Massive floods swept away 300 bridges in Peru as unseasonally heavy El Niño-driven rains lashed the country in early 1998. Weak infrastructure is partly to blame for El Niño's devastating impact on Latin America.
Martin Mejia/AP Peru 1998.

Chapter

6 El Niño and La Niña – the Pacific's deadly duo

As El Niño's storms pounded the Pacific coast of the Americas starting in late 1997 its effect on the Peruvian coastal city of Trujillo reached apocalyptic proportions. Rivers burst their banks and the sea surged 15 kilometres inland to flood the main plaza of the desert city of one million, which can go half a decade without a drop of rain. The deluge rendered hundreds of kilometres of roads in Trujillo's district of La Liberdad useless and destroyed or disabled 43 bridges around the city. Flood waters even eroded the earth of the city's oldest graveyard, sending ancient coffins and cadavers floating through the streets in a spectre so horrible that city leaders dedicated one stormy Sunday in March for beleaguered citizens to beg God for relief.

The name El Niño – Spanish for 'the Christ Child' – comes from Peruvian fishermen, who named it generations ago for the timing of its usual peak around Christmas. Historical records show the phenomenon has been occurring every two to ten years for at least the last five centuries. Since the turn of this century, 23 El Niños have affected the earth, according

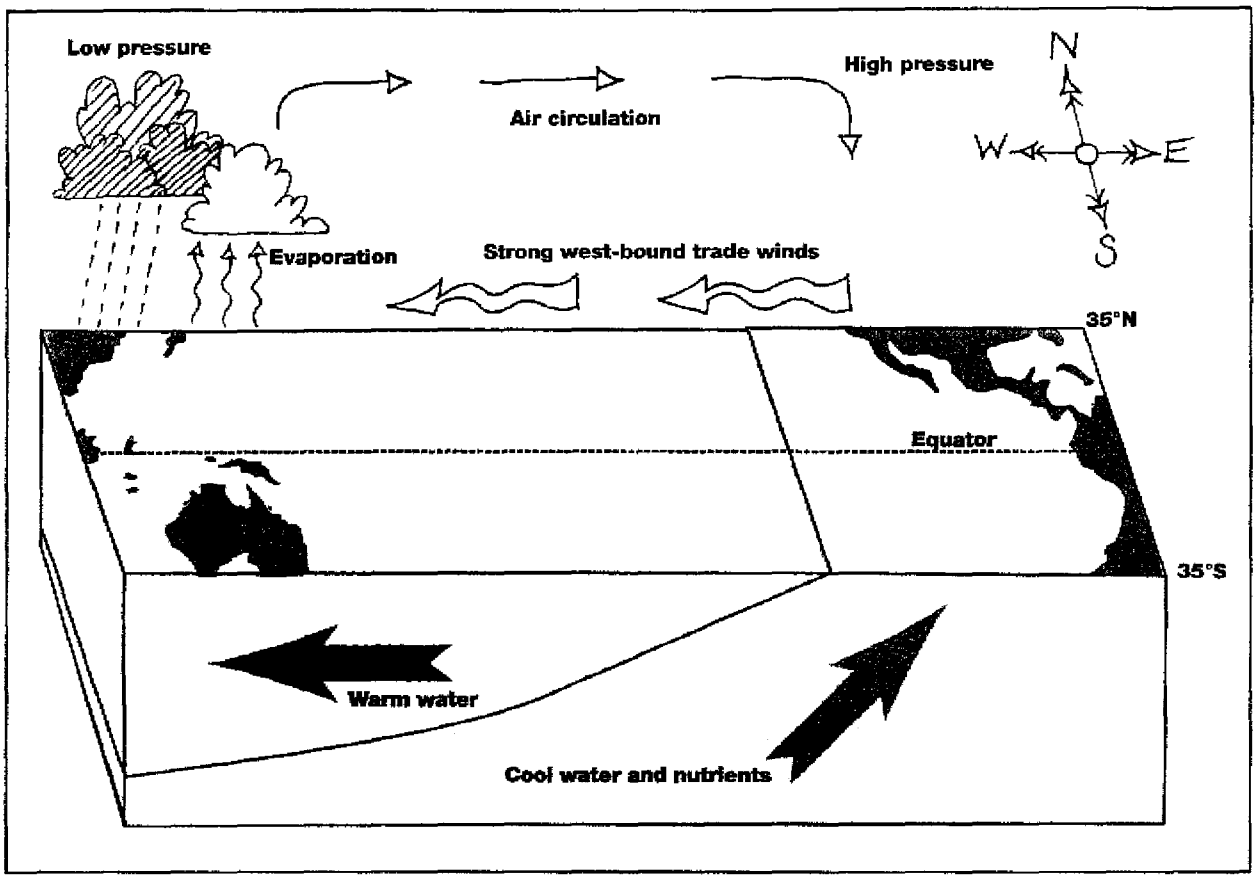

Figure 6.1 Normal/La Niña conditions: trade winds push warm surface waters west, causing heavy seasonal rains in the west Pacific and south-east Asia. Cooler waters well up off Latin America, bringing dry coastal conditions. The La Niña phase exaggerates these effects.

