UNIVERSITI PUTRA MALAYSIA

IMPACT OF NATURAL DISASTER ON HUMAN CAPITAL, BIODIVERSITY LOSS AND INFECTIOUS DISEASE

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By

HARPALJIT KAUR A/P PRITAM SINGH

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfillment of the Requirements for the Degree of Doctor of Philosophy

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Doctor of Philosophy

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HARPALJIT KAUR A/P PRITAM SINGH

August 2018

Chairman : Professor Muzafar Shah Habibullah, PhD
Faculty : Economics and Management

Natural disasters have become among the most pressing issues facing the world today. It is becoming more recurrent and more intense worldwide in the recent decades due to changes in the global climatic environment and has affected not only the human development drastically but has tremendous impact on biodiversity loss and on the increasing risk of infectious diseases. Many studies have been done at micro level, however, to the author's knowledge; the number of studies carried out to empirically investigate the impact of natural disasters, at a macro level, on human capital is rather limited, exception to Cuaresma (2010) and McDermott (2012).

The study employed two methodologies to achieve its objectives. For the first objective, the study employed system Generalized Method of Moment (GMM) to examine the impact of total disasters and four individual types of natural disasters (floods, storm, drought and earthquake) on secondary and tertiary school enrollment rates using panel data for 104 countries over the period 1970 to 2014. For robustness check, each natural disasters was measured using four proxies; the number of occurrences, number of deaths, number of people affected and total damages. The analysis is then extended by including a measure of the one-period lagged natural disaster whereby all the natural disaster variables are estimated with a lag to capture the delayed effect of these variables on the enrollment rates. Employing the system Generalized Method of Moment (GMM) model, we find that the number of occurrences of natural disasters and disaster related losses (number of deaths, number of people affected and total damages) decreases the enrollment rates. The magnitude of these effects differs significantly across the types of natural disasters and disasters like storm and floods have a delayed effect on secondary school enrollment.

For the second objective, ordinary least square and quantile regression are employed to study the effect of natural disasters on biodiversity loss. Biodiversity is declining rapidly in many parts of the world and during this same period, the population growth of humanity has nearly doubled, rapid urbanization, logging and conversion for agriculture have caused forest to be at jeopardy and have increased the rates of species extinction globally. In the present study, OLS and quantile regression were employed. The findings indicate that occurrences and damages affected positively all the four threatened species for all the quantiles differently.

The third objective of the study employed system GMM to examine the effect of natural disasters on the prevalence of malaria cases in 79 countries during the period 2008 to 2014. For robustness check, natural disaster was measured using two proxies; the number of occurrences and the number of people affected for total disasters and floods. It is found that positive association exist between these two measures of natural disasters with malaria prevalence throughout the nations.

Based from the findings, the study suggests that the government and policy makers place greater emphasis on the importance of disaster preparedness and risk reduction for different level of education. In addition, since education is vital to reduce the cycle of poverty and to improve income and health in the long-term, the government should prioritize the restoration and reconstruction of damaged schools and education related infrastructure, with high quality materials that can withstand the impact of disasters, hence reduce the prolonged disruption to schooling. Policy makers should also create new alternative places for the students to study and establish campaigns to create awareness to the public about the importance of continuation of schooling after disaster.

Bolder steps need to be taken in order to conserve and preserve the species, flora and fauna through the efforts of reforestation such as the mangrove project, which will dampen the impact of disaster related losses caused by tsunamis and hurricanes and create job opportunities. With the rapid increase in population growth and the value of economic activity, the government need to increase protected areas and restoration projects besides enforcing strict laws, to ensure the safety of the threatened species. These steps will help the economy of the country by attracting tourism. Finally, policy makers and government should improvise prevention and control measures for minimizing infectious diseases, especially in the aftermath of natural disasters.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

IMPAK BENCANA ALAM KE ATAS PEMBANGUNAN MANUSIA, KEHILANGAN BIODIVERSITI DAN PENYAKIT BERJANGKIT

Oleh

HARPALJIT KAUR A/P PRITAM SINGH

Ogos 2018

Pengerusi : Profesor Muzafar Shah Habibullah, PhD
Fakulti : Ekonomi dan Pengurusan

Bencana alam telah menjadi antara isu yang paling mendesak yang dihadapi dunia hari ini. Ia menjadi semakin berulang dan lebih ketara di seluruh dunia pada dekad-dekad kebelakangan ini disebabkan oleh perubahan dalam persekitaran iklim global dan telah memberi kesan bukan sahaja kepada pembangunan manusia secara drastik tetapi mempunyai kesan besar terhadap kehilangan biodiversiti dan peningkatan risiko penyakit berjangkit. Banyak kajian telah dilakukan di peringkat mikro, bagaimanapun, pada pengetahuan pengarang; bilangan kajian yang dilakukan secara empirikal untuk mengkaji kesan bencana alam, pada tahap makro, terhadap modal insan agak terhad, kecuali Cuaresma (2010) dan McDermott (2012).

Kajian ini menggunakan dua metodologi untuk mencapai objektifnya. Untuk objektif pertama, kajian ini menggunakan sistem 'Generalized Method of Moment' (GMM) untuk mengkaji kesan bencana total dan empat jenis bencana alam (banjir, ribut, kemarau dan gempa bumi) ke atas kadar pendaftaran sekolah menengah dan pengajian tinggi menggunakan data panel untuk 104 negara dari tempoh 1970 hingga 2014. Bagi ujian kelasakan, setiap bencana alam diukur menggunakan empat proksi; bilangan kejadian, bilangan kematian, bilangan orang yang terjejas dan jumlah kerosakan. Analisis itu kemudiannya dilanjutkan dengan memasukkan satu ukuran bencana alam yang tertinggal satu tempoh di mana semua pembolehubah bencana alam dianggarkan dengan lag untuk memahami kesan tertunda pembolehubah ini pada kadar pendaftaran. Menggunakan sistem 'Generalized Method of Moment' (GMM) model, kita mendapati bahawa bilangan kejadian bencana alam dan kerugian yang berkaitan dengan bencana (bilangan kematian, bilangan orang yang terjejas dan jumlah kerosakan) menurunkan kadar pendaftaran. Impak kesan ini berbeza secara signifikan merentasi jenis bencana alam dan bencana seperti ribut dan banjir mempunyai kesan tertunda pada pendaftaran sekolah menengah.

Untuk objektif kedua, regresi kuadrat kuantitatif biasa dan kuantil digunakan untuk mengkaji kesan bencana alam terhadap kehilangan biodiversiti. Biodiversiti merosot dengan pesat di banyak tempat di dunia dan dalam tempoh yang sama, pertumbuhan populasi kemanusiaan hampir dua kali ganda, urbanisasi pesat, pembalakan dan penukaran untuk pertanian telah menyebabkan hutan berhadapan bahaya dan telah meningkatkan kadar kepupusan spesies di seluruh dunia. Dalam kajian ini, regresi OLS dan kuantit telah digunakan. Penemuan kajian menunjukkan bahawa kejadian dan kerosakan terjejas secara positif semua empat spesis terancam untuk semua kuantil secara berbeza.

Objektif ketiga kajian ini menggunakan sistem GMM untuk mengkaji kesan bencana alam terhadap kes malaria di 79 negara dalam tempoh 2008 hingga 2014. Bagi ujian kelasakan, bencana alam diukur menggunakan dua proksi; bilangan kejadian dan bilangan orang yang terjejas akibat bencana dan banjir. Adalah didapati wujud hubungan positif wujud antara kedua-dua ukuran bencana alam dengan kelaziman malaria di kalangan semua negara.

Berdasarkan penemuan ini, kajian menunjukkan bahawa kerajaan dan pembuat dasar memberi penekanan yang lebih besar pada kepentingan kesiapsiagaan bencana dan pengurangan risiko untuk tahap pendidikan yang berbeza. Di samping itu, oleh kerana pendidikan adalah penting untuk mengurangkan kitaran kemiskinan dan meningkatkan pendapatan dan kesihatan dalam jangka masa panjang, kerajaan harus memberi keutamaan kepada pemulihan dan pembinaan semula sekolah-sekolah yang rosak dan infrastruktur yang berkaitan dengan pendidikan, dengan bahan berkualiti tinggi yang dapat menahan impak daripada bencana, oleh itu mampu mengurangkan gangguan berpanjangan kepada persekolahan. Pembuat dasar juga perlu mewujudkan tempat-tempat alternatif baru untuk pelajar belajar dan melancar kempen untuk mewujudkan kesedaran kepada orang ramai tentang kepentingan penerusan persekolahan selepas bencana.

Langkah-langkah kukuh perlu diambil untuk memulihara dan memelihara spesies, flora dan fauna melalui usaha penghutanan semula seperti projek bakau, yang akan mengurangkan kesan kerugian berkaitan bencana yang disebabkan oleh tsunami dan ribut taufan dan mewujudkan peluang pekerjaan. Dengan peningkatan pesat penduduk dan nilai aktiviti ekonomi, kerajaan perlu meningkatkan kawasan perlindungan dan projek pemulihan selain menguatkuasakan undang-undang dengan ketat untuk memastikan keselamatan spesies terancam. Langkah-langkah ini akan membantu ekonomi negara dengan menarik pelancongan. Akhir sekali, pembuat dasar dan kerajaan perlu membuat tindakan pencegahan dan kawalan untuk meminimumkan penyakit berjangkit, terutamanya selepas bencana alam.

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has beenaccepted as fulfillment of requirements for the degree of Doctor of Philosophy. The members of the Supervisory Committee were as follows:

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Date:

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This is to confirm that:

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- supervision responsibilities as stated in the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2012-2013) are adhered to.

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Name of Chairman of Supervisory Committee: Professor Dr. Muzafar Shah Habibullah

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Name of Member of Supervisory Committee: Associate Professor Dr. Law Siong Hook

Signature: _____
Name of Member of Supervisory Committee: Associate Professor Dr. Lee Chin

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LIST OF ABBREVIATIONS

CBD	Convention on Biological Diversity
CHESTRAD	Centre for Health Sciences Training, Research and Development
CRED	Centre for Research on the Epidemiology of Disasters
EM-DAT	Emergency Events Database EM-DAT
EPI	Environmental Performance Index
GDP	Gross Domestic Product
GMM	Generalized Method of Moments
IPCC	International Panel on Climate Change
MEA	Millennium Ecosystem Assessment
NABRAI	National Biodiversity Risk Assessment Index
OLS	Ordinary Least Square
TEEB	The Economics of Ecosystem and Biodiversity
UNDP	United Nations Development Program
UNEP	United Nations Emergency Programme
UNICEF	United Nations International Emergency Fund
VIF	Variance Inflation Factor
WDI	World Risk Index
WEF	World Economic Forum
WHO	World Health Organization
WWF	World Wide Fund for Nature

CHAPTER 1

INTRODUCTION

1.1 An overview

Natural disasters have become among the most pressing issues facing the world today. It is becoming more recurrent and more intense worldwide in the recent decades due to changes in the global climatic environment and has influenced the human development drastically (Guha-Sapir and Hoyois, 2012; Strobl, 2012; Mach and Mastrandrea, 2014). In the year 2016 alone, 102 countries experienced natural disasters that affected 411 million people, killed 7 628 people and caused economic damages of USD 97 billion (CRED Crunch, 2016).

During the post disaster period, major actions are normally taken to meet the immediate needs of people affected. However, one context that has been mainly overlooked during this period is the impact on educational outcomes and it is "one of the most underfunded and under-prioritized sectors in humanitarian responses, receiving less than two percent of humanitarian aid committed through appeals" (Save the Children, 2016). A disaster whether big or small, results in closure of schools due to damage and destruction to the infrastructure of school, recurrent or extended use of schools as emergency shelters, interruption in cycle of education, absenteeism of students and teachers who might be injured or somehow affected by the disaster. In the 7.8 magnitude earthquake in Nepal in 2015, at least 8 242 schools and tens of thousands of classrooms were damaged and almost 3.2 million children were badly affected in 36 districts (UNICEF, 2015; Harris, 2015). After one year of the disaster, many students continue to study in temporary facilities without walls and open to the cold winter weather, 15% or 26 272 people were still living in temporary displacement camps whereas thousands of them are living in the makeshift shelters next to their destroyed homes (UNICEF, 2016).

