Disaster Summary Sheet
Earthquakes

January 2012

Document objective

This disaster summary sheet (DSS) provides a general profile of the potential impact of an earthquake. The DSS helps understanding what the actual impact and priority needs after an earthquake may be, based on experience and lessons learnt from medium and large scale earthquakes that have occurred in the past.

This document does not intend to provide an in-depth analysis of the specific impact of earthquakes in different settings. It can however be used immediately after you received an earthquake alert as a framework for estimating the impact of the disaster or as a briefing package on "what do we know about the impact of an earthquake on life saving sectors".

Content

1. What do I need to know?

a. Physical impact

- The two most important variables affecting the impact of an earthquake are the **intensity of ground shaking** caused by the quake and the **quality of the engineering of structures** in the region.
  - **Type of construction**: concrete and masonry structures, because they are brittle, are more susceptible to damage than wood and steel structures, which are more flexible. Buildings made from steel, reinforced concrete and wood are less likely to collapse, because they flex somewhat without breaking. Family homes built completely out of brick are not as safe because they can break apart easily (Earthquake facts 2010). Middle-income neighbourhoods often are more severely impacted than the poorest neighbourhoods, as accommodation in poorer areas is often of light design – corrugated roofs, plastic sheeting, and wood.
  - **Ground shaking**: Some rock types transmit seismic wave energy more readily. Buildings on solid bedrock tend to receive less damage. Unconsolidated rock and sediments have a tendency to increase the amplitude and duration of the seismic waves increasing the potential for damage. Some soil types when saturated become liquefied.
- **The effects of an earthquake are concentrated.** Disasters of hydro-meteorological origin – such as floods, hurricanes and droughts – generally affect a wider geographical area than disasters of geological origin – such as earthquakes (ECLAC 2003).
- The **destruction of assets and infrastructure** resulting from earthquakes is generally much greater than that caused by floods. Production and other indirect losses, however, will probably be much greater in the case of floods and droughts (ECLAC 2003).
- Earthquakes create large amounts of **rubble**, which needs to be cleared before reconstruction can start (ALNAP 2008).

b. Impact on population

- **Mortality risk is highly concentrated**; of all the people killed by earthquakes over the last ten years, 91.8% were killed in just five mega-disasters (UNISDR 2009).
- In areas with similar population density, the number of victims in an earthquake will very probably be higher than in the case of hydro-meteorological events (ECLAC 2003).
- Death rates are higher for the most vulnerable: the aged, women and children (Peek-Asa, 2003).
- The **primary cause of death is injury (trauma) directly caused by building collapse**. Some survive but are trapped by the collapse. Those in buildings which did not collapse have a much lower risk of death. For a collapsed building, the proportion of occupants at the time of collapse who are either killed or trapped depends on the form of construction.
- Death is rare for people who are outside a building at the time of the earthquake.
- A 2009 study of all fatal earthquakes which occurred between 1987 and 2008 shows that the **majority of fatalities are caused by shaking-related causes** (77%), 17% due to **tsunamis**, 5% due to **landslides** and the rest are due to other causes. (Marano 2009).
- Unreinforced masonry buildings (URM) have historically been shown to be the greatest danger to their inhabitants, and the weaker the masonry, the higher the death toll in the event of a strong earthquake.
- Research (Macintyre et al., 2005) demonstrates that structural collapses from earthquakes generate trapped victims who infrequently may survive for 3–4 days. Under special, ideal conditions (with food and water), survival may extend to two weeks.
- The rescue rate of those trapped depends on the effectiveness of search and rescue (SAR). SAR effectiveness depends on: the proportion of buildings that have collapsed the availability of organised SAR to supplement local community capability, the distance travelled by rescue teams and the transportation disruption.
- Usually no warning precedes an earthquake, but after a major one, **aftershocks** may be as strong as a new earthquake.
- **Major population movements** are rare. However, it may occur in heavily damaged urban areas (PAHO 2002).

2. What is the likely impact of an earthquake?

a) Aggravating factors

- Earthquake vulnerability is highest in middle-income countries with relatively higher levels of economic and urban growth, but who haven't integrated planning and regulatory frameworks capable of factoring disaster risk reduction considerations into urban development. Typically, therefore, poorer countries with high exposure, rapid urban growth and weaker governance have the highest mortality rate after an earthquake (UNISDR 2009).
- Presences of dense collections of buildings with high occupancy.
- Time of day; higher losses of life tend to occur on weekdays between the hours of 9:00 AM to 4:00 PM as well as during the night when people sleep. During this time interval many people are in large buildings as they are attending work or school.
- Earthquake occurring under sea water (risk of tsunami).
- Lack or malfunction of early warning systems in the case of a tsunami triggered by an offshore earthquake.
- Lack of functioning health structures.
- Fire is a secondary effect of earthquakes which often causes damage. Because power lines may be knocked down and because natural gas lines may rupture due to an earthquake, fires are often started closely following an earthquake. The problem is compounded if water lines are also broken during the earthquake since there will not be a supply of water to extinguish the fires once they have started.
- Proximity of critical infrastructures (hydrodams, electric plants, etc.)
- Weather: Winter is the worst time to be left exposed to the weather, and those who survive the earthquake will be at risk of hypothermia, frostbite and illnesses caused by long exposure to dampness and cold. Bad weather also hampers rescue efforts and makes recovery from the disaster much harder. In cold weather it is also more likely that houses will have contained

stoves and fires that were burning when they collapsed, greatly increasing the chances of fires after the shock waves have gone.
Quakes that strike in warm dry weather also have specific problems, but these are more associated with hygiene. In addition, high temperatures make it harder for trapped people to survive in the rubble due to a lack of water (Geography-site).