to the US National Oceanic and Atmospheric Administration (NOAA) But the four strongest have all struck since 1980.

El Niño is a fluctuation in the distribution of sea-surface temperatures and of atmospheric pressure across the tropical Pacific Ocean, leading to worldwide impacts on regional weather patterns No one knows exactly why it takes place, but recent computer climate modelling suggests the frequency and strength of both El Niño and its sister effect La Niña are increased by global warming – and 1998 was by far the warmest year since worldwide records began 150 years ago.

Despite doubts over the precise relationships of climatic cause-and-effect the mechanisms are well documented. In normal conditions, trade winds blowing west along the equator push warmer surface waters towards south-east Asia, where they accumulate, evaporate and fall as heavy tropical rains. Meanwhile, off the Pacific coast of Latin America, cooler nutrient-rich waters well up from the ocean depths, causing dryer conditions along the shores of Peru and Chile, and making their fishing grounds among the most fertile in the world.

During El Niño, trade winds weaken or reverse, and the warm surface waters of the western equatorial Pacific shift east. This generates unseasonal rain and storms over the Pacific coast of the Americas, while leaving drought to afflict south-east Asia and the western Pacific. By January 1998, at the peak of the latest El Niño, a pool of hot water the size of Canada and up to 400 metres deep stretched west from Latin America, preventing the cooler coastal waters from welling up and seriously disrupting oceanic food chains. Surface water temperatures in the eastern equatorial Pacific reached around 30 degrees Celsius – up to five degrees higher than normal – affecting climates around the world. But the areas