Further prolongation on these unstable environments not only exposes children to the risk of child labour, early marriage, exploitation, health problems and malnutrition but also causes disruption in their education process. Students exposed to the disasters may not be able to continue schooling or catch up with their studies and could drop out of school permanently due to conditions of the household (Baez et al, 2010). The prolonged interruption in education whether in the short term or long term, may decrease the human capital accumulation through the disruption in children's education, their development, outcomes and may reduce their lifetime earnings in the future (Park et al., 2015, UNICEF, 2015). These effects on human capital accumulation may significantly impact the economic development of the country.

Biodiversity is vital as it supports major economic activities and employment in agricultural, fisheries, forestry, pharmaceuticals, pulp and paper, cosmetics, construction and biotechnology (UNDP, 2014). Seventy percent or eight hundred and forty million poor people who live in the rural areas, depend on the ecosystem such as forest, rangelands, rivers, lakes and ocean for their livelihood (World Bank, 2014). In Philippines, for example, sixty percent of Philippine's population reside in the coastal area and their livelihoods depend on coastal resources such as mangrove forest, sea grass beds, fisheries and coral reefs (Philippine Development Plan 2011-2016). However, biodiversity is at risk and is declining rapidly mainly due to the growing world human population, human activities, climate change and natural disasters (McLellan et al., 2014; Halkos, 2011; Visconti et al., 2011). Apart from that, natural disasters such as floods, cyclones and earthquake causes water sources to be either polluted, causes pathogens to enter the drinking water, creates water shortage and lack of hygiene, all leading to infectious diseases such as vector-borne and water based diseases (Butenop et al., 2013).

Natural disasters affects millions of people every year and the impact can be calamitous. It brings with them a host of various issues that include humanitarian, environmental, infrastructure and health problems. Many lives are lost and millions of people are made homeless due to the type of disaster and its severity which eventually leads to disruption in accessibility to education, health care, food supplies and clean water besides causing outbreak of diseases. Continued disruption reduces human capital accumulation that adversely affect the economic development of the country. Natural disasters often lead to health issues and disease outbreaks as there is no running water, water sources become polluted, water shortage, increasing vector breeding sites, unplanned and overcrowded shelters and lack of hygiene. These issues deteriorate the health conditions among the victims of disasters, which eventually affect human capital accumulation. Millions of people who live in the rural and coastal areas depend on the ecosystem for their livelihood and when disaster strikes, loss in biodiversity causes the ecosystem to be less resilient, more exposed to shocks and disturbances, less able to supply humans with needed services

1.2 Background of the study

1.2.1 Global trend of natural disasters

Natural disasters are defined as "severe alterations in the normal functioning of a community or a society due to hazardous physical events interacting with vulnerable social conditions, leading to widespread adverse human, material, economic, or environmental effects that require immediate emergency response to satisfy critical human needs and that may require external support for recovery" by the International Panel on Climate Change (Field et al., 2012).

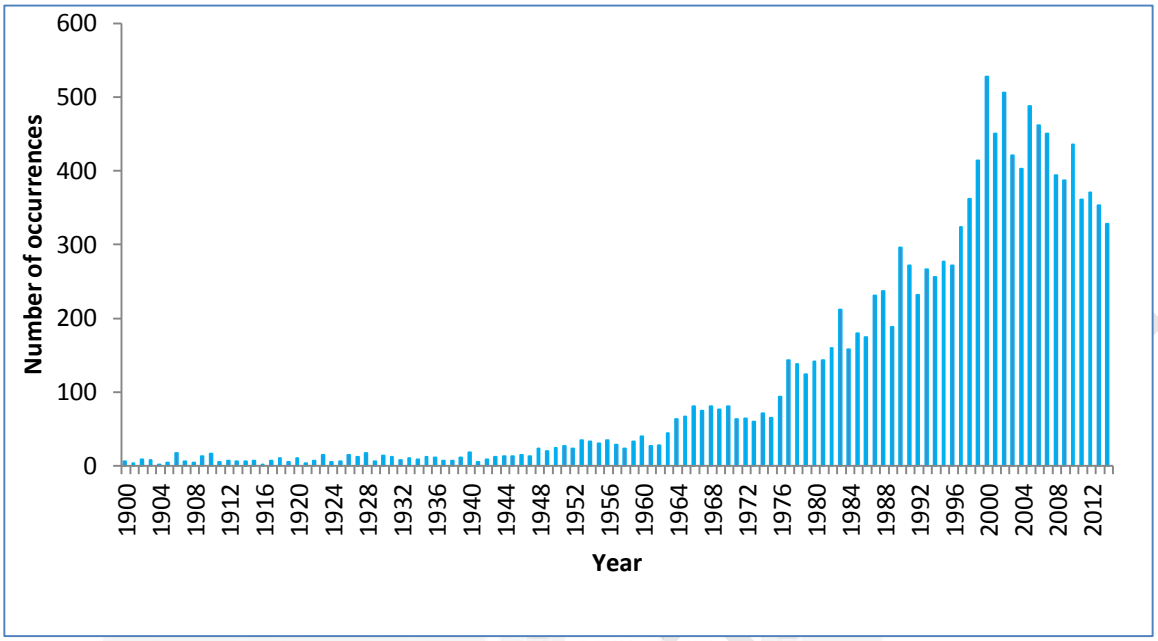

Figure 1.1 : The Number of Natural Disasters for the period 1900-2014
Source: EM-DAT Database

The number of natural disasters has been increasing since 1900 as shown in Figure 1.1. The highest numbers of disasters was in the year 2000 with 528 natural disasters followed by the year 2002 where there were 506 disasters. In the year 2000 and 2002, the most frequent natural disaster was the floods. The numbers of natural disasters have decreased to 352 in 2013. In the year 2014 alone, there were 270 country level disasters, which killed 6434 people and affected 102 million people.

The economic losses from these catastrophes has increased drastically over the years. In the last 20 years, disasters have affected 4.4 billion people, killed 1.3 million people and caused damages of USD 2 trillion (EM-DAT). In the year 2000, the damages caused by natural disasters was USD 46.2 billion whereas in 2002 and 2014, it increased to USD 52.07 billion and USD 97.6 billion, respectively. The highest economic losses was in 2011 which was USD 364.09 billion followed by USD 156.4 in 2012, as shown in Figure 1.2.

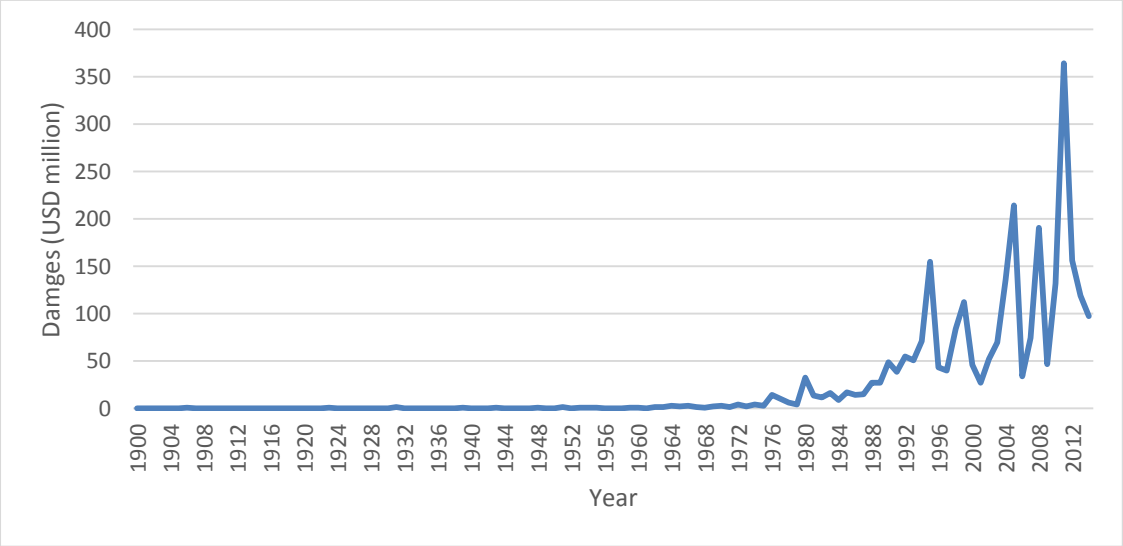

Figure 1.2 : The Estimated losses (USD) for the period 1900-2014
Source: EM-DAT Database

The number of disasters has increased by more than four times since the 1970s and during this period, the continent that was most hit by natural disasters was Asia followed by Americas, Africa, Europe and Oceania as shown in Figure 1.3. In 2014 alone, 269 disasters occurred in Asia, 139 in Americas, 101 in Africa, 89 in Europe and 20 in Oceania.

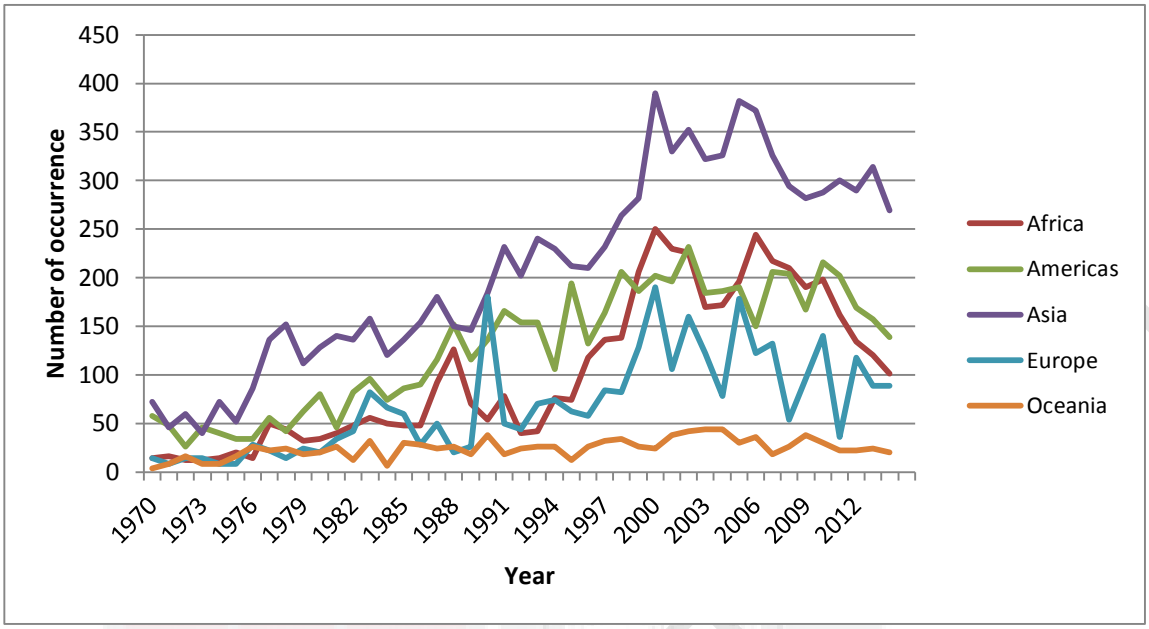

Figure 1.3 : Number of Occurrence by Continents for the period 1970 to 2014
Source: EM-DAT Database

The economic losses were highest in the Asia region followed by Americas and Europe from the years 1970 to 2014, as depicted in Figure 1.4. In 1970, the damages caused by natural disasters in Americas region was about USD 3 million against USD 1.15 million in Asia. These costs increased significantly over the years and in 2014, the economic loses in Asia and Americas region increased to USD 121.22 and USD 49 million, respectively. During this period, the increase number of floods, earthquakes, drought and cyclones has undermined Asia's economic progress. The effects of these natural disasters are bigger in these continents due to its location, population density, lack of adherence to improve building codes and rapid growth in the coastal areas.

