

# Dealing with Disasters

## Background information on disasters and natural hazards

### Earthquakes

An earthquake is a sudden shaking or movement of the earth's crust.

#### Why do earthquakes happen?

The ground beneath our feet seems to be stable and fixed in one place, but in fact it is constantly moving. The earth's crust is made of massive interlocking blocks of rock (tectonic plates), rather like a three-dimensional jigsaw. The crust floats on a layer of semi-liquid rock called the mantle. This semi-liquid rock flows from place to place, which causes the blocks of rock in the crust to move against each other. Most of these movements are so small that they can only be detected with special scientific instruments. However, sometimes there is a sudden release of energy in one place, and the crust moves very violently. This can cause cracks in the ground (fissures), and shaking of the earth's crust (tremors).

Some earthquakes are caused by human activity. When very large reservoirs (deeper than about 100m) are filled with water, the weight of the water can disturb the rocks below and cause immediate shallow earthquakes. Over a number of years, the water can spread deep into the rocks, and destabilise the whole area.

In 1965, five years after it was first filled, the Koyna Reservoir in India caused an earthquake of magnitude 6.5 on the Richter scale, which killed 177 people, injured 2,200 and left thousands of people homeless.

#### Where do earthquakes happen?

Earthquakes can happen anywhere in the world, but some places are more at risk than others. Nearly all earthquakes (about 95 per cent) happen at the point where mobile plates in the earth's crust join each other (faults). Parts of China, Japan, the Philippines, South America, and the USA are situated on major faults. Earthquakes can start deep in the crust (up to 270km deep), but the most dangerous earthquakes start closer to the surface, less than 30km deep. Tremors spread outwards from the epicentre, and a single earthquake can affect an area of many hundreds of square kilometres.

### **How do we measure earthquakes?**

There are different ways of measuring earthquakes. The Richter scale (which is open-ended) is a method of measuring the energy, or intensity of an earthquake (how strong it is). The Modified Mercalli scale (which has twelve classes) is a way of measuring the effects of an earthquake (how damaging it is). An earthquake that is small in magnitude (low on the Richter scale) can still cause a lot of damage (high on the Modified Mercalli scale). Different countries may use different scales of intensity: Japan uses the Japan Meteorological Scale (JMS), which has seven classes of earthquake intensity; the Modified Mercalli scale (MM) is used in the Americas.

In 1988, an earthquake of magnitude 6.9 on the Richter scale struck an area of Armenia where there were several large towns and cities. At least 25,000 people were killed, and 130,000 people were injured. The following year, an earthquake of similar magnitude, 7.1 on the Richter scale, struck California in the USA. Only 67 people were killed.

The Armenian earthquake happened at night, close to major cities where houses were made from heavy concrete, which are likely to collapse under stress. In the city of Leninakan, 80 per cent of buildings were destroyed. About 14 buildings were hardly damaged at all. These buildings were the only ones in the city which had been designed to withstand earthquakes.

The earthquake in the USA happened in an area of California where fewer people live. Houses in this area are usually designed to resist earthquakes. Although major roads were destroyed, fewer people than normal were out driving, because many people were watching an important baseball game in the area.

### **Why do we need to measure earthquakes?**

Measuring earthquakes helps us to learn more about them. Scales which measure the effects of earthquakes, like the Modified Mercalli scale, help us to understand how earthquakes affect people. This means that we can understand more about how earthquakes cause damage, injury, and loss of life. This can help communities to prepare better, and minimise their risk.

### **The Modified Mercalli scale**

The Mercalli scale was developed in 1902 by Giuseppe Mercalli. Since then, the scale has been changed to include the effects of earthquakes on more recent inventions such as cars and skyscrapers – things which didn't exist in Mercalli's day! This scale has twelve classes.

Some of the classes are summarised below.

