In addition, they believe that the net alone will occupy the whole house.
- The government decided to give one new boat to every group of three fishermen, but the fishermen must be registered. However, the registration of fishermen was discontinued about five years before the earthquake. The contradictory conditions of not registering new fishermen and paying compensation only to the older, registered ones seems to have caused discord.
- The government completed the assessment of fully damaged and partially damaged boats and provided uniform compensation across the whole affected area. Also, NGOs with a good track record and integrity were expected to come in, assess the actual situation, and provide information to the government about any inconsistencies. But it was found that the amount of compensation paid to the fishermen was less than the amount that was said to have been paid to them.

Figure 8. Fishermen displaying gill nets and trawler nets that had been left to dry in the open sun for days; these nets became ineffective for further use.

Figure 9. Repairmen from Kerala working in the Nagapattinam area to fix fiberglass boats for redeployment.

RESCUE AND RELIEF IN KERALA

The search and rescue operations were carried out in the Allapad and Arattupuzha areas with the help of the Indian Navy. Immediately after the disaster, about 100 relief camps housed over 100,000 people. By 19 January 2005, the number of relief camps was reduced to 23, housing 26,247 people. All the expenses related to the treatment and lodging of those admitted to the hospitals were borne by the state government. The government response in Kerala appeared to be sluggish. There seemed to be resentment among the local residents about what they perceived as inadequate response. For example, at Karunagapally in the Kollam district, some people lost their household items and had no food supplies from daybreak until 4:00 P.M. on the day of the reconnaissance, which was more than a week after the tsunami. However, in general, the people of Kerala appeared to be far more enterprising and capable of taking care of their own situation and did not appear to expect much government support. The number of fatalities was low (about 180 people), in contrast to the high level of damage.

The government of Kerala did not announce relief packages until five days after the event. The compensation package included Rs. 100,000 (US $2,200) to the family of a deceased adult, Rs. 50,000 (US $1,100) to the family of a deceased minor, Rs. 25,000 (US $550) to a person handicapped with loss of limbs, Rs. 50,000 (US $1,100) to a person sustaining major injuries, and Rs. 5,000 (US $110) to a person with other injuries. As a relief measure, 5 kg of rice was given per week to each family. In the Vernacular district, a grant of Rs. 7,500 (US $165) was given to each family for temporary housing, while in the Kollam district people were given the option of (a) accepting Rs. 5,000 (US $110) as a grant for temporary shelter or (b) living in a government-built temporary shelter and, if they so desired, their houses would be reconstructed at the former location within three months of handing over land—subject to its not being west of the road, in conformance with CRZ requirements. In case of delay, the family would be provided compensation of Rs. 1,000 (US $22) per month. In the Allapuzha district, people were not given the option of a cash dole for temporary shelter, because the temporary shelters were built by the government. The government also provided boats, nets, and other equipment to fishermen who had lost these resources in the tsunami.

The government also undertook to improve the public infrastructure, such as repairing and dredging the Neendkara fishing harbor, reforestation in tsunami-affected areas, repair of the power supply systems in the coastal area, repair and reconstruction of the dwellings damaged by the tsunami, and construction of new houses for those who had lost their houses. Permanent housing was the biggest concern for the government. In the Ernakulam district, type-design housing (that is, houses of a generic design constructed identically everywhere, irrespective of the local conditions) at a unit cost of Rs. 175,000 (US $2,750) was planned, while in other districts housing at a unit cost of Rs. 150,000–250,000 (US $3,300–5,500) was planned. The cost difference was stated to be due to conformance of the latter housing with "tsunami safety features." It is not clear why some houses would have better integrity than others. Three options were available for permanent housing: (a) private housing built by NGOs; (b) housing built by an NGO-government partnership, wherein the government would contribute Rs. 50,000 (US

$1,100) and the houses would conform to type-design; and (c) government-built type-design housing. It is not clear what procedures would be put in place to check the design and ensure the quality of construction. In general, due to the relatively low number of fatalities in the state, tsunami rehabilitation and reconstruction did not appear to be a priority concern, despite thousands of people having lost their homes.

The response in Kerala was primarily government-driven, and NGO participation was minimal. The state government was formed on the basis of a coalition of parties, and its decision making was sluggish. Even though the area affected stretched only over a small length of the coast, there were difficulties in coordination among the government departments. Despite this weakness, the district collector of the Kollam district continued to champion the relief effort. Also, there was inadequate consultation with the affected population on matters related to relief packages, and this led to dissatisfaction among the affected people.

