

# Earthquake and Tsunami

## Preparedness and Response:

The disparity between developed and developing nations

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Due: Thursday, May 12<sup>th</sup>, 2011

## Preface

The purpose of this report is to explore the devastating effects of seismic activity on developed and developing countries. This report will focus on the physical impact of these natural disasters and investigate the politics of aid, the difference in response between developed and developing countries and how these nations can improve their future emergency preparedness.

The issue of seismic activity is world wide. These activities are a natural process and are unavoidable. We must adapt to the conditions that the plate tectonics provide because there is no real way that we are able to avoid them. When a seismic activity occurs there can be devastating consequences.

Plate Tectonics is defined as “a theory of geology developed to explain the phenomenon of continental drift” (wordiq, 2010). This theory was developed in the 1960’s while other theories of seafloor spreading and continental drift were being explored. The world is made up of seven major plates, African, Antarctic, Australian, Eurasian, North American, South American, and the Pacific. There are also some smaller plates including, Arabian, Nazca and Philippines. All of these plates have different boundaries and have different consequences when they shift (cotf.edu, 2005). The results of the shifts can include devastating earthquakes, tsunamis and volcanic eruptions.

The conditions created with plate tectonics is world wide. Because it is wide spread it can affect large numbers of people. There is a wide range of

impacts, from a tsunami sweeping away an island to an earthquake shaking a city to ruins. Emergency preparedness is lacking in developed countries and is even worse in developing countries; in many cases there is no training done to educate people about what to do in a serious situation such as an earthquake. Most developing countries do not have the technology or economic systems to help themselves when disasters occur.

The politics around aid can get very complicated when dealing with governments. Aid organizations are only authorized to enter a disaster zone when granted permission from the government of the country. Aid can also be used as bribery or a “favour” (Pat Watson, 2011).

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## Summary

This report will discuss the worldwide phenomenon of seismic activity and its effects on the developing and developed countries. This report will focus on the differences in the preparedness and response of developing and developed nations. It will touch on the subject of foreign aid and the politics of foreign aid. The importance of this issue will be emphasized in the case studies that are explored in later portion of the ISU. They include the 2004 tsunami in Indonesia, the 2010 earthquake in Haiti and the 2011 earthquake and tsunami in Japan. The role of control in a natural disaster will be discussed; as well as the religious views on seismic activity. Much research has been conducted on the countless NGO's (non-governmental organizations) and the IGO's (inter governmental organizations) that provide aid for the countries in the case studies presented. In addition, all the information in this report will relate back to Canada, and the role we play in responding to these disasters. In conclusion, this report will discuss possible solutions that can address the preparedness and response of developing and developed nations.

## Background

The issue of seismic activity is worldwide. There is no way that we can prevent or control the activity. We must adapt to the reality that seismic activity exists and focus on what we can control to mitigate the impacts of natural disasters that accompany seismic this.

To minimize and mitigate the impact of seismic activity, humans need to first get a better understanding of the science of seismic activity around the globe. We need to answer the questions of what, where and how. Second, what can we do to predict seismic activity and minimize the impact through early detection systems, planning and minimizing development in those areas of high impact? Third, how do we best respond once the seismic activity occurs? This can best be accomplished by learning from past disasters and preparing plans that reflect the type of disaster, the economies of the region, and the social/ cultural background of the countries affected.

Seismic activity is: "An earthquake (also known as a quake, tremor, or temblor) is the result of a sudden release of energy in the Earth's crust that creates seismic waves". This release of energy is a result of a natural process called plate tectonics which occurs in the outer shell of the earth called the lithosphere (google.ca, 2011).

The earth is made up of several tectonic plates. There are seven major plates: African, Antarctic, Australian, Eurasian, North American, South American, and the Pacific and there are eight smaller plates: Nazca Plate, Carribean Plate, Cocos Plate, Juan de Fuca Plate, Arabian Plate, Indian Plate, Philippine Plate and the Scotia Plate. Each plate borders other plates but they all have different types of boundaries. There are three different types of boundaries: Divergent, Convergent and Transform Boundaries (cotf.edu, 2005). Each boundary can have somewhat of a different effect.