Class I	Not felt, except by a very few people.
Class V	Felt by nearly everyone. Some windows broken. Unstable objects fall over. Pendulum clocks may stop.
Class VII	Everybody runs outdoors. Buildings designed to resist earthquakes and made of strong materials are hardly damaged at all; ordinary buildings are moderately damaged; buildings not designed to resist earthquakes, or made from weaker materials, are severely damaged. Earthquake is noticed by people driving cars.
Class XII	Total devastation. Earthquake waves are seen on the surface of the ground. Objects are thrown upwards into the air.

### **Can we tell when an earthquake is going to happen?**

It is very difficult to predict an earthquake, and most earthquakes happen with little or no warning. This is because scientists still do not fully understand the causes of earthquakes. Predicting earthquakes can be expensive, because lots of special scientific equipment is needed. Poorer countries and regions will not be able to afford such equipment.

If a prediction is wrong, then there can be serious consequences. Many people cannot afford to stop working, even for a few days.

In 1986 56,000 people were evacuated from the towns of Lucca and Modena in Italy. Shops and businesses closed for two days. No earthquake happened, and local people were angry about the loss of business, and the inconvenience of the evacuation. The mayor was forced to resign.

One way to predict future earthquakes is to look at how many earthquakes have happened in a particular area in the past. Studies suggest that an earthquake of magnitude 8 or more on the Richter scale will hit California on average once every 160 years.

If an earthquake is detected as soon as it starts, then better precautions can be taken: for example, power stations can be shut down, hospital generators started, and the emergency services can be alerted.

In February 1975, the Chinese authorities successfully predicted a major earthquake in the city of Haicheng-Yingkou, and many people were evacuated. Although more than one thousand people were killed, this was far fewer than might have been expected. Successful predictions such as this one, which save lives, are very rare.

In Japan, special instruments called accelerometers, which detect earthquakes as soon as they start, are located every 20km along the Tokaido railway line. When an earthquake is detected, electricity is automatically shut down, and the train's brakes come on. The track is then inspected for damage. Over the last twenty years, trains have been stopped about 100 times by this system.

### **How are people affected by earthquakes?**

The effects of earthquakes are very variable. People are more likely to die or be injured where large numbers of people live close together, and where local buildings are not designed to resist earthquakes. About 95 per cent of people killed in an earthquake are killed by falling buildings.

An earthquake can cause other dangerous events, such as landslides, floods, fires, and huge ocean waves called tsunamis.

When an earthquake happens it is important to help survivors quickly, and most of the first-aid and rescue work will be carried out by people already in the region. After an earthquake, the first thing people do is to search for their family and friends. People can be helped better when there are good transport systems, and trained local emergency workers such as nurses and paramedics.

Why are some people more at risk than others? (below)

#### **Factbox**



There are more than 3000 perceptible earthquakes (ones that people can feel) worldwide every year.



The first known earthquake detector was invented in China in 132 A.D. by Zhang Heng. It used a pendulum suspended inside a bronze jar.



About 360 earthquakes in Britain are detected by scientists every year. Only about 20 of these can be felt by people.



Earthquakes are most dangerous when they happen at night. This is because people may sleep through the first tremors (foreshocks), and so have less time to prepare. Also, lying flat in bed means that you are more likely to be hit by falling objects than if you are standing up.

## Floods

A flood is when water flows or rises above and beyond its normal place. The danger this causes to people and buildings is called the flood hazard.

### What is a flood?

The most common kind of flood happens when a river overflows its banks, and water spreads on to the surrounding land (a riverine flood). This is caused by rainwater or melting snow draining into the river faster than the river can discharge water into the sea. The amount of water that a river can hold before a flood starts is known as channel capacity.

Other causes of flooding are strong tides, storms at sea, hurricanes, and tsunamis.

### Where do floods happen?

Floods are a normal part of the life of a river. Most rivers have areas nearby known as floodplains which fill with water when the river becomes too full. Floodplains are usually on low ground, often near the coast.

The chances of a flood happening in any one place are related to the shape of the river and the land around it, the local and regional weather, and the ways in which people live on and use the surrounding land.