- Duration and depth of the tremor

b. Lessons learnt

General:

- Ratio of dead to injured varies widely – response should be based on accurate assessment, not on rules of thumb (IRC 2010).
- Destruction of roads, bridges and other infrastructure makes access and communication difficult. Roads can be blocked with debris or have their surfaces broken.
- Earthquakes can cause considerable damage to the communications infrastructure, damaging for instance telecommunications cables and the public telephone system.
- Aftershocks can remain a significant hazard, causing further damage and increasing the psychological stress of both victims and aid workers.
- Inclusion of environmental impact assessment as part of reconstruction planning, at both the program and project level, can help avoid immediate negative effects as well as costly remediation measures in the longer term.
- There is no gap or stability phase between relief and recovery as may occur with for instance protracted refugee crises. Households begin their recovery efforts immediately after the earthquake.
- The effects of a disaster last a long time. Disaster-affected countries deplete much of their financial and material resources in the immediate post-impact phase (ALNAP 2008).

Food security:

- Most urban populations, particularly the poorest, survive by buying and cooking food daily with limited storage for maintaining longer-term food supplies. Given the constraints on urban food systems, any disruption to supply or distribution from a disaster causes immediate consumer shortages. (O'Donnell 2009)
- Urban households often rely on a more varied diet.
- Urban households pay more for food in both time and financial costs, particularly the urban poor for whom food is their largest expense.
- Urban households are smaller in average size, but have higher proportions of children to adults and higher proportions of non-family members.
- Urban women's participation is greater in income-generating activities (IRC 2010).

DIRECT IMPACT	INDIRECT IMPACT
Loss of food stock, crop yields and livestock	Decreased food access from purchase, due to loss of income
Damage to people's homes and business premises	Lack of basic food necessities
Destruction of infrastructure and equipment	Disruption of food production, markets and transportation systems
Damage to markets and supply routes	Decreased food availability
Loss and injury of family members and workforce	Increase in price of staple food
Damage to irrigation systems	Reduced income for farmers
	Decreased amounts of food consumed, due to decreased availability and/or increased prices

	Lower quality of diet by choice (coping) and/or unavailability
	Reduced participation in food production and distribution
TYPICAL ASSISTANCE NEEDS	
• Short term food supply • Market support • Cash for work, Food for work • ...	

Health and nutrition:

- Natural disasters such as earthquakes usually result in a dramatic peak in mortality and injury within the first 72 hours. Survival chances after this time are bleak (however, survivors were found after two weeks after the Haiti earthquake in 2010).
- The biggest cause of fatalities is building collapse, responsible for 75% of all deaths in a survey of 1,100 fatal earthquakes (ALNAP 2008).
- Survival in entrapment rarely lasts longer than 48 hours: 85-95% of persons rescued alive from collapsed buildings are rescued in the first 24-48 hours after the earthquake.(WHO)
- Evolution of morbidity and mortality in ensuing weeks depends largely on the occurrence of epidemics, though these have usually been of very modest proportions (HPN 2007);
- Outbreak of diseases is unlikely – out of 600 geophysical disasters only 3 were found to lead to epidemics (IRC 2010).
- The broad pattern of injury after an earthquake is likely to be a mass of injured with minor cuts and bruises, a smaller group suffering from simple fractures, and a minority with serious multiple fractures or internal injuries and crush syndrome requiring surgery and other intensive treatment. (WHO)
- Most injured people appear at medical facilities during the first three to five days after which consultation patterns return (almost) to normal. Patients may appear in two waves. First, the casualties from the immediate area around the medical facility will arrive followed by a second wave of referred cases as relief gets organised in more distant areas. Victims of secondary hazards (post-earthquakes aftershocks and fires) may arrive at a later stage. Camp/field hospitals and rescue teams usually arrive too late to have a real life-saving impact. (WHO)

DIRECT IMPACT	INDIRECT IMPACT
Many severe injuries requiring extensive treatment: • High levels of fractures, blunt trauma, wounds and crush syndrome. • Morbidity and mortality resulting from trauma, asphyxia, dust inhalation in collapsed buildings (acute respiratory distress), or exposure to the environment (i.e. hypothermia). • Burns and electroshocks (PAHO 2002)	• Overcrowded health structures • Increased portion of the population handicapped.
• Severe damages to structure and equipment of health facilities can lead to an interruption in basic health care services.	• Lack of access to basic healthcare • Overcrowded health structures • Deterioration of nutritional status, famine and illness may occur if victims does not have access to health care

• Decaying corpses and carcasses on the streets	• Psycho-social problems due to unclean environment and confrontation with corpses • Carcasses of livestock can represents a risk to human health as a direct source of disease from vectors that may be attracted to the area, and decomposition products contaminating the air and water
RISKS	
• Measles (in case of low baseline immunization coverage) – Airborne transmission • Coccidiomycosis (Airborne dust from landslides) • Hepatitis E in case of water scarcity • Malaria in case of change of habitat • Tetanus caused by injuries and low baseline immunization coverage	
TYPICAL ASSISTANCE NEEDS	
• Search and rescue assistance • Emergency medical assistance, including the management of crush syndrome • Repair and reconstruction of health facilities • Management of health care waste • Prevention and control of communicable diseases • ...	

Source: IFRC guidelines for public health in emergencies, 2007

WASH:

- In many earthquakes the underground pipe system is surprisingly undamaged relative to the enormity of the destruction above ground (Cocking 2010).

