Geography 306: Human Dimensions of Natural Hazards

Assignment 1
Analysis of Hazard Mitigation/Disaster Risk Reduction: 2011 Tohoku Disaster

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INTRODUCTION

Japan sits near the boundary of four tectonic plates: the Pacific, Eurasian, North American, and Filipino plates (Marder, 2011). These parts of the earth's crust are endlessly moving in a way that creates seismic activity and is the major cause of earthquakes and tsunamis in the region (Marder, 2011). When the continental plates move against each other, pressure is released. This causes seismic activity under the surface of Japan and can lead to both an earthquake and a tsunami (Marder, 2011).

This is what happened on March 11, 2011 when these tectonic hazards turned into the costliest disaster of Japan's history. The main area that was effected during this disaster was the Tohoku region. The Japanese word "Tōhoku" literally means the Northeast Region, and consists of the northeastern part of Honshu, the largest island of Japan (Frédéric, 2005). The demography of the region is remote and the climate is harsh.

Tohoku consists of six administrative subdivisions which include Fukushima, Aomori, Akita, Iwate, Miyagi, and Yamagata (Frédéric, 2005). The Fukushima subdivision had a nuclear power plant which melted down during the incident (International Atomic Energy Agency (IAEA), 2011). This amplified the disaster because of the adverse environmental and health effects that came with the failure of such sensitive infrastructure (IAEA, 2011).

The area was prone to hazards based on historically collected data. The incident began when sub-water seismic activity occurred 77 miles off the eastern coast of Japan with the hypocentre reportedly to be approximately 20 miles deep in a subduction zone called the Japan Trench (Norio, Ye, Kajitani, Shi & Tatano, 2011). This caused an earthquake of 9.1 magnitude on the Richter scale, the worst in Japan's history (United States Geological Survey (USGS), 2011). It is also one of the costliest natural disasters reported with losses estimating to half a trillion dollars (Vervaeck & Daniell, 2012). There were a reported estimate of 19,000 deaths (Vervaeck & Daniell, 2012). Japan declared the incident as a disaster because the situation was too adverse for the Japanese community to cope with on their own.

This report aims to highlight the main hazards that affect the Tohoku region, and describe the mitigation and relief efforts for disaster risk reduction already attempted. The report also studies the success of these efforts, and upon finding gaps in the current attempts, provide recommendations for government officials and mitigation planners for an effective route to proceed with disaster risk reduction.

MAIN NATURAL HAZARDS AFFECTING THE REGION

Japan lies within the boundaries of the ring of fire; the region that is highly prone to seismic activity as a direct result of tectonic movements (Marder, 2011). This causes the Tohoku region to become prone to two main types of hazards: primary and secondary.

A. PRIMARY HAZARDS

Primary hazards are those that are directly related to the disaster. In the case of the Tohoku region, there are two main types of primary hazards: tsunamis and earthquakes.

A tsunami is generated when there is seismic activity under water (Smith, 2013). The force produced by seismic activity is greatest perpendicular to the centre of the seismic activity. As the force is transferred through the water the wave gets bigger, slower, and deadlier as it moves into shallower waters (Smith, 2013). In the Tohoku region, the tsunami was responsible for the most destruction, deaths, and financial and economic loss. Over 18,000 of the 19,000 deaths are expected to have died as a direct result of the tsunami, i.e. drowning (Vervaeck & Daniell, 2011).

The earthquake is estimated to be the second largest cause of death, killing 268 people (Vervaeck & Daniell, 2011). Earthquakes are caused by the movement of subsurface tectonic motion of plates (Smith, 2013). Force is released when one plate is pushed under or against the other resulting in two main kinds of waves: Primary wave (P-wave) and Secondary wave (S-wave) (Smith, 2013).

The P-wave is the first sign of an earthquake and causes the linear propagation of particles. This kind of wave barely does any kind of damage and is used by warning systems as a pre-emptive warning that the secondary wave is to follow (Smith, 2013). Particles in an S-wave oscillate up and down and produce the shaking that is felt. This is what causes the majority of infrastructure to collapse (Smith, 2013).