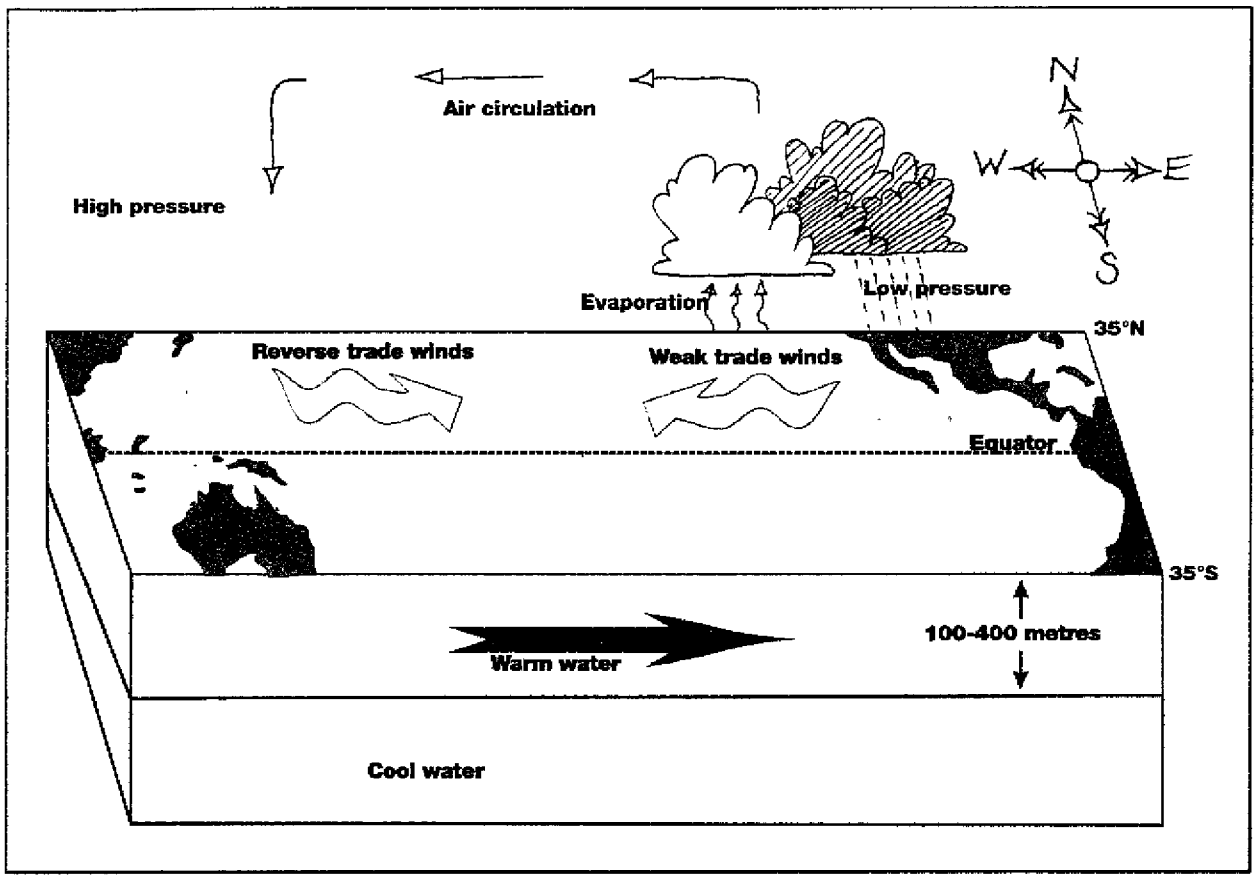

Figure 6.2
El Niño conditions: trade winds weaken or reverse, allowing warm surface waters to mass off Latin America, bringing unseasonal heavy rains and flooding. Meanwhile, the west Pacific and south-east Asia suffer from severe drought.

hit hardest by El Niño's effects are usually the western and eastern rims of the Pacific, between 35 degrees north and south of the equator.

Pioneer meteorologist Sir Gilbert Walker, working in the 1920s, was the first to notice that when air pressure increases in the west Pacific it drops in the east, causing the Pacific's west-bound trade winds to reverse course. Subsequent statistical analysis in the 1960s linked this pressure inversion (known as the Southern Oscillation) with El Niño. Lower pressure in the eastern equatorial Pacific during El Niño events also draws the subtropical jet stream further south, producing winter storms in the south-west US and north-west Mexico. As the jet stream continues east, it meets little resistance from weak westerly trade winds and slices off the tops of Atlantic hurricanes, preventing many of them from reaching the US east coast and Caribbean.

