

Impact of the 2004 Tsunami in Aceh, Indonesia: A Case Study

a. Introduction:

On December 26, 2004 at 8am, an earthquake of 9.1 magnitude resulted in a tsunami that rocked the fate of several countries off the coast of the Indian Ocean resulting in over 200,000 deaths and 2 million people homeless. This catastrophic event, later dubbed the Boxing Day Tsunami, would go down as one of the deadliest disasters in modern day history and pave the way for heightened global prioritization of disaster preparedness and risk reduction.

b. Facts of the Case:

The Sumatra-Andaman earthquake of 9.1-9.3 magnitude occurred due to a rupture in the 900-mile stretch of fault line between the Burmese and Indian tectonic plates. This earthquake was considered a megathrust quake as it was caused by a heavy ocean plate slipping under a lighter continental plate. The waves, traveling at 500 mph, severely impacted 14 countries surrounding the Indian Ocean. Those affected the most included Indonesia, Sri Lanka, India, Thailand, and Myanmar⁴.

Banda Aceh, in Indonesia, lies within the Pacific Ring of Fire and was identified as the epicenter of the earthquake. This city was hit within 20-30min of the initiation of the earthquake and reported the greatest number of fatalities with 108,100 killed, 127,700 missing/presumed dead, and 426,800 displaced.

An hour and a half later, southern Thailand was hit resulting in a death toll of 5,400. The tsunami then reached the coast of Sri Lanka and Chennai, India within two hours, resulting in the death of 30,000 and 16,000 people, respectively. About 8 hours after the earthquake struck, the tsunami reached the east coast of Africa increasing the number of fatalities by 300 people.

The impact to infrastructure resulted in a required total budget of \$9.4 billion USD to rebuild. The Boxing Day Tsunami not only destroyed homes, buildings, and roads but also brought to ruins the livelihoods of individuals who relied on the fishing and tourism industries within these countries.

c. Epidemiological aspects of the event:

To understand the epidemiological impact of the tsunami at the epicenter i.e. the cities of Aceh and North Sumatra, Frankenberg et. al conducted a prospective cohort study over the span of 5 years from 2004-2009 accounting for sex, age, SES, and proximity to the coast². A 2004 National Socioeconomic Survey conducted by Statistics Indonesia 9 months prior to the earthquake was used to identify the baseline population of 800,000 households. Of this, a sample of 43,606 respondents were identified as living in a district with a coastline targeted by the tsunami and were used to make up the Study of the Tsunami Aftermath and Recovery (STAR) sample. To account for coastal proximity, the study was designed to include three groups: people living in areas directly affected, people living in nearby areas but not directly affected, and people living several hundred kilometers away from affected areas. The final group served as a control.

Sex, age, and socioeconomic status were found to be significant confounding variables in identifying the mortality rates of this population. Sex has been found to be an effect modifier with results showing an increase in the rate of mortality for women compared to men. Explanations for this phenomenon include differences between men and women in physical attributes as data showed that strength played a significant role in an individual's survival with men showing a mortality rate of half that for prime-age women (15-44 years old)

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and children (<15). Similarly, socioeconomic status (SES) was studied as a significant confounding variable. This accounts for available resources within the household, the material from which houses were built and the occupation of the head of the household. For example, in considering the latter, a lower mortality rate was found amongst fishermen as they may have been on their boats at 8am when the tsunami hit rather than on land. Fishermen would also be expected to be stronger swimmers and may be able to withstand tumultuous waves. Frankenberg et al. found a 28% lower mortality rate amongst prime-age male fishermen².

d. Management:

The United Nations has been reported to have acted quickly, immediately jumping to action in raising international awareness and mobilizing funds. Donors, NGOs, and corporations around the world banded together to pledge a total of \$13.6 billion dollars. The efforts of the UN were the largest coordinated relief operation in history at that time and are credited with the prevention of epidemics as well as efficient food assistance and emergency shelter relief. The United States military was brought in to help aid in logistical obstacles as most roads, beaches, and air strips had been destroyed.

While the immediate response and fund-raising seems to have been effective for short-term goals, an article written by VanRooyen and Leaning in February of 2005 show that there were some inefficiencies in accomplishing long-term humanitarian relief goals which primarily consist of a switch from activities focused on immediate relief to implementing more sustainable development solutions for the most vulnerable areas⁹. There appears to have been a difference of opinions amongst relief organizations in the approach to reconstruction of infrastructure and health systems. This directly impacted areas of high poverty, specifically communities that had already been shown to have experienced the greatest mortality rate and destruction, as well as households dependent on fishing and farming for a source of income.

Despite the absence of long-term improvement, overall, the response management was significant in the global mobilization of relief and the increased prioritization of emergency and risk management. This was seen in the adoption of the Hyogo Framework for Action which was in effect from 2005-2015 and served as the “global blueprint for disaster risk reduction efforts”³.

e. Communications:

There appears to have been limited communication during the event due to the sudden and destructive nature of the earthquake as well as a lack of an Indian Ocean early warning system, a deficiency highlighted by this event⁵. However, as mentioned in the discussion of the response tactics, there was significant global communication in an effort to garner impressive funds within a short period of time. This appears to have been an effective approach as close to \$14 billion USD was raised almost immediately.

f. Summary:

The Boxing Day Tsunami of 2004 was an incredibly devastating event of unforeseen proportions. As a result, relief efforts and emergency management that followed is incredibly impressive given that organizations did not have a reference for a such a large-scale disaster. The lessons learned from this event have and will continue to save lives for years to come.

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