A Divergent Boundary is defined by two plates (faults) pulling away from each other. A Convergent Boundary occurs when two plates collide when shifting. A Transform Boundary occurs when two plates slide past each other. There are two different types of tectonic plates. There are Oceanic plates and Continental plates.

A Continental plate is above sea level and is made of very thick rock. An Oceanic plate is below sea level and is thinner than a Continental plate (SC, 2010).

The Richter scale is the scale used to measure earthquakes. This scale was invented in the 1930's by Dr. Charles Richter. The Richter scale measures the "magnitude" of an earthquake which is how we define how disruptive the earthquake is. To measure the magnitude of an earthquake a



magnitude 5 earthquake



magnitude 6 earthquake



magnitude 7 earthquake

machine called a Seismogram is used. This machine studies the shaking of the earth. Each increase of magnitude is ten times worse than the one before. For example, a magnitude six is ten times worse than a magnitude five. The Richter scale has no limit, so an earthquake can be small or large; it depends on the magnitude which changes with every earthquake. The largest earthquake ever recorded on the Richter scale was 9.5 magnitudes in Chili in 1960 (Tremor, 2008).

There are very clear differences when it comes to the preparedness and response between developing and developed nations. Developed countries have the human, technological and financial resources to deal with a disaster. Technology could be anywhere from a television to warn people about a storm, to a tsunami detector system. In developed countries, there are many more ways to be prepared. Developed countries have training systems in place. These people are trained to respond in a disaster situation, in or out of their country. For example, in Canada there is a preparedness plan, for preparation they create emergency response plans, mutual assistance agreements, resource inventories and training, equipment and exercise programs. In response they will have, emergency communication, search and rescue, medical supplies and evacuation plans (PC, 2011). Appendix A, shows Canada's west coast where there is a great chance for the tectonic plates to shift and cause an earthquake.

In developing countries they are not as fortunate and do not have the human, technological and financial resources or awareness to protect themselves from the destruction a natural disaster can cause. For example, in Haiti, before the earthquake hit, they had one seismometer in the country and it was used in a high school for teaching.

## **Expert: Eric Calais**

Eric Calais was born September 15, 1964 in Paris, France. He is a French citizen and has permanent residency in the USA. Calais is a professor of Geophysics at Purdue University in Indiana, USA. He has a degree in earth science from the University of Breast. Mr. Calais received a PhD in earth science from the University of Nice in France (web, 2010).

Mr. Calais has received multiple awards. In 2008, he received the "Jacob-Fallot-Jérémime" award from the French Academy of Sciences. In 2005, Calais was presented with the University Faculty Scholar from the university he is employed by, Purdue University. In 1992 and 1993 he received the postdoctoral fellowship from NATO (web, 2010).

Calais has a few different interests with his research. He studies current plate motions and plate boundary deformations with active plates. This brings us to his current role in this issue of seismic activity. In 2010, Mr. Calais was elected as Co-Chair of the United Nations Haiti Earthquake Risk Reduction Task Force (web, 2010).

He has done many things to help with the situation in Haiti. He took a one year leave from this research to help run the Risk Reduction Task Force program. His work on the task force has had several positive outcomes. He has been creating a seismic hazard map for Haiti that helps architects learn about the grounds that they are building on. Also, what type of seismic activity a building they build will

have to withstand, on those grounds. He has also started to train two local engineers as seismologists. Funding has been provided for him to open three seismic stations in Haiti as well. Creating hazard maps and opening seismic stations will help Haiti better predict and prepared for future earthquakes. In addition, training the seismologist will help spread the awareness of earthquake preparedness through the government (Nicola Jones, 2010).

Creating hazard maps, training seismologist and opening seismic stations will help Haiti better monitor, predict and prepare for the next earthquake. It will also help inform and educate both the people and government of Haiti of the need for better emergency preparedness.