Once El Niño has passed, sea water and air circulation reverse direction again. If the swing back is dramatic, it creates a condition called La Niña – less frequent and therefore less studied than recent El Niños. During La Niña, the warm waters off Latin America head west and are replaced by unusually cold currents known as the 'equatorial cold tongue', chilling sea-surface temperatures by up to seven degrees Celsius below El Niño levels. West-bound trade winds blow stronger than usual, and cycles of flooding and drought are often inverted. Heavier rains fall on the western Pacific, southern and eastern Asia, northern Australia and as far west as southern Africa. High atmospheric pressure over the central Pacific weakens the subtropical jet stream, allowing powerful Atlantic hurricanes to form. On 24 September 1998 for the first time this century, four Atlantic hurricanes – including Mitch – were active at once. "Such enhanced hurricane activity", says the World Meteorological Organization, "is consistent with developing La Niña conditions."

El Niño pummels Peru

In Latin America, the unusually long and severe weather fluctuations of 1997-98's El Niño were aggravated by changes in population concentration, over-development in urban areas and the rapid growth of weather-sensitive industries like fishing and agriculture, making the fallout among the worst ever recorded.

Across Peru, rain-swollen rivers and mudslides destroyed 300 bridges and swept away entire villages, making up to half a million homeless. Government estimates put El Niño-related damage to public infrastructure alone at US$ 2.6 billion – nearly five per cent of the country's gross domestic product. Waters offshore became so warm that many fish species headed north or south in search of cooler, more nutrient-rich climes. Violent rainfall churned up coastal seas and freshwater runoff decreased salinity, further affecting fish stocks. Peru's merchant fishing fleet – usually the country's second largest industry – saw output in the first quarter of 1998 fall a staggering 96 per cent compared to the same period in 1997. Severe weather completely closed the ports of Callao and Chiclayo (Peru's first and fourth most important ports) and flooding buried half the major port of Ica under two metres of mud.

There are still no consensus estimates for the cost of damage to private property, but some health-care providers say the most lingering effect of El Niño could be the diseases spread, in part, through overworked sewer systems and waste-treatment facilities. One local magazine argued that such diseases and even birth defects may not become apparent for a generation. Even if this overstates the case, floods increased the chance of contracting diseases transmitted by rodents and polluted water. The Pan-American Health Organization (PAHO) warned that floods and warmer weather produced conditions favouring the spread of malaria, yellow fever and dengue fever. In the Piura region alone, three times as many residents as usual contracted malaria – 30,000 cases affected one in 50 of the population. And health services were severely handicapped by El Niño-related flooding, which damaged equipment, supplies and buildings – affecting nearly a tenth of the country's already over-burdened health-care facilities. Nevertheless, health preparedness throughout the region was far better than prior to the 1982-83 event.

The economic impact on Peru may be felt for a decade or more. The fishing industry isn't expected to match 1996 levels (the last full pre-El Niño year) until 2002-03 and may not resume its growth curve for several years after that, according to the private-sector National Society of Fishing. Mining, Peru's largest industry, had already been crippled by low commodity prices associated with Asia's economic problems, and El Niño prolonged production schedules at several important coastal mines through flooding and road damage. Tourism-related revenues fell in 1998 for the first time this decade. Consumer spending fell 15 per cent compared to the previous year. And one survey showed the Peruvian's confidence in the economy and government sliding to 18 per cent at its low point during El Niño, compared to 72 per cent in late 1996.

Damage to the agriculture sector, which saw production fall by a quarter in the first half of 1998 compared to 1997 levels, forced Peru to become a net importer of several key food products, swelling the country's trade gap to an estimated US$ 2.7 billion in 1998 from US$ 1.8 billion in 1997. The country's usually robust economy, which grew an average of 6.9 per cent a year from 1993 to 1997, mustered only 0.7 per cent year-on-year growth in 1998 – actually an economic contraction in per capita terms, as Peru's population grew 2.2 per cent during the same period.

Crowded coasts court disaster

The impact of El Niño is made worse by urban development and corresponding population shifts. Peru's capital, Lima, is home to 8.5 million people – compared to just 1.8 million in 1970. Of Peru's 24 million residents, 73 per cent live within 80 kilometres of the sea, up sharply from 54 per cent three decades ago. That shift is partly due to the activities of Maoist Shining Path rebels and the pro-Cuban Tupac Amaru Revolutionary Movement

(MRTA) which, from 1980 onwards, drove farmers out of the provinces to coastal areas (especially Lima) where army protection was more effective.