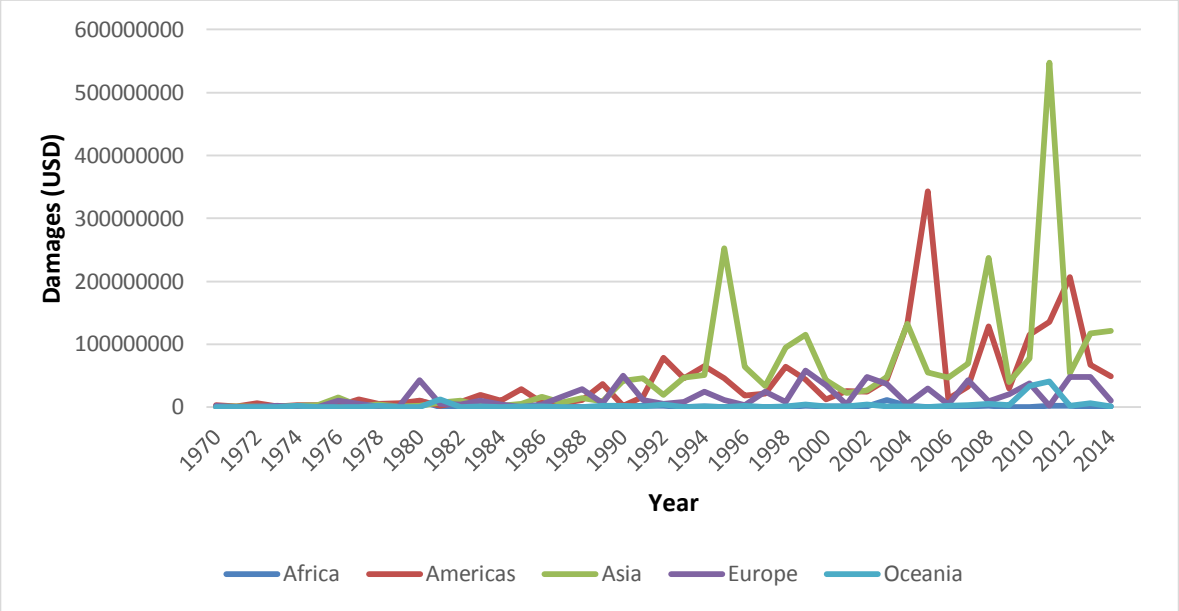

Figure 1.4 : Damages (USD) by Continents for the period 1970 to 2014
Source: EM-DAT Database

Natural disasters are sub grouped into four categories; geophysical, hydrological, meteorological and climatological as portrayed in Figure 1.5. The classification of these disasters are obtained from Emergency Events Database (EM-DAT) provided by the Centre for Research on Epidemiology of Disasters (CRED). Geophysical natural disaster is defined as hazard originating from solid earth such as earthquake, dry mass movement and volcanic activity. Meteorological disasters such as extreme temperature, fog and storm last from minutes to days are caused by "short-lived, micro to meso-scale extreme weather and atmospheric conditions". Climatological disasters (drought and wildfire), on the other hand, are "long-lived, meso to macro-scale atmospheric processes that range from intra-seasonal to multi-decadal climate variability". "Occurrences, movement and distribution of surface and subsurface freshwater and saltwater" cause hydrological disasters (flood, landslide and wet mass movement) (EM-DAT).

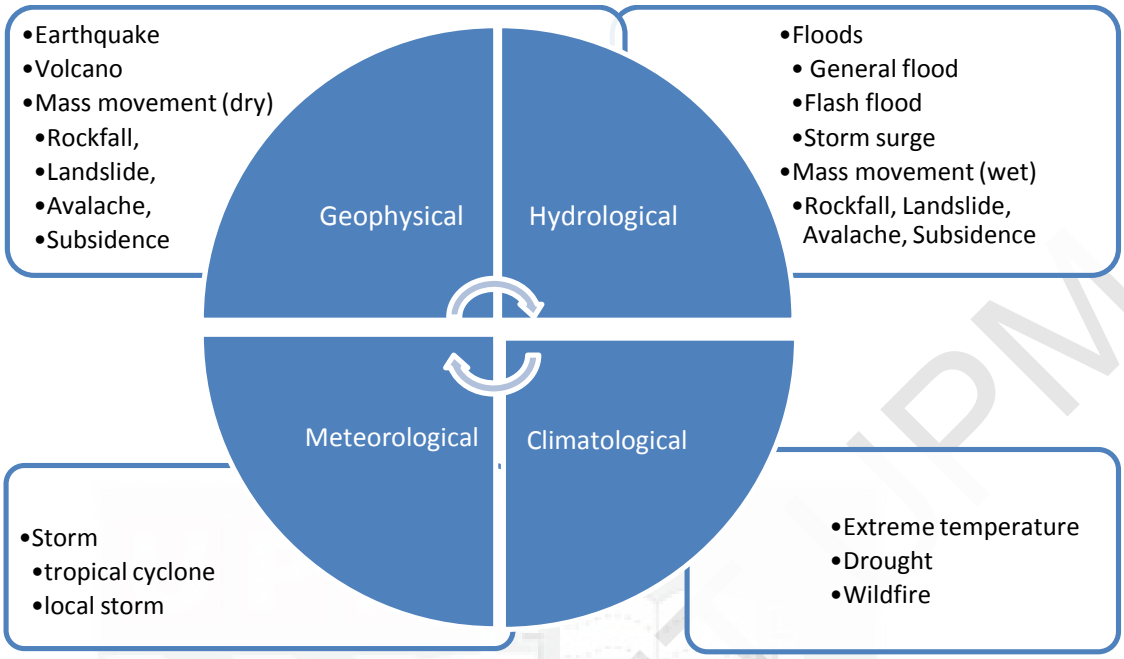

Figure 1.5 : Disasters Subgroups Classification
Source: EM-DAT Database

Over the period 1960 to 2014, there has been a drastic increase in the number of meteorological-related and hydrological–related disasters. The number of meteorological-related and hydrological–related disasters from 1960 to 1995 was 1721 and 1650 respectively and increased to 2261 and 3240, respectively from 1996 to 2014. The numbers of geophysical and climatological disasters have increased as compared to 1960 but have remained more or less the same after a certain period of time, as shown in Figure 1.6 (Guha-Sapir and Hoyois, 2012; Blunden et al., 2012).

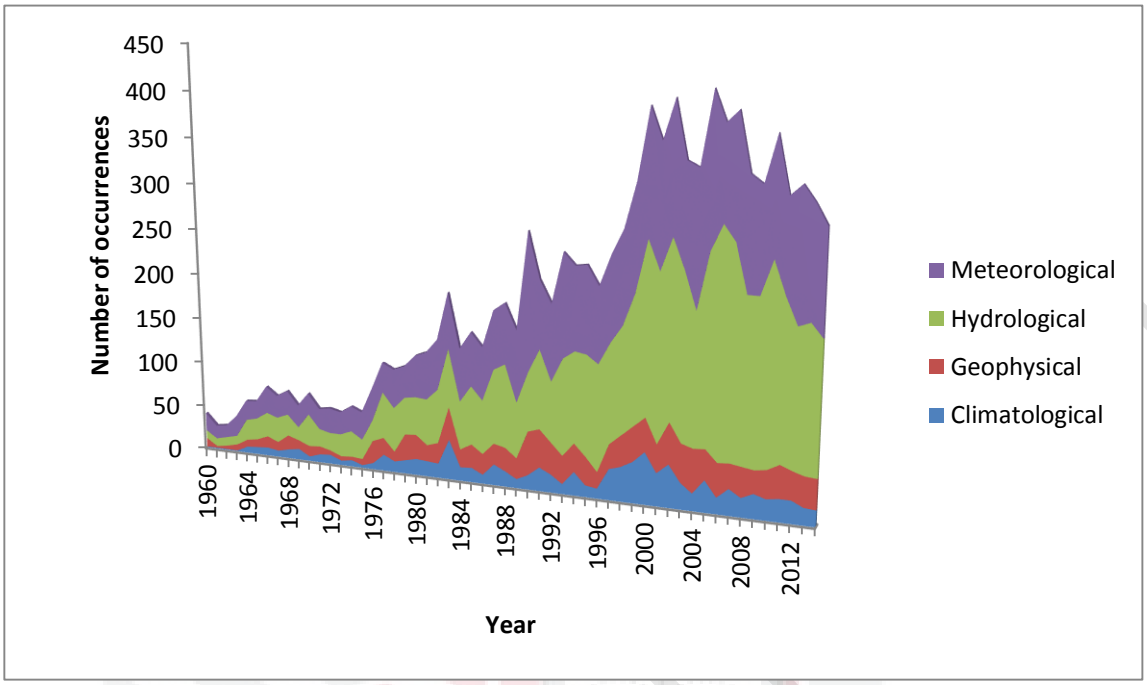

Figure 1.6 : Number of Disasters by Subgroups Classification for the period 1960 to 2014
Source: EM-DAT Database

Among all the sub-groups, meteorological and hydrological accounted for most of the worldwide increase in natural disasters causing major destruction of infrastructure and fatalities. Between the years 1970 to 2014, about 11 985 natural disasters have taken place whereby 64% of the number of natural disasters were floods and storms (EM-DAT). Figure 1.7 shows the number of occurrences and death tolls that took place between 1970 to 2014, along with the most prominent natural disasters that occurred during that period. One of the deadliest natural disaster was Bhola cyclone in 1970 that killed about 300 000 people and affected 3.6 million people (EM-DAT). It destroyed almost 85% of the homes in the area with greatest destruction along the coast, wiped out villages, and destroyed crops in the whole region. One of the villages, Tazumuddin lost over 45% of its population which accounted to about 167 000 people. Two decades later, another cyclone hit Bangladesh but the total number of people affected and killed dropped by half because of the disaster management efforts taken by the country. The advanced warning and evacuation systems in the area allowed several million people to be evacuated ahead of the storm, reducing the number of fatalities.

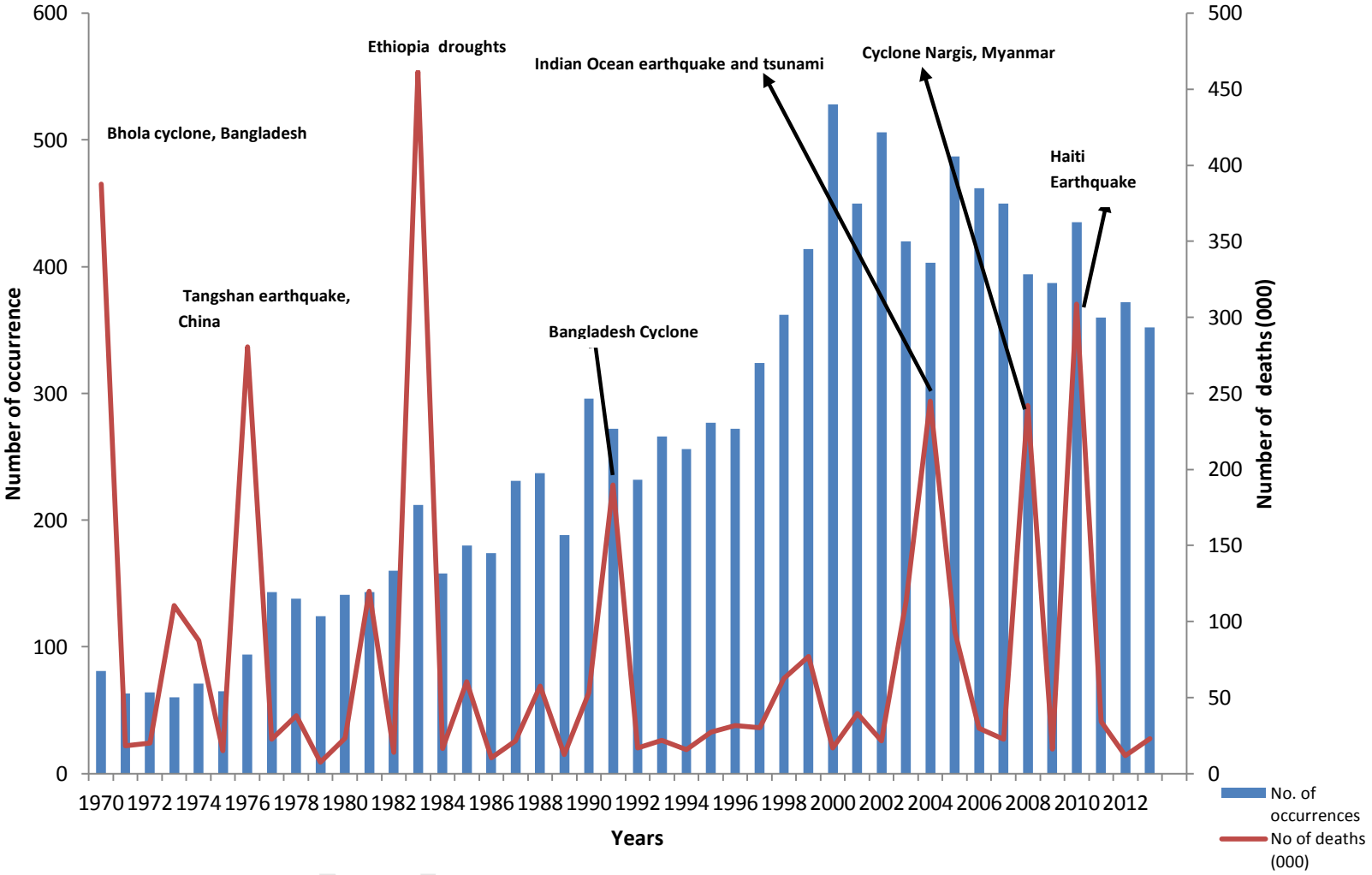

Figure 1.7 : Global Trends in Number of Natural Disasters and Death Tolls, 1970-2014
Source: EM-DAT Database

