What was not destroyed by drought or frost became a fire-risk. Cash crops, commercial plantations, gardens, homes and extensive areas of natural vegetation were consumed by widespread bush fires across the highlands. By early 1998, an estimated 650,000 people were at risk from starvation or disease. Many had migrated from the stricken mountain regions to the lowlands and quickly fell victim to malaria, against which they had little natural immunity

In February, rain returned and in many areas farmers began replanting the staple sweet potato. But this is a slow-maturing crop, so supplementary food supplies had to continue, as did distribution of seeds and seedlings more resistant to frost and drought.

A common thread runs through Pacific island nations: they are small and cut-off, with fragile, undiversified economies and populations which rely largely on fishing and subsistence agriculture for their livelihoods. Small-scale market-gardening of crops like taro, sweet potato and yams, combined with fishing, is pivotal to the existence of most inhabitants.

El Niño has had a profound effect on these communities Drought has led to severe crop failures among peoples with very few alternatives to their subsistence lifestyle. Add to this the localized effects of frosts and adverse sea conditions and the past 12 months have wrought considerable suffering.

In the past, traditional cropping methods have coped, more or less, with El Niño. But the 1997-98 event was particularly severe, pointing the way for a dramatic rethink of agricultural practices in this part of Oceania. Diversification of crops, however, cannot be achieved by Pacific states alone. Most rely heavily on foreign aid and cannot by themselves sustain their citizens when times are hard. The goodwill of developed countries is needed to provide the finance, and in some cases the expertise, to help establish El Niño-proof systems of agriculture able to cope with accelerating climatic changes. For the south-west Pacific, the El Niño of 1997-98 has served as a warning and one that must be heeded if similar consequences are to be avoided in the future.

Floods and droughts afflict Africa

El Niño may be born from the waters of the Pacific, but its global effect on precipitation and temperature anomalies severely threatens Africa's agrarian regions and subsistence farmers And the droughts and floods it brings can be deadly for the continent's millions of nomads, refugees and displaced people.

Southern Africa has suffered some of its worst droughts and subsequent famines during El Niño episodes. Drought related to the 1982-83 El Niño cost nearly one billion dollars in direct damages, with another US$ 350 million spent on famine relief (1983 prices).

In 1991-92, El Niño-induced drought over much of southern and eastern Africa threatened 30 million people with malnutrition. Kenya was forced to import grain for the first time in nearly a decade and southern African grain imports increased overall from two million to seven million tonnes. The economic loss to Africa's agricultural sector was estimated at a staggering US$ 7 billion (1992 prices) – twenty times the value of 1993 World Bank loans to sub-Saharan agriculture. But the toll on human life was even worse. Drought-related famine in Somalia claimed an estimated 500 to 1,000 victims each day. Djibouti, Ethiopia and Kenya also suffered heavy casualties.

As early as October 1997, meteorologists forecast severe El Niño-generated drought across much of southern Africa. Zimbabwe and other previously affected nations set aside funds for expected food imports. Farmers planted drought-resistant crops and conserved seed and water – but heavy rains in January 1998 dispelled their fears. Even so, Namibia's total harvest fell nearly a third from 1997 output and Zambia's maize crops slumped.

Despite southern Africa's comparatively good fortune during the 1997-98 event, the Horn of Africa experienced heavy, unseasonal rainfall from October 1997 to January 1998, causing floods that displaced at least 1.5 million people and affected nine million more.

Flooding along the Juba and Shabelle river valleys in Somalia claimed around 2,000 lives and damaged 60,000 hectares of agricultural land. Thousands more fell victim to water-borne disease. Floods ruined the harvested crops and next season's seed, which Somalis traditionally store underground. And thousands of animals drowned or starved for want of fodder, threatening the very existence of families who would normally sell their livestock to cope with sudden crisis.

Roads, railways and irrigation systems throughout the Horn were severely damaged. The World Food Programme (WFP) had difficulty shipping food to intended recipients and was forced to use more costly air transport. Damage to transportation infrastructure impeded shipments of exports not just from the affected regions, but also from inland countries (e.g., Uganda) to coastal areas.

