A snapshot of the 2004 Indian Ocean tsunami: societal impacts and consequences

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Abstract

Purpose – The purpose of this paper is to explore the societal impacts and consequences of the December 26, 2004 Indian Ocean tsunami.

Design/methodology/approach – One month after the tsunami, a group of social science researchers from the Disaster Research Center, University of Delaware, and the Emergency Administration and Planning Program, University of North Texas, participated in an Earthquake Engineering Research Institute reconnaissance team, which traveled to some of the most affected areas in India and Sri Lanka. Data were obtained through informal interviews, participant observation, and systematic document gathering.

Findings – This research yielded important data and information on disaster preparedness, response, and recovery. A number of issues are identified that emerged from the field observations, including: tsunami education and awareness; the devastation and the loss; economic impact; mental health issues; irregularities and inequities in community based response and recovery efforts and in the distribution of disaster relief aid; gender and inequality; and relocation and housing issues.

Practical implications – The paper highlights the role and importance of generating integrated early warning systems and strategies aimed at fostering sustainable recovery and building disaster resilient communities.

Originality/value – An extensive amount of perishable data were collected thus providing a better understanding of the societal impacts of disasters on impoverished communities. A number of emerging issues are identified that should be of primary concern in efforts to protect populations residing in coastal regions throughout the world from similar catastrophes.

Keywords Disasters, Sumatra, Earthquakes, Sustainable development, Tidal waves

Paper type Research paper

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Introduction

The December 26, 2004 earthquake and the tsunami that it generated across the Indian Ocean have been described as one of the "worst disasters" in recent history. Very few natural hazards in recent history have had such widespread, catastrophic consequences. As a result of the Sumatra earthquake (measured as 9.0-9.3 magnitude on the Richter scale), a massive tsunami traveled 4,500 km across the Indian Ocean in a period of about seven hours. Twelve countries suffered the consequences of the tsunami but Indonesia, Sri Lanka, India, and Thailand were most dramatically impacted, as measured by the death toll and the number of missing and displaced individuals. The number of people killed is estimated at about 250,000 (United Nations International Strategy for Disaster Reduction, 2005), though precise numbers will probably never be available[1]. Further, the number of people missing ranges from 14,000 to over 51,000; about 1.5 million people were displaced, and the economic impact is estimated to be in the billions of dollars (www.eeri.org/lfe/clearinghouse/sumatra_tsunami/overview.html). These preliminary estimates portray the extent of societal disruption and human suffering generated by the Indian Ocean tsunami.

Field research goals and objectives

Approximately one month after the tsunami, a group of social science researchers from the Disaster Research Center, University of Delaware, and the Emergency Administration and Planning Program, University of North Texas participated in an Earthquake Engineering Research Institute (EERI) reconnaissance team, which traveled to some of the most affected areas in India and Sri Lanka. We engaged in a two-week field research expedition that yielded an extensive amount of data and information on disaster preparedness, response, and recovery from this devastating tsunami. The goals of the field team were to:

- collect perishable data;
- identify communities particularly hard hit by the tsunami;
- observe methods being used to restore lifeline facilities;
- identify local, regional, and national-level government agencies as well as local and international non-governmental agency (NGOs) taking part in the recovery and relief efforts; and
- establish contacts with local researchers and practitioners.

The social science reconnaissance team

The EERI social science team included the authors of this paper and A. Subramanian (Political Scientist, Madras Christian College, India) and Ram Alagan (Department of Geography, University of Peradeniya, affiliated with the International Center for Ethnic Studies – ICES – in Kandy, Sri Lanka[2]). Subramanian and Alagan have conducted research and were actively engaged in disaster relief work in some of the areas that the team visited in India and Sri Lanka. They provided detailed information focusing on cultural, historical and political aspects in these countries thus providing the needed context in which to ground our observations.