WATER SUPPLY	DIRECT IMPACT	INDIRECT IMPACT
URBAN	**Disruption of water distribution systems due to:** • Interruption of electric power, hampering water supply • Total or partial destruction of water intake, transmission, treatment, storage and distribution system. • Rupture of distribution pipes, damage to joints between pipes or tanks. • In case of pipe material like Asbestos Cement, the pipes may develop hairline cracks which expand once the water pressure increases **Urban water system contaminated due to:** • Leaks or destruction in sewerage systems causing sewage contamination to water sources and supply system • Ground water contamination due top underground storage tanks, septic tanks, municipal landfills and/or agricultural activities • Shallow groundwater contamination due to effluent, or outflow from septic tanks, cesspools and privies • Deep groundwater polluted by underground storage tanks • Overflowing of industrial drainage	• Consumption of contaminated water: potential risks of water-borne diseases • Insufficient quantity of water available per person and per day • Increased distance to functional water source

	system causing chemical contamination to water sources and supply systems	
RURAL	**Disruption of water distribution systems due to:** • Shallow protected and unprotected wells destroyed and obstructed by debris • Shallow tube-wells and hand pumps destroyed **Rural water system contaminated due to:** • Ponds and other surface water sources contaminated by debris • Shallow groundwater contamination due to effluent, or outflow from septic tanks, cesspools and privies • Shallow protected and unprotected wells contaminated by debris.	• Consumption of contaminated water: potential risks of water-borne diseases • Insufficient quantity of water available per person and per day • Increased distance to functional water source • Living livestock, may no longer be confined and roaming uncontrolled, the pollution they generate is not confined or controlled and may contaminate surface waters used for drinking
SANITATION	**DIRECT IMPACT**	**INDIRECT IMPACT**
	• Destruction and/or damages to (public and/or private) existing latrines • Destruction and/or damages to sceptic tanks and underground excreta disposal systems	• People defecating in the water, thereby contaminating water sources • Contamination of water by damaged sceptic tanks or disrupted excreta disposal underground systems • Overcrowded sanitation facilities can filled up and/or overflowed remaining functional latrines • Increasing presence of vectors • Increase in communicable diseases • Lack of available and functional latrines can force women to wait after dark to be able to use an (open air) latrine in private. This can cause constipation.
WASTE	**DIRECT IMPACT**	**INDIRECT IMPACT**
Urban and rural	• Destruction or damage of existing waste disposal structures. • Large amount of rubble. Materials can be standard construction materials (e.g. chips of wood, brick and metal, and blocks of concrete. concrete, stone, etc.), as well as hazardous wastes, including asbestos from housing insulation and damaged water supply lines, stored fuels, lubricating oils, industrial materials, medical waste from clinics/hospitals, and possibly radioactive waste from X-ray devices	• Accidental releases to ground water • Disruption and/or overwhelmed waste collection system • Shortage of waste disposal facilities in (overcrowded) displaced centres • Altered drainage patterns. Land surface alterations may increase flooding in areas previously not at risk. Existing drainage channels, canals may be clogged with waste or muds, again inducing altered patterns of runoff and creating flood situations
HYGIENE	**DIRECT IMPACT**	**INDIRECT IMPACT**

Urban and rural	• Loss of basic hygiene items for personal and domestic uses	• Lack of clean water needed for basic hygiene practices • Increase in communicable diseases • Lack of access to basic hygiene items for personal and domestic uses (disruption of market supply, lack of income) • Inadequate laundry and showers in displaced centers

TYPICAL ASSISTANCE NEEDS

- Water supply and treatment
- Rehabilitation and/or reconstruction of water sources
- Rehabilitation and/or reconstruction of water supply systems
- Hygiene items distribution, hygiene promotion
- Rehabilitation and reconstruction of latrines
- Vector control
- Waste management, drainage system rehabilitation and/or (re)construction.
- ...

Shelter:

- Even when their homes are intact, many survivors opt to sleep in the open in the immediate aftermath of an earthquake, fearing the effects of further tremors. (Haiti Revised Appeal 2010, Indonesia Response Plan 2006).
- Shelter should not be approached simply as an engineering/technical challenge, but address all aspects: immediate and future needs; livelihoods (e.g. animal shelters) and protection issues (e.g. land dispute resolution) (ALNAP 2008).
- Land and property issues and related disputes typically emerge in the aftermath of an earthquake, particularly in urban areas where there is high demand for housing.
- Rubble contains elements such as timber, metal and other scrap that can be used to provide emergency shelter (ALNAP 2008).
- Lessons from previous disasters recommend minimising resettlement and social dislocation. In the aftermath of the Bam earthquake in Iran for instance, there was a low occupancy of camps set up to house affected populations as households preferred to stay close to their homes. (O'Donnell 2009).
- There is a need to plan a transitional stage to bridge the gap between emergency shelter and permanent housing (ALNAP 2008).
- Transitional shelter works best when it is integrated with the permanent shelter solution (ALNAP 2008).
- Any new construction should be designed and built to resist the likely major hazards as to not rebuild vulnerability (ALNAP 2008).

Protection:

- Disasters cause more damage to vulnerable geographic areas, which are more likely to be inhabited by poor people. Especially in developing countries, disasters take a greater toll on the poor (PAHO).
- **Children** are especially at risk of dying from earthquake-related injuries. During the 2010 Haiti earthquake it was reported that children were considerably more likely to have been killed during the earthquake than adults, and were 11 times more likely to have died of injuries after the quake (Kolbe 2010)
- Natural disasters do not only seriously disrupt the functioning of a community by causing widespread human, material, economic or environmental losses, but also the mechanisms established, formally or informally, to protect the lives, security and basic rights of the population.

- A breakdown of law and order can occur following earthquakes. Emergency situations also tend to exacerbate existing inequalities among the population, or other human rights/protection concerns (Haiti Flash Appeal 2010).

Gender:

- Women are especially vulnerable to disaster (e.g. earthquake) for the following reasons:
  - Changing role of women (from care giver to head of household) and less access to resources, social networks and decision-making. Lack of safety nets
  - Informal and agricultural sectors are usually the most impacted by disasters. In different societies, these sectors are the main income source for women; hence women become over represented among the unemployed.
  - Women have less freedom and mobility to look for alternative sources of income.
  - Less access to relief and information in specific cultures
  - Low visibility in society and sometimes limited understanding of women's needs in post disaster situation (i.e reproductive health). Identification and attention to their needs is most often inadequate.
  - Majority of shelter residents remain women and thus may leads to increase in levels of domestic physical and sexual violence/harassment. Protection issues in settlements, such as the location and lightning of washrooms, are generally not sufficiently addressed.
  - Reproductive and sexual health care are often neglected in an emergency.
- In the Latur, Maharashtra (India) earthquake of 1993, women accounted for 48% of the affected population, but accounted for 55% of those who died (Twigg 2004).
- In the Asian tsunamis, five times as many women as men are believed to have died (Chew and Ramdass 2005).
- Disproportionate numbers of women were killed in the earthquake that devastated large areas of Kashmir and NWFP (Pakistan in 2005) (Chew and Ramdas, 2005).
- Because housing is most at risk in disasters, **women** are more likely to be among those killed, in particular where women's mobility outside the home is restricted by seclusion, custom or culture (EERI 2005).
- Although targeting women can have numerous advantages in certain contexts, there is a need to address women's safety after departure from distribution sites, as well as the physical effort required by women to transport distributed relief (for instance bags of rice) (Haiti Revised Appeal 2010)