In Sudan's North Darfur state, farmers and nomads used to battling against drought were drenched with up to 91 millimetres of rain a day. Kenya's coast and north-east experienced the worst floods in nearly 40 years – killing 60 per cent of the region's cattle. Torrential May rains in Tanzania's capital, Dar es Salaam, claimed 4,000 lives, and in Ethiopia floods inundated 30,000 hectares of land and swept away 10,000 animals. In all, over 15,000 east Africans died as a direct result of El Niño-related floods and disease – amounting to nearly three-quarters of the total global death toll.

But why didn't El Niño bring drought to southern and eastern Africa, as it did in 1991-92? The phenomenon's effect changes with the variability of its strength and timing, especially in relation to seasonal rains. And the relationship between its fluctuations and the weather of higher and lower latitudes is never linear. Local climate variations also affect regional weather. "During 1997 and 1998, the Indian Ocean was abnormally warm," reveals Kelly Sponberg of NOAA. "This may well have influenced climate variability over parts of Africa. Was the Indian Ocean abnormally warm because of El Niño? Or was El Niño aggravated by abnormal Indian Ocean sea-surface temperatures? They are connected, but no one really knows which influences the other more, or if there is feedback within the system."

Direct attribution of epidemics to El Niño phases is complicated by factors like local nutrition, prior concentration of the pathogen in host populations and natural population cycles. But the 1997-98 event bears a lot of the blame for epidemics accompanying the Horn floods. Rift Valley fever affected nearly 90,000 Kenyans and Somalis – an epidemic so severe the Saudi government banned imports of animals from Horn countries. Worse still, cholera is now endemic to eastern Africa and the Horn – in Kenya, Tanzania and Uganda, around 100,000 cases and over 5,000 deaths were reported last year.

So marked is El Niño's effect on Africa that much attention has been focused on using climate information to help save lives, promote food security, manage land more effectively and improve energy production. Drought in sub-Saharan Africa is predicted by the United Nations' (UN) Food and Agriculture Organization's FEWS (Famine Early Warning System) which issues monthly bulletins on rainfall, food production and vulnerability forecasts. Prior to and during the 1997-98 El Niño, a series of climate-outlook forums was convened. Mainly designed to provide a consensus forecast of seasonal rainfall and temperature, the process (led by the Southern Africa Regional Climate Outlook Forum and similar groups from the Horn and western Africa) provided a regional framework for coordinated production, dissemination and interpretation of forecast information.

Compound disasters demand comprehensive solutions

Floods, forest fires, droughts and disease resulting from 1997-98's El Niño have claimed the lives of over 21,000 people worldwide. The World Bank estimated global damage costs may surpass US$ 8 billion and the bulk of that was in South America. The Worldwatch Institute in New York billed international economic losses at US$ 89 billion. Parts of the eastern Pacific rim may take five or six years to rebuild completely and return to pre-El Niño production levels. But that could be too slow, since the phenomenon can strike every two to

three years – so those areas recently hit could suffer from two more El Niños before they completely recover from the 1997-98 event.

Throughout the world, the latest El Niño has contributed to 'compound disasters' in which natural catastrophes shatter societies already flawed by inherent economic and political fault lines. In Peru, El Niño's floods inflicted production and transportation problems on a mining sector already reeling from lost revenues as metal prices plummeted during the Asian economic crisis. Consequently, Peru's trade gap ballooned, hurting wages, shrinking consumer spending and resulting in a banking and currency crisis that plunged the economy into recession.

Elsewhere, compound disasters were even more pronounced. In Indonesia, economic crisis was aggravated by El Niño-driven drought which precipitated food shortages, desperate hunger and persistent, widespread air pollution from rampant wildfires. This contributed to such popular discontent that the nation's 30-year old government eventually collapsed (see box 6.2). Many economists point to this chain of events as a catalyst for recent world economic turmoil. In Papua New Guinea, unseasonally cold weather, drought and highland fires associated with El Niño destroyed the country's main crop, wreaking havoc on its undiversified economy. A huge tsunami – or tidal wave generated by a submarine earthquake – compounded Papua's problems by devastating coastal areas and leading to pronounced political unrest. A recent World Bank analysis reported that "this country is a hopeless case with no hope for recovery."