## Role of Control

So who has the control in this situation? As discussed earthquakes are part of a natural process of which we have no control and the potential for destruction, and loss is devastating if populations and communities are not prepared. However if countries understand the risks and are prepared, they do have control over the degree of the human loss and infrastructure destruction.

Human beings have a constant need to control things, and what they cannot control, scares them. This lack of control explains why natural disasters are so terrifying. An earthquake could happen right now and cause major chaos but there is nothing that we can do to stop it. What we can do is control the aftermath of the situation.

To have control in the time following a natural disaster can be very powerful. So then who does have the control? The level of control can be gauged by the degree of preparedness, financial resources and the type of aid provided. Aid is the main control in a disaster situation. If aid does not arrive, a situation can not move forward and improve. Therefore, countries that can provide aid are given the role of control.

Earthquake disasters around the world like Japan, Haiti and Indonesia have proven that both developed and developing countries need some level of aid.

Unfortunately, developing countries are more vulnerable to the loss of control of

aid situations because much of the aid is controlled from outside governments and agencies.

There are different types of aid. Tied aid, is used when donor countries can benefit economically by investing aid money in another country. For a country to receive aid they must buy services or goods from the donor country. This arrangement is a large manipulation process (SC, 2011).

Aid is also controlled by the government of an effected country. Unless that government seeks assistance no aid can be provided. Aid organizations and their workers are not permitted to enter a country to help until they are granted permission from the receiving countries. This condition delays the response and help that is waiting. Reasons for governments not wanting to accept aid can stem from the idea that it is ruining the "pride" of the country. A leader of a country wants to be seen as strong and able to help their people but a moment of weakness can hurt their pride (Pat Watson, 2011).

## Religious and Spiritual Views

In a natural disaster people search for ways to deal with the stress and hardship that comes with a situation where they have lost control. A natural reaction from people during their times of hardship is to pray and turn to religion and spiritual help to provide comfort and the internal strength to overcome and deal with the situation at hand. They rely on their religion or spiritual beliefs to help them cope with the hard times. They look to a higher power to help them in their desperate situation. For people, having their religion or other beliefs gives them hope and that is something that no one should give up during a difficult time.

When disasters hit, a village can be physically split in half or crumbled to ruins. But this devastation can also bring everyone together in the end. People not only pray for themselves but everyone around them.

There are many old stories and myths told about volcanoes and religion. For example, in Hawaii there is Madame Pele, who is goddess of volcanoes. Everyone who visits is told not to take rocks from the volcanoes because it is bad luck to do so.

In Africa, many people practice Mana. Mana is a Pacific Islander concept of impersonal force of people, animals and inanimate objects. This religion believes

that the dead that are in the underworld are causing earthquakes (britannica.com, 2011).

There are many other religious explanations, such as; the cultures that believe in the man bearing the weight of the world on his back. When the man switches shoulders to share the weight, it causes an earthquake (britannica.com, 2011).

## **Case Study #1: Indonesia and surrounding countries**

Indonesia and the surrounding countries can be identified as developing countries. The natural disaster commonly known as "The Boxing Day" tsunami; on December 26, 2004 was the result of a massive earthquake on the sea floor of the Indian Ocean just off the coast of Sumatra, Indonesia. The earthquake was later recorded as a 9.3 magnitude on the Richter scale. It originated on the ocean floor closest to Sumatra, Indonesia, the worst hit spot by the disaster. The earthquake lasted approximately 10 minutes. It is the longest recorded earthquake ever (Fleury, 2008).

After the earthquake hit, devastating in itself, a tsunami soon followed. The wave travelled in a north east direction. The wave hit Sumatra Indonesia, Thailand, India and Sri Lanka, Somalia and the southern tip of Africa.

The total death toll for this earthquake and tsunami was, according to the UN, 229,866 people that were dead, lost or missing (Fleury, 2008). Because this disaster happened during Christmas there were many tourists which may have raised the death toll.

It is clear by the amount of devastation and death toll that these countries were not prepared for this natural disaster. As a result of this disaster, some countries and world organizations have reevaluated their emergency preparedness.