Recovery:

- The recovery phase is likely to last at least three to five years for a major disaster. The greater the impact of the disaster on livelihoods, and the weaker the resilience of the community, and the less effective the recovery effort, the longer recovery will take (ALNAP 2008).
- While short-term action is important to save lives and protect assets, much of this work may be done by the community itself. Paying people for their work can provide much-needed short-term employment especially for those whose principal livelihood is daily labour (ALNAP 2008).
- The local population almost always covers immediate life-saving needs. Only skills that are not available in the affected country are usually needed. Few survivors owe their lives to outside teams (Myths and Realities by P. Chataigner).
- Deaths should not be buried in mass graves. Death bodies do not pose a public health risk and survivors have a strong need to identify lost loved ones and grieve for them in customary way (Myths and Realities P. Chataigner).
- Livelihoods are the key to recovery. Agencies should give the same priority to livelihoods as does the affected population (ALNAP 2008).
- Agencies should not attempt to restore particular livelihoods unless these livelihoods are probably going to be viable in the changed circumstances after the disaster (ALNAP 2008).

b) Coping mechanisms

The following table contains a list of coping mechanisms generally adopted by affected population to cope with the impact of an earthquake.

REVERSIBLE STRATEGY	IRREVERSIBLE STRATEGY	RISK SURVIVAL STRATEGY
Changes in food intake (e.g. less meals, cheaper foods)	Taking out loans which cannot be paid back	Decrease food intake
Drawing on food stores	Sale/mortgaging of productive assets (tools, and seeds)	Theft
Increased (sustainable) sale/slaughter of livestock	Mortgaging of farm land	Travel to insecure areas to work or to gather food or fuel
Collection of firewood, charcoal, building poles	Intensification of self-employment activities	Over-use of natural resources, such as excessive fishing and collection of firewood
Harvesting of reserve crops	Increased social support/gifts	Reduced expenditure on productive inputs (fertilizer, livestock drugs)
Migration for work		Child labour
Intensification of local labour activities		Reduction in expenditure on school fees and health care
Selling non-productive assets		Sale of household assets
Taking out loans or calling in debts		Prostitution and external relationships
Changes in livestock migration patterns		Engaging in illegal economy e.g. drug trafficking
Separation of families and mothers from children		
Short-term/seasonal labour migration		

3. Quick impact analysis

In the immediate aftermath of an earthquake, the likely impact of an earthquake can be remotely assessed by analysing different factors, using different online sources and tools. The following step by step approach presents the different types of parameters and factors that you will need to measure and assess in order to reach a reasonable conclusion on the earthquake impact

a) Before to start...

- **Earthquake alerts:** Register to the GDACS alert. Regarding earthquake, it is recommended to receive only alerts with colour codes **Orange** or **Red**. Within minutes after the occurrence of an earthquake, GDACs alerts provides you with basic but crucial information regarding the disaster, the location, the time and some further characteristic of the country.

- **Locate earthquakes:** Make sure that you have the last version of Google Earth (GE). The Google Earth Pro version is actually more interesting for satellite imagery analysis as it integrates measuring tools that enable to measure distance, area, and radius a well as modules to import, style and view GIS data without adding additional and costly GIS software. Download USGS KML related to earthquake. You will specifically need the *M1+Real time earthquake past seven days and the shakemaps* KML to map last earthquake within GE.

- **Locate past earthquakes**: Download the *Earthquake catalogues KML* from USGS KML. You can also use the NOAA KMZ on Natural hazard (include localization of Tsunami source, major past earthquake with fatalities and volcanoes).

- In case you need to find some information on a past earthquake, look at the Earthquake list and map within USGS archive where you can search for earthquake by country, region and year. If you're looking for more in depth information on a past earthquake, look also at the PAGER archives or at the Earthquake Search page. GDACS is also archiving information about past earthquake and have interesting earthquake reports and the related news archives for each red and orange earthquake alert since 2006. The Cambridge Earthquake Impact Database provides information on damage and human casualty related to past earthquake.

- To get more information on specific area characteristics, you can proceed through a spatial request on the EMOPs Web portal of the Pacific and Disaster Center (registration required). Using the *regional reporter* within the tool bar, you can select a specific area of the map and ask for all related hazard information within this area. Very useful to find disaster history of a specific zone.

b) Identify the aggravating factors:

Look for…	
Localization of the epicentre	GDACS, USGS PAGER, Google Earth
• Will help you determine which country is (or are) potentially affected by the earthquake. Earthquake vulnerability is highest in middle-income countries with relatively higher levels of economic and urban growth, but who haven't integrated planning and regulatory frameworks capable of factoring disaster risk reduction considerations into urban development. Poorer countries with high exposure, rapid urban growth and weaker governance have the highest mortality rate after an earthquake (UNISDR 2009). • Earthquake occurring under sea water can cause tsunamis ➢ *Locate the epicentre of the earthquake*[1] ➢ *Draw a circle*[2] *around the epicentre and identify critical human settings and infrastructure within the considered area. The greater the magnitude, the bigger the radius of the circle should be (Magnitude 7 can have destructing and deadly effect 300-400 Km away from the epicentre. For a 5M earthquake, you can use a 100 Km radius).* ➢ *Identify if any earthquake occurred in the last 20 years*[3] *years in the same area (or closed to) and look for related impact information that will facilitate your analysis.* ➢ *Identify livelihoods within the considered area (agriculture, industry, fisheries, etc..)* ➢ *Identify vulnerability factors*[4] *present in the potential affected area before the disaster (socio economy, food security, livelihood, governance, impact of recent other hazards, etc.)*	
Magnitude, depth, duration, aftershocks	GDACS, USGS PAGER, Google Earth, EM-DAT
• Will help build a first estimation of the intensity of the ground shaking related directly to the earthquake. • The two most important variables affecting earthquake damage are the intensity of ground shaking caused by the quake and the quality of the engineering of structures in the region. The level of shaking, in turn, is controlled by the proximity of the earthquake source to the affected region and the types of rocks that seismic waves pass through en route (particularly those at or near the ground surface). Generally, the bigger and closer the earthquake, the stronger the shaking.	

