



# TUNZA



for young people · by young people · about young people

**Hazards and catastrophes**

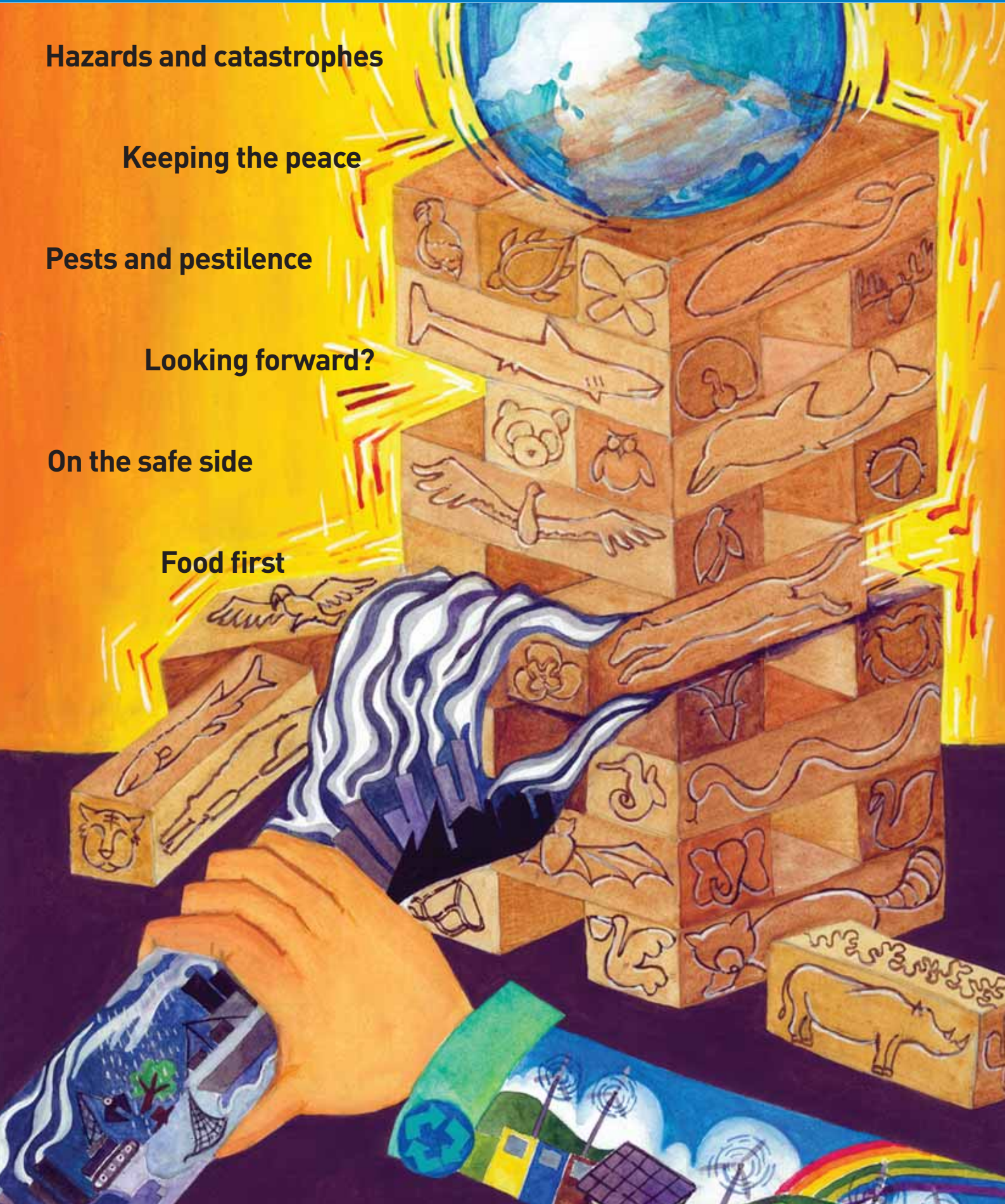
**Keeping the peace**

**Pests and pestilence**

**Looking forward?**

**On the safe side**

**Food first**



## TUNZA

the UNEP magazine for youth. To view current and past issues of this publication online, please visit [www.unep.org](http://www.unep.org)



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Partners for Youth and the Environment



**UNEP and Bayer, the German-based international enterprise involved in health care, crop science and materials science, are working together to strengthen young people's environmental awareness and engage children and youth in environmental issues worldwide.**

The partnership agreement, renewed to run through 2010, lays down a basis for UNEP and Bayer to enlarge their longstanding collaboration to bring successful initiatives to countries

around the world and develop new youth programmes. Projects include: TUNZA Magazine, the International Children's Painting Competition on the Environment, the Bayer Young Environmental Envoy in Partnership with UNEP, the UNEP Tunza International Youth/Children's Conference, youth environmental networks in Africa, Asia Pacific, Europe, Latin America, North America and West Asia, the Asia-Pacific Eco-Minds forum, and a photo competition, 'Ecology in Focus', in Eastern Europe.



# Numbers

**8** cm The shift of the Earth's axis caused by the 2010 earthquake in the Pacific, 11 kilometres off the coast of Chile. The huge quake caused damage estimated at \$4-7 billion, but because of disaster preparedness including strict building regulations, the death toll was limited to 512 people.

**10** The strength of seismic activity is measured on a logarithmic scale (the Richter scale) based on a factor of 10. So a force 2 earthquake is ten times stronger than a force 1 earthquake (not just twice as strong) and a force 4 is 10,000 times stronger.

**13** times more people die in each reported disaster in developing countries than in developed countries.

**1450** BC (approx) The year the Minoan civilization – along with the mythical 'lost continent of Atlantis' – was destroyed by a volcanic eruption in the Aegean Sea. The remains of the volcano now form the Greek islands of Thera (Santorini) and Therasia. The lagoon between the two islands is actually the caldera of a volcano some 400 metres deep.

**3,000** The official death toll of the world's worst chemical disaster, when 40 tonnes of poisonous gas were accidentally released from Union-Carbide's pesticide factory in Bhopal, India, on 3 December 1984; a further 600,000 people were affected. The company paid compensation of \$470 million in 1989, and in June 2010, eight people were convicted of causing 'death by negligence'.

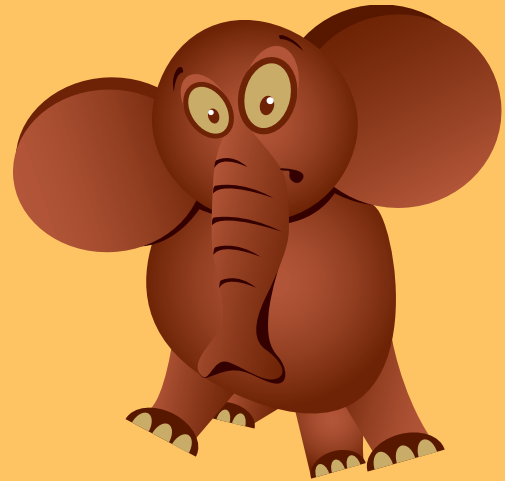
**18,156** The number of confirmed deaths worldwide from the 2009 swine 'flu pandemic. The effectiveness of worldwide action, led by the World Health Organization, is apparent when you compare this with the 750,000 people who died in the 1968 'flu outbreak and the 50-100 million casualties of the 1918-1920 pandemic.

**230,000** The number of deaths across 14 countries caused by the Indian Ocean tsunami on 26 December 2004. Up to 30-metre-high waves, created by an ocean-floor earthquake 160 kilometres northwest of the Indonesian island of Sumatra and measuring 9.3 on the Richter scale, reached as far as Africa's east coast.

**830,000** The number of deaths in the world's deadliest earthquake in Shaanxi province, northern China in January 1556, which reduced the local population by 60 per cent. Hills and valleys changed height and shape, destroying entire towns and villages.

**100,000,000** or more. The number of deaths caused by the Black Death – bubonic plague – that spread from China, across Asia, Africa and Europe, killing more than a third of the population, and possibly two thirds, between 1346 and 1352.

# EDITORIAL



**T**wo of this year's disasters have underlined how dependent even the richest economies are on nature and the environment. The eruption of Iceland's Eyjafjallajökull volcano created an ash cloud that closed down most air travel in northern and western Europe for six days in April. And on the very day that flights began to get back to normal, the blow-out in the BP oil well deep in the Gulf of Mexico caused America's worst ever environmental disaster. Primarily an environmental crisis with oil gushing into the sea, endangering its life and washing up on Louisiana's vital wetlands, it soon mutated into an economic crisis devastating the area's fishing and oil industries, a corporate crisis jeopardizing one of the world's richest companies, and a political crisis engaging much of the time of the President of the United States.

Virtually no one, it became clear, was properly prepared for either event. Neither the airlines nor the authorities had adequate measures in place to cope with the ash. And BP was unable either rapidly to stem the flow of oil, or to prevent the slick from damaging fisheries or reaching the shore, as the crisis intensified week after week. In both cases it appeared that nature had been taken for granted, and in both cases the world learned the hard way that, in the end, it calls the shots.

But the crises also present an opportunity, and one that goes well beyond the need for better preparation and regulation in future. The power of the volcano – and the threat of more, and bigger Icelandic eruptions over coming years – may cause people to question the assumption of easy air travel, one of the more damaging of human activities to the climate. And the devastation in the Gulf of Mexico – far more visible and obvious than the early effects of climate change – could provide an impetus to the world to turn away from its addiction to climate-wrecking oil and fossil fuels and towards using energy less wastefully and expanding the huge potential of clean, renewable sources. We must work to make both crises hasten the advent of the green economy and low-carbon prosperity, working with the grain of nature and the environment rather than against it.

# Hazards & catastrophes

We call them 'natural disasters', but it is usually human actions that turn hazards into catastrophes, either by causing the disasters in the first place, or by making them very much worse.