This has been a learning experience for everyone. At the time of this disaster there was no tsunami warning system in place in the Indian Ocean. As of 2006, a warning system has been installed in the Indian Ocean for better preparedness (Fleury, 2008).

One of the lessons learned concerns the removal of natural barriers. There are many natural barriers that have been destroyed that could have helped reduce the amount of devastation caused by the tsunami. Some coral reefs have been removed to make way for fish farming and boating. Coral reefs are a natural way to reduce the impact of a tsunami wave because the reef can slow the wave. Trees on the shoreline have been cut down and sand dunes have been flattened to make beaches and these aspects of the shoreline could have helped slow the impact of the wave or help make the wave less damaging (Fleury, 2008).

Another lesson learned from this tsunami is around emergency preparedness. "Generally speaking, we have learned that tsunami presented us with a chance to improve ourselves not only in Aceh but also at the national level," said Titi Moektijasih. After the tsunami, Indonesia parliament put a law into place to address disaster management (UN, 2009).

When the tsunami hit Japan in March of 2011 Indonesia realized they are still not prepared well enough, if another tsunami were to hit. If a developed country such as Japan can be reduced to rubble in a natural disaster with all their

preparedness than a developing country which doesn't have all the same resources will find it difficult to prepare for an equal disaster. This year Indonesia plans on spending 13 trillion Indonesian rupiah on disaster mitigation (ANY, 2011).

Malteser International is a German organization that provides disaster preparedness and also provides assistance when a disaster occurs (MI, 2011). Malteser International has gone into 11 different villages and trained people in search and rescue. They have trained 20 volunteers from each community to be a "disaster preparedness committee". They have been trained in search and rescue, to help evacuate villagers and have first aid training as well (trust.org, 2011). This program is helping Indonesia build a brighter future. Hopefully, in the future Indonesia will have sufficient training to be able to respond to a disaster like the 2004 tsunami.

## Case Study #2: Haiti

Haiti is classified as a developing country. On January 12, 2010, a 7.0 magnitude earthquake hit the small island of Haiti. The epicenter was about 15 miles away from Port-au-Prince. Fifty-nine aftershocks followed the initial earthquake. The earthquake caused chaos and widespread destruction.

The Haiti earthquake was devastating, killing over 220,000 people and displacing many more (Reuters, 2011). It has been estimated that the reconstruction will cost over \$14 billion US (CBC, 2010).

The Haitians were clearly not prepared for a disaster such as this. "Many Haitians grabbed cement pillars only to watch them crumble in their hands. Haitians were not schooled in how to react - by sheltering under tables and door frames, and away from glass windows" (Huff, 2010). They were not trained on how to handle a situation as this; therefore, their lack of preparation hindered their response. This statement, "Aid agencies usually focus on response. It's a new thing to spend money on prevention and mitigation. It's sad it takes 250,000 people dead to get to that point, but we're there now", made by Eric Calais clearly defines that Haiti was not prepared well enough (Nicola Jones, 2010).

When this earthquake hit, it was very big news and donations started flooding in. The American Red Cross received more the \$479 million in Haiti relief

money. This money was used to provide food to help more than 1 million people, drinking water, emergency shelters, cash grants, medical care, vaccinations and latrines (Redcross, 2011). Though there is plenty of aid being delivered to Haiti, it is not enough to help the 3 million people that need food and water (Hub,2011).

Plans are now underway to help Haiti become more prepared for the future. Equipment is being installed, Haiti's first ever seismic hazard map is being developed and two locals are being trained as seismologist. Eric Calais is a geophysicist from an Indiana university and he has come to Haiti to help lead a disaster risk reduction program. He is gathering information on Haiti's fault lines to help create a Hazard map. He has also been looking at the soil types to help determine the vibrations from the ground. These different maps will help architects know the conditions under which the buildings that they will build will have to withstand for the next 50 years. Funding has been provided to install three seismic stations around the country on top of the three that were installed immediately after the earthquake (Nicola Jones, 2010).

Currently Haiti has no seismologist. Two Haitian engineers have stepped up and will be enrolled into a master program for seismology in the United States. It will be good to have seismologist in Haiti because they can help keep building codes up and fight for earthquake preparedness from the government. They will also be there to run the seismic stations (Nicola Jones, 2010).

