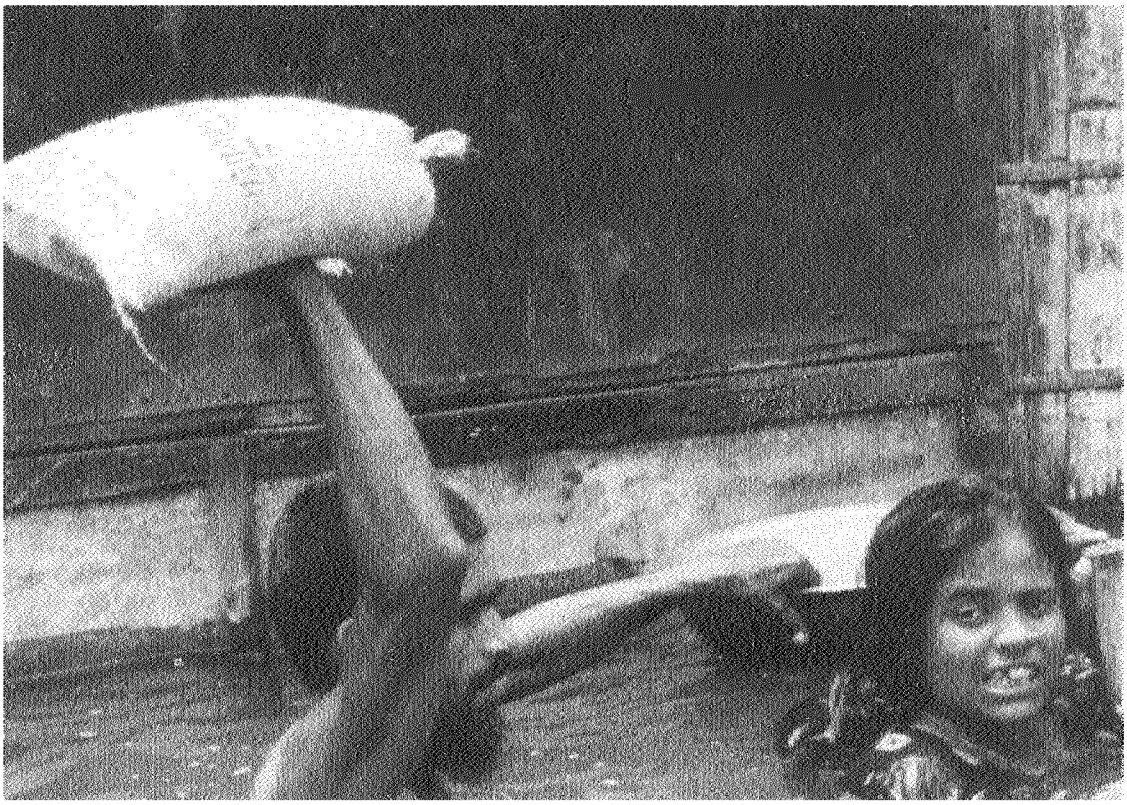

Chapter

2 Flood waters rising

Floods remain the vastest and most deadly of natural disasters. Around 300 million people, mainly in Asia, were afflicted last year. Mitigation is moving away from structural solutions to 'softer' self-help measures like community-based early warning and emergency preparedness, combined with better land-use and planning regulations.
Bjorn Ederl International Federation, Bangladesh 1998.

Floods are usually considered the most destructive of all natural disasters. and 1998 may have seen the most catastrophic floods of the century Even without counting the devastation linked to Hurricane Mitch, floods from Asia to the South Pacific broke record after sad record. Up to 300 million people were affected by storm surges, torrential rains landslips, mudslides and tidal waves. Statistics from China, Bangladesh, India and Papua New Guinea added up to over 10,000 flood-related deaths even before the waters had all subsided. El Niño and his grim handmaiden La Niña have, rightly or wrongly, taken much of the blame. This chapter looks at their natural and man-made history, what impact floods have on the lives of people and societies affected, and what can be done to prevent or mitigate their pernicious effects

Floods are the primeval catastrophe In an amazing variety of cultures, the Great Flood in one form or another is present in collective memory as one of the strongest and most enduring myths of mankind Many flood stories are based in reality as archaeologists have been able to prove. There really was a cataclysmic flood at Ur in Mesopotamia, as transmitted in the Epic of Gilgamesh. It devastated everything in the delta of the Tigris and Euphrates rivers, leaving only a few vestiges of structures built on raised mounds It transformed the lie of the land and effectively destroyed the Al-Ubaid civilization which once flourished there.