As the climate changes, weather-related disasters – like storms, hurricanes, floods and droughts – are happening more often, just as scientists have long predicted. In the 1980s, the Worldwatch Institute reports, 300 such events were recorded, on average, each year. By the 1990s this had risen to 480, and it soared to 620 over the last decade. And the Intergovernmental Panel on Climate Change forecasts they will get even more frequent and more severe, as global warming – caused, after all, by human activities – progresses.

Environmental destruction also makes such disasters worse. By the time Hurricane Mitch hit Central America in 1998, it had lost so much of its force that it had been downgraded to a tropical storm. But it caused the worst catastrophe to hit the western hemisphere to date because its torrential rains fell on hillsides stripped of trees, causing mudslides that killed some 10,000 people.

Similarly, a series of hurricanes and storms in the Caribbean in 2008 caused far worse flooding in Haiti, where only 2 per cent of the original forest cover remains, than in the neighbouring Dominican Republic, which has retained 30 per cent of its forests. And the impact of Hurricane Katrina on New Orleans was made worse by the increasing destruction of the wetlands that protected it from the sea. Every 6 kilometres of wetlands reduces storm surges by 30 centimetres, but over the past 40 years their disappearance has brought the sea more than 30 kilometres closer to the city.

The same principle held true in the devastating 2004 tsunami. The Indian Ocean's shores had long been protected from such waves – and from

the angry seas stirred up by cyclones and typhoons – by a double barrier of coral reefs and mangrove swamps. Yet, as elsewhere around the world's warm oceans, both have, increasingly, been destroyed.

Places that still had these natural barriers generally fared far better than those that did not. Only a handful of people died on Surin Island, just off the Thai coast, even though it lies near resorts that suffered heavy casualties. The reason, said Thai authorities, was that it was surrounded by a ring of coral that both broke the force of the tsunami and acted as an early warning system: people saw the giant wave breaking on the reef and ran.

Mangroves proved, if anything, to be even more important, standing – as the great Indian scientist M.S. Swaminathan put it – 'like a wall to save coastal communities living behind them'. All round the ocean, areas that had preserved their mangroves escaped more lightly than those that had not. To give one vivid example: only two people died in one Sri Lankan village where their mangroves were intact, compared to 6,000 who died in an unprotected village nearby.

And the tsunami is not an isolated example. The area around Bhitarkania in the Indian state of Orissa, which has one of the world's largest remaining mangrove forests, was largely spared in 1999 when a cyclone brought a 6-metre wave crashing 20 kilometres inland, killing some 10,000 people elsewhere. And the planting of new mangroves along 100 kilometres of Viet Nam's coast protected the land behind them from the worst typhoon in a decade in 2000. By contrast, in 2008 Cyclone Nargis brought devastation to Myanmar's Irrawady Delta, where 83

Skarphéðinn Bráinsson/www.flickr.com



per cent of the mangroves had been cut down since 1924.

Human activities, of course, bore no responsibility for the underwater earthquake that caused the tsunami, but were vitally important in determining the scale of the disaster. And it is the same on land. Eighty per cent of earthquake deaths are caused by collapsing buildings yet – even in the fiercest ones – well-built structures save lives. More than 200,000 people died in Haiti earlier this year, while an earthquake of the same magnitude in San Francisco in 1989 killed fewer than 70.

Of course relative wealth is even more important in determining the toll than the quality of buildings. An earthquake in Guatemala City, which killed 23,000 people in 1976 was even called the 'class quake' after the accuracy with which it hit the poor, who could only afford bad housing. Floods, storms, and droughts also disproportionately target the poor. Between 1980 and 2007 the number of natural disasters was more or less evenly split between developed and developing countries, but the wealthier ones suffered only 8 per cent of the casualties.

Anders Wijkman, the Swedish Member of the European Parliament who served as President of the International Red Cross Disaster Relief Commission, once said: 'Most disasters in the Third World are unsolved development problems.' He could have gone further: they are environmental problems too. Indeed, tackling the three great challenges of our age – poverty, climate change and the destruction of vital ecosystems like forests and coral reefs – will also do much to lessen the impact of what we persist in calling natural disasters.

# A disaster documented



In mid-June 2010, photographer and author James Duncan Davidson joined a group of photographers and a videographer to document the Deepwater Horizon oil spill in the Gulf of Mexico. He sent TUNZA photos and thoughts from the first days of the expedition.

'Flying over the source of the oil spill, the smell of oil and gas is intense. It's like standing next to a bucket of gasoline sitting next to a leaky propane tank. Flying north from the source to Gulf Shores, we see oil all the way to the coast and as far as the eye can see in both directions. It's more than 160 kilometres from the spill site (known locally simply as 'the source') to the coast of Alabama. We talk to clean-up workers and local residents, examining beaches and taking photos by air.

'This is a disaster of the largest magnitude – nearly inexpressible. Whole communities and livelihoods are being destroyed, and the oil is eroding landscapes that will take a long time to recover, if at all. Various populations of wildlife are being stranded, alive and dead. But the worst is that the leak has not stopped. The effects since the explosion on 20 April 2010 are merely consequences of a continuous oil leak, while the long-term devastation is impossible to even imagine.'



Photos: James Duncan Davidson

**Above:** The *Discoverer Enterprise* and other ships at the site of the spill.

**Below:** The oil forms patterns and mosaics that are terrifyingly beautiful.

To view the full expedition reports and photos, visit <http://tedxoilspill.com/expedition>.



# A grey world

I come from Vík í Mýrdal, a village on Iceland's south coast, 37 kilometres from Eyjafjallajökull volcano. My family, some of whom are farmers, still live there. Currently, I live in Reykjavík where I study biochemistry, and where I was when Eyjafjallajökull erupted.

Vík í Mýrdal lies beneath Katla, another, much larger volcano that scientists fear may soon erupt too. Having grown up in its shadow, I thought I was prepared. But when the pictures started flowing in through the media, I was shocked. Floods crashed down; mud completely covered the land as if someone had dumped millions of tonnes of cement. Lone straws poked through the grey coating.

I felt like crying every day that first week, though I was geographically disconnected from the event. I saw a picture of my great-uncle leading his horses to slaughter, because the pastures are ruined – one of the saddest things I've ever seen.

When I went home, we were already chewing ash in the car as we approached, even with no windows open. A dozen people were working in the garden, shovelling ash from the land, ash falling on their heads. Sticky ash coated every blade of grass and every tree branch. After a couple of minutes outside the car it hurt to breathe. It was



Julia Staples

Fríða's great-uncle leading his horses to slaughter.

dry, and the air had a metallic taste to it. I got a headache and felt nauseous – a combination of ash and emotion.

What has surprised me the most is the profound emotional impact it's had on my family. The ash is likely to stay for at least a year. People are collapsing from the burden, kids can't play outside or open the windows, and every day, they wake to a grey world. What a wake-up call about how our power, as a species, is dwarfed by that of nature.

Fríða Brá Pálsdóttir, 21



# Wrecking reefs

Ayana  
Elizabeth  
Johnson

We call hurricanes, tsunamis and floods disasters because they harm humans – but what about the havoc they wreak in ocean ecosystems? In fact, they can all cause fish to scatter and corals to shatter – partly from the impact of water moving with great force, but also from the tumble of scouring sand, land debris and dislodged corals. The wind-created waves of hurricanes tend to damage shallower reefs, while the earthquake-created waves of tsunamis can cause deeper damage, and floods can assault reefs with freshwater along with the sediment, pollution and debris they bring from land.

These powerful forces can reduce a healthy, biodiverse and productive reef to mere rubble in a matter of minutes. Where tsunamis are concerned, some reefs can even rise out of the water as seismic activity pushes them up. Fortunately, such dramatic damage isn't uniformly spread. Depending on geography and the previous state of the reefs, some areas emerge relatively unscathed.

Though they get damaged, reefs can help buffer the impacts of hurricanes and tsunamis on coastal areas. By slowing down and reducing the force of waves as they approach the shore,

reefs can diminish the distance that waves travel inland, preventing damage. The healthier – and therefore more structurally complex – a reef is, the better protection it provides. However, the critical role of mangroves and coastal vegetation should not be overlooked; they are much better than reefs at mitigating coastal damage.

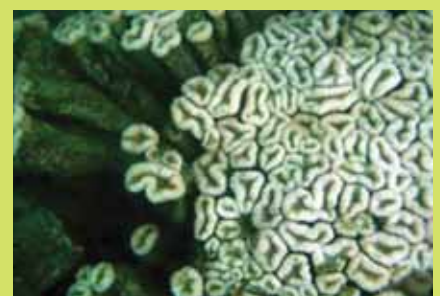
During the 500 million years that coral reefs have existed, they have been exposed to a broad range of environmental conditions, so they have evolved the capacity to resist and recover from periodic natural disasters. Just as a young, fit person recovers more quickly from the 'flu than an older and weaker one, a healthy, intact reef ecosystem can more rapidly restore itself after being pummelled by natural disaster.

The problem is that coral reefs are becoming less and less healthy, and for that, we are to blame. Man-made pressures like pollution, sedimentation, overfishing and climate change stress reefs, weakening their immune systems. Pollution from fertilizers, chemicals, sewage and oil spills poisons reef organisms; sediment runoff from agriculture and coastal development smothers corals; and overfishing removes important components of the

food web. Climate change warms water (often leading to coral bleaching and death), and may increase the frequency and severity of storms, while increased CO<sub>2</sub> acidifies the ocean, weakening the skeletons of corals and other creatures. All these are a greater threat to reefs than natural disasters. Corals grow slowly – many species only 1 centimetre a year – so a constant barrage of man-made threats prevents reefs from recovering before they are faced with the next damaging natural event.

Coral reefs are at a tipping point. They can only take so much abuse. And their reduced health is worrying not only because it would be sad to lose their natural beauty, but because hundreds of millions of people around the world depend on these havens of biodiversity for their nutrition and livelihoods. It's important to do everything we can to reduce the negative effects of our activities, so that reefs can bounce back from the natural disasters that are inevitable.