The third deadliest earthquake in recorded history was the 1976 Tangshan earthquake with a magnitude of 7.5. The earthquake occurred along the Tangshan Fault, killing at least 242 000 people and injuring at least 700 000 people. In 1983, the drought in Ethiopia compounded with the effects of civil war killed almost half a million people and made millions more destitute. Another deadliest natural disaster in human history was the Indian Ocean Tsunami in 2004 which affected 11 Indian Ocean countries, killed 220 000 people across countries and millions of people were made homeless (EM-DAT). The earthquake with a magnitude of 9.1 -9.3 was an undersea megathrust earthquake caused by a rupture along the fault between the Indian Plate and Burma Plate. In 2008, Cyclone Nargis caused catastrophic destruction in Myanmar killing at least 138 000 people and affecting 1.5 million people, becoming one of the most deadly tropical cyclone worldwide. In the 2010 Haiti earthquake 300 000 people were injured, a quarter million people died and about 5 million people were displaced (EM-DAT).

1.2.2 Types of natural disasters

From the period 1960 to 2014, floods were the most frequent natural disaster as shown in Table 1.1. This was followed by other natural disasters such as storm, earthquake and droughts. The disaster that occurred the least was mass movement. In terms of number of deaths, droughts top the list followed by earthquake, storm and floods. Flood is the disaster that affected the most people in all the countries studied during this period. The second disaster that affected millions of people is drought, followed by storm and earthquake. In terms of damages cost by natural disasters, storm takes the lead, followed by earthquake, floods and droughts.

Table 1.1 : Types of Natural Disasters from 1960 to 2014

Disaster type	No. of occurrence	Total deaths	Affected (million)	Injured	Homeless (000)	Total affected (million)	Total damage (USD million)
Drought	627	2,211,271	218.766764	0	20.000	2,187.688	135,719.906
Earthquake	1,067	1,360,240	158.371835	2,365,989	22,418.631	183.156	766,210.497
Extreme temperature	500	170,650	96.729125	1,939,962	255.587	98.925	60,425.343
Flood	4,287	315,501	3,478.047215	1,327,839	85,930.398	3,565.305	671,851.272
Landslide	603	40,403	9.649071	10,602	4,235.921	13.896	8,832.998
Mass movement	48	4,729	0.022688	442	3.981	0.027	211.600
Storm	3,488	938,988	934.415952	1,351,607	51,951.841	987.719	1,017,555.242
Volcanic activity	202	29,408	5.167002	11,561	361.790	5.540	3,230.348
Wildfire	374	2,211	5.776260	5,883	168.655	5.951	54,400.455

Source: EM-DAT Database

The impact of natural disasters differ according to the type of disaster. Flood impacted more people than any other disaster. It affected almost 3.5 billion people in the years 1960 to 2014, which account for 51% of the total people affected as illustrated in Figure 1.8. Floods seem to be very frequent in regions that are undergoing large-scale rapid transformation towards urbanization. For example, Asia is the most flood prone continent and it was found that more than 18% of the urban population stay alongside the coast area, which is less than 10 meters above the sea level as compared to 8% of Europe and North America's urban population (McGranahan et al., 2007).

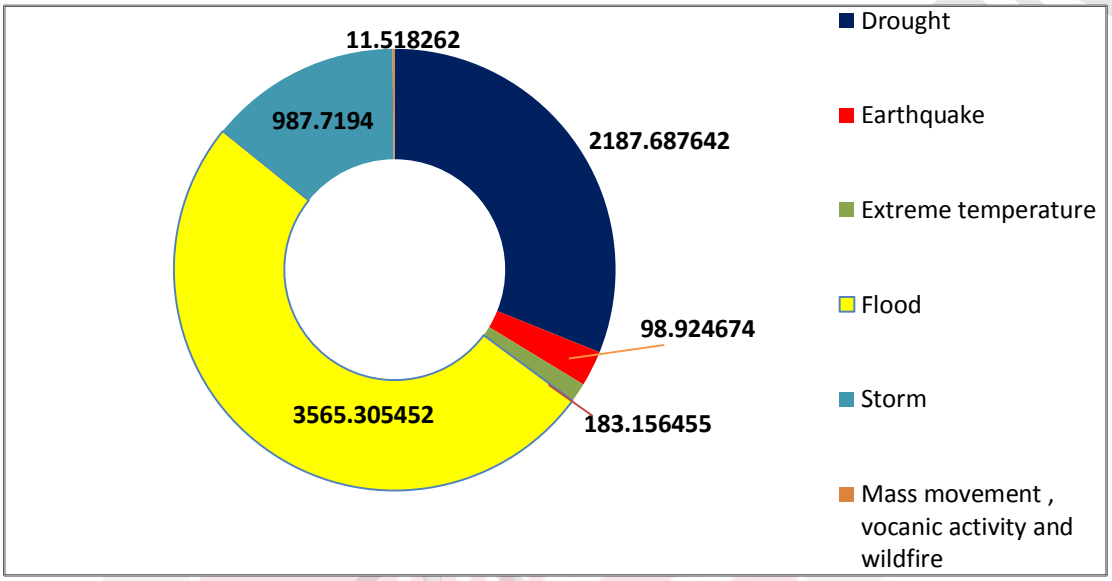

Figure 1.8 : Number of People Affected (in millions) by Natural Disasters (1960-2014)
Source: EM-DAT Database

On the other hand, droughts, which account for 5% of the disaster events, affected more than one billion people (31% of the overall number of people affected) during the same period despite early warnings being in place. Africa suffered droughts more than any other continent in the world. Since these countries depend on agriculture, droughts cause shortages of water and outbreak of epidemic diseases and in long term leads to food insecurity. During the period 1960 to 2014, drought caused the highest number of deaths (2.21 million lives), as shown in Figure 1.9, whereas storms caused almost one million deaths and earthquake, 1.36 million deaths (EM-DAT)

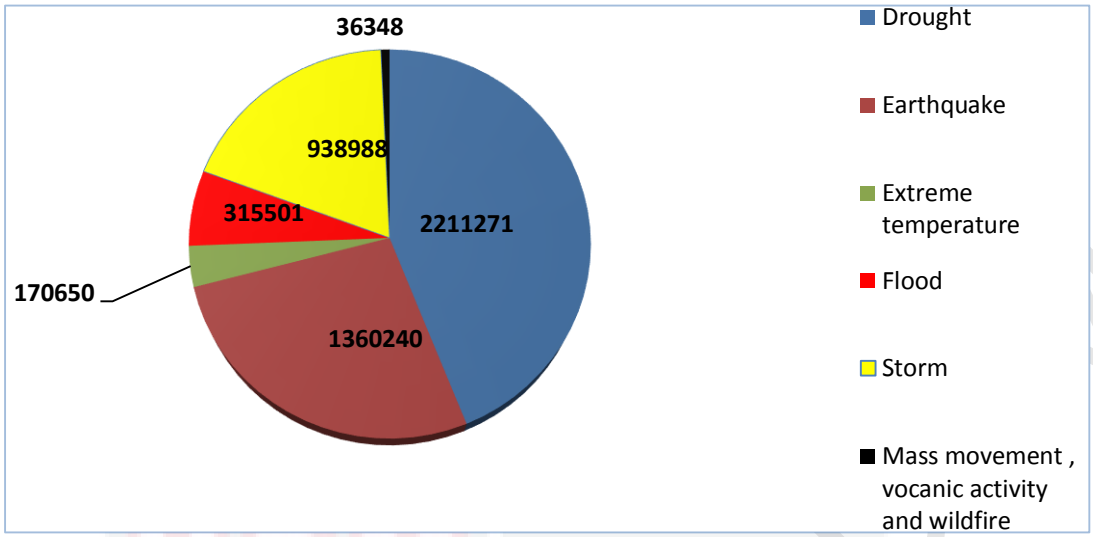

Figure 1.9 : Number of Deaths due to Natural Disasters (1960-2014)
Source: EM-DAT Database

1.2.3 Economic losses by countries with different income groups

Among the four income countries, it was found that lower middle income countries had the highest total number of deaths and number of people affected (contributed by Typhoon Haiyan and floods in India and Pakistan) whereas the low income countries were the least affected by the natural disasters in 2013, as shown in Figure 1.10. The high income countries, on the other hand, had the highest total damages mostly due to the local storm in the Unites States (USD 14.6 billion) and floods in Germany (USD 12.9 billion) and Canada (USD 5.7 billion) in the year 2013 (EM-DAT).

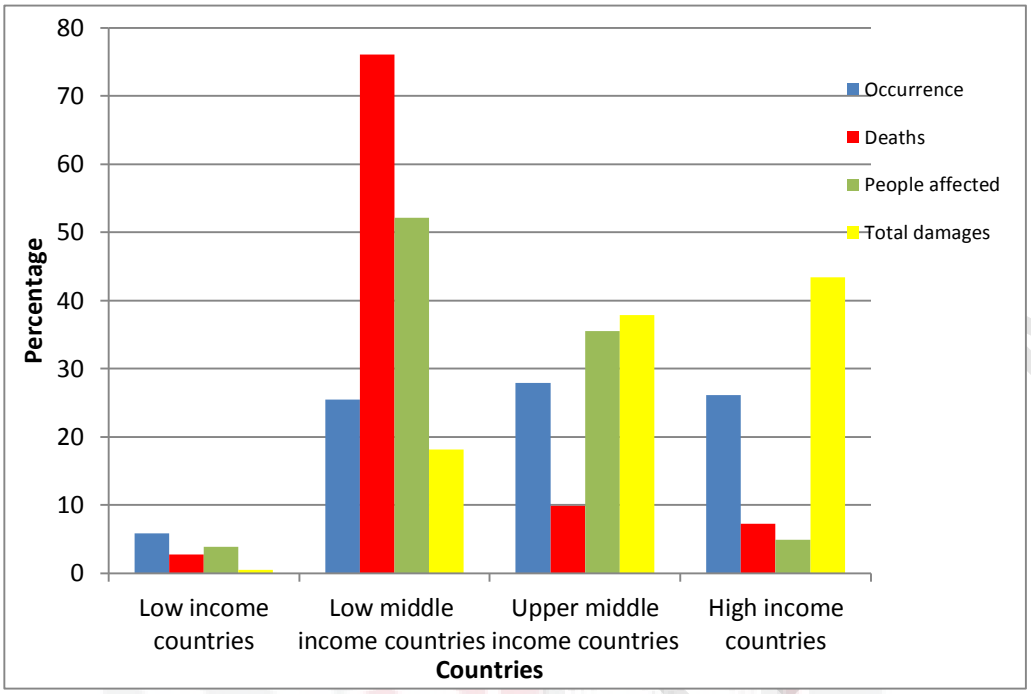

Figure 1.10 : Countries with Different Level of Income Affected by Natural Disasters, 2013
Source: EM-DAT Database, 2013

Among all the types of disasters in 2013, three major disasters caused the highest economic damages; flood, cyclone and storms as illustrated in Figure 1.11. South and East Germany had the highest damages from floods in 2013 followed by India, Indonesia, Philippines and Pakistan (EM-DAT). Typhoon Haiyan and Fitow also added significantly to the total disaster damages in 2013. From Figure 1.11, it was found that most of the economic damages are in the high income and upper middle-income countries and the economic losses of the middle low income and low-income countries are relatively smaller.