[1] With USGS 'Historic Earthquake past seven days' KML
[2] Use the measuring tools from Google Earth. Only the google earth Pro version allow to draw circle, but it is possible to draw a line with the standard version
[3] Use the earthquake catalogues KML from USGS and upload them into GE. Locate closest earthquake with similar magnitude/depth. Retrieve date. Search within USGS archives for characteristics and reports on this earthquake. You can also proceed using the *reporter tool* from the EMOPS webportal or the GDACS archives (if the earthquake is recent).
[4] Use the GDACS summary report including several indicators on country

- The damage to a given structure will depend both on the amplitude of the shaking and its duration. How to best combine these quantities into an estimate of the amount of damage is ongoing research...
- Damage does not usually occur until the earthquake magnitude reaches somewhere above 4 or 5.5M magnitude. 7M earthquake can have devastating effects.
- There have been large earthquakes with very little damage either because they caused little shaking or because the buildings were built to withstand that shaking. In other cases, moderate earthquakes have caused significant damage either because the shaking was locally amplified or more likely because the structures were poorly engineered.

➢ *Look into the characteristics of the earthquake[5]. A combination of not very depth, high magnitude and long tremor length can have devastating impact on human settings.*
➢ *Look to previous impact of past earthquake in the same area to support your assumptions.*

Geography, geology, soil type	Google Earth, EMOPS

- Some rock types transmit seismic wave energy more readily. Buildings on solid bedrock tend to receive less damage. Unconsolidated rock and sediments have a tendency to increase the amplitude and duration of the seismic waves increasing the potential for damage. Some soil types when saturated become liquefied.
- As a secondary effect, earthquake occurring in mountainous areas can triggers landslides, avalanches and mudslides in case of bad weather.

➢ *Look at the characteristics of the area[6]: mountainous, coastal, plain, rural, urban,...*
➢ *Using the sectoral impact sheets of part 2 of this document, determine which damages and effects can be expected in the potentially affected area and which areas are the most at risk.*

Time of the day	USGS PAGER

- Higher losses of life tend to occur on weekdays between the hours of 9:00 AM to 4:00 PM as well as during the night when people sleep. During this time interval many people are in large buildings because of work or school.

Consider the time of the day and the main activities of the population in the considered area. Estimates where the following categories of people are supposed to be at the local time of the earthquake (women, men, elderly, children). Differentiate between rural and urban areas.

Population density	GDACS, Google Earth, Population explorer, EMOPS

- More people often means a greater chance of impact on livelihood, habitat, injury, death as well as loss of assets and capital. The closer people are from the epicentre, the greater the humanitarian impact should be.

➢ *Within the considered affected area[7], look at high density areas and key human settlements (cities, villages).*
➢ *List the five most important cities within the considered radius and figure out how many inhabitants are potentially affected[8].*

Type of building and infrastructure	Google Earth

- Structures which are not resistant to ground motion will be vulnerable as well as settlements in

[5] Use USGS Summary reports and GDACS alert reports
[6] Use GE
[7] Use GE
[8] Use GDACS population estimates and/or PopulationExplorer.

seismic areas. Dense collections of buildings with high occupancy can also aggravate the situation.
- The main death and injuries related to earthquakes are caused by collapsing buildings and fires (as well as avalanches, landslides and tsunamis)

➢ *Look for the type of building existing within the affected area[9]. Determine which settlements are composed of building and the most at risk of collapse, especially in urban settlements. In rural areas, look for the type of housing and roof (majority of injuries and death happen when roofs and walls fall apart)[10]*
➢ *Identify proximity of critical infrastructures (hydrodams, electric or nuclear plants, bridges, road, hospital, etc.) which can suffer directly or indirectly of the earthquake shock.*

Weather, temperature and altitude	GDACS, Google Earth, EMOPS

- Winter is the worst time to be left exposed to the weather, and those who survive the earthquake will be at risk of hypothermia, frostbite and illnesses caused by long exposure to dampness and cold. People living in mountainous areas and affected by earthquakes are also a risk of low temperature (Pakistan 2005).
- In cold weather it is also more likely that houses will have contained stoves and fires that were burning when they collapsed, greatly increasing the chances of fires after the shock waves have gone.
- Bad weather and rainy seasons can also hampers rescue efforts and makes recovery from the disaster much harder.
- Quakes that strike in warm dry weather also have specific problems, but these are more associated with hygiene. In addition, high temperatures make it harder for trapped people to survive in the rubble due to a lack of water (Geography-site).

➢ *Identify within the affected areas the variations of altitude and temperature, particularly temperature at night (min and max)[11]. Provide estimates of population at risk of extreme temperature. Identify when the winter will come.*
➢ *Identify the precipitation average per day in the different affected areas[12]. Identify when the rainy season will come[13].*
➢ *Isolate key upcoming climatic events or situations that can aggravate the situation or hampered humanitarian access to affected population.*

Disaster management capacity	Preventionweb, evaluation report of past earthquakes in the same area.

