Box 2.2 Community-operated early warning in Guatemala

Spanning an area of 900 square kilometres, the Coyolate River basin encompasses both volcanic highlands and fertile coastal plains. The upper basin is planted with coffee, and the middle and lower basins with sugar cane, African palm and bananas. The river has flooded several rural towns in the flood plains on a yearly basis, prompting Guatemala's national emergency council to seek resources for flood-plain risk reduction. The resulting project began in 1997 with support from the Swedish International Development Agency (SIDA) and involved designing and implementing a community-operated early warning system, along with other risk management measures.

Early warning is the first line of defence against natural hazards, especially floods. The early warning system was designed to involve at-risk communities in all aspects of its operation. Plastic rain gauges to monitor rainfall and simple electronic instrumentation to measure river levels were installed throughout the basin. The project established local emergency committees, selected community volunteers, and trained them in early warning through simulation exercises. The project also helped communities to develop hazard maps, establish emergency plans, create specific committees to deal with search and rescue, shelter management and security, and maintain and extend dykes to prevent floods.

Community volunteers now use these simple instruments to transmit information on rain and river levels, via a solar-powered radio network, to a local forecasting centre. The centre, staffed by members of the local emergency committee, is then able to forecast floods two to three hours in advance and initiate emergency preparations. If serious flooding is imminent, the committee may issue alerts using sirens, bells or a public-address system.

Since its inception, the Coyolate early warning system has benefited more than 5,000 inhabitants in around 100 flood-prone communities. It proved its strength during Hurricane Mitch in 1998, when the flood information it provided to authorities helped save dozens of lives. The cost of setting up such a system starts at around US$ 50,000, depending on the scale of the project. That's about a quarter of the price of the cheapest telemetric system, which measures rainfall and river levels using sophisticated stand-alone instruments.

All community-operated early warning systems are based on three pillars: voluntary community observers with the necessary tools, training and continued institutional support; simple, practical instruments to measure rainfall and river levels, supported by a radio network and sustained by the national emergency management institution; and recognition by that institution that risk management and disaster response can initially be handled at a local level.

The key point with all community-operated early warning systems is to ensure they are implemented with the full support of the national emergency agency, which must continue to support the system once the set-up phase is finished.

Coyolate's success has led to similar systems being developed throughout Guatemala and Central America. There are now more than 20 community-operated early warning systems in watersheds throughout the region, most of which have been implemented since Hurricane Mitch. ■

are warned and know what to do. In Cuba, effective civil defence planning and dissemination of information through state-run media allowed the country's evacuation procedures to be activated in the hours before Michelle struck. Few such systems were in place three years before in Central America when Mitch hit, but some communities had devised their own systems.

Jorge Ayala of the Centre for the Prevention of Natural Disasters (CEPREDENAC), a regional organization based in Panama, cites a flood-protection project on the Coyolate River in Guatemala (see Box 2.2). Towns along the river got together in the mid-1990s to map flood hazard zones, build shelters and monitor river levels. The first alarm is triggered by rainfall gauges in the mountain headwaters. It alerts communities in the upper reaches of the river to check river flows. Then, as flows reach danger point, communities downstream are alerted to head for the shelters.

Soon after the Coyolate system was established, Hurricane Mitch came along. The project, which cost little to install, probably saved dozens of lives. While almost 300 people died in floods along other rivers in Guatemala, on Coyolate "there was no loss of life...during Mitch, because the people downstream were successfully evacuated before the floods hit," says Ayala. As a result the charity CARE USA has funded similar community schemes along several more flood-prone rivers in Guatemala.

It sounds simple, but such basic monitoring and communication systems for the natural environment remain rare in Latin America, because of the level of social and political organization needed to establish and maintain them. Ayala makes the point that these community-based early warning systems must be recognized and supported by the national emergency agency or civil defence. Without this integration of local and national levels, community-based disaster preparedness will prove less effective and harder to sustain.