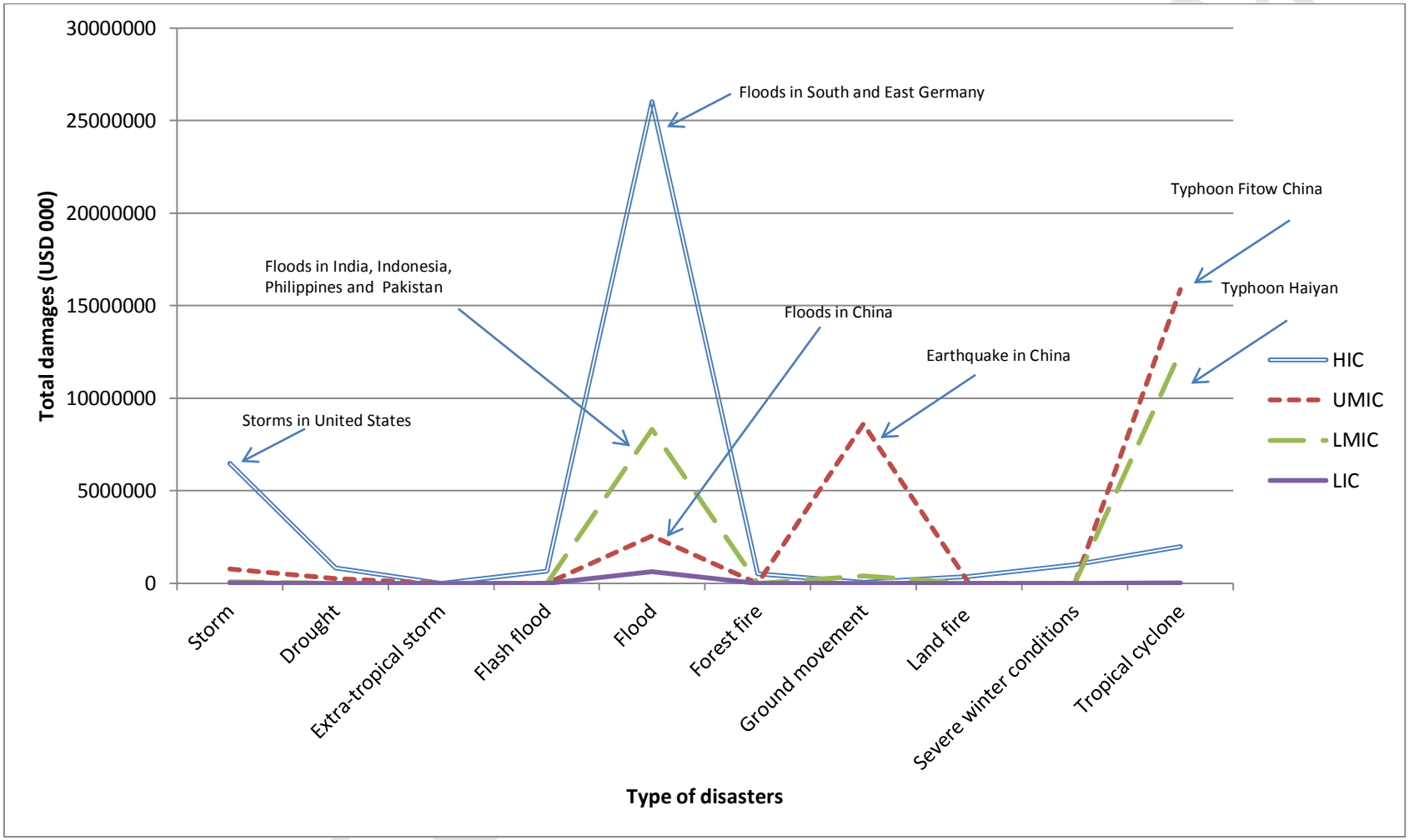

Figure 1.11 : Economic Damages (USD 000) in 2013 by Disaster Type
Source: EM-DAT database, 2013

Figure 1.12 shows the economic losses incurred by the high income countries were USD 1660 billion whereas the low-income countries incurred about USD 71 billion from the years 1994 to 2013. However, as a proportion of GDP, the economic losses for high-income countries amount to 0.3% of their GDP and for low-income countries, 5.1% (Wallemacq et al., 2015).

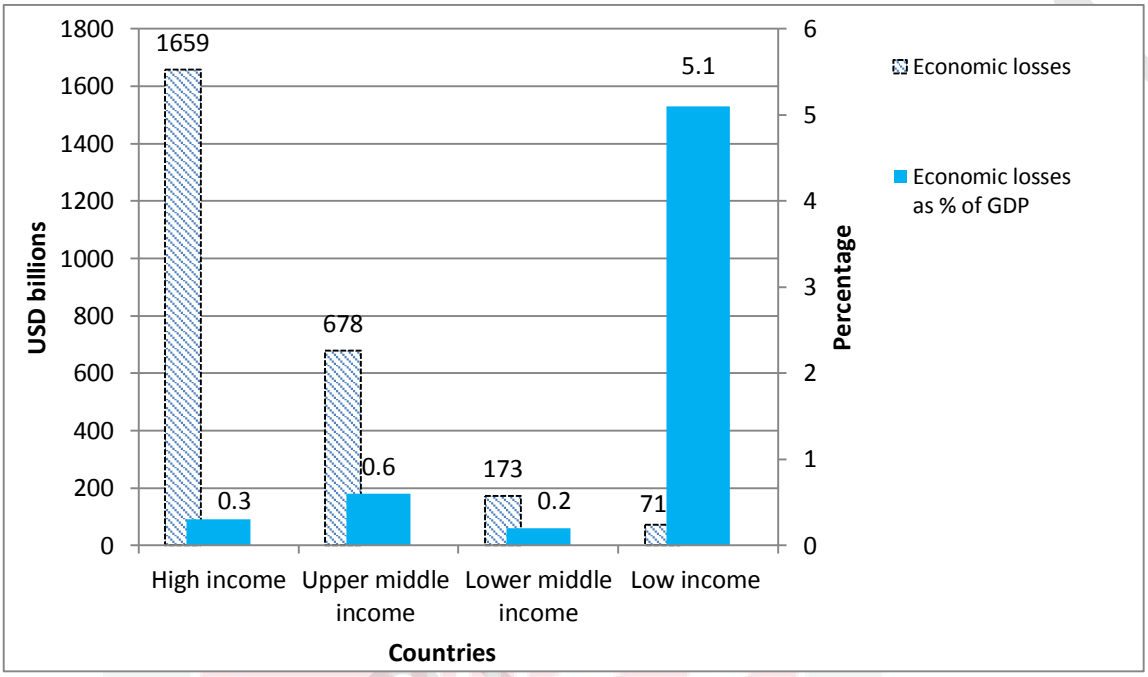

Figure 1.12 : Economic Losses in Absolute Values and Compared to GDP over the period 1994-2013. (Adapted from: CRED 2015) **The Human Cost of Natural Disasters**

In terms of fatalities, the top 30 countries with the highest deaths due to natural disasters are shown in Table 1.2. It was found that majority of the fatalities were in the lower middle income and low income countries during the period 1960 to 2014 and very few in the high income countries. Fatalities numbers in high-income countries is lower as these countries have strict building codes application and standards, good urban planning and effective early warning and evacuation systems, as compared to the other countries. Therefore, the pattern of death tolls is very different when the income levels of the countries are taken into account. The upper middle and high-income countries experienced 56% of the total disasters but 32% of lives were lost during this period whereas low-income and lower middle income countries experienced 44% of total disasters with a 68% live loss (EM-DAT).

Table 1.2 : Top 30 Countries with the Highest Number of Deaths caused by Natural Disasters (1960-2014)

Year	Type of disaster	Country affected	Number of deaths	Income group
1965	Drought	India	1500000	LMIC
1970	Tropical cyclone	Bangladesh	300000	LIC
1983	Drought	Ethiopia	300000	LIC
1976	Ground movement	China P Rep	242000	UMIC
2010	Ground movement	Haiti	222570	LIC
2004	Tsunami	Indonesia, Sri Lanka, Thailand, India, Bangladesh,Myanmar, Maldives, Malaysia	220000	LIC, LMIC, UMIC
1983	Drought	Sudan	150000	LMIC
1991	Tropical cyclone	Bangladesh	138866	LIC
2008	Tropical cyclone	Myanmar	138366	LIC
1973	Drought	Ethiopia	100000	LIC
1981	Drought	Mozambique	100000	LIC
2008	Ground movement	China P Rep	87560	UMIC
2005	Ground movement	Pakistan, India, Afghanistan	88000	LIC, LMIC
1970	Ground movement	Peru	66823	UMIC
2010	Heat wave	Russia	55736	HIC
1965	Tropical cyclone	Bangladesh	48921	LIC
1990	Ground movement	Iran Islam Rep	40021	UMIC
2004	Tsunami	Sri Lanka	35399	LMIC
1999	Flash flood	Venezuela	30000	UMIC
2003	Ground movement	Iran Islam Rep	26797	UMIC
1978	Ground movement	Iran Islam Rep	25045	UMIC
1976	Ground movement	Guatemala	23000	LMIC
1963	Tropical cyclone	Bangladesh	22079	LIC
1985	Ash fall	Colombia	21800	UMIC
2003	Heat wave	Italy	20089	HIC
2001	Ground movement	India	20005	LMIC
1974	Ground movement	China P Rep	20000	UMIC
2010	Drought	Somalia	20000	LIC
2011	Tsunami	Japan	19846	HIC
2003	Heat wave	France	19490	HIC

Source: EM-DAT Database

High-income countries, which are not prone to typhoons, tsunamis and earthquakes, seem to have the lowest exposure to disasters and high human development as shown in Table 1.3. Qatar is the safest country in terms of disasters with a reading of 0.1% followed by Malta, Barbados and Saudi Arabia. All these countries also have adequate financial revenue and functioning government that invest on developments of the effectiveness of global natural disasters mitigation efforts, which helps them to be less vulnerable to extreme disasters (Mucke et al., 2014). On the contrary, the countries with high disaster risk were greatly exposed to tsunamis, cyclone, storms or earthquakes due to their geographical positions. Vanuatu, a lower middle-income country, has been ranked the world's most disaster prone country (Butenop et al., 2013) followed by Tonga, Philippines and Guatemala.

Among the high-income countries, Japan is highly exposed to earthquakes, typhoons and severe storms and Chile to active earthquake, which has triggered several tsunamis and is the home to several active volcanoes. During the 2004 Indian Ocean disaster, Chile experienced a more severe earthquake as compared to Haiti but Chile only had about 1000 fatalities. Both Japan and Chile experience lower fatalities as they build buildings and bridges that can withstand heavy earthquakes and these countries have enough funds in the aftermath of a disaster (Cavallo et al., 2013). These countries invest heavily on their infrastructures and when they are hit by a natural disaster; their GDP is not badly affected as the other countries. That is why Japan is classified as 'low risk' despite having a disaster risk of 14.1% as it is ranked 178 out of 198 in the socio-economic resilience index due to good disaster preparedness and has high coping and adaptive capacities. On the other hand, Philippines is ranked 80th and considered high risk partly due to poor institutional, high poverty level, rapid population growth and urbanization (Mucke et al., 2014).