The following parameters can mitigate the impact of an earthquake:
- Functioning early warning systems in the case of a tsunami triggered by an offshore earthquake.
- Existence of emergency stockpiles (shelter, NFI, food, Water, medicines)
- Functioning health structures for primary health care
- Functioning emergency services (including civil protection, military)
- Existence of effective planning and regulatory frameworks capable of factoring disaster risk reduction considerations into urban development

➢ *Collect few key indicators about the affected country (health, HDI, WASH, GNA, ...)*
➢ *Estimate the capacity of the affected country to cope with the situation compared to the estimated scope and extent of the earthquake impact[14].*

[9] Use satellite imagery, GE, photos, Wikipedia, etc..
[10] Use the Cambridge Earthquake Impact Database
[11] Use GDACS Alert report
[12] Use GDACS alert report
[13] Generally available in Wikipedia or at the national meteorological website
[14] Use your estimation of affected population and the scope of the disaster to judge the in-country capacity to address needs.

➢ *Look at the main present INGO in country and consider if they are involved in relief operations or development programme. Look at regional capacities.*

c) Building a disaster snapshot report:

Disaster snapshot	USGS PAGER Reliefweb Alertnet GDACS, VOSSOC, media

The report needs to be concise and clear, no more than four pages (including one page of reference map). Use bullet points.

- **Country profile and key indicators**
  - Key indicators
  - Past hazards
  - Disaster management capacity

- **Disaster characteristics**
  - Magnitude, location, depth, etc.
  - Time and date, weather

- **Affected area profile**
  - Map of affected area
  - Name and number of potentially affected districts/areas
  - Characteristics of the affected areas (livelihood, geographical characteristics, density, rural, urban, housing, etc...)
  - Total number of inhabitant living within the affected area

- **Affected population**
  - Estimation of affected population number: potentially affected, injured, death and missing people
  - Number of affected and fatalities/casualties reported after similar past earthquake
  - Pre-disaster vulnerabilities
  - Desegregation per sex and age

- **Estimation of impact on life saving sectors**
  - Main sectors likely affected by the disaster and priority needs
  - Potential secondary effects
  - Lessons learnt and experience from past earthquake in the same area

- **Estimation of physical damage (hospital, houses, roads, bridges destroyed, etc.)**
  - Critical infrastructure potentially affected within the affected area

Constraints
- Access and communication

- **Key concerns**
  - Secondary effects (landslides, avalanches)
  - Temperature, weather, altitude
  - Key upcoming events (rainy season, winter)

- **Key messages**
  - Likely scope and scale of the disaster
  - Priority sector for assistance / recommendations for intervention
  - External assistance required

Information gaps and needs

Template
Double click on the following icon to see a Disaster Snapshot Report template:  110214 Disaster Snapshot report temp

4. References

- ALNAP 2008, Responding to earthquakes; Learning from earthquake relief and recovery operations. http://www.alnap.org/pool/files/ALNAPLessonsEarthquakes.pdf

- Cocking, J and Bastable, A. 2010. Water, sanitation and public health in post-earthquake Haiti: reflections on Oxfam's experience *Humanitarian Exchange magazine*. Issue 48, September 2010

- Earthquake facts, 2010. http://earthquakefacts.net/Interesting-Earthquake-Facts.html

- ECLAC, 2003. Handbook for Estimating the Socio-economic and Environmental Effects of Disasters. http://www.proventionconsortium.org/themes/default/pdfs/ECLAC_handbook.pdf

- EERI 2005, *Learning from Earthquakes: First Report on the Kashmir Earthquake of October 8, 2005*. EERI Special Earthquake Report — December 2005.

- HPN 2007, Public health in crisis affected populations; A practical guide for decision-makers. http://www.odihpn.org/documents/networkpaper061.pdf

- IASC, 2010. Response to the Humanitarian Crisis in Haiti. http://www.alnap.org/pool/files/ocha.pdf

- IFRC, 2000, Disaster Emergency Needs Assessment;

- IRC 2010. Haiti Earthquake 2010: Lessons Learned and Essential Questions. International Rescue Committee http://oneresponse.info/Disasters/Haiti/Education/publicdocuments/Haiti_earthquake%20_lessons_learned_200110.docx.

- John Hopkins and IFRC, 2007. Public health guide for Emergencies http://www.jhsph.edu/refugee/publications_tools/publications/_CRDR_ICRC_Public_Health_Guide_Book/Public_Health_Guide_for_Emergencies

- Kolbe, A. and Muggah, R. 2010, Surveying Haiti's post-quake needs: a quantitative approach. Humanitarian Exchange magazine. Issue 48, October 2010.

- Marano, K. D., D. J. Wald, and T. I. Allen. (2009). Global earthquake casualties due to secondary effects: a quantitative analysis for improving rapid loss analyses. Nat. Hazards., v. 49, DOI: 10/1007/s11069-009-9372-5.

- O'Donnell, I., and K. Smart with B. Ramalingam 2009. *Responding to Urban Disasters: Learning from Previous Relief and Recovery Operations.* ALNAP and ProVention Consortium. London, June 2009. http://www.alnap.org/pool/files/alnap-provention-lessons-urban.pdf

- PAHO, 2002 Humanitarian Assistance in Disaster Situations. http://www.paho.org/english/Ped/pedhumen.pdf

- Save the Children, 2010. *Safety First: A safety and security handbook for aid workers*. Save the Children UK, London, second edition.