The field team traveled from Chennai to Point Calimere, India (January 23-27, 2005), and from Colombo, Sri Lanka to destinations across the country (January 28-February 1). It is important to note that the research team visited India and Sri Lanka in the immediate

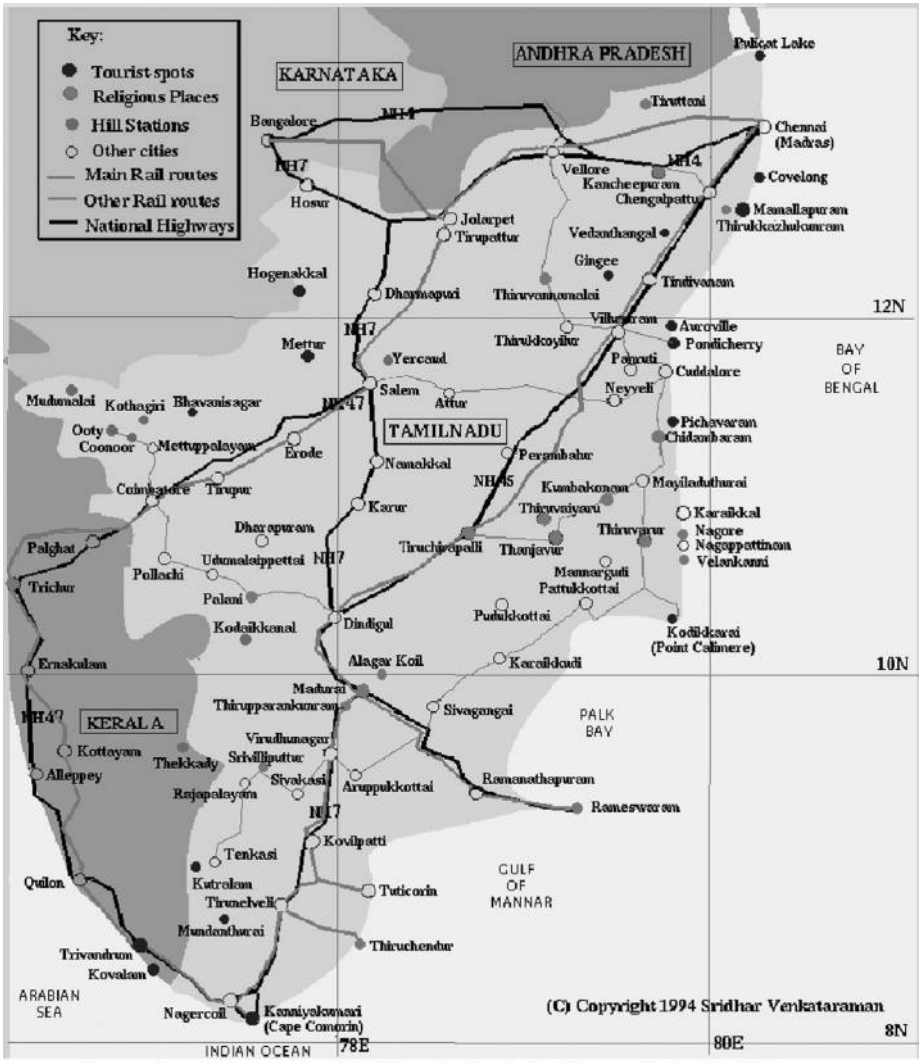
post-impact phase of the disaster. Therefore, although we saw signs of the initiation of the reconstruction and recovery process, the overwhelming majority of the communities we visited were still in the response or the very early phase of recovery. For example, victims were engaged in the grieving process, corpses were being uncovered and burials were taking place, the cleanup process was underway, temporary shelters were being built, many of the fishermen (particularly in India) had not returned to the sea to engage in fishing activities, and many children had yet to return to school. It is noteworthy, however, that as we compare data, notes and observations with other social science teams that also visited a number of countries, including India and Sri Lanka, as recently as the summer of 2005, the preliminary observations, problems, and issues that we document in this paper were also documented and reported by some of these teams. As we attend professional meetings, continue to review government reports and professional/scientific articles, and monitor media reports on the 2004 Indian Ocean tsunami, we are able to confirm that the emerging issues and concerns raised in our initial field reports and explained in detail in the following sections still remain pertinent topics. More important than supporting our initial observations, recent work by other researchers serves as an indicator of the continued need to devote resources and research efforts to better understand the demographic, societal, economic, and political implications and ramifications of the tsunami on communities throughout the Indian Ocean.

Field research and data collection methodology

In India, we surveyed coastal communities in the State of Tamil Nadu, the region most significantly impacted by the tsunami. The communities visited spanned the Indian coast from Chennai to Point Calimere, including Sulerekuttukuppam, Mudaliarkuppam, Puddukuppam, Kanpatichettikullamkuppam, Pattinacherry, Kameswaram, Kodiyakkarai, Pushpavanam, and Velankanni (Figure 1). We also visited a number of ports with hundreds of damaged boats, bridges that sustained substantial damage, a salt mining operation, the Nagapattinam Office of the Collector, and an emergent tsunami-related protest (Figure 1).