Table 1.3 : Top 25 and bottom 25 Countries with HDI, WRI and EPI, 2013

WRI Rank	Country	HDI	WRI (%)	EPI	WRI Rank	Country	HDI	WRI (%)	EPI
1	Qatar	0.851	0.1	63.03	160	Vanuatu	0.616	36.43	45.88
2	Malta	0.829	0.61	67.42	159	Tonga	0.705	28.23	61.68
3	Saudi Arabia	0.836	1.32	66.66	158	Philippines	0.66	27.52	44.02
4	Grenada	0.744	1.44	35.24	157	Guatemala	0.628	20.88	48.06
5	Iceland	0.895	1.55	76.5	156	Bangladesh	0.558	19.81	25.61
6	Kiribati	0.607	1.78	55.82	155	Solomon islands	0.491	18.11	31.63
7	Bahrain	0.815	1.81	51.83	154	Costa Rica	0.763	16.94	58.53
8	United Arab Emirates	0.827	2.1	72.91	153	Cambodia	0.584	16.9	35.44
9	Sweden	0.898	2.26	78.09	152	El Salvador	0.662	16.85	43.79
10	Finland	0.879	2.28	75.72	151	Papua New Guinea	0.491	15.9	41.09
11	Egypt	0.682	2.34	61.11	150	Brunei	0.852	15.8	66.49
12	Norway	0.944	2.35	78.04	149	Mauritius	0.771	15.18	58.09
13	Israel	0.888	2.49	65.78	148	Nicaragua	0.614	14.89	50.32
14	Singapore	0.901	2.49	81.78	147	Japan	0.89	14.1	72.35
15	Estonia	0.84	2.52	74.66	146	Fiji	0.724	13.56	53.08
16	Seychelles	0.756	2.58	55.56	145	Guinea-Bissau	0.396	13.09	35.98
17	Switzerland	0.917	2.61	87.67	144	Vietnam	0.638	12.81	38.17
18	Luxembourg	0.881	2.68	83.29	143	Chile	0.822	12.28	69.93
19	Cyprus	0.845	2.77	66.23	142	Haiti	0.471	11.88	19.01
20	France	0.884	2.79	71.05	141	Gambia	0.441	11.71	29.3
21	Denmark	0.9	3.1	76.92	140	Guyana	0.638	11.65	38.07
22	Mongolia	0.698	3.1	44.67	139	Niger	0.337	11.62	36.28
23	Ukraine	0.734	3.14	49.01	138	Benin	0.476	11.32	32.42
24	Canada	0.902	3.18	73.14	137	Dominican Republic	0.7	11.28	53.24
25	Lithuania	0.834	3.18	61.26	136	Cameroon	0.504	11.23	36.68

Source: Human Capital report (2013), World Risk report (2013), Human development report (2013), Environmental Performance Index (2014)

Majority of the countries, which are highly exposed to disaster, are the middle-income and low-income countries. The loss of human capital and the number of people affected by natural disasters in these countries are massive. These countries also suffer excessively high damages from disasters even though the economic losses faced by low-income countries are small as they are not able to bear the cost of adaption and preparedness that is too high. Both the low-income and middle-income countries face various issues such as economic uncertainty, political conflict, insufficient health and housing infrastructure, inadequate water supply, poor sanitation system and lack of support for capacity development, which are among the main reasons why the low-income countries are unable to address the disaster risk. These countries often have to depend on development aid, remittances from abroad to able to cope with the shocks of the disasters. Due to this, these countries have the highest economic losses relative to GDP as fund is used for the speed of recovery and reconstruction (Rentschler, 2013). On the contrary, the high-income countries have the capacity and resources to borne at the margin the high economic losses incurred due to natural disasters without long-term consequences. These countries implement explicit procedures in responding and adjusting to changes in exposure, vulnerability and climates extremes, as they are better prepared financially and

1.2.4 Human Capital

Human capital is the backbone of a country and is one of the most important drivers to economic growth. High-income countries have high human development and most of these countries have at least 10% higher GDP level than their peers (Dutta et al., 2014). Human development is defined as "enlarging people's choice in a way which enables them to lead a longer, healthier and fuller life" (UNDP, 1990). GDP per capita and human development are inter connected. Higher GDP per capita allows the possibility to achieve a higher degree of human development whereas improvements of human development levels increases the per capita GDP of a country. Literature has shown that as people become more educated and have better health, they contribute more to the economic growth through higher labour productivity, better and improved technology, attract more foreign capital and increase exports which eventually leads to greater income equality.

Figure 1.13 shows the top 20 countries in the world with very high human capital. In terms of size, USA economy appears to be the largest in the world in 2013 with a total GDP of USD 16.768 billion followed by China with a total of USD 9.24 billion and Japan with USD 9.19 billion (World Bank Database). Even though China has a large economy but it is ranked as the 87th country in terms of income, worldwide (World Bank Database). On the other hand, Iceland, a country with small economy, performed better in terms of per capita GDP level due to growth in tourism and high income from fishery industry

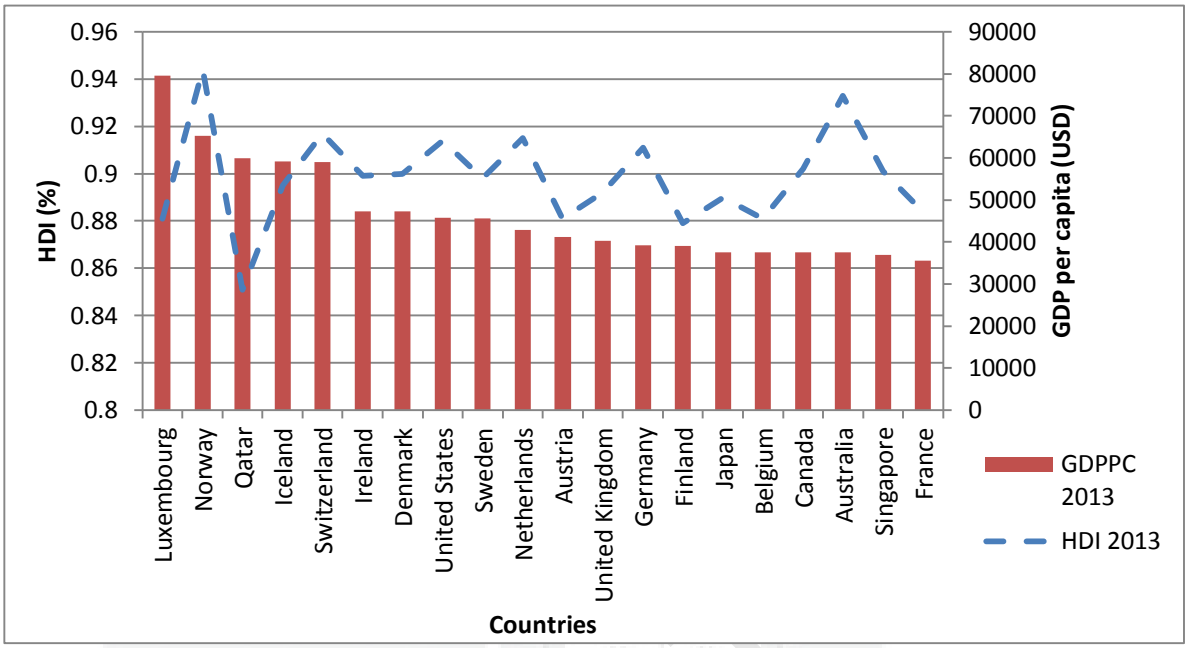

Figure 1.13 : The Top 20 Countries with the Highest GDP per Capita (USD), 2013
Source: World Bank Data

Countries that have low GDP per capita have small economy and low human development, as shown in Figure 1.14. These countries are not able to provide enough incentive for the youths to pursue higher education and economy will not grow with unskilled population (Gneezy et al., 2011). Hence, these countries will face extreme poverty whereby the people are living on less than $1.25 a day and about 80% of the global poor come from the Sub Saharan Africa and South Asia (World Bank Group, 2015). The economic status of these countries is extremely vulnerable to natural disasters, which cause long-term consequences in the human and economic development (Barr et al., 2010).

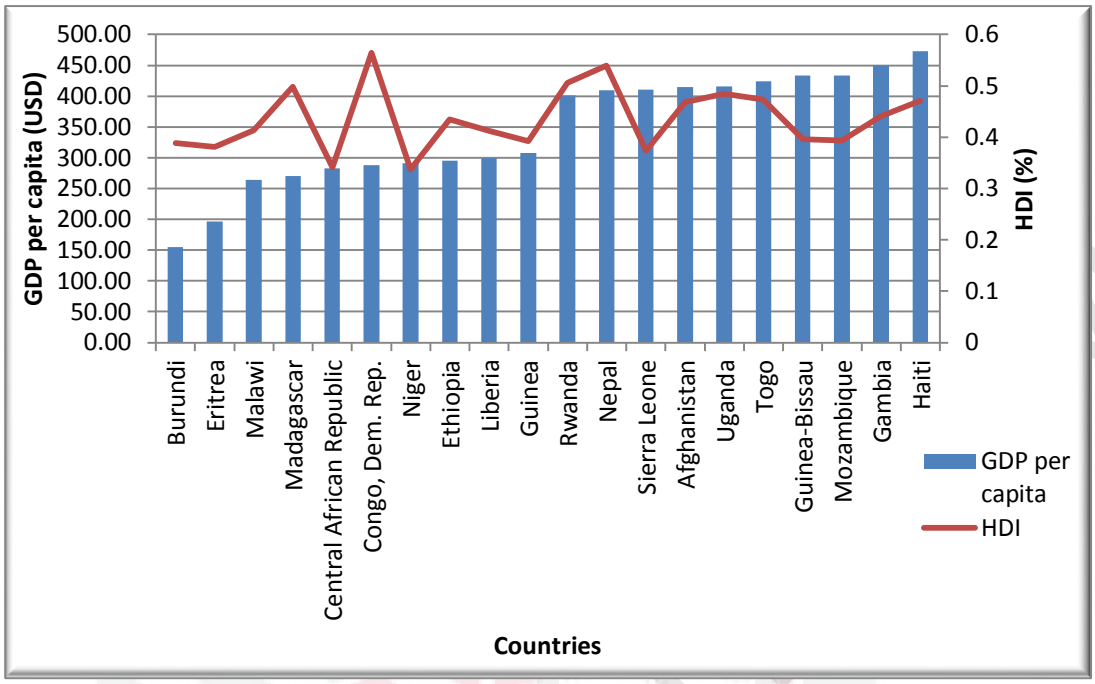

Figure 1.14 : The Bottom 20 Countries with the Lowest GDP per Capita (USD), 2013
Source: World Bank Data

The human capital measurement is vital in implementing policies regarding human resources therefore in the last few years, there has been a notable increase in the number of studies on natural disasters investigating variables from different dimensions and disciplines using a variety of theoretical and methodologies approaches. One of dimensions used is education as it is a compelling indicator for human capital progress of a nation's economy. Becker (2009) in his book entitled "*Human Capital: A Theoretical and Empirical Analysis with special reference to education"* concluded that education investment and training is vital to create human capital as it increases the productivity of workers by giving them useful knowledge and skills.

During the Nepal earthquake in 2015, at least 7 800 thousand schools and tens of thousands of classrooms were damaged and almost one million adolescents who were enrolled in schools were badly affected (Harris, 2015). When the education related infrastructure is destroyed in a disaster and there is no plan for alternative teaching location, it affects the adolescent's education, whether it is secondary or tertiary, as students are not able to continue schooling or catch up and could drop out of school/university permanently. A recent study by Rush (2018) found that secondary school enrollment is more sensitive to damages caused by different types of disasters. Studies have shown that due to shortfalls in income and to smoothen the household consumption, adolescents, especially those in the secondary school, may not be able to continue schooling or catch up with their studies and are

withdrawn from schools as parents are less willing to send them to school (Baez et al, 2010). This in the long-term will decreases the human capital accumulation.

On the other hand, studies by Wilkinson et al. (2013) and Di Pietro (2018) concluded that university students have better adaptive and coping strategies to natural disasters. Past studies have indicated that those who have tertiary education tend to earn more, have more wealth and are more concerned about their health (Lutz and Samir, 2011; Fuchs et al. 2010). They live in places that are less prone and more protected from natural disasters shocks besides being better prepared for disasters. People with higher education also face lower negative impacts of disasters and were able to recover faster from the effect of disaster. They were more effective in adjusting to the changed reality (Muttarak and Lutz, 2014; Frankenberg et al., 2013) as they have better access to relevant information such as early warnings to disasters (Moser and Ekstrom, 2010) as compared with people who were less educated.