## Case Study #3: Japan

Japan is considered a developed country. On March 11, 2011, an 8.9 magnitude earthquake occurred, originating off the coast of Japan. This earthquake triggered a devastating tsunami.

The earthquake has been estimated at possibly costing up to \$235 billion (mode, 2011). Also, a big threat in Japan is the Fukushima Nuclear power plant. When the earthquake hit causing the tsunami, it flooded the back up generator for the plant. This prevented the cooling system from cooling the reactor which, resulted in the explosion, and partial meltdown of the reactor, and release of radio active gases into the air and water (recovered, 2011).

Japan was well prepared for this type of disaster. Although the damage was huge, the authorities were quick to respond, and were able to avoid a worse crisis (Rt.com, 2011). Japan has annual emergency training sessions for response crews. They learn how to help people, such as remove them from a car or administer first aid (CTV news broadcast). Japan is always prepared for earthquakes because the ground shakes at least once a month. These shakes prepare them for something big that might occur. Japan has a sea wall to protect it from the ocean which would have helped reduce the impact of the tsunami. Japans preparedness saved many lives.

"When you have an earthquake in developing countries, they die. In the developed countries, they pay" (STR, 2011). This quote is a good way to describe the difference between the preparedness and responses between developed and developing countries. In developing nations they are not prepared well enough to be able to help their whole population therefore many die. But, in a developed country we have a lot more physical possessions that we can lose.

Not all countries can afford the level of preparedness for all natural disasters. Emergency preparedness needs to reflect actions that various countries can afford to implement, as well as a global aid plan that can assist nations when they need it.

## International Organizations

There are many different organizations that help countries when disasters hit. They can be NGO's (non-governmental organizations) or IGO's (inter-governmental organizations) or religious organizations. No matter what type, they put in their fair share of effort to help people in need.

An NGO is a non-profit group that can be organized on any level, from local to international. Some examples of these types of organizations are, The Canadian Red Cross, The Salvation Army, and Samaritan's purse.

The Red Cross is probably one of the most popular and acknowledged organizations. The Canadian Red Cross was founded on May 19<sup>th</sup>, 1909. In Canada the main focus is on emergency response, first aid and water safety training, community health, family reunification, and other services. The Canadian Red Cross is part of the International Federation of Red Cross and Red Crescent Society, which has over 100 million volunteers (Redcross, 2010).

The International Federation of Red Cross and Red Crescent Society (IFRC) is the larger organization. This organization was founded in 1919 after World War 1. The IFRC is formed of 186 Red Cross and Red Crescent Societies. The vision of the IFRC is:

"To inspire, encourage, facilitate and promote at all times all forms of humanitarian activities by National Societies, with a view to preventing and alleviating human suffering, and thereby contributing to the maintenance and promotion of human dignity and peace in the world." (ifrc.org, 2011).

"The IFRC carries out relief operations to assist victims of disasters, and combines this with development work to strengthen the capacities of its member National Societies. The IFRC's work focuses on four core areas: promoting humanitarian values, disaster response, disaster preparedness, and health and community care" (Ifrc.org, 2011). Disaster response is one of the IFRC's biggest priorities. They help approximately 30 million people each year in response to disaster refugees. They have pre-trained teams of volunteers and equipment prepared and ready to be put in use during a disaster at short notice (Ifrc.org, 2011).

The Salvation Army first started its work in Canada in 1882. This organization is an international Christian church. Its mission statement is:

"The Salvation Army exists to share the love of Jesus Christ, meet human needs and be a transforming influence in the communities of our world."

(SA, 2011)

The Salvation Army is equipped to handle any demands that are asked of them. In disasters they are often assigned roles such as, counseling, registration and identification, emergency housing, food and clothing (SA, 2011).