*Ayana is a 29-year-old marine biology PhD student from Brooklyn, New York, who studies the management of fishing on coral reefs at the Center for Marine Biodiversity and Conservation at Scripps Institution of Oceanography, University of California at San Diego.*



**Above:** A coral before, five days after, and six months after the 2004 Indonesian tsunami.

**Left:** A reef in French Polynesia before and after Cyclone Oli in 2010.

www.greenlivesociety.org

Mohsen Kayal

# Keeping the peace



**SOPHIE RAVIER, 33, works as an environmental officer of the UN Department of Field Support, which is in charge of logistical support for UN peacekeeping missions. TUNZA asked her about the relationship between peacekeeping, conflict and the environment.**

## **To what extent is conflict driven by natural resources?**

Environmental factors are rarely, if ever, the sole cause of violent conflict. But UNEP was involved in recent research suggesting that in the last 60 years, at least 40 per cent of all intrastate conflicts have a link to natural resources. Since 1990, at least 18 violent conflicts have been fuelled by the exploitation of natural resources, whether 'high-value' resources like timber, diamonds, gold, minerals and oil, or scarce ones like fertile land and water. Climate change is also seen as a 'threat multiplier', exacerbating threats caused by persistent poverty or weak resource management institutions.

## **What is UN peacekeeping?**

It's a way to help countries torn by conflict create conditions for lasting peace. In 1948, for the first time, the Security Council deployed UN military observers to the Middle East to monitor the Armistice Agreement between Israel and its Arab neighbours. Since then, there have been 63 UN peacekeeping operations globally.

Field operations have evolved from 'traditional' missions involving strictly military tasks to complex 'multidimensional' enterprises designed to ensure the implementation of comprehensive peace agreements and help lay foundations for sustainable peace. Peacekeepers, comprising civilian, police and military personnel, do everything from helping to build sustainable institutions of governance, to human rights monitoring, to security sector reform, to disarmament, demobilization and reintegration of former combatants.

## **How does peacekeeping impact the environment?**

Often, the countries to which thousands of peacekeeping personnel are deployed have very little infrastructure. All these extra people produce waste, which can impact the local environment if not managed properly. Moreover, temporary peacekeeping missions deployed in remote areas often generate their own power using a lot of fuel – emitting greenhouse gases and sometimes causing soil pollution.

In water-scarce areas like Darfur or Chad, the local community may see the UN mission as competing for resources. So we must carefully manage all resources properly to avoid possible tension.

## **What steps are you taking to make peacekeeping more sustainable?**

We've identified the need to improve peacekeepers' environmental footprint, so in 2009 we developed an internal environmental policy. Key areas include waste, energy, water, hazardous substances, wild animals and plants, and cultural and historical resources management. An environmental officer is to be appointed to each mission.

The mission in Sudan (UNMIS) now uses wastewater treatment plants, reducing the consumption of water. And the Timor-Leste mission (UNMIT), among others, organized events around World Environment Day. In 2009, 13 missions participated in the UNEP Billion Tree Campaign, pledging and planting 117,848 trees.

## **Can the greening of peacekeeping missions affect the mission's host country after the mission is over?**

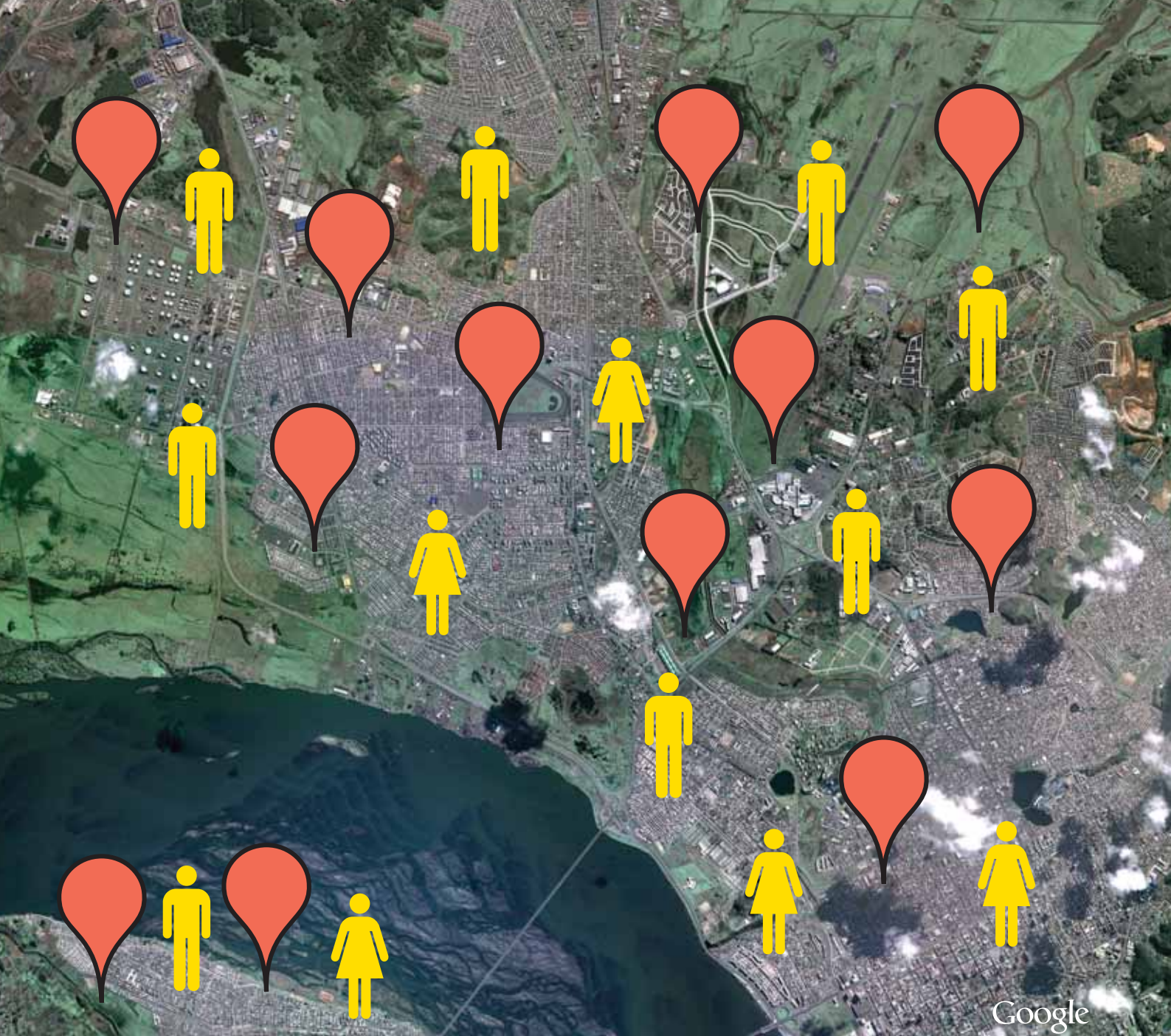
It's really too early to tell, but certainly by practicing good environmental management and setting a good example in its own operations, the UN should have a positive influence on local communities, which should help support their transition from post-conflict recovery to sustainable development after peacekeepers leave.

To find out more about UN peacekeeping visit [www.un.org/en/peacekeeping](http://www.un.org/en/peacekeeping); for more on Sophie's department visit [www.un.org/en/peacekeeping/dfs.shtml](http://www.un.org/en/peacekeeping/dfs.shtml); and for more on what the UN is doing about their CO<sub>2</sub> emissions visit [www.greeningtheblue.org/what-the-un-is-doing/department-peacekeeping-operations-dpko](http://www.greeningtheblue.org/what-the-un-is-doing/department-peacekeeping-operations-dpko).



UN Photo/Albert Gonzalez Farran





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Edit road segments



Add a point of interest



Add a road



Add a region



# On the map



Getting help to where it's needed in the critical first hours after a disaster depends on good maps. But as recently as five years ago only 15 per cent of the world had been charted in detail.

'Mapmaking was a slow and expensive process, done by specially trained people – originally from the military,' explains Lalitesh Katragadda, co-founder of Google India and lead developer of Map Maker, an online tool that lets people all over the world contribute to cartography. 'It was originally done partly to enable access to natural resources and partly to ensure security. Modern considerations – like development and people's needs – were not really taken into account. In many countries, particularly in the developing world, we are still using maps made in the 19th or 20th centuries.'

But don't satellites record every millimetre of the planet? 'True,' acknowledges Lalitesh, 'but satellite imagery can only show us where roads are, not how good they are. Nor can it identify schools, hospitals, electrical or water facilities and so on.'

Map Maker aims to close that gap: recent strides in high-resolution satellite imagery and map-making technology mean that anyone with access to a computer and the internet can contribute. 'It's easy: you go to Map Maker and search for the satellite imagery of your area,' explains Lalitesh. 'You look at the existing road network and add landmarks. Or if a road or track is not shown, you can add it. Typically, once someone starts, others jump in, adding information, and soon we see an explosion of mapping. Internal checking mechanisms ensure accuracy of the information, which gets fed into our sister service Google Maps.'

Map Maker was first used for disaster relief after Cyclone Nargis hit Myanmar in May 2008, leaving some 80,000 dead,

60,000 missing and up to 2.5 million needing aid. 'Within 12 hours of the cyclone, the United Nations contacted Google Maps, saying there were no maps of the country. We got the necessary clearances and within four days had mapped 3,000 logistics points, hospitals, major roads and waterways. Most of this was done outside the country, but it was locals, on the ground, who supplied some of the information.'

Map Maker was launched for public use in June 2008, and has gradually spread to more than 150 countries, with a focus on developing ones. And community mapping has already come in handy. 'Haiti was a country we'd been working on, so when the earthquake hit, the maps were pretty good. We made them available for download and got Google phones loaded with the latest maps to aid workers. And all the time volunteers were updating us on changes in the island's infrastructure.'