Apart from education, urban development promotes changes in land use and if managed well, urbanization can help to incubate innovation and initiative economic growth of these countries as it creates greater job opportunities and better life styles in emerging economies. However, if the rapid urbanization is poorly planned, it can create negative problems such as spread of diseases, unhealthy living conditions, lack of quality infrastructure and poverty (Maxwell, 2010). 62% of the Sub Saharan Africa and 43% of South Central Asia of the urban population live in slums due to rapid unplanned urbanization and this has increased the rate of illness and spread of infectious diseases in these countries (Maxwell, 2010).

Due to poor planning of urbanization and lack of affordable residential area especially in low-income and middle lower income countries, poor people or poor migrants live in urban wastelands or slum areas along the flood and erosion prone river banks and canals. For example, in Mumbai, India, 55% of the population lives in urban wastelands or slum areas which are prone to disasters (UNICEF, 2012) and in Manila, three million people live in areas that are prone to floods and almost half a million of them live along the river banks, under bridges, on dams or on slopes (Philippine Development Plan 2011-2016). Besides that, the poorly planned rapid urbanization in developing countries has caused expansion of cities towards the coastal area, which is prone to natural disasters (Yin et al, 2013; Wang et al., 2012). Three quarter of the megacities (more than 10 million people) in the world is located in the coastal area vulnerable to storms and rise of the sea level (World Bank, 2010). This will aggravate the damage caused by potential natural disaster.

People carry on staying at these dangerous places even in the aftermath of the disaster due to poverty and due to their livelihood. The coasts or rivers are suitable for farming and fishing as the flood plain and volcanic soils are very fertile, and the water supply is sufficient (World Disaster Report, 2014). Moreover, construction of infrastructure in the developing countries, which are at the early stages of urbanization, use concrete and metals, which tend to generate extremely high levels

of greenhouse gas emissions (Seto et al., 2010). These countries contribute 63.37% of the annual greenhouse emissions globally (Kreft et al., 2013) which contribute to the climate changes globally.

1.2.5 Biodiversity loss

Biodiversity is declining rapidly in many parts of the world and among the major drivers of biodiversity loss are climate change, habitat destruction, degradation and exploitation (McLellan et al., 2014). These drivers have contributed to a decrease of 52% of the planet's biodiversity since 1970 (WWF, 2014). The number of mammals, birds, reptiles, amphibians and fish in the planet has dropped by half as shown in Figure 1.15 and during this same period, the population growth of humanity has nearly doubled (WWF, 2014; McLellan et al., 2014) becoming one of the greatest threats to global biodiversity and function of ecosystems (McKee et al. 2004). Species extinction is partly due to human activities, which have caused habitat loss due to land use changes, degradation and destruction, overexploiting natural resources and introducing invasive species to nature (Spicer, 2004). Globally, the overall population of animal species has declined; 76% of freshwater wildlife, 39% of marine wildlife and 39% of terrestrial wildlife have been lost since 1970 (McLellan et al., 2014). From the period 1970 to 2010, the greatest loss of biodiversity was in the low-income countries. The high-income countries showed an increase of 10% whereas for the middle-income countries, there was a loss of 18% during this period (McLellan et al., 2014).

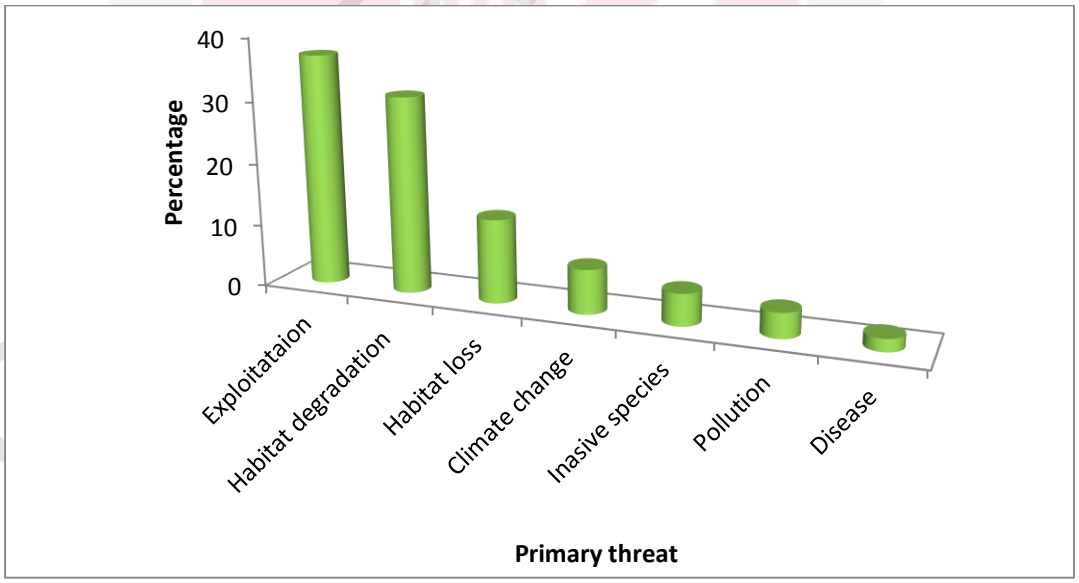

Figure 1.15 : Main Threats to the Populations in the LPI (Living Planet Index)
Source: WWF, 2014

Biodiversity supports major economic activities and employment in agricultural, fisheries, forestry, pharmaceuticals, pulp and paper, cosmetics, construction and biotechnology. Since biodiversity and healthy ecosystem provide food, fuel, fertile soils, wood, clean air and water and plays a vital role in reducing impact of droughts, floods and tsunamis (UNDP, 2014) declines in biodiversity leads to declines in ecosystem services and causes threats to human well-being.

The Environmental Performance Index (EPI) indicates the performance of 178 countries on environmental issues in two areas, human health protection from environmental harm and ecosystems protection. Table 1.3 shows that countries that have high World Risk Index (WRI) tend to have lower EPI and vice versa. However, even though Japan and Chile have high WRI but they seem to have a higher EPI. This is because their GDP per capita is higher and they use more financial resources to enhance better implementation of policies to protect the environment and human health. As for the middle-income and low-income countries, they tend to have lower EPI as they score poorly on the air quality (due to urbanization), biodiversity and habitat protection and on forest and water resources.

Due to rapid urbanization, logging and conversion for agriculture, the forest which is vital to sustain natural life cycles and biodiversity is at jeopardy around the world and this have increased the rates of species extinction globally. There is a net loss of 11.5 million hectares of the forest a year since 2000 (Hansen, 2013). In Philippines, 526 species of flora and 221 species of fauna have been incorporated in the threatened species list in the year 2008 (Philippine Development Plan 2011-2016).

From the year 2000 to 2012, Indonesia has the greatest forest loss followed by Paraguay, Malaysia and Cambodia. As a result of deforestation, the global CO2 emission has become between 4 to 14% and there is a negative impact on the climate regulation, water supplies and biodiversity richness (Hsu et al., 2014). This of great concern as climate change affects environment and living things in various ways, such as, hurricanes and heat waves that will be life threatening, polluted air that will affect health, among a few.

The coastal ecosystem such as coral reefs and mangrove forest has been removed to make way for population growth, industrialization and intensification of agriculture that created ecosystem degradation. This contributed to a loss of natural protection against cyclones and tsunamis, as demonstrated by the 2004 Tsunami. In South East Asia, 28% of the mangrove forest was removed in the years 1970 to 2000 to accommodate to the commercial shrimp farming. In addition, during the period 1975 to 2005, 82% of the mangrove forest was loss for agricultural activities (Giri et al., 2015).

Biodiversity loss has a greater impact on the poor than the wealthier people due to the dependency level of the poor on biodiversity and ecosystem services for their

livelihoods. 840 million people (70% of the world's poor) stay in the rural areas and are dependent on the ecosystem such as forest, rangelands, rivers, lakes and ocean for their livelihood (World Bank, 2014). For example, 350 million are affected by the loss of coral reefs (World Bank, 2014) and around 60% of Philippine's total population who live in the coast area are dependent on coastal resources such as mangrove forest, coral reefs, fisheries and sea grass beds for livelihoods (Philippine Development Plan 2011-2016). However, due to climate change impacts that have increased the sea level and sea surface temperature, the productivity and quality of the country's coastal resources has declined and this has a major effect on the income of these households. Not only do natural disasters trigger enormous damage to the environment and human development but degraded environments and climate change can also aggravate disaster impacts (UNEP, 2009).

Forest and oceans are considered carbon sinks as they can absorb and accumulate carbon over a long period of time. The world's forest ecosystems stores about 289 gigatonnes of carbon in their biomass alone (FAO, 2010). From the year 2005 to 2010, the carbon stocks have decreased by 0.5 gigatonnes yearly due to degradation, deforestation and poor forest management. (FAO, 2010). This leads to an increase in the earth's average global temperature (Forster et al., 2007) which eventually leads to melting of glaciers and aggravating flood risk. Climate change boosts the spread of pest species in new areas affecting the interaction among species causing biodiversity and economic losses (De Meester, et al., 2011).

Human activity related to climate change may also indirectly affect the severity of natural hazard events (Balmford et al, 2005). For example, mining fossil fuels for the transportation industry may involve the systematic removal of forested areas that act as a natural barrier against hurricane winds. With the removal of such forest barriers, hurricane winds may exert more force on community infrastructure, and potentially cause more damage (Balmford et al, 2005).

The ecosystem that is disturbed will cause significantly more damage to human lives, environment and livelihoods as seen in the Cyclone Nargis in 2008 (UNEP, 2009). In contrary, the ecosystem in Thailand was badly affected by the 2004 Tsunami (Cochard, 2011). These disasters have also increased economic losses such as damage to cultivable land, physical and social infrastructure, and provision of quality, sewage, health and nutrition (Cochard, 2011).

1.2.6 Infectious Diseases

Infectious diseases have important consequences on human health and biodiversity. Natural disasters often lead to disease outbreaks especially in the low-income countries (McDermott, 2013). The impact of climate changes include floods, droughts, increase in sea level, loss of livestock, shortage of clean water and air and increase in water-borne and vector-borne diseases. Other factors such as urbanization,

habitat destruction, overcrowded camps, physiological stress and population density also increase the frequency of these diseases (Patz et al., 2005; Githeko et al., 2000; Vora, 2008).

Water-borne infections can cause severe diarrhea in humans, especially children and eventually causing undernourishment, which sometimes leads to death. For countries with insufficient sanitation and water systems, the most common disease is diarrhea especially when the temperatures are high (WHO, 2009). Water contamination due to floods and storms causes cholera and other diarrheal diseases (Hashizume, 2008) for instance in Bangladesh, the number of cases due to the outbreak of diarrhea in the aftermath of floods in 2004 was 17000 and in Pakistan, there were 750 cases during the 2005 earthquake (WHO, 2009).

Figure 1.16 shows the number of cholera cases in 2013, a contagious intestinal infection due to poor sanitation for 33 countries. The highest number of cases, about 26 944 cases, was reported in Democratic Republic of Congo due to the drainage system destruction, overflowed latrines and wells and standing water caused by heavy rains (Adagbada et al., 2012). This was followed by Somalia (6864 cases), Angola (6655 cases) and Nigeria (6600 cases). The lowest number of cholera cases were reported in the high-income countries; Singapore, Australia, Republic of Korea and Japan. As for the number of deaths caused by cholera, Somalia had the highest fatalities followed by Democratic Republic of Congo and Nigeria.