So what can be done to mitigate the effects of future El Niño/La Niña phenomena? The international NGO CARE recognizes that compound disasters of the kind seen in Indonesia mean agencies must face "the challenging issue of integrating relief, rehabilitation and development – sometimes within the same district – into a coherent overall strategy." In practice, this involves meeting immediate needs while protecting and strengthening longer-term livelihoods. Many families sold seeds, livestock and even land to stay alive – threatening themselves with destitution. CARE implemented labour-intensive food-for-work and cash-for-work projects to improve basic infrastructure and generate the income families need to survive without selling off their most precious assets.

Box 6.2 Indonesia: a year of living dangerously

The latest El Niño was the strongest ever recorded in Indonesia, inflicting the country's worst drought in half a century. Rice yields plummeted, prompting imports totalling 5.1 million tonnes. Economic crisis had devalued the rupiah by almost 80 per cent, pushing up the price of imported rice to four times pre-crisis levels. Blazes begun by traditional slash-and-burn agriculture raged out of control in Sumatra and Borneo when the rainy season, which normally puts them out, never arrived. And popular discontent with the government's indifference or inability to fight fires and feed the nation contributed to widespread riots and unrest.

The political crisis climaxed on 21 May 1998 when President Suharto resigned from office after 32 years in power. By July, weather systems had reversed and La Niña began to unleash heavy rains which burst dams in Kalimantan, and sent flash floods and mudslides sweeping through areas denuded by forest fires earlier in the year.

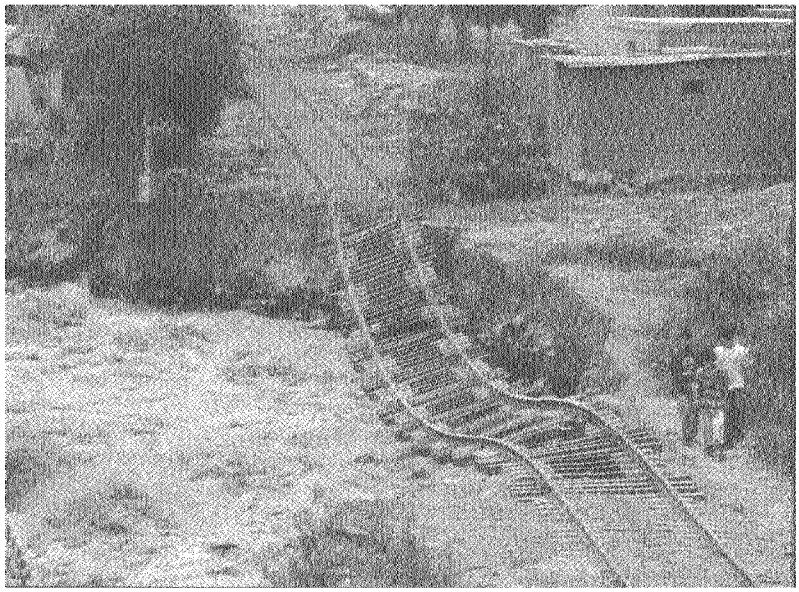
Since the Asian economic crisis struck, Indonesians have seen a dramatic turnaround in their fortunes. From a steadily rising standard of living, many of the new middle classes have slipped back into poverty – defined as a daily income of a dollar a day in urban areas and 80 cents elsewhere. Unemployment soared as 15,000 Indonesians a day lost their jobs, according to International Labour Organization figures. Millions of urban unemployed struggled to fend for themselves and many families throughout the archipelago could afford no more than one meal a day. By August 1998, 1.5 million families were dependent on international assistance to stay alive. Many banks and companies closed down. Inflation reached 65 per cent, and by February 1999 interest rates were still over 70 per cent.

Much now hangs on the June 1999 elections – the first multi-party elections in Indonesia for 40 years. But a deadly cocktail of natural disasters mixed with economic and political crisis has seriously sapped this Asian tiger's strength.

In autumn 1997, the UN, alarmed by the unusual strength of the latest El Niño and its anticipated development, established an El Niño Inter-Agency Task Force of all specialized UN agencies concerned with natural disasters. Within the framework of the International Decade for Natural Disaster Reduction (IDNDR 1990 to 2000), the task force worked during 1998 to ensure concerted action on El Niño, and contributed to a scientific review of the phenomenon at a conference in Guayaquil, Ecuador.