Low-lying coastal regions can also be at risk from flooding, especially when there are severe storms at sea.

### Living in floodplains

From the dawn of human history, people have chosen to live in floodplains. Regular flooding improves the fertility of the soil, so people can grow more food; living beside a river gives people and their animals and crops easy access to life-giving water; rivers are important for transport and communication; and many industries, both traditional and modern, require a regular supply of water.

In 1955 10 million people lived in the floodplains of the USA. By 1985 the number had doubled to 20 million people.

## Living with flooding - Bangladesh

Bangladesh is the largest river delta in the world, and the country is used to dealing with regular flooding. On average, 20--30 per cent of the land is covered by the floods each year. The season of floods in Bangladesh is known as kharif, and the season of drought is known as rabi.

Most people in Bangladesh work on the land, and farmers have developed ways to use the floodwaters and the natural fertility that they bring. The crops grown in Bangladesh, such as rice and jute, thrive in wet conditions. Rice is the main food crop in Bangladesh, and farmers grow different kinds of rice in different seasons of the year, depending on the amount of water standing on the land.

The soil in Bangladesh is one of the most fertile in the world. Flooding can improve soil fertility by encouraging the growth of algae, causing plants killed by the water to decompose, and by starting chemical reactions in the soil. All of these processes release vital minerals which help crops to grow.

Bangladesh has about 250 rivers. Many of its major rivers start in other countries – 90 per cent of the water in Bangladeshi rivers comes from outside the country. The three main rivers in Bangladesh are the Padma (or Ganges), the Jamuna (or Brahmaputra), and the Meghna.

### One river, many countries

The Brahmaputra begins in the Chemayungdung Mountains, which are partly in Nepal. In Tibet, it is called the Yarlung Yangbo. It passes through Lhasa on its way to China, where it is called simply the Yangbo. It enters India in the north-east state of Arunachal Pradesh, where it is called the Dihang. Meandering through Assam, it is known as the Brahmaputra, the name by which it is known internationally. In Bangladesh it is called the Jamuna, and it keeps this name until it joins the Ganges, and eventually ends up in the Bay of Bengal.

Flooding in Bangladesh happens every year, and the Bangladeshi people are usually well prepared. Problems can occur when the floods are much greater than usual, or happen with little or no warning. Over the last decade or so, Bangladesh has suffered a number of very severe floods, most recently in 1998. The reasons for this are not clear, and different theories have been put forward.

It has been suggested that deforestation in the Himalayas has increased the amount of water and sediment in Bangladeshi rivers, which in turn increases the flooding. Another theory blames the construction of the Farakka Barrage. This was built by India just beyond the border with Bangladesh to regulate the amount of water in the River Hoogly, which flows out of the Ganges. Overall, the flow of water in the Hoogly has been reduced, but the flow of water into Bangladesh via the Ganges has increased. Others say that the recent major floods

are part of normal statistical variation. Whatever the precise combination of reasons for the increased flood hazard, it is clear that any solution must be an international one.

### **Living with flooding -- the USA**

Large parts of the USA are regularly at risk from flooding. Estimates show that between 50 and 90 people are killed in floods each year.

In the 1930s, dams were built on many of the large rivers in the USA to control the flow of water, but it was found that dams alone were not enough to solve the problem. People still moved into vulnerable areas, and dams themselves can cause severe flooding if they fail. Nowadays, a combination of approaches is used in addition to dams and other engineering solutions. A national flood-insurance scheme encourages vulnerable communities to insure against flood damage. At the same time, flood-warning systems and flood-proofing measures have been improved. In some areas, local governments have bought land in floodplains, to make sure that these areas are kept clear of excessive housing development.

The experience of the USA shows that even countries with many resources at their disposal must still search for the right solutions -- there is never a simple answer.