In Sri Lanka, the team arrived in Colombo and then traveled to Kandy to meet with the ICES faculty and researchers. We then traveled to a number of impacted communities on Sri Lanka's eastern and southern coasts, including Trincomallee, Kinniya, Balapitiya, Kahawa, Relief Camp Peraliya, Hambantota, Paiyagala, and Galle (Figure 2). We visited other heavily damaged areas along the way, a grade school, a salt harvesting operation, and other businesses impacted by the disaster. We also met with representatives from UNICEF, members of a local community based organization, local residents operating under the auspices of USAID, as well as with organizers of relief camps and a field hospital.

In both countries, we talked with fishermen, women, community and organizational leaders, representatives from NGOs, disaster relief aid workers from both local and international organizations, government representatives, people in different types of industries, and researchers. The field team covered a variety of substantive areas in our conversations with these individuals including but not limited to: the physical aspects of the tsunami; individual and community activities that were taking place at the time of the event; individual, community, and governmental response to the event; the social and economic impacts of the tsunami; distribution of disaster relief aid and the role of NGOs and the local government in this process; the building and use of

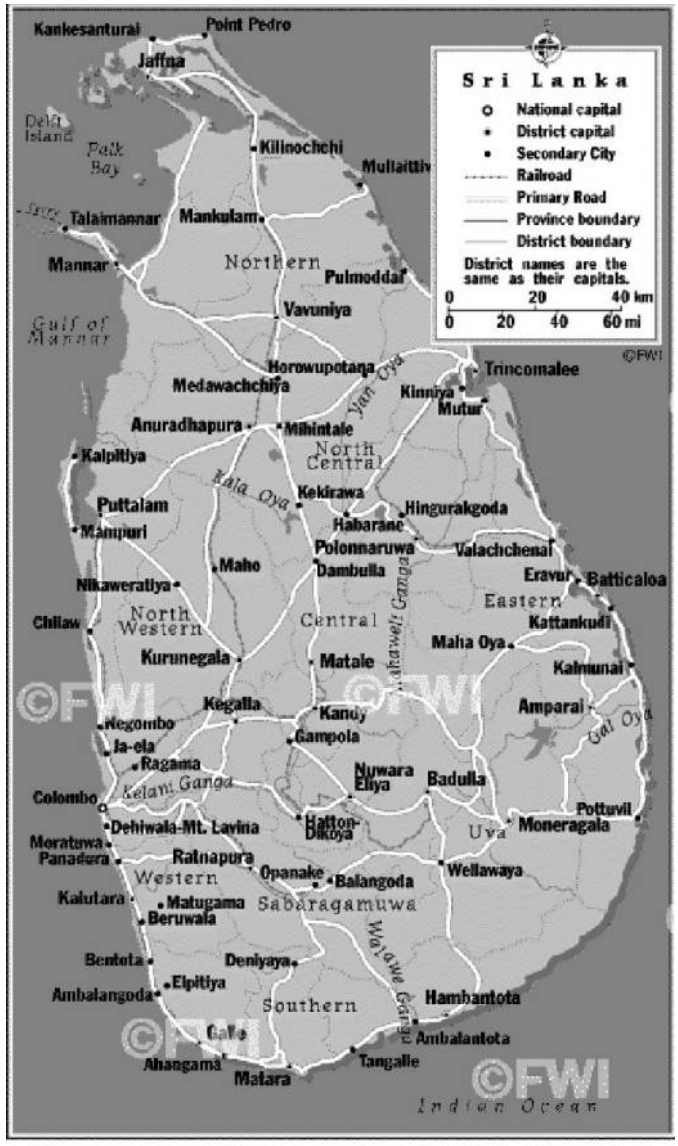


Source: http://www.cs.utk.edu/~siddhart/tamilnadu/MAP/latest.gif,April 4, 2005.

Figure 1.
The State of Tamil Nadu, India

temporary shelters; the relocation process, including the government's intentions to enforce legislation focusing on the coastal buffer zones; and the primary concerns and difficulties that these communities, organizations, and industries were confronting.

Each night, the team would meet to discuss our observations and to generate preliminary reports; field notes were also transcribed. Other field documents collected and analyzed include: government reports, secondary data (e.g. census data, socio-economic data on the impact of the tsunami), and other types of reports and documents.