Disaster-resilient infrastructure

The IDNDR has highlighted disaster-resilient infrastructure as one important requirement within integrated disaster prevention planning. Hospitals and other medical buildings, roads and bridges, water reservoirs and supply facilities, communication lines, port installations, airports and similar infrastructure are crucial for ensuring basic services before, during and after a natural disaster. Fragile infrastructure increases vulnerability and risk. And its destruction exacerbates disasters and increases rehabilitation costs severely. "Development programmes must insist on an extra ten per cent to make key roads and bridges storm-proof, otherwise when the next El Niño hits, things will just get worse," said Wolfgang Wagner of the IDNDR.



Peru's economy was set back years by El Niño floods – infrastructure was badly damaged, fishing output fell 96 per cent, slumping agriculture forced the country to import key food products, and confidence in the government plummeted from 72 per cent to 18 per cent. *Alejandra Brun/AP Peru 1998.*

John Rogge of the UN Development Programme's Emergency Response Division argues that, despite previous experience and clear scientific warnings, nations did not respond quickly enough to the latest El Niño. This reveals disconnections between the high-tech world of climate scientists, the political/humanitarian arenas of governments and aid agencies, and the community level where much disaster preparedness must begin. One key way of bridging these gaps, suggests Rogge, is to create or strengthen a national disaster management authority in every highly vulnerable country. Ideally this authority should answer directly to the president or prime minister, so that it can coordinate the roles of other ministries – including defence, public health, education, civil defence and transport – within the framework of a national disaster management plan. "It is not so much a question of disasters becoming more frequent", says Rogge, "but rather of ever-more people becoming more vulnerable by having no choice but to live in high-risk areas."

Speaking at a forum in February 1999 on post-Hurricane Mitch reconstruction, Eduardo Stein Barillas, minister of foreign affairs for Guatemala, argued that in addition to international aid, the private sector is a key actor in long-term reconstruction: "All destruction carries with it an opportunity for foreign investment," he said. Caio Koch-Weser, managing director of operations at the World Bank, speaking at the same forum, stressed the importance of adopting a culture of prevention in development programmes. He suggested the World Bank should rate countries by their disaster preparedness to provide an indicator for reinsurance companies.

But insurance density is still minimal in developing countries. The ice-storm which paralysed south-east Canada and parts of the northern US in January 1998 caused economic losses totalling around US$ 2.5 billion, of which 46 per cent was covered by insurance. In Peru, the 1997-98 El Niño caused public infrastructure losses of US$ 2.6 billion, of which just US$ 150 million was insured – less than six per cent. One solution to address this imbalance would be for governments of El Niño-threatened nations to pool risks and premiums with the insurance industry in order to offer poorer people affordable cover

Disaster prevention, preparedness and recovery measures, drawn from the organizations mentioned above and others, range from community to international initiatives and include:

- using early warning systems to forecast the severity of imminent El Niños in time to prepare;
- mobilizing political will to act on scientific predictions and prepare for potential disaster;
- creating or strengthening national disaster management authorities;
- developing appropriate disaster prevention, preparedness and coping strategies at regional, national and community levels;
- assessing the location, threat and return period of natural hazards;
- mapping areas and populations vulnerable to natural hazards;
- building stronger infrastructure to withstand the effects of severe weather;
- improving roads and evacuation routes,
- strengthening water and sanitation facilities, and building public awareness to combat the spread of contagious diseases;
- reversing environmental degradation, including deforestation;
- passing land-use planning and zoning laws to limit dangerous population concentrations;
- developing drought-, flood- and cyclone-resistant cropping patterns;
- food- and cash-for-work projects to improve local infrastructure and incomes;
- reforming the insurance industry to help cover private-sector damage more adequately;
- enabling private-sector and foreign investment to participate in long-term reconstruction;
- diversifying economies to reduce reliance on weather-dependent industries; and
- linking debt-relief to disaster preparedness and sustainable development measures

Scientists spot El Niño six months in advance

For the first time ever, the latest El Niño and its accompanying droughts and floods were predicted by scientists up to six months in advance, giving countries like Peru time to prepare

Remote early warning systems were put in place after the severe 1982-83 event took the world's scientific community by surprise. NOAA anchored 70 buoys across the equatorial Pacific to help predict future El Niños. Known as the TAO (tropical atmosphere-ocean) array and completed in 1994, the buoys measure surface air and wind conditions, and sea

temperatures to a depth of around 500 metres. Combined with data from the French-American TOPEX-Poseidon satellite, which monitors ocean circulation and sea-levels, climate scientists are better informed than ever before. NOAA estimates that improved long-range forecasts could save producers and consumers in the US alone between US$ 240 to 324 million every year. Nevertheless, accurate forecasting of specific effects remains problematic. As Giovanni Rufini, coordinator of the Brussels-based Voluntary Organizations in Cooperation in Emergencies (VOICE), points out, "Several predicted droughts have instead turned out to be floods", although he agrees continued development of such systems is "vital".