This story of destruction and rebirth after the passage of cleansing waters became the prototype for Noah's flood in the Old Testament of the Bible. Comparable flood stories, some with colourful variations, are found throughout south Asia, from India and Myanmar to Sumatra and Papua New Guinea. And this area remains the world's most important flood belt.

Around 80 per cent of the Yangtze river basin's forests have been logged, clogging waterways with silt and debris, and increasing run-off during torrential rains. Following the devastating floods in China last year, which inflicted an estimated US$ 30 billion of damage, the government ordered all logging in the basin to stop, and all areas deforested since 1994 to be replanted. *Shenlyn Amy/ International Federation, China 1998.*

Even though we have not in recent centuries seen a cataclysmic destruction of humanity, experts unanimously agree that floods have been getting worse. But they disagree about why. And yet, even in the disastrous year we have just seen, the death toll was less than that of other bad floods in the last 100 years. Asia remains the region where floods are most murderous. From 1987 to 1996, 44 per cent of all recorded floods were in Asia, but they caused 93 per cent of flood-related deaths.

In the macabre hierarchy of natural disasters, floods account for about one-third of all 'events' – 32 per cent in the comprehensive analysis made by specialists at reinsurance giant Munich Re for the period from 1986 to 1995. This is compared to 34 per cent for windstorms (e.g., hurricanes, typhoons, tornados, cyclones) – some of which also led to flooding. The proportions for economic loss are almost the same. But strikingly, floods were responsible for over half of all fatalities caused by natural catastrophes, while windstorms accounted for just nine per cent.

If most specialists are convinced that floods of recent years have increased in severity, not all agree there are more of them. The perception that there are more natural disasters generally could be fostered by the emergence of a worldwide instant information society, especially a television culture that requires constant feeding with spectacular images Floods that in the past may hardly have raised an eyebrow now become media stars. Just as El Niño – for which historians and archaeologists have found evidence in Peru going back 4,000 years – has become a global buzz-word in the last decade.

Anatomy of floods

A flood can be defined as an irruption of water over otherwise dry land. But not all floods are disasters, and need not be destructive In fact the demise of the annual Nile flood, as a result of the Aswan High Dam (built to generate electricity, not for flood control), has dramatically reduced soil fertility and increased erosion downstream – a caution for those tempted to tamper with annual floods elsewhere, for example in Bangladesh. Destructive floods can broadly be categorized as either river or coastal floods, but are caused in many different ways

• **River floods** are the most frequent form recorded globally. They usually inundate the largest areas of land and destroy more lives and property than other types of flood. Most result from long periods of rain – often seasonal monsoons, or from rain combined with melting snow and ice. They can be catastrophic: northern Iran in 1992; the Mississippi and Missouri rivers in the US, in 1993; central Europe's Oder River in 1997; and China and Bangladesh almost annually.

• **Flash floods** are caused by very high, often violent, rainfall over a limited and constricted area. Combined with snow-melt or heavy rain falling on frozen or saturated soil, they can be

devastating even on small rivers. Debris dragged downstream clogs channels, increasing the risks for loss of life and property damage. They are the most common form of flood in temperate climates, and, often striking without warning, they can be at least as destructive as longer-lasting river floods. Flash floods also occur – with dire consequences – in very dry regions. Parched soil can absorb no more water than frozen tundra, so after a sudden cloudburst, as much as 1,000 cubic metres of water per second can rush down the dry watercourses or *wadis* of arid areas. Such flows may come only once a lifetime, making planning problematic for bankside constructions. Yemen has repeatedly seen very destructive *wadi* floods, and a spectacular one in 1994 on the Libyan 'Great Man-Made River' project swept away carefully-constructed embankments.

• **Barrier failures:** dams and dykes can burst, or be overtopped, for many reasons: (a) overflow during torrential rainfall or unexpectedly rapid snow-melt, which causes water intake to exceed the 'design flow'; (b) the design itself may be faulty, (c) overaging or structural fatigue; (d) weakening by prolonged soaking of high water levels; (e) damage or waves caused by earthquakes, landslides and avalanches; (f) undermining by burrowing animals and trampling of earth barriers by cattle or buffaloes; (g) settlement damage through subsoil drainage, which can often be traced to design and maintenance decisions not by the engineers, but by the political forces which paid for the dam and often chose the site; (h) poor site selection, for example filling up old mining pits, which although convenient can often fail – as happened when the Italian Stava valley dam gave way in 1985, setting off a surge that killed 300 people.