Samaritan's Purse is a nondenominational Christian organization. This organization has been operating since 1970. They provide spiritual and physical aid to hurting people. They provide emergency relief when needed. They usually provide food, water and temporary shelters. The mission of the Samaritan's Purse organization is:

"To meet emergency needs in crisis areas through existing evangelical mission agencies and national churches" (samaritanspurse.ca, 2011).

There are literally hundreds of NGO's dedicated to helping peoples and communities in natural disasters; however the problem is coordinating this aid. Proper coordination can help improve the response times, the efficiency and effectiveness of the aid and the recovery time. Organizations like the United Nations and its Disaster Assessment and Coordination team do coordinate these large scale disaster relief activities. The UN relies on assistance, both financial and direct on the ground help from NGO's and member countries.

## Canada's Role

On average, there are approximately 1500 earthquakes every year in Canada. Out of these 1500, about 100 reach 3 magnitudes on the Richter scale which can be felt by humans. British Columbia is assumed to be the place with the most seismic activity in Canada. It rests on the fault of the North American plate and the Pacific plate. There is potential for a Japanese style earthquake and tsunami on the west coast of Canada. The government of Canada and British Columbia need to have disaster plans to deal with such epic events. Part of this plan requires working with international organizations in other countries to design and implement disaster and risk reduction plans for the future. As shown in Appendix A, on Canada's west coast there is a great chance for the tectonic plates to shift and cause an earthquake.

Canada has a preparedness plan that details the need for emergency response plans, mutual assistance agreements, resource inventories and training, equipment and exercise programs. In response, they will have emergency communication, search and rescue, medical supplies and evacuation plans (PC, 2011).

For disasters abroad, Canada donates massive amounts of money and relief to natural disaster causes. Canadians raised approximately \$16 million for Haiti (Amy Judd, 2010).

When disasters strike abroad the Department of Foreign Affairs and International Trade (DFAIT) and the Canadian International Development Agency (CIDA) coordinate relief efforts for the Canadian government. Working through partners such as IFRC and United Nations agencies, Canada provides humanitarian aid through financial contributions, and direct assistance on the ground. Direct assistance can take the form of deploying the Disaster Assistance Response Team known as DART. This team has over 200 Canadian force personnel that provide non-medical assistance and fresh water relief (international.gc, 2011).

## Possible Solutions

There are many different solutions that can be conceived, all coming from different angles. Some possible solutions are: moving people away from tectonic fault lines, helping developing countries prepare better for situations such as the case studies discussed and improving responses for disasters that hit.

Moving people away from fault lines can help reduce the chaos and the people affected. If there are less people around the fault lines then it can help reduce the death tolls in some situations. This action will help with people having to deal with the devastating loss of a family member, or a friend. As well it can help minimize the cost of the disaster. If there are fewer people and infrastructures in an affected area, then there will be less damage. This will obviously help the state of the situation as less damage means less money needed for repairs.

Helping developing countries be more prepared for disasters like an earthquake or tsunami, or any other type of natural disaster, will help them when a disaster occurs. There would be a faster emergency response time. This preparation would bring down the fatality rate, as well as having people trained with first aid would help.

Installing more tsunami warning systems on the coastlines, of not only developing, but also developed nations would help with the preparedness of

countries. It will help people feel more secure and ready. The system will alert people when a tsunami is about to hit so people can be ready for the impact. These early warning systems will be accompanied by emergency evacuation procedures.

Natural barriers should be left where they originate. Structures such as a coral reef can slow a tsunami wave, which in turn would reduce the impact of the wave. A lighter impact would mean less casualties, less damage done to infrastructure, and less money spent on clean up.

Public awareness and education campaigns are also necessary if emergency preparedness is to be effective. If people are more aware of this issue then it would increase the extent to which people are prepared for a natural disaster. A family in an earthquake prone zone can have an earthquake drill that could be used in the same way as a fire drill plan.

Although natural disasters like earthquakes and tsunamis cannot be prevented, people can minimize and mitigate the damage and loss of life associated with the horrendous events. We do have some level of control as long as we take time to understand the nature of the potential disaster, and are prepared with a thorough and coordinated disaster response plans, and share the financial responsibility, because these are global issues that eventually affect everyone.



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