

Tectonic activity offers varying degrees of challenge for the communities experiencing it. Discuss.

1 – Introduction

Before beginning this report, it is important to note that many forms of tectonic activity do not affect communities at all and a distinction needs to be made between tectonic activity and tectonic hazards. This can clearly be explained by examining Dreggs Model of a Natural Disaster as seen below in *figure 1*.

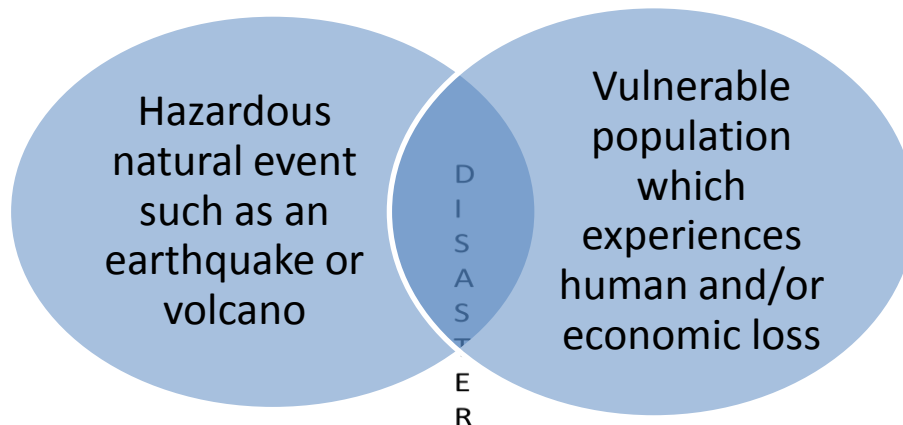


Figure 1 – Dreggs Model of a Natural Disaster

Of course, Dreggs Model can be changed. If the vulnerability of the population is greater due to aspects such as poverty, living on poor land, overpopulation etc, then the circle on the right hand side of Dreggs Model becomes larger, as there is a greater chance of disaster. Also, there are certain aspects of a tectonic event profile (see figure 2), that can make the left hand circle larger, creating a larger population that would be deemed to be vulnerable. For example, a larger magnitude earthquake is going to create a more vulnerable population even in an economically developed country.

Figure 2 - A tectonic event profile comparing the 2004 Asian tsunami (red) to the ongoing eruption of Kilauea on Hawaii (blue).

MAGNITUDE	Enormous		Small
SPEED OF ONSET	Rapid		Slow
DURATION	Long		Short
AREAL EXTENT	Widespread		Limited
SPATIAL PREDICTABILITY	Random		Predictable
FREQUENCY	Frequent		Rare

Therefore, in this essay I will be focusing on tectonic hazards rather than just tectonic activity as these create challenges for people. I will be focussing on earthquakes and volcanoes as primary tectonic hazards, but will also be looking at secondary and tertiary tectonic hazards such as tsunamis, disease and fires. It may be interesting to

note that according to EM-DAT, the number of earthquakes has gone up fourfold since the last century but the economic losses have gone up fourteen fold. However although EM-DAT is a credible source this may be due to advances in international communications and technology e.g.

seismometers. EM-DAT also claim deaths are decreasing – therefore hazards may be becoming more or less of a hazard depending on different perspectives.

What therefore is a challenge? A challenge is a difficult, often large scale problem which requires solutions. Challenges can be economic, social and environmental. They may not necessarily involve death and destruction. (e.g the Eyjafjallajokull volcanic eruption of 2010 which created huge economic and social disruption due to the cancellation of so many flights) Challenges will depend on aspects of the event profile (*see figure 2*). For example, an earthquake with a larger magnitude may create greater challenges than one of smaller magnitude, but also will depend on aspects of the community, such as economic development, the type of land that the community lives on, religious beliefs and politics.

In this report, I will be examining why challenges will be different for different communities. I will be contrasting similar tectonic events leading to disasters to show how economic development can be so important in effecting a challenge (i.e. the Chilean and Haitian Earthquakes of 2010). I will bring in the Parks Model of Response here and contrast the Kobe Earthquake and Managua Earthquake in Nicaragua in 1972 to see how economic development can affect recovery. I will also be looking at challenges that are not necessarily based around rebuilding communities such as the problems caused by the Eyjafjallajokull volcano in 2010. I will also be examining how challenges can be made more complicated when certain social factors come into play such as politics as when different international communities had to face the same challenge together such as in the case of the 2004 Indian Ocean Tsunami.