Source: http://www.comebackalive.com/df/dplaces/srilanka/map.gif, April 4,2005

Figure 2.
Sri Lanka

Emerging issues: a snapshot one month after the tsunami

In the course of our field research in India and Sri Lanka, we identified a number of emerging issues that merit future research collaboration and that should be of primary concern in the effort to protect populations residing in coastal regions throughout the world from similar catastrophes, including: education and awareness regarding

tsunamis; the devastation and the loss; economic impact; mental health issues; irregularities and inequities in community based response and recovery efforts and in the distribution of disaster relief aid; gender and inequality; relocation and temporary shelters; and social organization and social cohesion, among others. We elaborate on these issues in the following section and conclude by highlighting the role and importance of generating integrated early warning systems and strategies aimed at fostering sustainable recovery and building disaster resilient communities.

Lack of education and knowledge regarding tsunamis

Though our conversations with community members and government officials we documented an apparent lack of awareness and knowledge regarding tsunamis, how they are generated, and what are the appropriate actions to take. This should come as no surprise given that these communities had never experienced a tsunami and, therefore, had no reference points regarding what would be the most appropriate behavior. Consequently, they did not recognize one of the "typical" signs of a tsunami (e.g. the receding ocean). One elementary school teacher in Sri Lanka informed us that his students had never heard of a tsunami and that they did not know the meaning of the word. Further, the population in these two countries did not receive advanced warning regarding the impending tsunami and, after the onset of the event, there was little or no communication, thus contributing to a sense of despair among those impacted. Our findings show that there is an urgent need for transferability of knowledge as well as for information sharing and capacity building in order to enhance disaster mitigation, preparedness, and response in these communities. To the extent possible, local NGOs, as well as education and outreach initiatives associated with government agencies and universities with a planning or natural resource focus, should be at the forefront of such efforts. All such efforts have the challenge of avoiding paternalistic meddling while helping to avoid recreating the socio-economic patterns that led to a heightened level of disaster vulnerability. Our observations suggest that local initiatives, bolstered if necessary by external support and expertise, offer the best opportunities for sustainable recovery, since such efforts are more likely to be aligned with the particular needs of the communities, and offer the best prospects for long-term initiatives. Further and more extensive research, incorporating local participation, will also be needed to develop initiatives that are designed to meet the needs of local communities. This might include assessing the extent to which fishing is the preferred or de facto industry, the possibility of other economic endeavors, and the potential and consequences for increasing women's involvement and participation in economic initiatives and decision-making processes at the community level.

The devastation and the loss

The loss of life and the destruction of property varied significantly from community to community in both India and Sri Lanka. The communities we visited were characterized by substantial loss of life (ranging up to 5,000 deaths in one community), the partial or total destruction of property, and the loss of primary livelihood. In some communities there was extensive damage or complete destruction of almost every housing structure. Given the different types of construction of the houses in India and Sri Lanka, the level of devastation observed was also different. For example, in India, communities with a housing infrastructure primarily consisting of lashed timbers and

thatched roofs were essentially washed away. In India and Sri Lanka, housing constructed of adobe and brick was largely reduced to rubble and those structures that remained standing had significant erosion at the base of the structures, giving the appearance that they would collapse at any moment. In both countries, we visited areas where entire communities had disappeared as a consequence of the tsunami. Fishing communities experienced a substantial loss in terms of boats, motors, and nets that directly impacted their ability to work and provide sustenance to their families. In some communities, schools, hospitals, and other critical infrastructure were also destroyed or badly damaged. Some communities had no electricity or potable water; for some, the water that they obtained from their wells had been contaminated by the ocean. It became quite evident that these impoverished fishing communities had lost what little they had, even the ability to provide for their basic needs through fishing.

The tsunami also resulted in significant damage to the ecosystem in both countries. Coastal erosion was extensive throughout the most impacted coastlines in India; coral reefs, mangroves, and other type of vegetations in the coastlines bore a large share of the tsunami's impact. A number of fishermen from different communities indicated that the tsunami had transformed their landscape and ecosystem, sand dunes had disappeared, the ocean had not recovered its original color, and some had caught species of fish that are not normally found in those areas. Fishermen were concerned that all these changes may have a significant impact on their fishing activities thus negatively impacting their livelihoods.

