

1 Introduction

Andaman and Nicobar Islands, comprising 572 islands, islets, and rocks, is situated between 6° and 14° north latitude and 92° and 94° east longitude in the Bay of Bengal. It has a total area of 8,249 km² of which approximately 87 percent or 7,171 km² is under forest cover, and 38 of the islands are inhabited with a total population of 356,265 as of the 2001 census.

The Andaman and Nicobar Islands are a Union Territory (UT) of India. The whole territory is divided into two districts, Andamans and Nicobars. Port Blair, the territory's capital and the only urban area in the territory, has a municipal council.

This territory is home to six primitive tribes: Andamanese, Onge, Jarawas, Sentinelese, Nicobarese, and Shompen. The total population of these tribes, excluding Jarawas and Sentinelese, as of 1991 census is 26,770. Jarawas and Sentinelese could not be counted in the 1991 census as they maintain their independence and refuse most attempts at contact. An autonomous body called Andaman Adim Janjati Vikas Samiti (AAJVS), with the Lt. Governor serving as its chairman, looks after the welfare of the primitive tribes. A separate Tribal Sub-Plan, which comprises flow of funds from UT plan and Special Central Assistance from the government of India is being implemented for the welfare and development of the tribes.

During the earthquake, more than 2,000 people were confirmed dead, more than 4,000 children were orphaned or left with one parent, and at least 40,000 lost their homes and were moved to relief camps (Figure 1.1).



Fig. 1.1. More than 1,000 people were airlifted from Car Nicobar to a Relief Camp in Port Blair, South Andaman Island.

Because of a strong oral tradition, the tribal people knew to move inland and seek higher ground to avoid injury from the tsunami. However, they are less likely to survive the rescue, as their culture is sensitive to deterioration through contact with civilization.

People living on the Andaman and Nicobar Islands had little time between the earthquake and the accompanying tsunami. The islands that were closest to the epicenter were almost instantly inundated. The Indian Air Force (IAF) base in Car Nicobar was leveled. Buildings damaged by ground shaking were washed away by the waves, including the residential officer quarters. Many officers as well as teachers at the school for government employees were among the victims. The side of the islands facing the epicenter was the most vulnerable. The Nicobarese villages of Malacca and Kakana on the southeastern side of the island suffered heavy casualties, while on the northwestern side, people in the villages of Sawai, Arong, and Tea Top moved deeper into the forests and formed new settlements. Sandbands connecting islands such as Katchal and Pillow Millow gave way, and two smaller islands appeared in place of the one. Tiny Trinket, with a population of 222, was entirely flooded, and the survivors had to be evacuated.

The Indian defense services reacted quickly to the disaster. The Coast Guard conducted search-and-rescue operations, and the Navy sent its biggest ships to the farthest islands in the Nicobar group following the first reports of casualties. The Air Force sent its transport planes for restoration work, and the Army took charge of rebuilding infrastructure and restoring communications. The seriously injured were taken to Port Blair by aircraft.

The distance between the mainland and the hostile terrain hampered relief work, and damage to the jetties meant that ships could not approach the affected islands. Small boats were used to ferry relief materials. The shortened airstrips in Port Blair and Car Nicobar added to the difficulties. In the first few days, food, clothes, and medicines piled up in Port Blair because the authorities could not deliver them to the affected islands. A delivery mechanism was eventually established, and the islanders were organized to handle the relief supplies. However, with the tsunami taking its toll on the civil administration and given the demands on the relief front, rehabilitation took a back seat.

Eventually, an Integrated Relief Center (IRC) was organized to speed up relief and rehabilitation. The situation demanded close coordination between the civil administration and the Unified Command of the Armed Forces. Accordingly, Lieutenant Governor Ram Kapse served as IRC chairman and commander-in-chief, Andaman and Nicobar Unified Command. B.S. Thakur served as vice-chairman, operational head and spokesperson. In addition, an Integrated Logistics Committee was formed to coordinate the relief efforts of the Defense, Civil Aviation and Shipping Ministries in Andaman and Nicobar.