2 – Research and Methodology

2.1 – Primary Research

Primary evidence was difficult to access due to the lack of volcanic activity in the local region and therefore, few local communities in the area have experienced tectonic activity. However, I managed to interview a number of people in the school who had actually visited some of the places mentioned in my essay. For example, I interviewed a number of students in school who returned late from their 2010 Easter holidays to school due to their flights being delayed from Europe by the Eyjafjallajokull volcanic eruption in 2010, and this was especially stressful as for some of these students, it was the beginning of examination season.

2.2 – Secondary Research

To do this report, the endless array of websites available to me were invaluable but I found the *USGS (United States Geological Society's)* website probably the most useful with all the links it had. I also picked up lots of useful information from news articles read online on the *BBC and the Guardian's websites*. I also watched all of the relevant episodes of '*How the Earth Was Made*' on the *History Channel* which allowed me to view how communities even in areas such as California, with all the technology that they have, are still in the early days of tectonic event prediction and without prediction, vulnerability is still great. Podcasts downloaded off the internet, such as "*Tsunami Research – Keeping People Safe*" and "*The Science of Volcanoes (by the Naked Scientists)*" gave me a huge insight into the challenges that tectonics still hold for communities. The *National Geographic Magazine* was also of good value. An article on "*Surviving the eruption at Mount Pinatubo*" was of special value to me because it included several eye-witness accounts and interviews. *Online essays written on various case studies (such as the 1995 Kobe Earthquake)* were reasonably useful as they allowed me to follow other peoples' analysis of certain factors and events and compare them to my own train of thought. *Megaessays.com* was a good source of online essays.

2.3 – Methodology

I wanted to use recent case studies that emphasised certain points in this essay. For example, when I was discussing how economic development can affect vulnerability for a population, I chose the Chilean and Haitian Earthquakes of 2010 as these were recent earthquakes, with similar event profiles in countries of differing economic development. However, when it came to examining recovery over time, I had to examine less recent tectonic disasters so I examined the Kobe Earthquake in 1995 against the Nicaraguan Earthquake of 1972. I also wanted to emphasise the fact that challenges may not necessarily be based around rebuilding communities and therefore I chose to look at Eyjafjallajökull in Iceland in 2010. Finally, I wanted to look at how challenges can be complicated when they cross international borders and therefore examined the Indian Ocean Tsunami of 2004.

3 – Analysis

3.1 – The Theory of Plate Tectonics

It must be remembered that the Theory of Plate Tectonics, essentially the idea that the earth's crust is made up of many major and minor rigid sections, or plates, that move in different directions and speeds, ranging from about 2-10cm a year in relation to each other (*Source: adapted from cotf.edu, earth section*), is a relatively new one and therefore, the challenges created for communities are enhanced due to lack of knowledge at all levels. This theory is not taken by all communities. For example, the Aeta people around Mount Pinatubo believe that the 1991 eruption was caused through anger of the gods. The challenge for this community therefore differed greatly from the challenge of the Philippine government who were trying to evacuate this community while the people were trying to appease the gods!

3.2. Event Profile

The event profile of a tectonic event (*see figure 2*) determines what type of challenge will affect communities. In many cases it will be the strength of the tectonic event, magnitude for earthquakes and VEI for volcanoes. The differences between these two types of event is that earthquakes tend to give less warning than volcanoes and therefore tend to cause greater destruction, especially when the epicentre is close to centres of population combined with a shallow focus. Earthquakes and their associated tsunamis therefore create different challenges for communities as very little can be done at present before the event. Therefore, the challenge is in preparing the people for the disaster. In many developed countries this is easier. The *Federal Emergency Management Agency (FEMA)*, for example in the USA, (www.fema.gov), is an entire government agency whose aim is to prepare its populace for the eventuality of disaster. When Haiti had their earthquake in January 2010, they did not have this facility and therefore the people were less prepared.