In the Tohoku disaster, once seismic activity was sensed by the Japanese Meteorological Association, the general emergency earthquake bulletin was sent to the Tohoku region within 8 seconds after the detection of the first P-wave; which was 31 seconds after the actual earthquake had occurred (Yamada, 2011). After the warning is sent out by sensing the P-wave, and before the S-wave hits, there is usually less than a minute to react. Places closest to the epicentre of the earthquake are first to be hit. Hence, people who are closer to the epicentre of the waves have less time to respond (Yamada, 2011).

B. SECONDARY HAZARDS

Secondary hazards are a direct or indirect effect of the primary hazards. In the Tohoku disaster, there were several secondary hazards, which later amplified the physical effects of the actual disaster (Zaré & Afrouz, 2012). These included:

- Falling construction: this was generally considered the major cause of death caused by the earthquake and tsunami (Zaré & Afrouz, 2012).
- Sensitive installations: in this case, it's particularly the nuclear power plant in Fukushima and the adverse environmental effects that came with the failure of the infrastructure (IAEA, 2011).
- Landslides, fires, and other similar incidents are estimated to have caused 230 casualties in the Tohoku disaster (Zaré & Afrouz, 2012).

HAZARD MITIGATION AND DISASTER RISK REDUCTION

Since Japan is situated in such a vulnerable area of seismic activity, several mitigation and disaster risk reduction efforts were already made prior to the incident.

A. RISK ASSESSMENT

Due to Japan's geographical location, there is enough information to suggest that a disaster of a seismic nature occurs approximately every 800 to 1100 years in the region (Minoura, Imamura, Sugawara, Kono & Iwashita, 2001). Historic data has been collected to analyse and anticipate the magnitude of the disasters and vulnerable areas such as coastal towns. In recent times, Geographic Information Systems (GIS) technologies have been used to map vulnerable areas based on computerized spatial data sets (Miyazawa, 2011). This helps map, assess, and forecast the loss caused by the hazard. *After making sensible estimates, effective infrastructures, such as the tsunami walls, practice and legislation such as introducing earthquake drills in academia and building codes were devised to minimise the effects of the disaster when it strikes.* However, the reason the disaster was so huge was because a tsunami and earthquake of such a high magnitude was unprecedented in Japan's history (Norio, Ye, Kajitani, Shi & Tatano, 2011).

B. MITIGATION

A few mitigation plans have been in effect, but it must be noted that not much can be done to mitigate the effects of a tsunami. Flood gates and tsunami walls are one such example of mitigation efforts. An example was the Fudai floodgate (Daily Mail, 2011). It was built as a protective structure by the late mayor of Fudai, who had survived a similar calamity. Initially, people deemed the project unnecessary, but following the success of the 51 foot wall, people have been visiting the mayor's grave to pay homage. The wall saved the town of Fudai from once again being reduced to rubble (Daily Mail, 2011). Land planning is also a popular way to mitigate a tsunami (Kyodo, 2011). Policies regarding the use of land and energy have been revised as the previous policies were clearly insufficient to cope with the disasters (Kyodo, 2011).

What must also be noted is that there is no insurance for tsunamis. This is because insurance companies cannot afford to rebate entire populations. However, earthquakes have insurance and buildings in Japan need to be retrofitted to meet building codes (Seeker Daily, 2016).

C. PREPAREDNESS

In an effort to prepare for the hazards, the Japan Meteorological Agency uses early earthquake warning systems to detect seismic waves near the epicenter and warn the public about the impending hazard (Norio, Ye, Kajitani, Shi & Tatano, 2011).

Stockpile aid was available from the civil and military departments, as well as the highly organized Yakuza (a highly organized Japanese criminal syndicate that helped maintain order and aided relief efforts) (Kento Bento, 2016).

Forces from countries like the United States helped set up field hospitals to enhance relief efforts in the affected areas. Many international charitable organizations such as the Red Cross Society and the United Nations also helped with relief efforts (United Nations Office for the Coordination of Humanitarian Affairs, 2011).