Google is also working with the UN to help create disaster-response maps. 'It was heartening to see that, within 60 days of Map Maker opening up different parts of the world, the UN had used it to create 40 different disaster-response maps,' says Lalitesh.

Despite all this progress, only another 15 per cent of the world has been mapped to neighbourhood standard through Map Maker – which means 70 per cent is left. 'It's slow going,' says Lalitesh, but adds: 'You can help. Pick any country that you know. We especially need help from people who have been to countries in Africa where internet connections aren't so good, particularly road names, hospitals and educational institutions. Those are the first things that really matter when disaster strikes.'

*For a nice before-and-after example of emergency response mapping, see [www.unitar.org/unosat-and-google-shape-future-geographic-information-emergency-response](http://www.unitar.org/unosat-and-google-shape-future-geographic-information-emergency-response).*

**Port-au-Prince by satellite (left), and the mapping done by users (right). This area had been well mapped before the earthquake hit, but users rapidly stepped up the mapping of hospitals, relief camp grounds and schools when the disaster occurred.**



Natural Hazards and Disasters



# Don't blame nature

Ramón  
Lorenzo Luis  
Rosa Guinto



University of the Philippines Manila

www.shelterbox.org

**T**yphoon Ketsana hit Manila on the night of 25 September 2009. I wasn't concerned: we Filipinos are used to frequent storms. After all, we live in the Pacific, the birthplace of tropical cyclones. But the following day I was shocked by what I saw on television – photos of boulevards and buildings submerged in waist-deep murky waters; families standing on their roofs; cars and buses turned upside-down by gigantic waves. The number of reported deaths seemed to increase every half hour. In the end, some 400 people perished.

The typhoon devastated not just the Philippines but neighbouring countries like Viet Nam and Cambodia. Unlike most past typhoons, it exerted its power not through wind speed but through vast rainfall. No typhoon as heavily loaded as this one has occurred in recent history.

Meteorologists attribute the changing pattern, frequency and severity of typhoons in the Philippines to global climate change. This is, of course, plausible, but nature alone cannot be blamed for the loss of lives and damage to infrastructure. Ecological systems change inevitably and often uncontrollably, and at their own pace. No environmentalist can shoo away a typhoon. But we can manipulate their impact on communities; we can reduce risks, mitigate effects and adapt to changes. Human systems – the way we organize ourselves – play a key role in

determining our vulnerability to natural disasters.

The main problem in the Philippines is improper disposal of domestic waste. Despite our Ecological Solid Waste Management Act, most people, especially in urban areas, do not implement waste separation, recycling and composting. So, when the torrential rains arrived, the floods could not flow into our clogged waterways, creating a Noah's Ark-like deluge.

The catastrophe could have been prevented through strictly implementing the law, and educating and empowering local communities. Sadly, it was too late for that. But young Filipinos then mobilized, volunteering through schools and non-governmental organizations to help pack relief goods and take them to needy communities, and to provide comfort to victims. As chair of

the University of the Philippines' student council, I coordinated such efforts there.

Many medical students like me joined missions to affected communities. After Ketsana, many Filipinos needed medical help – a testament that human health and the environment are interconnected and inseparable. The ecological disaster led to an increase in infectious diseases, particularly leptospirosis, which can be contracted from floods contaminated with rodents' urine, as well as in injuries and depression.

As the saying goes, prevention is better than cure, and this is true for both diseases and disasters. Nothing can beat the life-saving power of proper urban planning, comprehensive waste management, effective early warning systems and community education. The best way to ensure health and protect life is to respect nature and look after the home environment.

*Ramón Lorenzo Luis Rosa Guinto, a 2007 Bayer Young Environmental Envoy, is founder of One Earth, a student environmental organization in the Philippines that works to educate local communities about environment and health.*



# House of bricks



**I**t was Peru's worst ever earthquake, killing over 74,000 people, partly because the buildings made of adobe – sun dried bricks made of earth and straw – collapsed. The 1970 Ancash earthquake prompted Professor Marcial Blondet of Lima's Pontificia Universidad Católica del Peru – then a 20-year-old student – to devote his career to designing seismically safe earthen buildings, particularly for the poor. He tells TUNZA how he and his colleagues spent several decades working out how to keep houses standing when the shaking starts.

'About 30 per cent of the world's population lives in adobe houses, and about a fifth of these are in earthquake zones. Adobe is heavy, weak and brittle, so houses break suddenly during earthquakes. Huge cracks start at the corners and run up the intersections of walls, which then separate, crushing people as they fall out onto the street and causing roofs to collapse. The 2007 Pisco earthquake only killed 600 people (as it was evening, most were outdoors) but around 75,000 houses collapsed, and hundreds of thousands of people were left homeless. Such earth-based

structures are typically concentrated in the poorer areas of developing countries, so it's the impoverished who suffer most.

'Of course, ancient Incan adobe monuments have stood for hundreds of years, but these have walls at least a metre thick, which provide stability. Such dimensions aren't possible when building for families in crowded urban areas or their outskirts. So since the 1970s, my colleagues and I have been searching for a way to reinforce such houses. In the 1980s, we found it worked to reinforce adobe walls internally with bamboo cane. But it couldn't be installed in existing houses, and, if a time came when we'd have to rebuild tens of thousands of houses, there simply wouldn't be enough cane available. In the 1990s, we tried steel wire mesh covered with cement mortar, but it proved too brittle under seismic conditions and the materials were too expensive and difficult to transport.

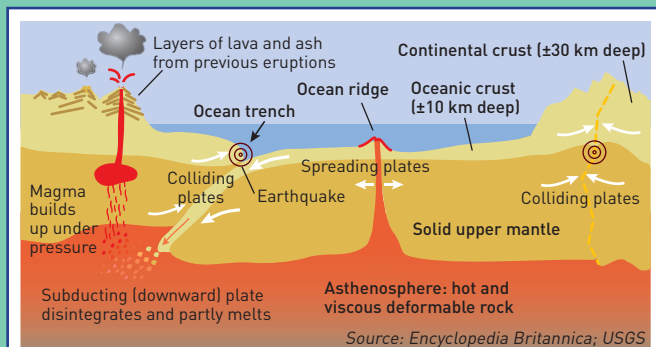
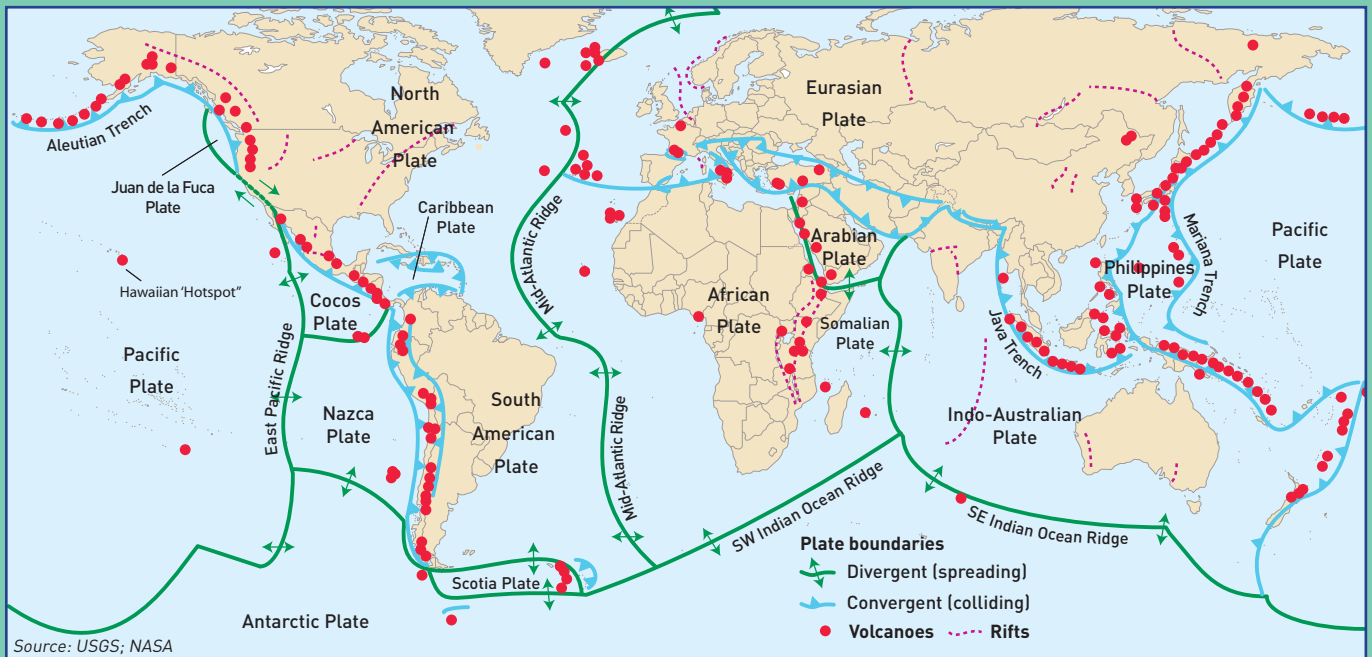
'Finally, in 2000, we hit upon a system using polymer webbing called geomesh, a relatively cheap industrial engineering material used for stabilizing road embankments and

mining operations. Held in place by the structure's foundation, wooden roof beams and plastic ties, the mesh encases the adobe walls, holding them together even when walls crack, thus avoiding collapse. Several layers of plaster integrate the mesh with the wall and protect it from the environment. We've proven this works on a shaking table, and have already rebuilt 3,000 houses damaged by the Pisco quake.

'The next step is to implement the technique widely: we must educate people so they accept the new way of building, train them and find financial support to help them to afford the geomesh, which is imported from the United States or China. Unfortunately, it's a slow process. Meanwhile, we're introducing the system to other regions: I'll soon be travelling to Iran, where the 2003 Bam earthquake almost totally destroyed the ancient monument Arg-é Bam – the largest adobe structure in the world – and killed around 30,000 people, many under collapsed adobe buildings. The great thing is that the method isn't geographically specific. It could be used anywhere, and potentially save millions of lives.'