Economic issues

As is generally the case with disasters (Wisner *et al.*, 2004; Easterly, 2001; Cannon, 1994), it was the most impoverished population groups that were significantly impacted by the tsunami. While not all fishing communities in both countries are necessarily poor, most of the communities we visited during our reconnaissance trip, especially in India, were poor fishing villages. Such communities, in both countries, lost even the basic resources needed (i.e. boats, motors, and nets) to maintain self-sustainability. Although government aid was welcomed and needed, fishing communities did not want to become dependent on the government and disaster relief aid; people wanted to "return to the sea" and return to economic independence. Government aid was critical but clearly insufficient to meet the immediate needs of the community. Moreover, other types of government support, such as loans, would exacerbate the precarious economic problems of fishermen and their families, particularly given the fact that a number of fishermen reported that they still had outstanding loans for the boats that were destroyed by the tsunami.

During our stay in India and Sri Lanka, we observed how different parts of the economy (including agriculture, fishing, the salt industry, and tourism) were impacted as a consequence of the tsunami. Albala-Bertrand (1993) argues that, generally, disasters have little or no impact on a country's overall economy, particularly given that disasters are "local" in nature (Dynes, 2002). However, we argue that in countries where incomes are relatively low, poverty is high, and where economically marginalized populations continue to increase, the tsunami will exacerbate these problems thus contributing to increasing disaster vulnerability in the region.

Mental health issues

The Indian Ocean tsunami was perhaps the most devastating hazard event that had impacted the fishing communities that we visited. The overwhelming majority of persons that we spoke to had lost loved ones, neighbors, or friends. The sense of loss was widespread and affected all of these communities. For some, the losses were compounded by their inability to recover the bodies of their loved ones and carry out the corresponding burial rituals. Reports of mass burials were quite common. These issues were further complicated by the inability of fishermen and/or their spouses to provide sustenance or "security" to their families. Furthermore, one month after the tsunami, there was still widespread fear or concern that another tsunami would impact their communities. For example, in India, people would visit the remains of their housing structures and property along the shore during the daytime but at night they would return to their temporary shelters. Parents reported that their children would cry at night fearing another disaster, and both adults and children reported persistent nightmares. Many of the residents in these communities appeared to be living in a state of persistent uncertainty regarding when they would be able to resume their work, build new houses, procure locations for those houses, resume "normal" community rhythms, and even determine whether or not it was safe to return to the shore.

The literature provides inconsistent and even contradictory information on the mental health impact of disasters (some indicating that the mental health impacts of disasters are minimum or short-lived) (Tierney, 2000; Quarantelli, 1984). However, as Tierney (2000, p. 2) argues:

> . . . no one disputes the fact that disaster victims experience real pain and suffering and that disasters can be deeply distressing for those that experience them. Indeed, the disruption of communities, the shattering of lives, and sudden and seemingly senseless deaths and injuries are all part of what makes an event a disaster.

Our field observations highlight these issues and the importance of further research focusing on the short- and long-term health and mental health consequences of these disasters on the impacted communities.

Disaster relief aid

As we traveled through India and Sri Lanka we observed a variety of irregularities or inequities, particularly related to the distribution of disaster relief aid. We also received reports of challenges in the provision of relief and recovery services. For example, in some instances, NGOs duplicated efforts or provided assistance not suited to the locale or to the varying population sizes. Further, while in some communities there seemed to be an abundance of aid, in other communities, particularly remote ones, the distribution of aid seemed to be quite slow and limited. In Sri Lanka, the ongoing conflict between the government and the Liberation Tigers of Tamil Eelam (better known as the Tamil Tigers) generated a variety of concerns regarding how aid was distributed which made understanding the difference between political and disaster response issues complicated.

Another complicating factor in the distribution of disaster relief aid was brought to our attention when we encountered a protest in Karaikal. We were informed that this group of agricultural laborers was requesting that the government provide them with disaster relief aid in order to alleviate the economic impact of the tsunami. Given that they were agricultural laborers (not farm owners or fishermen), they reported having

been left out of proposed relief packages offered by the government. Though we noted problems and limitations, the individuals throughout the communities that we visited indicated that the work and disaster relief aid generated by NGOs was extremely important and contributed to meeting many of their basic needs.

Community response and recovery efforts

In many of the communities, both in India and Sri Lanka, community members were actively engaged in the response and recovery process. In some communities, there was an emergence of self-help groups, primarily consisting of women, some with the support of local NGOs, which took an active role in the cleanup and recovery process. Nevertheless, in a small number of communities there seemed to be limited community participation and no organized efforts to engage them in the cleanup and recovery process. Therefore, it is extremely important to determine what factors impact the recovery process and under what conditions community members are willing or able to engage in this process.