Poverty pushes people into urban and coastal areas where jobs are centralized. All four countries making up the Pacific coast of South America (Chile, Peru, Ecuador and Colombia) have seen their populations concentrate in coastal areas, in part because of the inhospitable environment of the Andes mountains and the Amazon jungle. Modern Latin Americans may not be as in tune with nature as their Inca predecessors, who built their cities on hilltops or away from rivers to escape the landslides and floods which have afflicted this land for thousands of years.

Weak infrastructure, common to most poor countries, further aggravates the effects of El Niño. According to a 1996 exposé in the news magazine *Sí*, modern Peruvian highways are built under government regulations that require only a one-centimetre base and eight centimetres of pavement. That compares to an average 22 centimetres of pavement and base in the US and 24 centimetres in most of western Europe. Bridges, sewer systems, embankments and other key structures are built to similarly poor standards, often due to lack of funds.

Peruvian President Fujimori appointed Alberto Pandolfi, a former prime minister, to head a special committee overseeing the country's efforts to limit the effects of El Niño. Armed with US$ 600 million from the Peruvian government and more than a billion dollars in guarantees

Box 6.1 Peru's independent fishermen: end of the line

Fisherman German Herrera's family has made a career of recovering from setbacks But Herrera, aged 71, said El Niño convinced him and his children to give up the fisherman's hard life. "A man can suffer only so much," he said, adding wearily: "A man can only start over so many times."

Atico, the southern Peruvian port where Herrera grew up, is home to a fishing tradition stretching back more than a millennium Before 1997-98's El Niño, the air of the town was filled with the smell of salt and the sound of metal halyards slapping against boat masts. At the end of a working day, the lagoon was so full of fishing boats it seemed the entire centre of town rose and fell with the tides. But El Niño filled the lagoon with mud, greatly reducing its depth. Severe rains destroyed one in four town buildings and changes in water temperature drove the fish indigenous to Atico far out to sea Though the currents off Atico are affected by every El Niño, the latest one lashed out at the area with uncommon fury. The port's economy crumbled, its young travelled north to Lima's growing slums in desperate search of work and those left behind fought to survive

Herrera started fishing with his father when he was eight, but El Niño has wrecked his boat. Tempted to sell the plot of land in Atico where he was born and join his sons in Lima, he is resigned to living out his days dependent on meagre government and family handouts. "My father fished until his eighties, and he used to say that our family had salt water in its veins," said the fisherman. "But I don't care to continue with that lifestyle and I don't want my children and grandchildren doing it either." Strange considering his personal history. Herrera survived a boat accident that killed two sons and a brother 35 years ago. He lost the use of his left hand in a motor accident half a dozen years later. But he successfully returned to fishing after the haphazard nationalization of the industry in the 1970s nearly destroyed most of the country's fishing companies Until the latest El Niño, he worked for one of the companies that invested in Peru's fishing industry when privatization began in the early 1990s. "Before El Niño, we were finally on track to return to the glory days [of the 1960s]", he said "Now it will take another 25 years...I won't be around to see it."

A large slice of post-El Niño funds from the Peruvian government and multilateral organizations is aimed at rebuilding the country's battered merchant fishing fleet But little is aimed at helping independent fishermen like German Herrera. That may mean many of them going the same way he has. "These small fishermen have no safety net to catch them during a disaster like El Niño," said Hernando Dicho Vasquez, a Peru-based disaster preparedness consultant. "They have to look elsewhere "

If that happens, it will be a sad day for Peru's coastal fishing villages, prophesies Herrera: "My grandchildren will be the first generation I know of in my family that won't earn a living from the sea," he said, adding: "Many of my cousins and friends say the same thing. This is the end of an era."