• **Glacial lake bursts** are a special case of barrier failure – usually referred to by the Icelandic name of *jökulhlaup*. These occur frequently in Iceland, but have been recorded elsewhere, including the Swiss Alps, the Andes and Alaska. Glacial lakes which sit atop active volcanoes or vents can become dangerously unstable during subterranean eruptions, causing lake water to boil and overflow its banks In some cases, the entire lake can be drained away when its natural embankments are completely destroyed by a seismic event or a volcanic eruption. Six thousand people were killed in Peru in 1941 when a moraine barrier burst, unleashing a glacial lake near Huarás In July 1998, a mountain lake burst in Kyrgyzstan killing over 500 people.

• **Rising groundwater** (to be distinguished from land subsidence) is usually ascribed to a medium- or long-term change in precipitation patterns. More and longer rains can force up groundwater tables, as often happens in El Niño-affected regions

• **Rises in lake and river levels**, caused by periods of exceptional rainfall, can have disastrous effects on poorly-drained lakes, which then react like overfilled bathtubs. This happened in 1993 on Lago Maggiore (between Italy and Switzerland) when much of the densely populated lake-shore stood under several metres of water. Backwaters in rivers, usually caused by rockfalls, avalanches or glacier advances, have similar effects. And it can be catastrophic if the natural dam blocking the river suddenly bursts.

• **'Seiche'** usually cause flooding around closed waters, like the North American Great Lakes. When a strong wind blows constantly in the same direction, water forced into the leeward zone can swing back if the wind pressure suddenly drops, creating 'resonance oscillations'.

• **Storm surges**, whipped up by ocean winds and tides, can cause havoc on low-lying coastlines They could become more frequent and severe if climate change drives up sea levels and fuels more severe windstorms In 1998, much of Hurricane Mitch's devastation was caused by a deadly combination of torrential rains and storm surges (see chapter 3)

• **Tsunami** is the Japanese name for a seismic sea wave set off by a submarine earthquake, landslide or volcanic eruption. Tsunamis can be incredibly powerful and have been recorded travelling at speeds of 700 kilometres per hour on the open sea. When Krakatoa erupted off Java in 1883, it set off a tsunami 30 metres high which reportedly killed more than 30,000 people. In 1960, an earthquake in Chile sent a tsunami across the Pacific which drowned

130 people in north Honshu, Japan. Four years later, an earthquake in Alaska set off a tsunami that reached Crescent City, California five hours later, claiming 119 lives. The tsunami which wiped out over 2,000 people on the shores of Papua New Guinea in 1998 was due to a submarine earthquake. Even though tsunamis are not nearly as frequent as river floods, they present enormous dangers as Pacific coastlines become increasingly built up with industrial complexes and leisure facilities.

• **Land subsidence** can be caused by movements of the earth's crust and by phenomena such as glacier isostasy and groundwater depletion. Scandinavia is rising by a centimetre a year because massive glaciers from the last Ice Age have melted and retreated. With this tremendous weight gone, the land rises naturally, while simultaneously, coastal land around the southern North Sea is sinking The gauge at London Bridge shows water levels up more than 75 cm in the last hundred years. Besides the global rise in sea levels, this can also be attributed to extraction of groundwater.

Not all floods are disastrous. The annual floods in Bangladesh deposit alluvion in the delta and assure the land's fertility, making it possible to grow the three crops a year which keep the people of one of the poorest countries in the world from going hungry. The population

Box 2.1 Sodden Asian summer

In the middle of the swollen Brahmaputra River in central Bangladesh, 11 family members are crouched in hammocks strung from the ceiling of their timber hut praying that the swirling river, 50 centimetres below, will spare their dwelling and their lives. Their little island has been underwater for a month. The family survives on rice, cooked in river water in a pot suspended from the ceiling

Go 2,000 kilometres east and you find yourself in central China on top of a narrow dyke among several thousand families, each living in an area the size of a small dining table. It is 35 degrees Celsius. A plastic sheet covers the chair, mattress and wash basin you managed to save from your house. The children have diarrhoea and skin diseases, and the mosquitoes are a constant irritant You are thirsty and hungry and the food is running out. But this is home for the next two months, until the waters recede and you can go back to your ruined field, where your house used to be.

"The enduring picture that will remain with me is the sight of huge encampments set up on dykes that were filled with the human flotsam of the disaster," said International Federation delegate Jim Robertson, who spent weeks travelling in flooded parts of China. "On one dyke I visited, there were an estimated 300,000 flood victims living in shelters made from a mixture of salvaged wood and plastic sheeting."

For hundreds of millions of people across Asia, this was reality in 1998. Rain and storm – much of it blamed on the El Niño and La Niña phenomena – caused large-scale flooding and ruinous landslides, destroying homes and devastating livelihoods. The south-west monsoon arrived early or on schedule in most countries of the region, but performed erratically, resulting in excessive rains and flooding in several countries and drought conditions in others. The UN's Food and Agriculture Organization (FAO) reported that large parts of Asia were likely to face increased food-supply difficulties in the months following the flood season.