# NATURAL HAZARDS

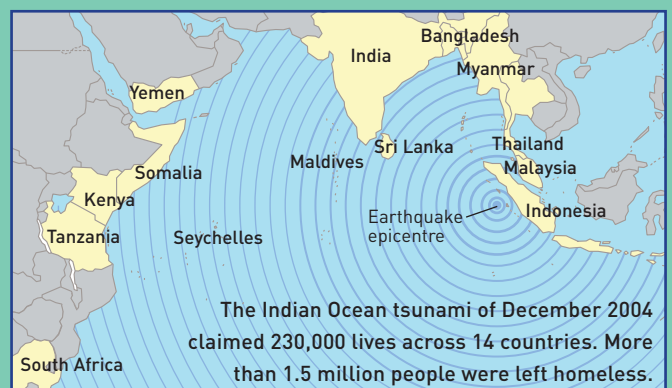
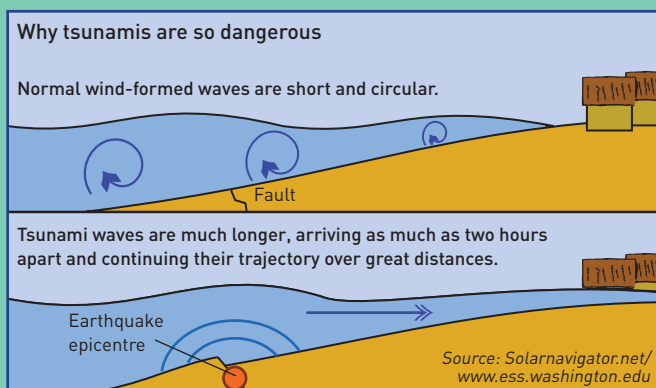
## Plates, quakes and volcanoes



The vast majority of active volcanoes are submarine and we don't even notice them, but around 500 are above sea level, with half of these in a belt around the Pacific Ocean called the 'Ring of Fire'. About 50 erupt each year, with some erupting continuously. Beyond the dangers of being in close proximity to a volcanic outburst, far-reaching effects include acid rain and a cooling of the climate. The Mt Tambora eruption of 1815 had such a cooling effect on the northern hemisphere that crop failure and livestock deaths led to one of the worst famines of the 19th century.

Wherever the Earth's tectonic plates – sections of the Earth's crust drifting on the hotter layer below – come together or pull apart, energy bursts out in the form of volcanoes, geysers and hot springs, or triggers earthquakes that send shock waves over many kilometres. Volcanic hotspots can form in the middle of plates, creating island chains such as Hawaii, and rifts in the crust that remain active may form a new plate, as is now happening in East Africa.

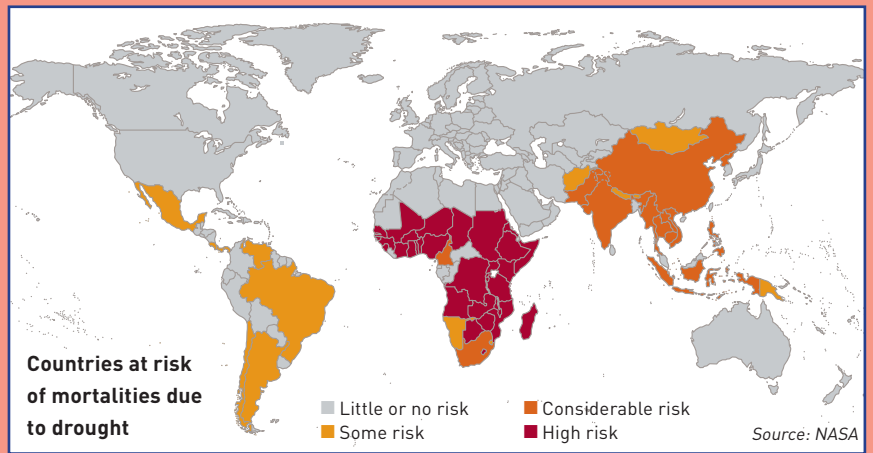
Earthquakes are notoriously hard to predict, with today's early warning systems giving only seconds of warning before the tremors are felt. The only way to safeguard against disasters is to invest in earthquake-proof construction. Tsunamis, which are caused by a submarine earthquake or volcanic eruption, move more slowly than tremors, so a few hours' warning should be possible. However, there is no way of telling whether an earthquake will result in a tsunami, so a complex system of both tremor detection and wave measurement is necessary. Volcanic eruptions can be predicted only by catching early signs of instability, requiring continuous monitoring, even of 'dormant' volcanoes.





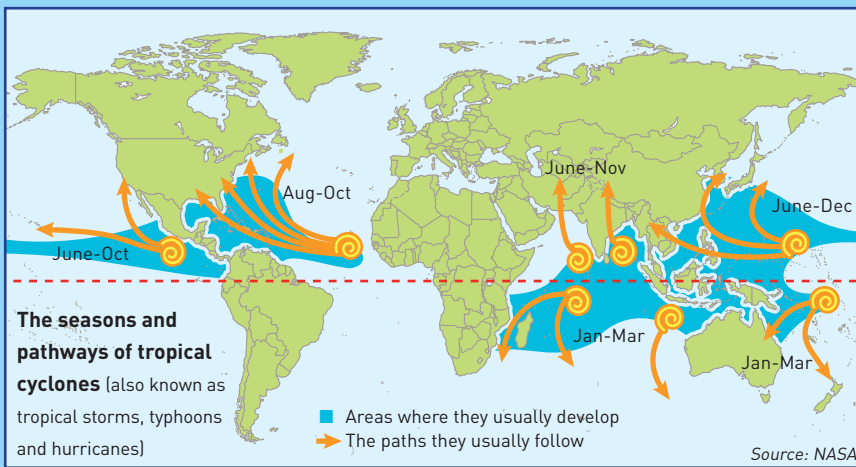
# Drought

Periodic drought occurs naturally in most parts of the world, and has been linked to the migration of early humans from Africa more than 100,000 years ago. The impact of drought can be reduced through careful land management, and drought alone rarely causes famine: poverty, poor distribution systems and other socio-political factors are also to blame. Many countries coloured grey on the map are vulnerable to drought, but unlikely to experience famine as a result.



# Tropical cyclones

Tropical cyclones bring deadly winds and surging waves. Forming over warm ocean water, they can be 900 kilometres across, and move at 15-30 kilometres per hour with winds spiralling at up to 300 kilometres per hour, only losing their power as they head inland. Although often devastating for human populations, they can relieve drought conditions and carry heat away from the tropics towards temperate latitudes. They are an important part of global atmospheric circulation.



# BEWARE!

**1** This 70-metre-wide crater in the desert of Turkmenistan appeared in 1971 when a drilling rig pierced an underground cave of natural gas. The gas was set alight to avoid disaster, and has been burning ever since.



**2** It is four years since a mud volcano began to erupt on the island of Java, Indonesia. Sulphuric mud continues to gush from the ground, and has covered 25 square kilometres, displacing tens of thousands of people.

**3** In May 2010, an enormous sinkhole, 20 metres wide and 100 metres



deep, appeared in Guatemala City, probably triggered by the floodwaters of Tropical Storm Agatha. A three-storey building disappeared.

**4** In 1986, Lake Nyos in Cameroon emitted a large quantity of naturally sequestered CO<sub>2</sub>. Some 1,700 people – and many heads of livestock – were asphyxiated by the gas. Some people



feel this illustrates the potential dangers of carbon storage as a means to combat climate change.

**5** The residents of Centralia in Pennsylvania (USA) have been forced out of their homes by a huge underground coal fire. The fire has burnt since 1962, undermining foundations and causing huge holes to appear in the ground.



# Swimming at the top of the world



On 22 May 2010, Lewis Gordon Pugh undertook a 1-kilometre swim in the freezing waters of Pumori Lake – a glacial lake at an altitude of 5,300 metres under the summit of Mount Everest on the Khumbu Glacier – to call attention to the hazard of glacial outburst flooding in the Himalayas. Such flooding is caused by runoff from rapid glacial melt, which scientists believe is caused by global warming.

The immediate danger of glacial lake outburst flooding is to the people and environments directly in the path of torrents that have broken the banks of glacial lakes, wiping out property, roads and electric plants as well as people, livestock and wild habitats. 'Temperatures in the Himalayas have risen by 1°C since the 1970s, and are rising by 0.06°C each year,' notes Pugh. 'Scientists working with UNEP have pinpointed 44 glacial lakes that are filling up so quickly they could overflow within five years.'

In the long term, the consequences are far reaching. 'These glaciers provide water to around 2 billion people, nearly a third of the world's population,' says Pugh. 'India, China, Pakistan, Myanmar, Bangladesh, Afghanistan, Nepal, Laos, Thailand, Cambodia and Bhutan depend on the meltwater from the Himalayan and Hindu Kush glaciers. Without it, there is a real risk of instability in the region.'

'Indirectly, the whole world relies on this water,' he adds. 'Many goods we consume are produced in India and China.'

This isn't the first time that Pugh – appropriately nicknamed the Human Polar Bear – has swum under extreme conditions: in 2007 he completed the world's first 1-kilometre swim at the North Pole, raising awareness about the effect of global warming on Arctic ice, and he has swum in Antarctica,

adventures he details in his recently published autobiography, *Achieving the Impossible*.

The icy temperatures would quickly kill most people, but Pugh can elevate his core temperature before he enters the water, which he describes as a visualization process. 'I spend a lot of time imaging the swim from the beginning to the end – every stroke. When I can see the swim in my mind, then I can do it.'

But Pugh says that the Pumori Lake swim – the first ever long-distance swim undertaken under the summit of Everest – has been the hardest of his career: 'Because of the altitude you need to swim very slowly and deliberately, not with aggression and speed as I did at the Poles. I was gasping for air, and if I had swum any faster I would have gone under.'