Despite scientists warning of El Niño's impact six months in advance, infrastructure along the Pacific coast of Latin America buckled under the onslaught of unseasonal rains.

from multilateral organizations, the committee concentrated on infrastructure problems in an aggressive rebuilding and repair programme. But the committee has been criticized in Peru for being under-funded, under-staffed and ineffective Pandolfi admitted the organization has been overwhelmed by the shattering effects of El Niño. "We based many of our estimates on damage reported in the last two El Niños (in 1982-83 and 1992-93) and that was not nearly enough," he said in an interview. "There is virtually no aspect of life in this part of the world that was not affected by El Nuño. .everyone felt the effects This weather phenomenon showed how unprepared we were.. and how difficult it would be to be adequately prepared."

Pandolfi added that future government responses will reflect what was learned during the most recent disaster. "It was a positive step not to attempt to run anti-disaster efforts from Lima", he said, "and rebuilt infrastructure will be to a higher standard more ready to stand up to a future disaster." On the use of early warning systems, he said· "Given the technology of this era, basing preparations on what has happened in the past is inadequate. There are methods we should employ that will give us a more accurate image of what is ahead."

As well as Peru, other countries in the region affected by El Niño/La Niña included:

- Bolivia, where severe mountain weather caused mudslides on roads joining the capital of La Paz with Cochabamba and Santa Cruz – two of the country's most important provincial cities. The capital suffered unseasonal freezing weather and hailstorms. And cholera reportedly broke out near La Paz, Cochabamba and Oruro.

- In Brazil, heavy rains in Rio de Janeiro caused severe flooding. In the province of Roraima, excessive drought led to over 200 fires, destroying more than 37,000 square kilometres of forest and displacing an estimated 10,000 people.

- Flooding damaged roads around the northern port of Arica in Chile. This, combined with unusually warm sea water temperatures, shrank the fishing catch usually landed through the port by at least 50 per cent. Cholera was reported in northern coastal areas.

- Ecuador, where heavy rains and flooding on the coast left roads and bridges in ruins. Damage to infrastructure was so severe the government estimated it would take a decade to recover. Outbreaks of leptospirosis and cholera were reported near the southern city of Guayaquil.

- In Paraguay, rains overflowed the Parana and Paraguay rivers. A tornado associated with El Niño devastated the capital, Asunción, followed by storm-floods that damaged houses, schools and hospitals. Water supply and treatment facilities were also significantly damaged.

- Central America: La Niña is thought to be responsible for the weather changes that encouraged Hurricane Mitch, which devastated Honduras and Nicaragua in October 1998, killing at least 10,000 people (see chapter 3).

El Niño's Latin American legacy has not, however, been all doom and gloom. Some consumer product sectors benefited from the unusually warm weather, with beer and ice cream sales surging 20 per cent in Peru during winter 1997, compared to the same period in 1996. In Ecuador, beverage sales in 1997 were 15 per cent higher than in 1996. And the rains in northern Peru and southern Ecuador watered a normally infertile desert, creating a lake locals named La Niña, 300 kilometres long, 40 kilometres wide and 10 metres deep. The lake stimulated tourism in the area and has even been stocked with fish, to be harvested until the waters dry up in a couple of years. The lake also created thousands of hectares of farm land, much of which will remain fertile for a decade or more And El Niño-inspired research into more sophisticated early warning systems will help better predict the severity and timing of other perennial weather patterns

Parched paradise in the Pacific

While El Niño drenched Latin America with unseasonal rains, the south-west Pacific sweltered under cloudless skies. Covering more than a third of the entire planet's surface, the Pacific Ocean is a 'continent of water' up to 16,000 kilometres wide and home to around 30,000 islands and coral atolls. Many are threatened by sea-level rise, resulting from the 'greenhouse effect', which is eroding coastlines, encroaching on arable land, and infiltrating groundwater supplies. But more damaging last year than rising tides was El Niño.