*Why are some people more at risk than others? (below)*

## **Hurricanes**

### **What is a hurricane?**

A hurricane is a tropical storm with strong winds, which starts at sea and can travel long distances. This kind of storm has different names in different parts of the world. In the Atlantic Ocean, they are called hurricanes; in the western Pacific Ocean, they are called typhoons; in the Indian Ocean and Australasia, they are called tropical cyclones.

In the northern hemisphere the winds travel anti-clockwise, and in the southern hemisphere they travel clockwise.

A tornado, or whirlwind is a smaller, more compact version of a hurricane which often forms over land. Tornadoes are common in the USA, but can also happen in Australia, Japan, and Central Asia. They occasionally happen in Europe.

**Why do hurricanes happen?**

Hurricanes are caused by water evaporating from warm seas (the sea temperature must be at least 26°C). The water vapour rises in the air before it condenses in the upper atmosphere. Condensation releases heat, which causes the air to rise more quickly. As the air above the region of evaporation rises, more air is drawn in, blowing across the surface of the sea. In turn, this increases the rate of evaporation, which fuels the process even more – and a hurricane is formed.

**Where are the effects of hurricanes felt?**

Hurricanes out at sea are not necessarily dangerous, except to shipping. Most damage occurs when a hurricane hits the land, and coastal regions are especially at risk.

**How are hurricanes measured?**

Wind speeds can be measured on the Beaufort Scale, which runs from 0 to 12. As well as measuring how powerful a hurricane is, it is important to know how damaging it might be. This is measured using an intensity scale, which shows what happens, or might happen when the hurricane hits land.

**The Saffir-Simpson scale**

This intensity scale estimates how damaging a hurricane might be. It runs from 1 to 5. Some of the classes are summarised below.

Class 1	Winds 120—150 kilometres per hour (km/hr); damage to trees and shrubs; some damage to signs; some low-lying coastal roads flooded.
Class 3	Winds 175—210 km/hr; there may be a storm surge 2.5—3.6m above normal sea level; many trees blown down; lots of damage to roofs, doors, and windows; serious coastal flooding; evacuation of people living near the coast might be necessary.
Class 5	Winds more than 250 km/hr; there may be a storm surge more than 5.5m above normal sea level; many buildings blown down; evacuation of people up to 16km from the coast might be necessary.

**Can we tell when a hurricane is going to happen?**

It is often hard to tell where hurricanes will start. However, once a hurricane has formed, then scientists can often track its path across the ocean and predict where it will hit land.

Hurricanes have been given names since the 1940s, to help in studying individual hurricanes and in warning people of their impact. When wind speeds reach 40 mph, then a tropical storm is declared, and a name is given. A storm is officially considered to be a hurricane when wind speeds reach 75 mph.

### **How are people affected by hurricanes?**

The main danger in a hurricane is the storm surge. As the hurricane approaches land, sea levels rise and coastal regions may experience severe flooding. High winds are an obvious danger, and people are at risk from falling buildings and from objects blown around by the wind. Sometimes hurricanes cause torrential rain, creating flash floods.

Many people may be drowned in the floods. Those who have lost their homes will need temporary shelter, and help to rebuild. If local communities are destroyed, and people are forced to move away from the area, it can be hard for people to find work and support themselves and their families. When crops and stores of grain and food are destroyed, recovery takes much longer, and food has to be provided from outside the affected area.

### **Hurricanes in Jamaica – Hurricane Gilbert, 1988**

Hurricane Gilbert hit Jamaica on 12 September 1988. Because Jamaica already had good warning and sheltering systems, only 45 people were killed, including 11 people who were shot by the police as suspected looters.

However, many buildings were damaged. In Jamaica, locally-made aluminium sheeting is a common and cheap roofing material. In high winds, the sheets of metal tore away from the houses. Damage to hospitals reduced medical services at a time when they were needed most, and expensive medical equipment was ruined.