However, even though it is easier to evacuate people from areas of volcanic activity, there are still huge challenges faced by the communities in dealing with them. Volcanic regions are areas of very fertile soil and trying to remove communities from areas of impending volcanic destruction, especially when there are uncertainties over exactly when it will occur, can be a very difficult thing to do. Also, unlike earthquakes, the areal extent of volcanic activity can create problems and in the case of Eyjafjallajökull in Iceland in 2010, problems that crossed international borders. No one was killed by this volcanic eruption but the grounding of so many flights caused huge social and economic problems and the international aviation community now has a challenge in designing engines that will not fail when flying through a volcanic cloud. This is especially sobering when considering what would happen if there was a volcanic eruption today of the scale of Krakatoa in 1883 or Tambora in 1815, where the volcanic cloud was almost global and lasted for up to 1 year!

3.3 – Economic Development

Of course, many tectonic hazards will create destruction but there is no doubt that in areas of higher economic development, the problems will be lessened. This can be for a number of reasons. I have already mentioned FEMA, but to prepare a population against disaster, the population has to be able to access the information to know what to do. An educated, literate populace with access to the Internet, television and other forms of communication is going to be far easier to inform and prepare than an illiterate, uneducated populace, many of whom are in isolated communities.

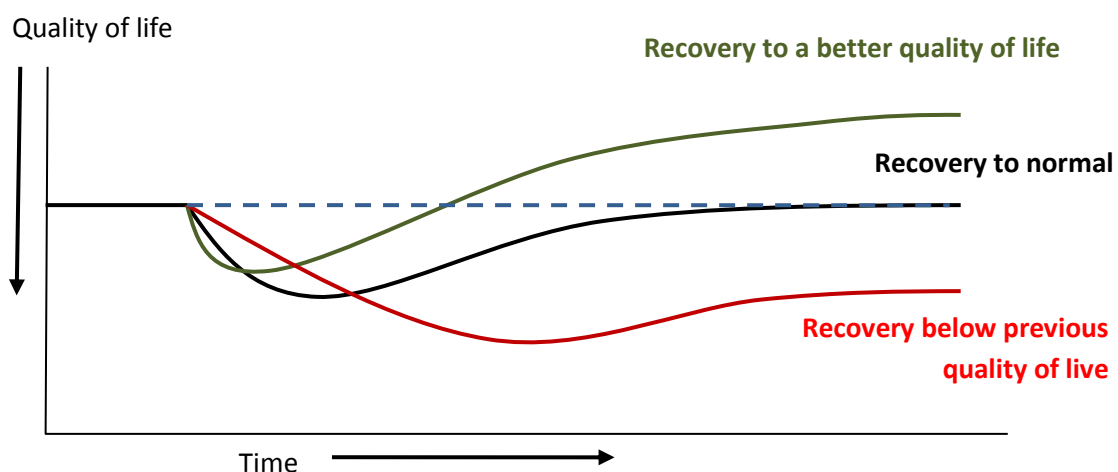
Secondly, of course, more prosperous countries have the ability to mitigate. They can build earthquake proof buildings and prepare evacuation zones. This can be highlighted if we compare the two major earthquakes of 2010 in Chile and Haiti. The Chilean earthquake was of a magnitude of 8.8, while the Haiti Earthquake was a 7.0, yet 230,000 people died in Haiti against 7000 in Chile. There were aspects of the earthquake's event profile that need to be considered such as the fact that the epicentre of the Haiti earthquake was 8km from Port Au Prince the capital compared to 60km from the nearest town in Chile. So why were there so few deaths in Chile? One major reason was building design. According to an article on the BBC News website of May 17th 2010, '*Chile has developed a seismic design code for new buildings, which has made them better able to stay standing in an earthquake*'.

There are also aspects of development that are less obvious. Many poorer countries tend to have more vulnerable populations purely because of where they are living. The amount of deaths in landslides in the favelas of Brazil and the destruction of homes in the 2010 floods of Pakistan were all caused as people should not have been living in these areas. In the Haitian earthquake of 2010, people were living on poor land so that when the earthquake occurred the soil liquefied. This also happened in parts of Chile but the reasons it occurred in Haiti were to do with that the soil had been made poor by deforestation as the people had to use the wood for fuel.