Gender inequities

The disaster research literature shows that women are differentially impacted by disasters, experience greater difficulties in recovering from them, and may experience relatively limited access to disaster relief aid primarily due to gender-based inequities inherent in communities throughout the world (Wisner *et al.*, 2004; Enarson and Morrow, 1998). An Oxfam (2005) report reported that women disproportionately suffered a higher death rate in almost every country as a consequence of the tsunami. Further, many issues and concerns remain regarding how gender roles were impacted by the tsunami and what are the short- and long-term effects. For example, Lalasz (2005, p. 1) highlights the difficulties that women are confronting in India following the tsunami in terms of access to maternal and reproductive health care, sexual abuse in refugee settings, and in their new roles as primary economic providers. Also, given the high female death toll, as a consequence of the tsunami, a non-trivial number of men now have to focus on issues such as raising and educating their children. Changing gender roles and their permanency (or lack thereof) warrant our attention and further research initiatives. We must consider the short- and long-term demographic and socio-economic implications in these regions, and how they impact the population in general and women in particular. For example, critical issues related to land tenure, property rights, and economic sustainability for widows, in primarily patriarchal and patrilineal societies, must be addressed.

Temporary shelters and housing

The provision of adequate temporary shelters to communities impacted by a disaster is a very difficult and complex undertaking. There are a variety of problems associated with temporary housing that may exacerbate the already critical situation of those impacted by a disaster, such as:

> ... culturally inappropriate housing, poorly located temporary housing camps, social conflicts among occupants, and physical inadequacy of the interim housing facilities (Bolin and Stanford, 1991, p. 25).

During our visit to Sri Lanka and India, we observed some of these complexities. The construction of temporary shelters varied quite significantly from one community to

another and between India and Sri Lanka. We noted a diverse set of temporary structures, ranging from donated tents, makeshift tarp tents, thatched houses, fiberglass or aluminum roofing, to a combination of these materials. Concerns included the extent to which villagers found the shelters appropriate due to heat conditions and size as well as safety concerns (particularly for thatched shelters). For example, in several communities in India, we noticed that the tents donated by foreign governments or NGOs were generally not being used by the villagers due to the extreme heat generated inside these structures and their limited ability to accommodate all family members. However, only a few feet away, makeshift shelters constructed by community members were being used at full capacity. In other communities in India, local NGOs had found compromises that incorporated the needs of the victims while meeting government safety recommendations.

Another critical issue that emerged for fishing communities in both countries was the fact that many temporary shelters could eventually turn into permanent housing, thus maintaining families residing in inadequate structures. Our field observations highlight the importance of conducting further research on the ways social organization and culture, within a given community, impacts the appropriateness and acceptance of temporary shelters, particularly in situations of an unprecedented catastrophe (such as a major tsunami) where potentially millions of people would be displaced.

Relocation: alternatives and implications

Relocation emerged as central to disaster recovery efforts in India and Sri Lanka. The extent to which relocation of communities and industries was possible in terms of land acquisition, community acceptance, and industry feasibility were in question. Pressures by industry, relocation distance, issues related to relocating communities reliant on the sea for their livelihood, zone enforcement, and lack of available land were reported as challenges to governmental relocation efforts early in our discussions with community members.

In the communities we visited in Sri Lanka, residents were well aware of government discussions to "enforce" a 100 m buffer zone along the coast[3]. We were informed that the government was considering relocating an entire community (Hambantota) which was severely impacted by the tsunami. The Indian government was reporting that it would now enforce its coastal regulation zone that prevents building construction 500 m from high tide point. Government sources suggested that fishermen relocated inland would be provided transportation to the sea, but fishermen questioned how long such support would last and the impact such a move would have on the economic livelihoods of communities who have depended on this industry for generations. In other cases, reports suggested that the sites being considered may put households at greater risk to flooding during monsoon periods. Also, given the degree of urbanization in the coasts of Sri Lanka (e.g. towns and cities with fishing segments rather than fishing villages), it is difficult to imagine how relocation of such substantial districts could be achieved. Other concerns involved the feasibility of moving equipment away from the shore, the lack of community support that would be present to draw in nets if the village was relocated, and the possibility of the government selling appropriated land in the buffer zone to developers in a few years; this concern was also found among fishing communities in Chennai (Krishnakumar, 2005). While

the residents we spoke with in the towns were afraid of another tsunami, for the most part, they wanted to stay where they were, along the sea.