D. EMERGENCY PLANS

Practice drills are a part of the academic curriculum and people in the area are mentally prepared to deal with such situations through regular drills. In addition, the Japanese Armed Forces, government, and charities have also pre-planned for similar situations and goods are supplied through air and water when road and rail are disrupted. The Yakuza syndicate also has a distribution network and the practice of ‘Gaman’ helps the Japanese to keep calm at the time of calamity (Kento Bento, 2016).

SUCCESS RATIO

Japan was not as well prepared for the disaster. The preparations in place were not for such a major calamity. All the efforts that were made did not predict a disaster of this nature and intensity (Norio, Ye, Kajitani, Shi & Tatano, 2011). In the aftermath, there was a level 7 nuclear emergency resulting as a secondary effect of the tsunami (Norio, Ye, Kajitani, Shi & Tatano, 2011). At the Fukushima Daiichi Nuclear Power Plant, the effects of the tsunami were so great that Japan moved 2.4m closer to North America. The earth's axis shifted approximately 10 to 25 cm (IAEA, 2011).

It is known to be the costliest natural disaster ever recorded with damages amounting to around 500 billion US dollars (Vervaeck & Daniell, 2012). This attributes to the fact that it is nearly impossible to do anything about a tsunami except to evacuate. Since insurance does not cover a tsunami, chances of financial recovery from the loss are also minimum.

The death toll is estimated to be around 19,000 people, with numerous people displaced (Vervaeck & Daniell. 2012). The role of the Yakuza and charities provided a great distribution network of goods (Kento Bento, 2016). The Yakuza also made sure that looting and robbery did not occur and acted as a charitable organization for humanitarian relief.

Overall, the entire preparations were inadequate given the size of the disaster. Had the disaster been of a lesser magnitude, Japan may have had a chance to recover from it independently or with minimal support (Norio, Ye, Kajitani, Shi & Tatano, 2011).

RECOMMENDATIONS

There is no system that can guarantee a 100% accurate and efficient warning system based on the timing and magnitude of the disaster. In the case of a tsunami, even if we know its timing and place, there is not much that can be done to mitigate it. There can, however, be some degree of effective mapping and planning for relief efforts (Smith, 2013). The best that can be done is to build a higher, more solid wall, and invest more in earthquake engineering, floodgates and land use planning.

In the event of an earthquake, however, there are a number of incentives that can be provided to people to mitigate the effects as a result of earthquakes.

Since most of the deaths in earthquakes are not caused directly by the seismic movements, but by the secondary effects of the movements (Smith, 2013), financial incentives, including financial tax incentives, can be provided for retrofitting houses to make them earthquake resistant and also help lower insurance costs.

Furthermore, in urban Japan, strict building codes are followed but there still needs to be a greater outreach in the rural areas for earthquake engineering.

Also, implementing pre-incident training and testing can help manage the risks. There needs to be effective programs that governments should include in part of academic curricula and legislations need to be passed to have drills every few months (Smith, 2013). Similar disaster relief drills should also be exercised by the law enforcement agencies.

Finally, land use planning efforts, such as the revised energy and land use policy in Japan, should be strictly implemented. Sensitive installations, such as the nuclear plants, should be gradually replaced with more sustainable energy options such as wind, tidal and hydropower along the coasts (Wood, 2011). In case of any calamity, the focus can be directed towards the actual relief efforts caused as a direct effect of the tsunami rather than dealing with secondary repercussions of the disaster.

CONCLUSION

Even today, Japan is prone to earthquakes and tsunamis due to its geographic location, and there is no 100% efficient forecasting system which we can use to prepare for a high magnitude disaster. It would be necessary to say that Japan needs to improve on its system to mitigate such disasters in the future. Newer policy and strict implementation can make sure that Japan remains at its safest given its vulnerable geographic location. New land use plans should accommodate for a rehabilitation of the communities as reasonably far away from the coastal areas of Japan. The Japanese military, police, and organisations should coordinate in case of such disasters in the future. In conclusion, mitigation efforts for tsunamis leave us with limited options, however, we can compensate that with an efficient post-disaster recovery system.

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