Appeals launched by the International Federation supported operations assisting nearly five million people affected by floods in Asia during the year. Millions more benefited from assistance by staff and volunteers of national Red Cross and Red Crescent societies. Aid came in two phases: emergency relief – saving lives during and immediately after the disaster – and rehabilitation, including food support to cover shortfalls of crops and reconstruction of houses.

Governments are finally recognizing the man-made causes of floods – and even acting on them. In China, where the quest for rapid development has long taken precedence over environmental conservation, officials acknowledged that deforestation and mining had contributed to the 1998 inundation. Loggers in the upper reaches of the Yangtze were ordered to stop felling trees and start growing them. Farmers were told that drainage lakes converted into farmland had to be restored to their original purpose. "We have asked a lot from nature, and now we are returning what we have taken," said Zhou Wenzhi, China's vice-minister for water conservancy, at a news conference in Beijing in August 1998.

Whether the apparent change of heart in China signals a serious global rethink on how to prevent floods is uncertain. The millions who spent last summer camping on dykes or sleeping in hammocks suspended over swollen rivers, can only hope that the trend towards greater and bigger floods, seen in recent years, can be arrested

density is too high, demographers tell us – but if the land were not so fertile, less people would be attracted to live there.

Technical reasons why floods become tragedies concentrate on mistakes in land use: bad zoning, bad planning, bad agricultural practices (e.g., ploughing up and down hill instead of along the contours) and, above all, deforestation – itself often connected to population pressures. One of the Chinese government's responses to the devastating 1998 floods has been a two-stage ban on logging in many parts of the Yangtze watershed, plus a decree to replant areas logged since 1994.

Unregulated building on flood plains is a major aggravating factor. This, of course, is nothing new. Humans have always settled beside lakes, rivers and estuaries, for obvious reasons: availability of drinking water, ease of transport, and the strategic and economic advantages of controlling crossing points and good defensive sites. Few settlements built in these otherwise choice locations have escaped floods. Records of floods in Florence (Italy), beautifully and strategically situated astride the River Arno, go back to 4 November 1177. Fifty-six seriously damaging floods have hit the city since then.

Floods target the poor

As urban populations soar worldwide, flood plains seem an obvious space for new developments. Their flatness, especially in otherwise hilly country, makes them hugely attractive for agriculture, for commercial or industrial buildings where economic simplicity of design is at a premium, and for infrastructure projects like airports. One road along a flood plain may not make much difference. But when, instead of porous soil, acres of runways and roofs, paved roads and parking surfaces are presented to the elements, the capacity of the plain to absorb excess water is severely reduced.

Climate change remains a controversial issue, but even the usually cautious World Meteorological Organization (WMO) confirmed 1998 as by far the warmest year since records began. With the globe predicted to heat up by anything from one to four degrees Celsius over the next century, melting glaciers and ice caps, combined with thermal expansion of the oceans, could raise sea levels by 20 to 100 cm before 2100. Consequences for coastal flooding could be dire. And a warmer atmosphere may fuel more storms and precipitate heavier rains, inundating river valleys and inland flood plains (see chapter 1).

But what makes some floods more devastating than others? Vulnerability of local inhabitants is one answer. Not the same thing as being 'at risk', vulnerability can be defined as the element that turns a danger from being a risk or hazard into a disaster. Although the terms are not synonymous, poverty is usually a major factor contributing to vulnerability.

While analysis of Hurricane Mitch's impact is still ongoing, clearly Central America's poor suffered far more than the rich. The classic studies of such disparities began in Brazil when floods devastated many poor areas in the state of Rio de Janeiro in 1988. That year, February summer rains fell just as heavily on rich neighbourhoods as on poor. But the poor suffered disproportionately. Rich inhabitants lived in well-built houses that could withstand the battering of flood waters, in areas less susceptible to torrential run-off, where local infrastructure was more likely to function properly. The poor, however, lived on marginal land in weaker structures, and were often the least informed of what they could do to protect themselves. Nor could they escape or move their belongings to an upper storey since their houses were usually built on just one floor. They lacked insurance cover for rebuilding and, through ignorance or illiteracy, were often unable to take advantage of government rehabilitation aid, even if theoretically it was available to all. The situation in Rio was made worse by bureaucratic wrangling over US$ 175 million of World Bank aid – specifically designated to promote "multisectoral development strategies". Three years later, it had still not been spent – incurring fines from the World Bank.

This story is repeated in many parts of the world – floods often target the poor. Even in Europe or North America, all victims are not equal. In the 1997 central European floods,