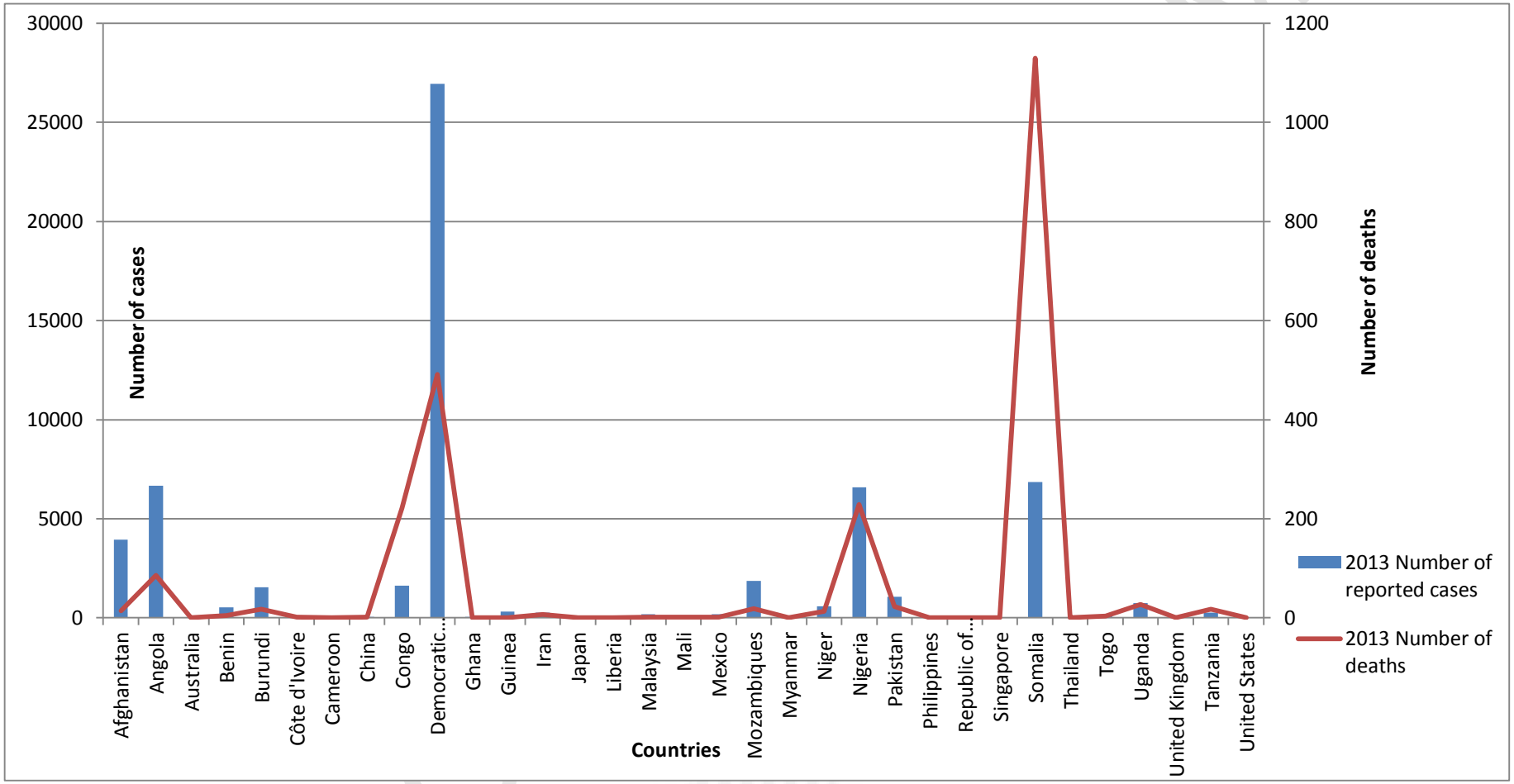

Figure 1.16: Number of Cholera Cases Reported and Number of Deaths caused by Cholera in 2013
Source: World Health Organization

Similarly, the vector-borne diseases represent diseases such as rift valley fever, malaria, dengue fever, diarrheal diseases and schistosomiasis. It is predicted that the world's population at risk due to vector-borne diseases will rise between 220 million to 400 million in the coming century (Field et al., 2012). More than 17% of all the infectious diseases are vector borne diseases which amounts to 700 000 deaths per year (WHO, 2017). Among all the vector borne diseases, malaria alone causes about more than 400 000 deaths worldwide yearly. Malaria is the most deadly vector borne disease and is the leading tropical disease. According to WHO (2017) about forty percent of the population worldwide live in intensified malaria risk areas. In addition, the number of malaria cases have increased from 211 million cases and 446000 deaths in the year 2015 to 216 million cases and 445000 deaths in 2016 (WHO, 2017).

1.3 Problem Statement

Human capital is vital to economic growth and education being the most compelling indicator for human capital progress of a nation's economy, has a pivotal role in reducing poverty, improving health, stability, peace, gender equality, spur innovation and resilience and strengthen institutions. Natural disasters, whether big or small, have devastating impact on the education system. Closure of schools due to destruction, damage to school related infrastructure, displacement of students and teachers, prolonged and repeated use of school infrastructure as evacuation shelters have disrupted education cycles, affecting the learning process of the adolescents. There is an urgent need to address these disruptions as adolescents exposed to the disasters may face difficulties in continuing schooling and might have to withdraw from school or universities permanently due to conditions of the household. In addition, natural disasters disrupt families' livelihood and adolescents are forced to work rather than attend school, to assist in income-generating activities to compensate for the loss. Prolonged interruption in education in the short or long term, may decrease human capital accumulation through the disruption in education of children, development, outcomes and may decrease the lifetime earnings in the future, thus, creating inadequate and weak skills in the workforce in future. These effects on human capital accumulation may significantly impact a country's economic development and expose adolescents to the risk of young labour, early marriage, exploitation and health problems.

There is a need for macro level analysis on the effect of natural disasters on human capital in a wider perspective rather than limiting it to the effect of geological and climatological disasters, and concentrating only on the effect of total disasters on secondary school enrollment rates. The alarming rate of increase in natural disasters and inconclusive nature of previous macro level empirical studies brings about an urgent need to address improvement upon past studies. Lack of existing literature on natural disasters linking to tertiary level education limits the knowledge to understand the importance of tertiary education that creates highly skilled workforce who are instrumental in fostering growth and innovation, reducing poverty, improving health and coping better with economic shocks. What is not yet clear is delayed effect of natural disaster on different education levels. The impact of natural

disaster is not necessarily a momentary effect, forcing a need to investigate the possibilities of the spillover effect. The ability of a country to return to its normal state in the aftermath of a disaster may take longer than a year or two, which is typically not addressed in considerable studies linking to natural disasters.

In light of recent events in natural disasters, it is becoming extremely difficult to ignore the existence of various natural disaster measures which are number of occurrences, number of death, number of people affected and total damages as a percentage of GDP. Generally, the measurement used to empirically prove the link between natural disasters on education is the number of occurrence, and there is a handful using number of people affected. Previous studies of natural disasters have not dealt with these four measurements simultaneously, thus the importance for broader perspective in understanding these measurements against natural disaster is imperative. Furthermore, most studies in the field of natural disasters have only focused on a specific disaster in a selected country and the relative impact of different types of natural disasters on a pool of countries is yet to be explored.

Another issue of concern is the effect of natural disasters on biodiversity loss. Biodiversity is declining rapidly in many parts of the world and during this same period, the population growth of humanity has nearly doubled and this is one of the greatest threats to global biodiversity and function of ecosystems. Living things depend on ecosystem products and services in their everyday life and biodiversity loss will have a negative impact on living things if the ecosystem service is unable to meet social needs. Besides that, loss in biodiversity means loss in world food production as biodiversity plays a crucial role in ensuring the productivity of soil. Biodiversity is important in offering genetic resources for all livestock, plants and marine species harvested for food. Apart from that, rapid urbanization, logging and conversion for agriculture have not only caused forest to be at jeopardy around the world but have increased the rates of species extinction globally. On top of that, the removal of coastal ecosystem such as coral reefs and mangrove forest to make way for population growth, industrialization and intensification of agriculture, created ecosystem degradation and caused loss in natural protection against cyclones and tsunamis. In addition, due to loss of biodiversity, the rate of species extinction is decreasing exponentially. Empirically, there are very limited studies on the link between extinction of species such as plants, birds, mammals and fishes with natural disaster. The present study seek to contribute further to literature of biodiversity loss due to natural disasters by employing the number of occurrences of natural disasters on four threatened species (bird, fish, mammal and plants).

Infectious diseases numbers are increasing drastically all over the world, especially in the developing world. Infectious diseases have the capacity to spread across borders and affects economic security. The spread of diseases are amplified by the increase of urbanization, natural disasters, globalization and rise in travel and trade. In addition, natural disasters cause stagnant water and sewage that affects the sanitation systems, contaminate water, air and soil at the agricultural and chemical repositories and also causes overcrowding of the displacement areas (WHO, 2012),

which, increases the probability of water-borne and vector-borne diseases (WHO, 2015). Rapid growth of world population in the future will cause cities to be increasingly dense with inadequate housing with a shortage of basic services such as water, waste management and sewage thus, creating more favorable conditions for infectious diseases. Therefore, there is an urgent need for governments and policy makers to reflect on the much needed change in the way policy decisions are made to accommodate to the increasing population growth with minimal growth of infectious diseases, especially in the aftermath of natural disasters.

Based on the issues discussed above, the present study intends to address the following questions:

- Does natural disaster have a role to play in influencing the human capital?
- Is there any empirical link between natural disasters and biodiversity loss?
- Does natural disasters affect infectious diseases?

1.4 Objectives of the Study

The general objective of this study is to examine how different types of natural disasters affect human capital, biodiversity loss and the number of infectious diseases using different measures of natural disaster. This study embarks on the following specific objectives:

1) to analyze the relationship between five different types of natural disaster on human capital (secondary school and tertiary enrollment rates).
2) to examine the impact of total natural disaster on different level of biodiversity loss (threatened species such as bird, fish, mammal and plants).
3) to investigate the impact of natural disasters on infectious diseases.

1.5 Significance of the study

The current study will provide a comprehensive coverage on the impact of natural disasters on human capital, biodiversity loss and infectious diseases on a wider perspective and in a more global context. In this study, we seek to clarify how various types of disasters affect human capital differently, using different measurements. The findings of the present study will be useful to the policy makers to provide different types of support, in terms of prevention and alleviation plan, based on the type of disaster.

Since education is a powerful instrument for human progress, this study looks at how different type of natural disasters affect secondary and tertiary level education. Past studies have acknowledge the importance of studying different levels of education and have endorsed the necessity to conduct an in-depth study on this subject matter.

Policy makers must invest in high quality education system and skills training as the world economies have become very competitive than ever (World Economic Forum, 2014). The government must also pursue new and innovative ways to increase the investment in higher education by the private sector. Through high quality education, individual capabilities can be enhanced to the maximum and this will contribute to social cohesion and political stability when a disaster strikes.

This study will provide new insights on the delayed effect of different types of natural disasters on human capital at different level of education. It is important to study these delayed effects as it will have a persistent effect on the future human capital accumulation, as natural disasters are becoming more frequent and intense recently. It will provide necessary feedback to policy makers on the importance of prioritizing education during a disaster response.

Despite the presence of various studies on biodiversity, there is room for further improvement as biodiversity is declining rapidly in many parts of the world and during this same period, the population growth of humanity has nearly doubled. This study hopes to contribute further novelty to the pool of present literature on biodiversity loss by providing a more elaborate understanding on the extinction of species due to the impact of natural disasters.

Several studies have acknowledge the significance of studying infectious diseases and have suggested the need to conduct further study on the subject matter. Having this in mind, the current study hopes to provide more insight by researching the impact of different types of natural on the increasing number of malaria cases.

1.6 Organization of Chapters

Chapter 1 provides an overview of the study, which includes background of study, problem statement, research objectives, significance of the study and organization of the thesis. Chapter 2 provides a comprehensive review of literature, which is related to the main issues of the study. The review gives an insight to broad and contradictory information relating to natural disasters, human capital, infectious diseases and biodiversity loss.

Chapter 3 describes the methodology that will be applied. The chapter starts with the theoretical framework that describes the relationship between natural disasters, human capital, infectious diseases and biodiversity. The followed by model specification, empirical methodology, variables description and data sources. Chapter 4 encompass the findings of the estimation and discussion of these results and Chapter 5 draws conclusions, makes policy recommendations, highlights the limitation of the study and makes some suggestions for future research.

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