The main telephone exchange lost part of its roof, and all international phone lines were cut off. Crops, food stores, stables and barns were damaged. Jamaica went from being self-sufficient in food to being dependent on imports. Even though relatively few people were killed, this example shows that damage to buildings can have far-reaching consequences. At the time of hurricane Gilbert, about 40 per cent of the damage was covered by insurance policies, which meant that reconstruction could start quickly. New building codes suitable for local conditions were introduced, including reinforcement of walls and the use of hurricane straps to hold roofs down. Jamaica is increasingly prepared for future emergencies, although much still remains to be done.

*Why are some people more at risk than others? (below)*

## Famine

### What is famine?

A famine is when large numbers of people in a region are unable to get enough food to keep themselves alive, a situation which leads to a sharp increase in deaths from starvation. Famine is difficult to define, because it is not an absolute measure. Instead, a number of indicators may be used to judge where and when there is a risk of famine, and when a famine is considered to have started. Indicators include child mortality figures, and the presence of certain illnesses caused by starvation.

With any attempt to define an actual famine, it must be remembered that many, many people in the world today exist in a state of chronic malnutrition. The World Health Organisation believes that more than 100 million children are moderately to severely malnourished. Oxfam estimates that 18 million people worldwide die of hunger every year. When people are surviving on the absolute minimum of food, then any change in the food supply, however small, can have devastating consequences.

### Why do famines happen?

Famines can happen for many reasons, and actual shortage of food is only one possible cause of famine. In fact, in today's era of mass transport there is very rarely an absolute shortage of food. People with money can often buy food, or travel to places where food is more readily available. At present, enough food is produced to feed everyone on the earth. The problem is getting the right food in the right place.

Famine is caused when people do not have access to food. In areas where people depend on the food that they grow, a period of drought, or other severe weather, can lead to crop failure. If there is no way for local people to earn money to buy food, and reserve stocks of food are low, then there are no alternatives -- a famine is threatened.

In many areas of the world today, famine has been triggered by war. Wars disrupt local economies, often for long periods, and destruction of crops is frequently used as a weapon of war; large numbers of refugees gathering in a small area can put great strain on the food supply. Up to 110 million land-mines lie in fields and roads around the world – good land remains uncultivated while people go hungry.

In areas prone to spells of drought, communities have developed strategies for coping with periodic food shortages. These might include building up communal stores of grain, a system of sharing food between families and communities, foraging for wild foods, and moving temporarily to another place. The declaration of a famine by international governments and other agencies can overshadow the fact that people have almost always been coping without assistance for very long periods.

### **Where do famines happen?**

Famine is not dependent on geography, and most countries have experienced famine at some time in their history. The reason why countries of the North no longer have famines is not primarily because the amount of available food has increased (although this is one factor), but because supply and distribution are more efficient, and because people in Northern countries usually have the resources to buy what they need. In times of local shortages, food can be imported from other countries.

### **Can we tell when a famine is going to happen?**

One of the reasons why it can be hard to predict a famine is that people do not always agree on definitions. Another difficulty is that accurate information about nutrition and health in a particular area can be hard to gather.

"It is important to keep records of rainfall, the price of food at market, and annual harvest yields. I also look out for people who are collecting wild fruits or who are surviving on leaves or plant roots – famine foods. This kind of information gives us early warnings about coming food shortages. [We] can then convince the aid agencies of our need before things get much worse and become a disaster . . . with things as they are, these facts and figures can mean the difference between life and death." Guitano Erib, who works for the Sudan Relief and Rehabilitation Association. Quoted in Global Express, no. 11, October 1998.

It is clear, however, that many people live with hunger every day of their lives. In such circumstances it is important to look for long-term solutions, instead of simply responding to each crisis as it happens. There is evidence that the right kind of support can significantly increase people's ability to avoid famine, and, if it does happen, to recover more quickly.

### **How are people affected by famine?**

Before a famine is declared, many people in the area will have been living with chronic malnutrition for some time. However, even in conditions of extreme famine, not everybody is affected equally. Children, the elderly, pregnant and breastfeeding women, and those already suffering from disease will be worst hit.