Relocation, changing community settlement patterns, and maintaining the communities' fishing industry while at the same time enhancing disaster preparedness and response will remain important issues and present significant challenges, which must be addressed by local governments and their communities. For example, will the governments of India and Sri Lanka be able to enforce their no-construction policies within the buffer zones? What will happen to communities that have been located within the buffer zones for generations? Is relocation economically viable and feasible? Previous research on community relocation following a disaster has shown that, generally, such initiatives are unsuccessful. Moreover, government forced relocation efforts are generally doomed to fail (Oliver-Smith, 1991). Relocation initiatives must take into consideration the impact that such movements will have on the communities' social, economic, cultural, and political activities; if the impacted communities are willing and able to relocate; and if such relocation is merely transferring communities from one risk area to another. For example, some of the communities that we visited reported that the government had proposed relocating them to a region where they would be significantly impacted by floods; others indicated that the government wanted to relocate their community to an area with a high prevalence of wild elephants thus endangering their lives; while still other communities reported that the government wanted to construct high-rise apartment type of housing for fishermen and their families, which seemed inconceivable to them. Whether these conceptions or ideas were real or imaginary, a result of rumors or government information, they were perceived as "real" and thus significantly and negatively impacted public opinion and their willingness and desire to relocate to other ("less viable") regions. In order to be successful, relocation efforts must:

> ... also be development oriented and planning must take into account that the social and physical infrastructure, school and health services, access to employment opportunities, and housing and dwellings will meet expanded needs (Oliver-Smith, 1991, p. 17).

Further, the communities themselves must take an active role in the decision-making process if these relocation efforts are to succeed.

Social organization and community cohesion

One of the clear patterns that emerged throughout our visits to the fishing communities in both India and Sri Lanka was a high level of social cohesion, significant social organization, extensive participation of community members (at least in some communities) in the recovery process, a strong sense of camaraderie and community membership among the individuals residing in the same area, and altruistic behavior, as shown by community members' eagerness to help and provide support to those that form part of their communities. As mentioned previously, the emergence of self-help groups was instrumental in the cleanup and recovery process in these communities. These types of behaviors and strategies are instrumental in fostering community resilience to disasters and will further contribute to enhancing a community's ability to protect itself. Considerable research (Alexander, 1993) has documented the importance of local participation in recovery efforts, and it is likely that these generally observed patterns will hold true in tsunami-affected areas.

Concluding remarks

Given the high death toll, the number of people displaced, the extensive devastation across many countries, and its economic impact, the 2004 Indian Ocean tsunami has been described as one of the most devastating disasters in recent history. Hundreds of volunteer organizations and NGOs converged to the Indian Ocean, governments pledged billions of dollars aimed at disaster relief aid, and it engaged many governments throughout the world in conversations regarding early warning systems. The tsunami also highlighted issues of poverty, inequality, and vulnerability in the countries impacted by this event.

Despite the many problems highlighted in this paper, it is important to note the critical role of communities, NGOs, and local governments in the recovery process. In the context of our somewhat limited observations regarding the response to the Indian Ocean tsunami, the data and information collected suggests that the disaster relief aid generated by NGOs (particularly local NGOs) was extremely important and contributed to meeting many of the communities' basic needs. NGOs in both countries were involved in a variety of recovery/relief activities, including the development of public/private partnerships to better assist tsunami victims; providing medical care, counseling, and addressing housing-related needs; long-term rehabilitation efforts; cultural, educational, and recreational programs; training; construction of shelters; repairing boats and catamarans or providing new boats and nets; distributing school kits and household kits; and engaging women in decision-making processes and recovery efforts. Moreover, the emergence of self-help groups, establishing groups to assist in the cleanup process, contributing funds to re-open a modest convenience store, gathering pieces of catamarans to construct a "new" one, and engaging local community leaders with local and international NGOs to coordinate the distribution of disaster relief aid and the cleanup process, among other efforts, are all illustrative of a community's disaster resiliency. Nevertheless, given the scope and magnitude of the social and economic impact of the tsunami on these communities, there is an urgent need to develop more formalized, systemic and structural changes that will promote and facilitate a sustainable recovery process. For example, initiatives aimed at increasing the population's level of education, reducing illiteracy rates, increasing employment opportunities, reducing poverty, enhancing the role and participation of women in the decision-making process, and reducing the population's vulnerability to disasters should be at the forefront of planning and preparing for future disasters. In this regard, the role of local and international NGOs and, more importantly, of local governments is critical. Unfortunately, among the communities that we visited in both India and Sri Lanka, there was a high level of skepticism regarding the extent to which the government would fulfill the promises made in terms of the recovery process and the aid to be provided to communities.