- UNISDR 2009, Global assessment report on disaster risk reduction. http://www.preventionweb.net/english/hyogo/gar/report/index.php?id=9413

- USGS Earthquake Hazards Program, http://earthquake.usgs.gov/hazards/qfaults/glossary.php

- WFP, 2009. Emergency Food Security Assessment Handbook. http://documents.wfp.org/stellent/groups/public/documents/manual_guide_proced/wfp203246.pdf

- WHO, 2010. Earthquakes, Technical Hazard Sheet, Natural Disaster Profile http://www.who.int/hac/techguidance/ems/earthquakes/en/index.html

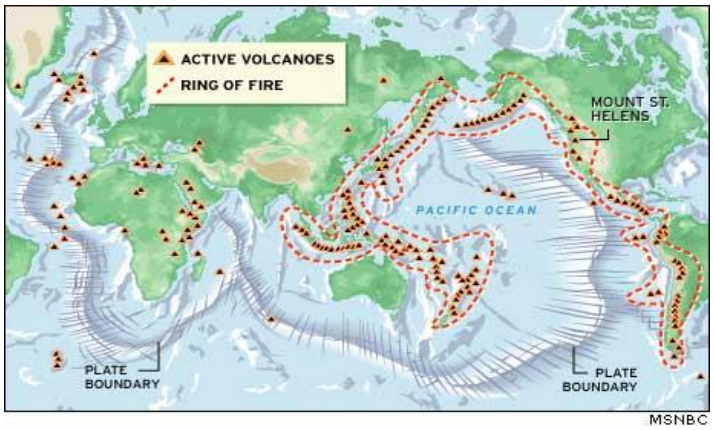
- World Bank, 2008 Good practices notes http://siteresources.worldbank.org/CHINAEXTN/Resources/318949-1217387111415/Environmental_Hazards_en.pdf

- Institute of Water Problems Bulgarian Academy of Sciences, 2000, Groundwater related environmental problems after an earthquake http://www.iiasa.ac.at/Research/RMS/july2000/Papers/nitcheva.pdf

- Cambridge University, 2009, Estimating shaking-induced casualties and building damage for global earthquake events. *Includes a review of damages and casualties of 11 major earthquakes.*

ANNEX I: General characteristics earthquakes

Earthquakes are among the most deadly natural hazards. They are characterized by a **tremor of the earth's surface**, usually triggered by the release of underground stress along fault lines. The earth's surface is broken into 7 large and many small plates, called 'Tectonic plates', which are in constant movement. Most earthquakes are caused by movement of tectonic plates, but they can also be the result of volcanic activity. 4 out of 5 of the largest earthquakes occur within the Pacific "Ring of Fire", a horseshoe-shaped band of volcanoes and fault lines circling the edges of the Pacific Ocean. Each year, there are about a million earthquakes around the world. However, only about 100 of these cause serious damage. Most earthquakes last a minute or less. Aftershocks can follow an earthquake on and off for days or weeks.



PREVIOUS EARTHQUAKES:

Haiti:

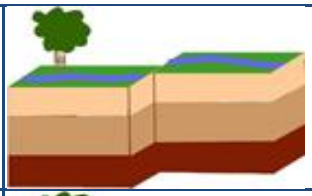
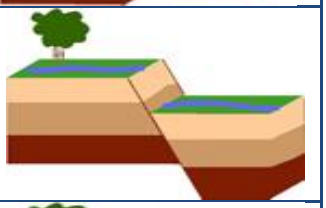
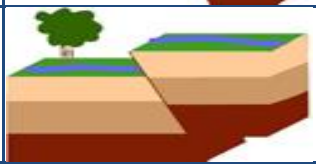
- 12 January 2010
- Magnitude 7.0 Mw. Hypocentre located less than 10 km below earth's surface and epicentre 25 km from Port-au-Prince. 52 aftershocks recorded of 4,5Mw and more by 24th of January.
- **Impact**: 222,750 people (2% of the population) were killed, 300,572 injured and 3 million were affected. 2.3 million people left their homes at the peak of the displacement (IASC 2010).

South-West Asia (Kashmiri region)

- October 8, 2005,
- Mw 7.6 earthquake, hypocentre 26 km. More than 978 aftershocks of magnitude Mw 4.0 and above, until October 27, 2005.
- **Impact:** More than 80,000 fatalities, 200,000 people injured, and more than 4 million people left homeless. Up to 25 km from the epicenter, nearly 25% of the buildings collapsed, and 50% of the buildings were severely damaged. (EERI 2005)

More facts on previous earthquakes can be found at EM-DAT

Depending on the type of plate motion, you can have:

Lateral movements called **transcurrent** or **strike-slip** faulting.	
A **reverse fault** : compression leads to upward thrusting or overthrusting of one block onto another: A thrust fault is a special kind of reverse fault where one or more plates are under the ocean. At a thrust fault, a plate below the sea is moving under another plate, thrusting its edge upward.	
A **normal fault**: extension produces vertical slippage downward	

a) Related disasters:

Earthquakes can trigger:

- **Tsunamis**: *see DSS 'Tsunamis'*.
- **Landslides**: In a landslide, masses of rock, earth, or debris move down a slope. The most common types of earthquake induced landslides are rock falls and slides of rock fragments that form on steep slopes.
- **Liquefaction:** A physical process that takes place during some earthquakes that may lead to ground failure. When liquefaction occurs, the strength of the soil decreases and, the ability of a soil deposit to support foundations for buildings and bridges are reduced. Liquefaction typically occurs in poorly consolidated, water-saturated sediment. Liquefaction sometimes generates sand boils which can cause local flooding and the deposition or accumulation of silt (USGS).
- **Displacement:** Because of the destruction of houses and shelter, earthquakes can force the affected populations to leave their homes. *See DSS 'Displacement'*.

b) Severity classification

The strength/intensity of an earthquake is usually measured on one of two scales, the Modified Mercalli Scale or the Richter Scale.

- The **Mercalli Scale**, also called the 'intensity scale', is a rather arbitrary set of definitions to calculate the intensity of an earthquake and measure the amount of shaking at a particular location based upon what people in the area feel and their observations of damage to buildings around them. So the intensity of an earthquake will vary depending on where you are.
- The **Richter Scale** is a "magnitude scale" and measure the size of the earthquake at its source. So they do not depend on where the measurement is made. It is designed to allow easier comparison of earthquake magnitudes, regardless of the location. Impact of one earthquake can vary greatly from place to place, so there may be many intensity values. Each earthquake, however, has only one magnitude**.** Because of the logarithmic basis of the Richter scale, each whole number increase in magnitude represents a tenfold increase in measured amplitude; as an

estimate of energy, each whole number step in the magnitude scale corresponds to the release of about 31 times more energy than the amount associated with the preceding whole number value. Often, several slightly different magnitudes are reported for an earthquake. This happens because the relation between the seismic measurements and the magnitude is complex and different procedures will often give slightly different magnitudes for the same earthquake.