3.3.1 – Economic Development and Recovery

Of course, one of the biggest challenges facing communities is dealing with the disaster after it has occurred, and economic development really plays a part here. We can use the Parks Response Model to help us here (*see figure 3*)

Figure 3 – Parks Model of Hazard Response



We do not know what the recovery is going to be like for both Chile and Haiti but if we examine two similar earthquakes from the past, we can get a good idea of the challenges that are going to be facing both communities. The Kobe Earthquake of 1995 was a major wake up call for the Japanese and created huge challenges for them. However, as they were an economically developed country they were able to address these challenges. They installed rubber blocks under bridges to absorb the shock and rebuilt buildings further apart to prevent them from falling like dominoes. They changed the way that management of disasters was dealt with. In response to the widespread damage to transportation infrastructure, and the resulting effect on emergency response times in the disaster area, the Ministry of Land, Infrastructure and Transport began designating special disaster prevention routes and reinforcing the roads and surrounding buildings so as to keep them as intact as possible in the event of another earthquake. The government invested millions of yen in the years following the quake to build earthquake-proof shelters and supplies in public parks. On the Parks Model in *figure 3* they have recovered to a better way of life.

If we contrast this to the 1972 Nicaraguan Earthquake that devastated the capital Managua, it changed the face of the city forever. The lack of funds made the long term response difficult especially as much of the funds were lost through corruption. Many people still, 38 years later, live in poorly built shanty towns on the edge of the city. (*Source: BBC archives*) On the Parks Model their recovery is still below the previous quality of life in 1972.

3.4 – Politics

One of the challenges facing communities is when politics comes into play. This can be if tectonic hazards cross international borders, as was the case in the 2004 Asian Tsunami. The challenges were getting together to form a response and that response came with the setting up of the Indian Ocean Tsunami Warning System. However, it is strange that it took this devastating event to put this into place as the Pacific Ocean has had a tsunami warning system since 1949, in response to the 1947 Alaskan Tsunami.

Political stability can also affect recovery and sometimes it is a challenge for communities to sort out their internal infrastructure in order to give the best protection and response to tectonic hazards as can be done. For example, in Izmit in Turkey in 1999 there was a magnitude 7 earthquake. It killed 17,000 and left 300,000 homeless, mostly due to corruption in industry and policing as building regulations, although they existed, had not been enforced and so poorly constructed buildings fell.

4. Conclusion

So therefore, tectonic hazards create challenges for all communities especially when dealing with extremities to do with the event profile of the hazard. No country, however developed can be prepared for earthquakes with a magnitude of over 9 when the epicentre is close to centres of population. However, economic development obviously is important in overcoming challenges. The ability to mitigate is so obvious by looking at the amount of deaths in the 8.8 magnitude earthquake in Chile compared to the 7.0 magnitude earthquake in Haiti. Economic development, in some cases can even modify the event as in the case of Kilauea on Hawaii where diversion channels have been put in place to stop the lava from flowing onto highways. I have also shown how economic development affects recovery over time in the case of Kobe against Managua. However, there are still immense challenges that face communities. Ignorance of many communities is still a major factor in disasters and making communities aware of the dangers that face them as well as providing them with advice on what to do is one of the greatest challenges facing many communities today. Surely this is linked to economic development. For example, Haiti has a literacy rate of 45% so it immediately becomes more difficult to prepare these people for disaster.

However, there are other factors beyond economic development that are going to continue to create challenges. How, for example will the aviation industry deal with another Eyjafjallajökull. How is corruption going to be overcome in countries such as Taiwan and Turkey so that any measures put in place to deal with tectonic eventualities are dealt with.

However, tectonic activity does not always have to be a negative challenge if it is managed. Iceland for example, uses their tectonically active landscape for tourism and geothermal energy to heat their water! They are lucky though to have a thin population density, non-viscous lava and a non-corrupt government and high economic development.

5. Evaluation

For this report, there was a huge range of information at hand and a huge amount of case studies. A lot of case studies contradict any generalizations so it is very difficult to put all the necessary information onto paper in 1 and a half hours. With regards to finding information, a lot of good information could be found on Wikipedia but I have been taught not to use it as a single source. What I therefore did was find information on Wikipedia and then back it up with information from more reputable sources such as the USGS, However, Wikipedia was a good starting point for the investigations, especially considering the amount of information on the web about tectonic events.