Many of the native people inhabiting the Andaman Islands escaped injury. The Great Andamanese on Strait Island, who have made peace with the mainlanders, were found to be safe, as were the Onges in Little Andaman, to whom the Coast Guard airdropped relief materials. Although the Jarawas are hostile, they do approach the mainlanders when they are starving or sick. The authorities have heard no reports of casualties, and through contact with some of the Jarawas, it is presumed that they are safe. Moreover, because they live in the jungle, the Jarawas would have been well protected from the tsunami. Only the Sentinalese, who shoot arrows at outsiders, are totally cut off, but the Coast Guard spotted them during an aerial survey. The Nicobarese, who form the largest tribe in the Union Territory, suffered the most from this disaster. The majority are agricultural laborers whose crops may have been destroyed along with their homes. It will take the survivors a long time to rebuild their lives. Another group that was especially vulnerable to the earthquake and tsunami were the 4,500 disabled people on the islands, who had trouble escaping falling structures and incoming waves.

The people on the islands soon became immersed in rescue activities. A Coast Guard pilot, R. Makwana, carried letters to the relatives of people stranded on Hut Bay. A homeopathic doctor established a video satellite link with Port Blair to obtain medical treatment for the affected people in Car Nicobar. Air Force pilots who had survived the tsunami immediately helped with rescue operations.

Despite the availability of resources and manpower, the mounting pressure on the relief centers and makeshift settlements required all the attention of the authorities, slowing the progress in rebuilding.

Because the Andaman Islands economy is largely based on tourism, the disaster holds long-term consequences. The many aftershocks as well as the fear of tsunamis have kept tourists away. The profile of several islands has also changed. Some beaches have disappeared, leaving no land between the forests and the sea, thus leaving no room for human habitation.

The Nicobar Islands were closed to tourists because of the fragility of the ecosystem and native people and because of the many military bases established there. However, these islands were the

most damaged by the earthquake and tsunami and may take the longest to recover.

The 572 islands are connected primarily via Port Blair, the major port and city in the territory, located on South Andaman Island. Inter-island travel is almost solely via boat, and each major island has its own port, with one or more piers. Of the 49 piers on the islands, 14 were considered unfit for use immediately following the earthquake/tsunami, and 15 were partially damaged. At the time of our visit about six weeks after the event, the port officials stated that they were back to 75 percent of normal operations. A unique problem with the ports is the change in water level, with more than 1 m at Port Blair, and 1 m to 2 m less water on the west side of the islands. In some areas, the piers are out of the water and essentially useless.

1.1 Investigation Team

Within two weeks of the M_w 9.3 North Sumatra earthquake of 2004, the Earthquake Investigation Committee of the Technical Council on Lifeline Earthquake Engineering (TCLEE), a technical council of the American Society of Civil Engineers (ASCE), organized an investigation team of members of TCLEE, the Coastal, Ocean, Ports and Rivers Institute (COPRI), and the Institute of Civil Engineers (IEC) to perform a reconnaissance of the lifelines in areas affected by the earthquake or tsunami. The investigation team started its reconnaissance on February 1, 2005. Most members departed the United States, UK, or Canada on January 30 or 31, and returned on February 5 or 6. The investigation team consisted of the following persons:

Alex Tang, P.E., C.Eng., TCLEE/ASCE, Toronto, Canada (Team Leader, January 30 through February 6)

David Ames, P.E., COPRI/ASCE, New Jersey (January 31 through Feb 6)

Ganapathy Muruges, CalTrans, Sacramento, California (January 28 through March 17)

Graham Plant, C.Eng., ICE, UK (January 30 through February 6)

John McLaughlin, P.E., Department of Transportation (DOT), Michigan (January 30 through February 7)

Mark Yashinsky, P.E., CalTrans, Sacramento, California (January 30 through February 6)

Martin Eskijian, P.E., COPRI/ASCE, Los Angeles, California (January 31 through February 6)

Rao Surrampalli, Ph.D., P.E., Environmental Protection Agency (EPA), Kansas City, (February 1—6)

P.A.K. Murthy, C.Eng., ICE local support

In addition, there was a local support team:

M. Prasad, Ph.D., P.E., Indian Institute of Technology (IIT), Chennai, Tamil Nadu

Prathibha Gandhi, P.E., IIT, Chennai, Tamil Nadu

M. Ganapathy, P.E., Tamil Nadu Public Works Department (retired)

The members of this investigation team also contributing authors and reviewers of this report.