As west-blowing trade winds weakened and atmospheric pressure decreased over the central Pacific, warm seas and rain-clouds moved east, radically reducing precipitation levels in the south-west Pacific. Droughts blighted many countries in the region including Australia, Indonesia, New Zealand, Papua New Guinea, Fiji and the Solomon Islands hitting hard states that rely on arable crops for domestic consumption and export revenue.

The island states of the south-west Pacific range in size from the largest, Papua New Guinea, down to Tokelau, covering just 12 square kilometres. With small economies based mostly on fishing and the export of coffee, tea, cocoa, sugar and exotic timber, these island states are highly vulnerable to the unpredictable fluctuations of global markets and climate alike. In an attempt to raise export levels, local food production has suffered, increasing

imports of processed food and pushing up costs. The islands' economies are enormously fragile and, with El Niño threatening to shatter them, are increasingly sustained through injections of foreign aid.

Some 84 per cent of people in the Solomon Islands live in rural areas at a subsistence level, surviving on traditional crops of root vegetables and fruit. Extra food is provided by pigs, chickens (which also generate cash income) and, more importantly, fishing. But most people rely heavily on the garden cultivation of kumara (sweet potato), yams, taro, pana (prickly yam), pawpaws and bananas.

Throughout 1998, the Solomon Islands experienced significantly reduced rainfall, causing widespread and severe drought. A typical casualty was Basakana Island off the northern tip of Malaita, one of the Solomon's six major island provinces. Basakana is just two kilometres long and one kilometre wide – its white sand beaches and coral reef seem the archetypal vision of a tropical island paradise. Along with most other Solomon islanders, Basakana's 380 inhabitants survive on what they can grow and harvest from the sea.

The failure of staple crops (potato and taro) planted in February and March led to a severe food shortage on the island. The government, along with non-governmental organizations (NGOs) and the Catholic church, had to initiate a supplementary feeding programme until the next harvest, in order to maintain nutrition levels, especially amongst children.

Rougher-than-normal seas, whipped up by changing climatic conditions, have added to islanders' woes by limiting coastal fishing activities and restricting access to 'main island' markets

Further to the east, Fiji – the largest state in the south-west Pacific after Papua New Guinea – has also borne the effects of an unusually severe El Niño weather pattern. Like other Pacific island nations, Fiji's economy is largely agrarian, with subsistence farming at village level still the primary means of livelihood. Tourism and sugar exports account for most foreign earnings

About 270,000 people, roughly a third of the population, have been affected by the 1998 drought. Across half the island no significant rain fell for over seven months. Many of the affected people rely almost entirely on harvesting sugar cane for their livelihood. Small-scale farmers, cane cutters and labourers, who under normal circumstances live just above the poverty line, have been badly hit, with 50 per cent of the year's crop decimated by drought. The resultant huge drop in income for these people has rendered them completely reliant on others.

The government of Fiji, already in severe financial difficulties, is finding it hard to cope. Support has come from, among others, the Red Cross/Red Crescent and the US and Japanese governments. This will need to continue for the foreseeable future until crops have been re-established.

Fire and frost in Papua New Guinea

Papua New Guinea features some of the most rugged terrain on earth. Its widely dispersed population lives in often very isolated communities and speaks over 700 languages and dialects. A land of earthquakes, volcanoes, floods and mudslides, Papua is no stranger to disaster. But, with the notable exception of a devastating tsunami in July 1998, events in this part of the globe do not command worldwide attention

By September 1997, the island was in the grip of its severest drought this century. Worse still, El Niño's clear, cloudless skies brought heavy frosts at high altitudes, which killed off all the top growth of cultivated sweet potatoes and natural vegetation such as cane grasses and trees. Freezing ground temperatures damaged buried tubers and made them unfit to eat. Replanting under these harsh conditions was fruitless, because although sweet potatoes can survive a single freeze, repeated frosts over a period of weeks will halt their growth for up to a year