Those who have transport, or are strong enough to walk, may leave the area. Some people never return, and communities cannot be rebuilt. In other areas, an influx of refugees will put pressure on scarce resources, spreading the problem more widely.

Farming suffers as animals die, and people become too weak to work the land. When grain stores have been used for food, there is no seed for next season's planting, and there will be no harvest.

Although food aid is an important short-term solution to famine, it is not always effective, and can sometimes even make things worse. It is hard to make sure that food gets to those who need it most, and in the long term food aid can disrupt the local economy and make it harder for the region to get back on its feet. If governments or charities flood the area with large amounts of free, or very cheap imported food, then local farmers cannot get a good price for the crops they grow.

*Why are some people more at risk than others? (below)*

### **Factbox**



Supermarkets and shops in the UK throw away more than £350 million worth of food every year.



Even during times of famine, many Southern countries continue to export food to the North. This is because they need to earn money to pay the huge debts that they owe to organisations like the World Bank.



The average person in the USA consumes 3,650 calories per day. The average person in Bangladesh consumes 1,925 calories per day. An adult needs between 2000 and 3000 calories per day to stay healthy.



Farm animals consume nearly half the world's grains. An acre of cereals can produce five times more protein than an acre devoted to meat production.

## **Why are some people more at risk from disasters than others?**

Some people are more at risk because of where they live. Others are more at risk because of who they are.

Certain types of disaster are specific to certain geographical areas. Hurricanes, for example, tend to hit the land closest to the warm oceans where they form. Earthquakes commonly happen along a geological fault (a place where two sections of the earth's crust join). Other types of natural hazard, such as flooding, are widespread across the globe. Throughout history, human society has become used to coping with, and adapting to, sudden and threatening changes in the natural environment.

However, even in places which have not recently been touched by disaster, there is no room for complacency. As the population of the globe increases, we are finding that human activity is influencing our environment in new ways. In the years to come it is possible that global warming will alter weather patterns and cause sea levels to rise, creating new areas at risk.

Some disasters, such as famine, are known as 'complex disasters'. This is because there is no single cause or event which precipitates them, but rather a gradual worsening of conditions until crisis point is reached. No country is immune from such disasters, and most countries have experienced famine at some point in their history. During the Second World War there were food shortages throughout Europe, but especially in Greece. The Oxford Committee for Famine Relief (OXFAM) was formed to help the starving people of Greece.

When disaster strikes, the poor are usually the worst affected. This is because they are likely to have less choice about where they live, and many poor communities are forced to settle on dangerous land – on steep hillsides, or in river floodplains.

In poorer regions, people often build their own houses, and may not have access to information about how to make their homes safer. Even when people do have information, they may not be able to afford stronger, better-quality building materials.

In parts of Iran, which is vulnerable to earthquakes, the days are hot and the nights are cold. Houses are often designed with thick walls and heavy roofs, which are excellent for insulating people from extreme temperatures, but not so good at resisting earthquakes.

After the first impact of a disaster is over, poorer people can find it hard to recover. As well as the physical injuries and destruction, the loss of livelihoods can have serious long-term consequences. If people lose vital tools, or means of transport, then they will have no way to support themselves and their families for the future. Those who are insured will get cash to buy the things they need, and to reconstruct their homes. Those with no insurance will probably have to make do with whatever they can find, and may never regain the position they were in before the disaster struck.

### **What can be done?**

In one form or another, disasters will always be with us. Technological solutions which try to prevent disasters from happening may appear attractive, but in reality such solutions can never work alone. The best approach seems to be a combination of good education about the risks, proper early warning systems, and good preparation.

### **What is meant by 'global warming'?**

Some scientists have measured an average increase in the temperature of the earth's atmosphere. Many people believe that this is caused by the release of carbon dioxide gas from motor vehicles and industry, which traps the heat from the sun.