Pugh is often asked how he went from being a maritime lawyer edu-







Photos: Michael Walker/Lewis Pugh

cated at the Universities of Cape Town and Cambridge to a full-time environmental campaigner, serving as ambassador for WWF. He says that long-distance swimming sparked his interest in the environment.

'I grew up in England, but when I was 10 we emigrated to South Africa, where I had my first proper swimming lesson. Since then, I have swum in every ocean of the world. I made regular visits to the Arctic for seven years, and witnessed the ice rapidly retreating. In 2005 and 2006 a quarter of the summer sea ice cover disappeared.

'These experiences helped me realize that what happens in one part of the world impacts every other part. We must stop arguing about which country should act first. Given the urgency of the state of the Earth, every country needs to put in place every solution at its disposal. There's no time for delay.'



# 'Remember the day you wanted to HELP?'



**ON 13 JULY 1985**, 72,000 people gathered at Wembley Stadium, London, and 90,000 at the JFK Stadium in Philadelphia, for Live Aid, a massive, transcontinental rock concert broadcast live to an estimated 1.5 billion viewers in 100 countries to raise money for victims of the 1984-1985 Ethiopian famine. Live Aid was a defining and unprecedented moment in the history of rock 'n' roll, broadcast media and disaster relief, and spawned the mega-charity concert as we know it today, including Geldof's own Live 8, the 2005 benefit concert pressuring governments to banish extreme poverty.

The story began with a song in 1984, when Bob Geldof, of the Irish band Boomtown Rats, saw a news report about the Ethiopian famine, the culmination of a long-brewing disaster that had started with severe droughts in 1981. Geldof felt moved to raise money and awareness by producing a single whose profits would go to charity. With Midge Ure of the British rock group Ultravox, Geldof wrote the song 'Do They Know It's Christmas' and enlisted the United Kingdom's top pop acts of the time to record it. The single went directly to Number 1 in the UK charts and sold more than 3 million copies, soon becoming the biggest-selling single in the UK in history.

Geldof felt this effort was not enough, so he and Ure planned Live Aid, a multi-venue rock concert that would be a show of global unity and support for Africa. The concert drew nearly all the biggest names of rock: Madonna, David Bowie, Paul McCartney, The Who, Queen, Led Zeppelin and many more. Throughout the show, which lasted 16 hours, viewers phoned in with donations, which at one point reached \$433 per second. Recent estimates state that the concerts directly resulted in \$216 million raised for relief.

Besides focusing the world's attention on the problem of famine, the extraordinary show of public support forced governments to address the problem. 'It prompted change in 30-odd laws governing multilateral and bilateral aid,' said Geldof, 'and it brought a sense of empowerment: that you weren't impotent in the face of monstrous human tragedy; that governments had to take notice of you; that there was a connectedness between you and other people; and that there were duties and obligations.

'It created something very powerful. For the first time, we had thrown an electronic loop around the planet and ordinary people were talking to each other.'



# Pests and pestilence

Famine has many fathers. Sometimes it is caused by drought, sometimes by poor policies, sometimes by conflict, often by a combination of factors. And pests and diseases can be responsible too: though some victories are won, the battle against them continues.



Photoshot/VISUM/Still Pictures

## Breeding resistance

Selective breeding is almost as old as agriculture, as farmers have sought to improve their crops and livestock, but breakthroughs in biotechnology have opened up previously unimagined possibilities. Recent developments include potatoes that resist the blight that caused the Irish famine (see box) and maize bred with genes from two wild ancestors that help fight off seven major diseases and turn it into a perennial crop.

Whether by old methods or new, crops need to be refreshed with new genetic material – often from wild relatives – every 15 years or so because pests and diseases adapt to man-made countermeasures. The latest big threat comes from a new version of an old enemy. Stem rust, a disease caused by a fungus, has destroyed crops since earliest times, cut harvests in the United States of America by a fifth on several



Oregon State University

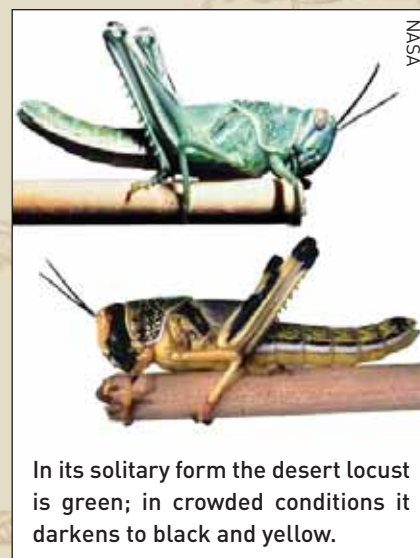
occasions between the world wars, and is so powerful it was developed as a biological weapon during the Cold War.

The last big US outbreak was in 1962, and by the 1970s victory seemed to be on its way as scientists had developed genetically resistant wheat. But recently it has returned with the evolution of a virulent new strain, Ug99 (*Puccinia graminis*). Since its discovery in Uganda 11 years ago, it has already spread to affect or threaten 29 countries in Africa, the Near East and Asia – which account for 37 per cent of global wheat production.

Scientists – who reckon that 90 per cent of all the world's wheat varieties are vulnerable to Ug99 – have been working hard to cross resistant varieties with high-yielding local ones. But this takes time and the fungus is ever evolving to beat them. Just this summer, four new mutations able to overcome existing genetic resistance were discovered. The constant struggle underlines the importance of conserving biodiversity: old and wild varieties often hold the genetic raw material that can avert disaster.

## Feeding frenzy

They sound biblical, but plagues of locusts are all too modern a scourge. Exodus describes how desert locusts



In its solitary form the desert locust is green; in crowded conditions it darkens to black and yellow.

(*Schistocerca gregaria*) 'covered the face of the Earth so that the land was darkened and ate all the plants in the land so that nothing green was left'. And swarms – with 80 million of the insects in each of hundreds of square kilometres – still appear 'out of nowhere' to devastate crops. And even greater swarms have been recorded: a century or so ago a single flight over the Red Sea stretched over 13,000 square kilometres.

The weather signals their sudden appearances. Desert locusts – which are usually solitary – lay their eggs in dry sand, where they can stay for years until rain, at the right seasonal moment, causes them to hatch, breed rapidly and gather in such numbers that swarming behaviour is triggered. In 2004, the



worst plague in 15 years swarmed across some 40,000 square kilometres of Mauritania, Mali, Niger and Senegal, devouring as it went.

On the other side of the world, unusually heavy rains in central Australia recently led to high plant growth in the desert, allowing Australian plague locusts (*Chortoicetes terminifera*) to thrive. Swarming locusts have already consumed thousands of hectares of pasture and such crops as carrot, oat and canola, and Australia is bracing itself for a much larger outbreak later in coming months.

Individual locusts pose no threat to people and can even provide food: many eat them for protein. But when they appear in vast numbers people and animals go hungry. No wonder, when a swarm can contain billions of insects and eat tens of thousands of tonnes of vegetation in a single day. The Food and Agriculture Organization of the United Nations (FAO) coordinates efforts to contain the plagues through Locust Watch, which serves as a clearinghouse of information on locust outbreaks and aids countermeasures, typically spraying pesticides from aircraft.

## Fear of the fly

Small but deadly, the blood-sucking tsetse fly (*Glossina*) infests 37 African countries, covering nearly a third of the continent and threatening millions of people with sleeping sickness (African trypanosomiasis). The fatal disease is caused by single-celled parasites, trypanosomes, transmitted by the fly's bite. Animals are also infected with the parasites, causing nagana, a similarly fatal disease.

Tsetse fly cuts agricultural productivity and increases food insecurity. It thrives in moist rural areas, so families are often forced to abandon good, fertile land to avoid it. The most recent outbreak



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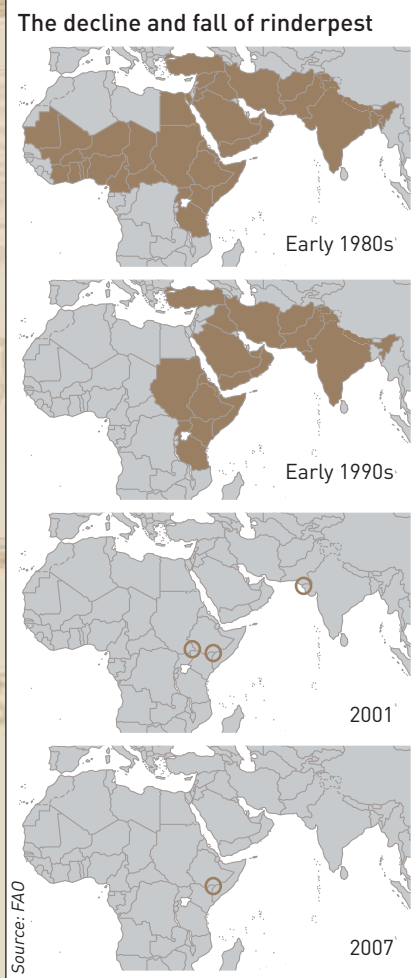
began in 1970: by 2004, around 500,000 Africans had been infected. In 1997 the Government of Tanzania successfully eradicated the flies on Zanzibar by releasing sterilized males into the wild. But despite a campaign to eradicate it, sleeping sickness still affects some 50,000 to 70,000 people each year, while 60 million are at risk of infection.

## Success!

Now here's some good news. This year the FAO will officially declare that rinderpest, a highly contagious viral disease related to measles, has been eradicated. Cattle plague, as it is also called, is only the second disease, after smallpox, to have been driven to extinction.

In 1889, infected cattle shipped from India introduced the disease to Africa. It killed around 90 per cent of cattle in sub-Saharan Africa, along with many other domesticated and wild animals like wildebeest and giraffe; the resulting catastrophic famine killed two thirds of the Tanzanian Maasai and a third of Ethiopia's people. And, until recently, it was still affecting countries as far flung as Brazil, Australia, Pakistan and the Philippines

The breakthrough began with a vaccine developed by scientist Walter Plowright,



who died earlier this year. The vaccine has been available since 1960, but only with the sustained global eradication campaign initiated by the FAO in 1994 has it been possible to eliminate the disease.