Warning systems: going beyond sensors and buoys

Our field research shows that communities in the areas that we visited in India and Sri Lanka lacked the necessary warning systems and other resources in order to generate effective preparedness and response initiatives. It is likely that the tsunami will remain a salient feature in the collective memories of these communities for a long time, and hence there will probably be a fairly long interval of interest in warning

systems and receptiveness to education. Education, of course, is critical, but given the comparatively short duration of compulsory education, responsibility must also fall on local officials, community based organizations, and residents themselves to recognize warning signs and to also be conversant with any systems that are developed and installed. Well-developed early-warning systems exist; the requirement is to maintain them, to publicize their operations, and to increase public awareness and knowledge and maintain public alertness for a hazard that may not occur again in the lifetime of these residents. It is noteworthy that these strategies can also serve to enhance disaster preparedness and response for other types of hazard events.

Lack of adequate disaster mitigation and preparedness efforts, including public and organizational training and response, also hampered the recovery process in many of the regions impacted by the tsunami. More effective community capacity and effective early warning systems could have limited the extensive loss of life. As a consequence of the Indian Ocean tsunami, the international community is now calling for the establishment of an early warning system. As quickly as January 2005, less than one month after the disaster, the US announced its intention to expand the Global Earth Observation System of Systems to include an expanded tsunami detection and warning system with enhanced capabilities, both nationally and internationally (Office of Science and Technology Policy, 2005). However, the emphasis has generally focused on the technological aspects of the warning system; that is, setting up sensors and buoys. While this technology is needed, and many scientists and researchers have lobbied for the implementation of such a system, particularly in the Indian Ocean, it has taken such a devastating event to call our attention to "early warning systems." Governments must focus on the development of integrated warning systems that emphasize the need and importance of risk communication, education, raising awareness, and responding to the needs of the population at risk. Public presentations, community fora, notices and pamphlets, signs and posters, and other communication media have been used worldwide to publicize hazards and mitigation and protective measures for diverse threats. Seemingly, more urgent needs will appear to compete for resources and attention, thus it will be important to maintain attention by consciously and explicitly linking economic development activities to disaster mitigation and preparedness.

Fishing communities throughout India and Sri Lanka are beginning a slow and painful recovery process from the devastating tsunami that struck their land on December 26, 2004. Some fishermen are beginning to return to the ocean; children are returning to school; and roads and houses are being rebuilt. Nevertheless, there are still many problems that these communities confront; the reconstruction process will take years if not decades and relocation efforts will remain a major challenge. These processes are intrinsically tied to the socio-economic development of these communities. Reducing societal vulnerability through enhancing disaster resiliency is key. However, this process also requires substantial gains in a community's economic capacity which in turn demands that we pay special attention to issues such as poverty, inequality, and sustainable development.

Notes

1. Thomas (2001) argues that there is no systematic or centralized data collection process or methodology regarding disaster losses. Therefore, data collection methodologies or

strategies, following disasters, can vary quite significantly depending on the agency, organization or country collecting the data. Consequently, disaster losses (e.g. deaths, injuries, economic impact) can vary quite significantly from one source to another and should be viewed with caution.

2. The EERI reconnaissance team also benefited from the extensive information and guidance provided by Stanley Samarasinghe and his colleagues at the ICES, and the staff from the Disaster Mitigation Institute in India. Also, the hospitality, kindness, and the time, cooperation, and information provided to the field team by many community members and governmental and non-governmental agency (NGOs) representatives were instrumental to the success of our field research.
3. It is noteworthy that discussions regarding the buffer zones and the reconstruction process have changed quite considerably since our reconnaissance trip to India and Sri Lanka, both in terms of what constitutes the "appropriate" buffer zone and in terms of how to enforce these policies. For example, most recently, the government of Sri Lanka indicated that they will apply with "flexibility" their policies prohibiting building within the 100-200 m buffer zone.

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