RESCUE AND RELIEF IN PONDICHERRY

The UT of Pondicherry appeared to be efficient in its rescue and relief. Because it is a UT, there was little political intervention, and the relief operations were being administered by an efficient district collector. The affected area was small, namely in the neighborhoods of Karaikal and Pondicherry. The mechanism of providing relief and supplies to the affected people was handled by the district administration, which led to a rapid, well-managed distribution of relief.

The Government of India gave Rs. 10,000 (US $220) to each family in cash for building temporary shelters. For the reconstruction work, the government laid down a framework for NGO-government coordination. The NGOs desiring to build housing were required to undertake an integrated village development—that is, to provide community facilities along with housing. The land on which the houses would be built would remain government land, but unalienable rights would be given jointly to the husband and wife of the affected families. Also, in the construction of the houses, the NGOs were required to conform to the technical specifications laid down by the government—that is, the houses had to be both earthquake-resistant and cyclone-resistant. Government-provided housing was required to be type-design housing. The government would have a quality control supervision system in place, essentially through the Public Works Department of the UT. In some places (e.g., Ganapthi Chettikulam), the owners had already started building houses on the existing plinth within a week of the tsunami.

RESCUE AND RELIEF IN ANDHRA PRADESH

Andhra Pradesh has about 500 villages within 5 km of the coastline, with a population of 1,163,000. Andhra Pradesh was affected on a very moderate scale, as compared with Tamil Nadu. Along a coastline of 1,030 km, a total of 301 villages were affected in 9 coastal districts: Srikakulam, Vizianagaram, Visakhapatnam, East Godavari, West Godavari, Krishna, Guntur, Prakasam, and Nellore. The death toll in Andhra Pradesh was 106, with 4 people missing. Also, 1,254 houses collapsed or were heavily damaged, and 303 were partly damaged. The cattle loss was 86 head. The ingress of seawater damaged

249 hectares of fish tanks and 1,316 hectares of salt fields. Fishermen lost 1,362 fishing craft, and 10,683 craft were damaged when they were swept inland by tsunami waves. In addition, 38,361 fish nets/tackle units were lost. A total of 153 drinking water sources were identified as being contaminated by the tsunami.

There were 67 relief camps housing 54,264 people who had been evacuated from various places. All camps in Andhra Pradesh were closed officially on 5 February 2005. There was damage to 210 km of roads, with the total loss estimated at Rs. 75.27 crores (US $16.7 million). The government of Andhra Pradesh provided compensation to fishermen in the form of 7,207 metric tons of rice and Rs. 1.44 crores (US $320,000) in cash. The Rajiv Gandhi rehabilitation package announced by the government covered many aspects: general relief of Rs. 19.53 crores (US $4.3 million), fishing relief of Rs. 34.16 crores (US $7.6 million), housing relief of Rs. 2.3 crores (US $511,000), water supply relief of Rs. 3.0 crores (US $666,000), and 10,000 metric tons of rice.

CLOSING COMMENTS

In recognition that the 26 December 2004 earthquake followed by the tsunami was an unprecedented event, a number of valuable lessons were learned:

- Distribution of relief materials was a difficult task. In areas severely affected, distribution was smooth where relief supplies were adequate; where there was a shortage of supplies, the affected people were in a frenzy to obtain their share. Such frenzy was also noticed even when there was only a perceived shortage. Thus one of the critical tasks to be undertaken by local governments consists of clarifying to the public that there is enough material for all.
- Since compensation is paid by the government for rebuilding, the damage assessment of the buildings and structures is a controversial exercise. There is a need to undertake comprehensive training of government engineers working in moderate and severe seismic areas not only in designing and constructing new structures, but also in assessing damage sustained by existing structures.
- The novel concept of the NGO coordination center proved successful. Before disasters occur, NGO coordination centers can help communities plan for postdisaster scenarios and can develop linkages among NGOs and private unregistered groups of people (such as groups with religious affiliations, or groups belonging to different housing communities across the country) coming together in the aftermath of a calamity for improved performance in the event of emergencies. This concept must be taken forward through detailed studies.
- This was the first time a major disaster occurred in which several Indian states were involved together. There was substantial variation in the responses of these states' governments. The central government's role was critical, and the Indian Navy's contribution in the relief work was substantial. In-depth research and analysis could indicate important lessons for the future.
- Vulnerability maps need to be made available to residents as part of an education process about living in seismic areas and in areas that can be affected by tsunamis.

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