# GREAT FAMINES

## Ireland 1846-1852

In 1846 Ireland had 8 million people. Over the next few years about 1 million died and 2 million were forced to emigrate after an imported fungus, potato blight (*Phytophthora infestans*), destroyed its potato crop, which provided 60 per cent of the nation's food.

## Great Chinese Famine 1959-1961

The worst famine in modern history arose not from natural disaster but from official policy. Chinese Chairman Mao Zedong's 'Great Leap Forward' forced farmers to leave their fields when they were brought under collective ownership. Annual grain production declined from 200 million tonnes to 160 million tonnes in two years, and 10 to 40 million people starved.

## Ethiopia 1984-1985

A million people died in 1984 when drought and disease destroyed crops in Ethiopia, leading to a 1-million-tonne shortfall in grain. The famine was made worse by civil war, slow delivery of aid from Western countries, and storms destroying new crops. Hundreds of thousands of refugees fled into Somalia, Djibouti and Sudan.



# On the **safe** side

It is not easy to evaluate risks. We are all exposed, directly and indirectly, to an array of chemicals, medicines and other products, many of which have only recently been developed or synthesized. Absolute safety can rarely be assured. Short-term effects can be assessed and observed, but long-term reactions are difficult to foresee, though they can be disastrous both to people and the wider environment. TUNZA asked David Gee of the European Environment Agency – who has put together two major studies of man-made hazards entitled *Late Lessons from Early Warnings* – to guide us through the maze.

**Q** Are the effects and risks of man-made hazards – like chemicals, asbestos or lead in petrol – similar to those of natural hazards?

**A** There are some similarities, such as the need for preparedness, fair and prompt rehabilitation and compensation; and the necessity for reliable early warnings and the right balance between false alarms and prudent precaution. There are also differences: man-made hazards often cause long-term harm that creeps up silently to destroy the ozone layer, for example, or to cause devastating cancers. We can, of course, do much more to control and diminish the hazard we ourselves create, for example by using biomass-based chemicals rather than oil-based ones, and avoiding molecules that are very long-lived and persistent in the environment or that accumulate in bodies.

**Q** Are only humans affected or does harm also spread into the wider environment?

**A** Many of the hazards described in the *Late Lessons from Early Warnings* books mainly damaged the environment. These included chlorofluorocarbons (CFCs) used in products from fridges to aerosols; polychlorinated biphenyls (PCBs) found, for example, in components of fluorescent light fittings and PVC; emissions of ammonium, carbon, nitrogen and sulphur which led to acid rain; endocrine disrupting chemicals in weed-killers amongst other things; and tributyltin (TBT) which was used in anti-fouling paint for boats and as a wood preservative. Most of these, however, also harm people.

**Q** How much evidence do we need to take action to avoid harm?

**A** The table shows the range of different strengths of evidence that can be chosen to justify taking action, from the high 'beyond all reasonable doubt' of the criminal courts and scientific 'causation' to the relatively slight evidence that could be used to ban a pill tentatively associated with birth defects in an experiment on rats. Choosing which strength of evidence to rely on is an ethical issue, a case of deciding which consequences you are happy to live with if you prove to be wrong.

**Q** Some risks are inevitable, so is this a matter of deciding what risks are acceptable, given the likely benefits?

**A** Yes, and this too is a societal not a scientific question. For example, how much evidence do you need to persuade you not to stick a mobile phone next to the head, given that

you get most of the same benefits by texting and using an ear piece? There is already suggestive evidence that the handsets cause brain cancer, especially in young people. But the authorities and phone companies would like to wait for much stronger evidence – from more cancers – before acting to reduce the hazard.

**Q** What is the 'precautionary principle' pioneered in the European Union?

**A** The principle was designed to help decision makers choose the appropriate strength of evidence for acting when the science is uncertain, or where there is much ignorance about large-scale exposures to potential harm, as is the case for genetically modified organisms (GMOs), weak radiations, some chemicals and nano products. It justifies action if there are reasonable grounds for concern and if the consequences of not reducing exposures could be very serious.

**Q** But how does this equate with innovation?

**A** There is a trade-off between risk taking and precaution, but we have got it wrong in so many devastating cases, such as asbestos (where the first early warning came in 1897), the ozone hole and climate change, that we need to take more care. The precautionary principle helps us to strike a better balance by asking such questions as: 'Is this product really needed?' or 'are there smarter ways of meeting needs?' In *Late Lessons* we showed that so-called 'cheap' universally used substances like asbestos, PCBs and CFCs actually held up innovation for decades, partly because they kept out competition since their real costs to society and the environment were not included in their market prices.

**Q** With so much manufacturing now in developing countries, can the precautionary principle in Europe make a difference?

**A** Yes, because it can limit trade in harmful substances such as imported toys containing lead that endanger European children, or European PCBs and other chemicals that now contaminate the Arctic. To take another example, the Cartagena Protocol on Biosafety uses the precautionary principle to try to stop the export of GMOs to countries that don't want them.

*Late Lessons from Early Warnings* can be accessed from the European Environment Agency at [www.eea.europa.eu/publications/environmental\\_issue\\_report\\_2001\\_22](http://www.eea.europa.eu/publications/environmental_issue_report_2001_22)  
A second volume is to be published in 2011.





## Different strengths of evidence for different purposes

Strength of evidence	Illustrative terms	Examples of use
Very strong (90–99%)	Statistical significance	Part of strong scientific evidence of 'causation'.
	Beyond all reasonable doubt	Most criminal law, and the Swedish Chemical Law 1973, for evidence of 'safety' of substances under suspicion. The burden of proof is on manufacturers.
Strong (65–90%)	Reasonably certain	Food Quality Protection Act, 1996 (USA).
	Sufficient scientific evidence	To justify a trade restriction designed to protect human, animal or plant health under the World Trade Organization's Sanitary and Phytosanitary Agreement.
Moderate (33–65%)	Balance of evidence	Intergovernmental Panel on Climate Change 1995 and 2001.
	Balance of probabilities	Much civil and some administrative law.
	Reasonable grounds of concern	European Commission on the Precautionary Principle 2000.
	Strong possibility	British Nuclear Fuels' compensation scheme for occupational radiation, 1984 (20–50 per cent probabilities triggering different awards and 50%+ triggering full compensation).
Weak (10–33%)	Scientific suspicion of risk	Swedish Chemical Law 1973, for sufficient evidence to take precautionary action on potential harm from chemical substances. The burden of proof is on the regulators.
	Available pertinent information	To justify a provisional trade restriction under the World Trade Organization's Sanitary and Phytosanitary Agreement, where 'scientific information is insufficient'.
Very weak (1–10%)	Low risk	Household fire insurance.
	Negligible and insignificant	Food Quality Protection Act, 1996 (USA).



# Looking forward?

Fred Pearce



Most of us know three or four generations of our families: us, our parents, our grandparents, and maybe some great grandparents too. Of course, we humans go back thousands of generations since we evolved from apes. But most of what we have done to create our modern world has happened over about 400 generations – since the end of the last ice age, when ice caps retreated from Europe, Asia and North America and humans first began farming.

Since then, the world's climate has been remarkably stable. We have had warm periods and little ice ages, but the changes have been relatively small. Our ancestors have always known pretty much when it will rain, what the temperature will be each summer and winter, and how high the rivers will flow.

That stable climate may be the main reason we went from being scattered tribes of spear-carriers living in caves to become the first farmers, the first city dwellers, the first industrialists and now the 7 billion inhabitants of a digitized, globalized world.

Our massively complex society sometimes makes it seem as though we don't need nature at all. But actually, we still rely on planting crops that we know will grow because the temperature will be right and the rains will come. And we rely on the fact that our cities won't be flooded by rising tides or washed away by torrential rains. If we didn't have this certainty, we wouldn't just lose the fruits of our labours, we might not even labour in the first place. Crops wouldn't be planted, and cities wouldn't be built. What's more, with so many of us living in big urban agglomerations, and so much of the planet's surface under cultivation, there aren't many places we could go to find safety and food security if our systems were to break down under the strain of an unpredictable climate.

Of course disasters do happen, including climate disasters like droughts and floods and hurricanes. But for now, they are rare enough for us to be able to pick up the pieces and carry on.

## All change?

Now comes the scary bit, however. It looks like this era of climate stability – of knowing what the seasons and the rains will do – is coming to an end. Climate disasters may become much more frequent and more intense. The reason, of course, is man-made climate change.

We know from basic physics that the gases we put into the air when we burn fuels like coal and oil heat up the atmosphere. That's old news. What is new, and even more worrying, is

that scientists are seeing more and more evidence that the warming won't come gradually. It may come suddenly.

And it won't just be warming: there will be big and fast changes in weather patterns. So hurricanes may start appearing in places where they have not been seen before, like Brazil or Australia. Desert conditions could spread from the African Sahara into Europe. The annual monsoon rains that irrigate crops for 3 billion people in Asia might fail. Rivers may rise up and flood whole cities while storm surges from the oceans inundate low-lying coastal areas.

## Evidence from the past

These are not yet firm predictions. But according to many scientists, our weather is about to get much more dangerous and unpredictable. Perhaps the most persuasive evidence that they are right is that it's happened before. Go back more than 10,000 years and it looks like nature has a track record of doing climate change not gradually but in sudden leaps.

Take events during the final few centuries of the last ice age, just over 10,000 years ago. Around then, average temperatures in much of the northern hemisphere rose by around 10°C within a decade. That's like going from permanent winter to permanent summer within 10 years. Researchers can measure that change in the bubbles of air left behind in ice cores in Greenland.

The warming caused huge ice sheets on land to collapse into the oceans, and sea levels rose round the world by 20 metres in less than 400 years. That is an average of 20 times faster than now, and enough to flood most coastal areas of the world.