The Modified Mercalli Intensity value assigned to a specific site after an earthquake has a more meaningful measure of severity to the non scientist than the magnitude because intensity refers to the effects actually experienced at that place.

Mercalli Scale	Richter Scale	Impact according to Mercalli scale
Intensity	**Magnitude**	
III	4.2	Resembling vibrations caused by heavy traffic
IV	4.5	Felt by people walking; rocking of free standing objects. Dishes, windows, and doors rattle. Walls creak. Parked cars rock.
V	4.8	Sleepers awakened and bells ring
VI	5.4	Trees sway, some damage from overturning and falling object
VII	6.1	People have trouble standing. Plaster and bricks may crack and fall. Considerable damage to poorly built buildings.
VIII	6.5	Walls, chimneys, and tree branches break and fall. Some poorly built buildings may collapse. Tall structures may twist and fall.
IX	6.9	Ground begins to crack and pipes break. Well-built buildings considerably damaged.
X	7.3	The ground cracks. Water splashes over the banks of rivers. Railroad tracks bend.
XI	8.1	Highways, railroads tracks, bridges and underground pipelines are destroyed. Most buildings collapse. Large cracks appear in the ground.
XII	> 8.1	Destruction of buildings and transportation systems. Almost everything is destroyed. The surface of the ground moves in waves or ripples. The ground is covered with cracks and holes.

Source; Earthquake facts 2010. Geography-site.

c) Terminology

- **Aftershock:** An earthquake of similar or lesser intensity that follows the main earthquake. If the main shock is large, aftershocks can continue for weeks, months or even years.
- **Earthquake magnitude:** This is the measured value of the earthquake size, the amount of energy released during an earthquake, which is computed from the amplitude of the seismic waves. It is a measurement of the size of the largest seismic wave recorded during a quake. The magnitude is the same no matter where you are, or how strong or weak the shaking was in various locations.
- **Epicentre:** The point on the Earth's surface directly above the (subterranean) point of origin (hypocenter) of an earthquake, typically located by its latitude and longitude
- **Fault:** A fracture or zone of fractures along which there has been displacement of the adjacent blocks relative to one another. There are three major types of faults: normal, reverse, and strike-slip.
- **Foreshock:** Some large earthquakes are preceded by a series of smaller earthquakes in the same place.
- **Hypocentre:** Also known as the focus, the hypocenter of an earthquake is the point on the fault plane where rupture began.
- **Intensity:** A measure of the level of earthquake shaking at a specific location. The dominant intensity system used in the U.S. is the Modified Mercalli intensity (MMI) scale. The magnitude of an earthquake is related to the total energy released by the event; an earthquake has only a single magnitude value. The shaking at the earth's surface produced by an earthquake decreases with distance from the epicentre and, therefore, an earthquake can have many intensities.
- **Liquefaction:** The transformation of loose sediment or soil into a fluid state as a result of increasing the pressure of the fluid in between the grains due to strong ground shaking.
- **Main shock:** The largest earthquake in a series of earthquakes that cluster, both geographically and in time. To be definitively called a main shock, it should generally be at least half a magnitude

unit larger than the next largest earthquake in the series. Otherwise, the series of earthquakes may be more accurately characterized as an earthquake swarm.

Annex II: Safety recommendations

d) What to do during an earthquake

Be aware that some earthquakes are actually foreshocks and a larger earthquake might still occur. Consider the following basic guidance, according to your position at the time:

If you are in a building:

- Drop, cover and hold on! Drop to the floor and crawl to a position of cover, such as under a sturdy table or against an inside wall, and hold on.
- Stay away from windows, outside walls, fireplaces and anything that could fall. Protect your head and body with your arms
- Stay under cover and hold on until the shaking stops, which should be no longer than one minute. If your cover moves, then keep hold and move with it.
- Only every attempt to exit the building if you are very close to an exit. Most injuries during an earthquake occur because people are hit by falling objects when trying to leave a building. Minimise your movements to a few steps to a nearby safe place, and do not attempt to use stairs, as this is more likely to result in injury.
- Stay inside until the shaking stops and it's safe to go outside
- If you become trapped in the debris, cover your mouth with a handkerchief or clothing. Do not light a match or use a light switch in case of gas leaks. Use your whistle or tap on a pipe or wall to help rescuers locate you. Shout only as a last resort- shouting can cause you to inhale dangerous amounts of dust.

If you are outdoors:

- Stay there! Move away from buildings, trees, overhead wires and poles
- Clasp hands behind neck, bury face in arms, make body as small as possible, close eyes and cover ears with forearms.
- Do not move from your position until the shaking stops.

If you are in a vehicle:

- Move to a clear area and avoid buildings, trees, overhanging rocks, bridges, overpasses or utility wires.
- Stop and stay in the vehicle
- If there is a danger of a structure collapsing on the car, get out and move away

- Proceed with caution once the shaking has stopped. Avoid bridges and roads that have been damaged by the quake.

e) What to do after an earthquake

In the immediate aftermath of any earthquake there will be much confusion, and so consider the following basic guidance:

- Remain calm and move cautiously out of the building – buildings can collapse some time after the quake itself.
- Be prepared for aftershocks. These secondary shock waves are usually less violent than the main quake but can be strong enough to do additional damage to weakened structures. Each time you feel one, Drop, Cover and Hold On!
- If it is dark and electricity goes out, use flashlights or battery-powered lanterns. Do not use candles, matches or open flames indoors after the earthquake, because of possible gas leaks.
- Look for and extinguish small fires. Turn off the gas and switch off the electricity.
- Check utilities. If you smell gas, hear escaping gas, or see a damaged pipe, then evacuating the building.
- If tap water is still available immediately after the earthquake, fill a bathtub and other containers in case the supply gets cut off. If there is no running water, remember that you may have water available in a hot water tank and toilet reservoir.

Source: Save the Children 2010