Over the next three years, a British university is launching a new remote-monitoring system in the Pacific. Called the Argo programme, it employs a series of floats which, by using deflatable bladders, will dive to depths of 2,000 metres every two weeks, take readings on ocean currents, sea temperature and salinity, and return to the surface to transmit their data back by satellite. The programme will help solve one of the key problems facing scientists trying to predict future El Niños: lack of baseline data. Scientists can then feed the data into supercomputers which create climate models capable of predicting anomalies in temperature and precipitation up to a year in advance – a technique now more accurate than traditional statistical analysis.

Lack of monitoring devices in the Indian and Atlantic oceans still hampers forecasts for Africa and South America. However, the Global Ocean Observing System (GOOS), set up under the auspices of the Intergovernmental Oceanographic Commission (IOC), based at UNESCO in Paris, will eventually cover these areas.

But there is far more to disaster preparedness than simply advance warning. More sophisticated early warning systems and advance planning are crucial – but remain useless if governments lack the political will to act on the information.

The commodity-driven economies of the developing world are less equipped to withstand the effects of natural disaster because their small industrial bases are usually centralized and economic production tends to rely on raw processes like agriculture, mining, fishing or lumber – sectors exposed to the effects of severe weather. Diversification of economies could insulate nations from the economic turmoil that often accompanies weather-related hazards like El Niño. And it would foster the kind of development needed to help prise populations out of poverty.

But diversification should include inter-regional integration to help share the fallout from El Niño's effects. During the 1997-98 event, for example, seas off Ecuador and Peru warmed up so much that vital stocks of sardines and anchovies moved south to cooler, richer waters – and Chilean fishermen enjoyed a bumper catch at the expense of their northern neighbours. Meanwhile, vast quantities of shrimp spawned in the milder seas off Ecuador, but the country could not capitalize on the change because its roads, ports and infrastructure were so badly damaged by El Niño-driven storms. And while Ecuador lacked the expertise to process shrimps, suitable facilities in neighbouring Colombia and Central America languished underused. One solution would be to develop a system of balancing out regional gains and losses. As Hernando Dicho Vasquez, a Peru-based disaster preparedness consultant, points out: "The economic problems would be more limited if governments found a way to look beyond their borders for solutions."

El Niño dictates political agenda

Returning to Trujillo, the direct effects of El Niño had waned by the end of 1998. President Fujimori had circumvented damaged transportation systems by requisitioning naval vessels to move vegetable produce and other perishables from Peru's northern coast to markets in Lima and elsewhere. Major highways near Trujillo had been patched or re-routed and key bridges connecting the city to the south of the country had been rebuilt, though some with

only temporary replacements. Citizens had grown used to the changes – adjusting journeys to avoid the worst-damaged roads, and boiling drinking water to kill the water-borne bacteria that had caused so much disease during El Niño's peak.

But economists say the legacy of El Niño-related damage will linger for years. "These rebuilding efforts divert resources, affect the well-being of citizens and hurt confidence in the country and government," said Lima-based economist Jorge Gomes, a former government minister. That worries President Fujimori and his controlling *Cambio-90-Nuevo Mayoria* political party. Early indications suggest Fujimori will stand for an unprecedented third term as president in 2000. If so, his task will be made doubly difficult by approval ratings that took as much of a pounding from El Niño as did his battered nation. Almost daily, local media run stories outlining the aggressive post-El Niño strategy the government is using to help spark recovery and win back the favour of the electorate. Pollsters insist that for that strategy to work, Peruvians will have to forget the government's slow initial reactions to El Niño and focus instead on its activities since then. "It was only when the water was up to our necks that government officials started paying attention to what we said," complained Jose Aguilar, mayor of the coastal city of Piura, one of the worst-hit cities in Peru. "If there is a good side to all of this, it is that governments in the future may remember how much people suffered. Maybe they will not let this happen again."

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