Not long before that, temperatures had lurched in the other direction. Research published just last year shows that around 13,000 years ago, the world took just one year to plunge into a thousand-year deep freeze, with average temperatures crashing by 16°C. Humans retreated into their caves and kept the fires going.

Those were violent times. They could happen again. What is unnerving today is that the key element in those changes, the





Hartmut Schwarzbach/Argus/Still Pictures



Mark Kregulec

trigger for the sudden shifts back then, appears to have been carbon dioxide. The very gas we are busy pumping into the air when we burn coal and oil. Carbon dioxide is the planet's thermostat. Nature has flicked the carbon switch before. Now we humans are flicking it ourselves. That's scary.

Here are some troubling thoughts. Some scientists are warning that the Amazon rainforest could die by the middle of this century as a result of global warming. The region will be too hot and too dry for the trees to survive. Trees are also made of carbon. If that happens, the trees would release their carbon into the air. Giving an extra boost to warming.

Another gas that can warm the planet is methane. Nature has lots of methane stored out of harm's way, in odd hiding places round the planet. Methane is frozen inside the ice of the Arctic, and buried under the seabed. If it escapes to the atmosphere it will add to warming.

There are signs that methane releases from the oceans warmed the world in the distant past. And it looks as if current global warming is starting to release methane from thawing soils in Siberia and Alaska. Scientists have measured it bubbling up into the air. Right now the bubbles are small. But as the world warms they could become bigger.

The worry is that we are starting a runaway reaction, in which we add carbon dioxide and methane to the atmosphere, causing warming that releases more carbon dioxide and methane, causing more warming.

### Taking control

That's the bad news. But here is the good news. None of this is yet inevitable. We humans are still in charge of our own destiny. We have the technology to end our dangerous dependence on carbon fuels like coal and oil. We can take our pick of alternative energy sources: wind and solar; tides and waves; even nuclear power maybe.

It is a big challenge for our species. We have had it easy for 400 generations. We have taken nature and the climate for granted. But we can't do that any longer.

Specialist/Stock

Joerg Boethling/Still Pictures



# Heroes of hazard



**Gro Harlem Brundtland** 1939-

At 41, Gro Harlem Brundtland became Norway's youngest-ever, and first female prime minister, serving in the office for nine years in three separate terms. But her greatest impact has been international. In the mid-1980s she headed the Brundtland Commission, which developed the now almost universally recognized concept of sustainable development that led to the 1992 Earth Summit. In 1998, she became Director General of the World Health Organization where she oversaw its first-ever international treaty on tobacco control, which lays down guidelines on health warnings, bans or restricts tobacco advertising, and recommends tax increases to discourage smoking. She launched the Roll-Back Malaria campaign, which has caused the distribution of over 140 million mosquito nets in Africa alone, and halved the toll of the disease in some countries.



**M.S. Swaminathan** 1925-

'Whoever could make two ears of corn or two blades of grass to grow upon a spot of ground where only one grew before,' says the King of Brobdingnag in *Gulliver's Travels*, 'would deserve more of mankind than the whole race of politicians put together.' M.S. Swaminathan, as father of India's Green Revolution, was one of a small group of scientists who did just that in 1960s. He convinced the Indian Government to try out a hybrid high-yielding wheat developed by the Revolution's pioneer, Norman Borlaug, and within seven years doubled the country's harvest, averting the threat of famine. The Green Revolution, however, often benefited the more prosperous farmers at the expense of smaller, poorer ones, and Swaminathan has devoted much energy since in adapting improved crops to the needs of the disadvantaged.



**Theo Colborn** 1927-

Pharmacist and farmer's widow, Theo Colborn decided to go back to college and get a PhD, aged 51, and, nine years later, ended up researching whether pollution of the US Great Lakes was giving people cancer. Her results were reassuring with respect to cancer, but her research turned up study after study showing disease, behavioural changes, reproductive failure and population declines in wild species. She worked out that a range of chemicals were damaging their endocrine systems, which govern sex and reproduction, regulate hormones and the immune system, and coordinate organs and tissues. Later research established that many of them – nicknamed 'gender-benders' – were also affecting people. Her research opened up a whole new area of concern about chemical contamination, and measures are now beginning to be taken to tackle it.

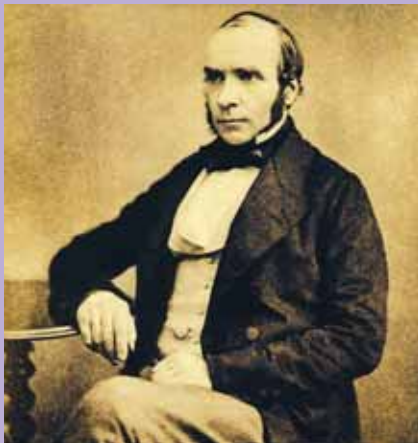






## Paul Crutzen 1933-    Sherwood Rowland 1927-    Mario Molina 1943-

Saving the ozone layer – which protects all life from the deadly ultraviolet light of the sun – started with scientific courage. In the late 1960s, Crutzen, a canal engineer turned meteorologist, first worked out that humanity could damage it but at the start ‘did not dare’ to go public, finally doing so some years later. And when Rowland and Molina, scientists at the University of California, first worked out what effects the common chemicals CFCs would have on it, the results were so shocking that they thought they must have made a mistake. But all three of them were right, and their work led to the phasing out of ozone-damaging substances through the Montreal Protocol, brokered by UNEP, which – by one estimate – has prevented 2 million cancers in Western countries alone. In 1995 they were jointly awarded the Nobel Prize for chemistry.



## John Snow

1813-1858

Cholera swept through British cities in the first half of the 19th century, and it was John Snow who discovered its cause and so laid the grounds for its prevention. People had believed since the Middle Ages that the cause was bad air, or ‘miasma’; Snow came to the conclusion that the disease was transmitted through contaminated water. He was able to prove it, after an outbreak killed some 600 people in Soho, London, in 1854. He narrowed down the source of the disease to a particular pump, had its handle removed, and cases of the disease immediately started to fall. It took some time for his proof to be accepted, but so lasting was his eventual achievement that a poll of British doctors in 2003 voted him the greatest physician of all time.



## Fatima Jibrell

1947-

Somalia has seen more than its fair share of disasters, including war and famine, but Fatima Jibrell is proof that a determined person can make a big difference, campaigning at the grassroots for peace and environmental protection. She was instrumental in forming the Women’s Coalition for Peace to counter a political crisis in the northeast province of Puntland, and successfully lobbied to save the area’s acacia trees from being felled for charcoal. The charcoal was, for a time, Somalia’s main export, but she succeeded in persuading the Puntland government to stop it being sold abroad, and has promoted solar cookers to reduce its use at home. In 2000 she was awarded the Goldman Environmental Prize.



## Zhang Heng

78-139 AD

People have been able to detect distant earthquakes for nearly 2,000 years, thanks to Zhang Heng. Born in China’s Henan province in 78 AD, and rising to become chief astronomer at the imperial court, he invented the first seismometer. In 132 AD he produced a bronze vessel, 2 metres in diameter, with a pendulum inside, surrounded by eight dragons at different points of the compass, each holding a ball in its mouth. When an earthquake occurred one of the dragons’ mouths would open, dropping its ball into the mouth of a bronze toad opposite it, thus indicating its direction days before horsemen from the area arrived to report it, and enabling aid to be sent promptly. It was not until 1880 that a better seismometer was developed.





# FOOD FIRST

**A hungry child sits in the rubble of her home in Port-au-Prince, Haiti. The house she has lived in is gone: the city is in ruins; shops, businesses and banks are closed. Where will her next meal come from?**

The World Food Programme (WFP) is the largest humanitarian agency fighting hunger worldwide. Up to 10,000 people work for the organization, mainly in remote parts of countries that most people wouldn't dream of visiting. In my 10 years with WFP I have been based in Afghanistan, Kenya, Iraq, Somalia and now New York, where my work is to plan the response: how to get food to that little girl and her family in Haiti.

Immediately following the earthquake, up to 3 million people needed emergency food assistance. In the highly populated capital, the narrow streets were clogged by remnants of the quake and endless traffic jams. The main port was largely destroyed, the airport was heavily congested as search and rescue teams arrived from all corners of the world, and our own warehouses were badly damaged and dangerous to access. It was WFP's most complicated challenge in its history. Food was brought in by boat, by plane, and by road from neighbouring Dominican Republic, and then moved in convoy to 16 pre-identified distribution sites where up to 1,000 families would come each day to collect their two-week ration of rice.

Depending on the location, WFP uses donkeys, yaks and elephants to carry food to remote villages. Moving food is one of our biggest challenges, and this year WFP expects to reach 90 million people in 73 countries with 3.7 million tonnes of it. Governments are WFP's principal source of funds, and contributions usually come in the form of cash or food. In an average year, more than 60 governments voluntarily provide funds, with which WFP purchases more than 2 million tonnes of food annually. WFP's policy is to buy food as close as possible to where it is needed, and at least three quarters of it comes from developing countries. By buying locally the agency can save money on transport costs and help sustain local economies.

Timely contributions allowed WFP to begin distributing food to Haitians immediately following the earthquake; in order to save lives and move quickly, food was provided to all of those in need of assistance. As life has gradually resumed, the operation has shifted to food-for-work to support families as they rebuild their lives, school feeding programmes to help get children back into the classroom, and special nutrition programmes for young children and pregnant and breastfeeding women.

Working for WFP means getting your hands dirty. Its strength lies in its deep field presence: we pride ourselves on being able to get food to that little girl in the rubble. Whether working as a field monitor in Baghdad, where I first joined the organization, or as programme officer in Kabul, I have witnessed first hand what can be done in the face of adversity.

Denise Brown is Senior Donor Relations Officer at WFP  
To learn more about WFP's work, see [www.wfp.org](http://www.wfp.org)