Predicting El Niño, the climatic flip in which unusual weather spreads east across the tropical Pacific from Asia, is broadly possible months ahead. Many countries have mapped areas likely to be hit by floods and droughts. But they are often less clear about what to do with this information. In late 2001, leading climate agencies such as the United States government's National Oceanic and Atmospheric Administration (NOAA) had warned of a local impending El Niño. But on the face of it there was little planning going on. In Panama, for example, the local Red Cross said that there were no special emergency plans. "We will wait until it happens," said José Beliz in Panama. Similarly in Peru – where El Niño caused more than US$ 2 billion in damage to fisheries, crops and infrastructure in 1998 – the argument was that, while clearing up from a major quake was real, "right now El Niño is only a probability," said the Red Cross's Richard Medina. "We have no official warning and will only act when we do."

Box 2.3 Risk mapping and relocation get political

Hazard risk mapping is an important first step in preparing societies for future natural disasters. The technique has been widely used in Latin America to identify zones at risk from floods, droughts and epidemics during El Niños. But, especially when accompanied by calls to relocate people from high-risk areas, mapping can also become an exceedingly political process. According to José Luis Rocha of the Central American University in Managua, the risk mapping that followed mudslides on Mount Casitas (which killed some 2,000 people during Hurricane Mitch) proved a money spinner for local landowners. Far from finding their land worthless, they successfully won compensation of US$ 3,000 per hectare – tens times its registered tax value – as aid agencies with plenty of money and not much time needed to relocate people.

The mapping of risk in southern Peru in the aftermath of the 2001 quake is proving a political minefield. The maps, being prepared with funding from the UN Development Programme, are "an important step to prepare for future disasters," says the provincial civil defence chief, Carlos Nacarino Rodriguez. Areas with loose soil, a high water table, suspect geology or on coastal land at risk from tsunamis have been identified as high-risk areas.

But Rodriguez admits there is widespread opposition whenever communities are asked to move, and suspicion that the authorities have ulterior motives. "Already there are complaints from the populations in these high-risk areas because the authorities won't let them rebuild," he says. And when communities oppose relocation in the aftermath of a disaster, aid agencies are left with a dilemma: help with rehabilitation and be accused of perpetuating risk, or refuse to help and stand accused of failing to prevent suffering? Two examples from southern Peru show what can happen.

The people of Catas, a small fishing and farming community where the River Tambo enters the Pacific Ocean, have been told to move. Half their village collapsed during the June 2001 quake. And geologists compiling hazard risk maps of the region say theirs is one of the most vulnerable to future quakes. Villagers are confused about exactly why. "They say the soil is cracked and sinking," says community leader Fernando Herrera. But in any case they suspect, rightly or wrongly, another motive behind why the authorities want them gone.

The village is a wreck today. The church collapsed. Of the 71 families in the village, 63 lost their homes Three people died here. Most of the survivors live in tents and are fed from a charity food kitchen in the roofless remains of the village hall. In an unexpected twist, the quake raised the local water table so that it is less than a metre from the surface, and caused salty sea water to pour into the wells. So now they drink water from tanks trucked in.

Having categorized the village as a high-risk zone in a future quake, the municipal authorities have earmarked new land nearby for resettlement. But the villagers must pay the price for it, around US$ 40,000, themselves. If they don't, the authorities warn that the villagers will not get help with rehabilitation if they choose to stay. "For us this is a big dilemma," says the Red Cross's rehabilitation coordinator Freddy Gonzalez. "If they refuse to go

to somewhere safer, should we help them? If we bring in housing modules, for instance, we would be encouraging rather than preventing a future disaster."

Herrera says they will agree to leave if the terms are right. They want to keep title to their old land. "We want to continue farming; we might build summer houses here by the sea," he says. "The trouble is the survey people say they found oil here. Some people think that is why they want us to go." Red Cross volunteers smile ruefully at the villagers' dreams and fear that, one way or another, they will be forced out just as soon as the oil derricks are ready to move in. "Risk mapping is a very political process here," says the International Federation's information delegate Fernando Nuño.

La Punta is a popular summer location for Lima's classier holidaymakers. The tsunami hit minutes after the June 2001 quake shook the continental shelf off southern Peru. The giant wave, some ten metres high, was triggered by the offshore tectonic shudder and swept towards the coast. It washed over the seafront and destroyed most of La Punta's buildings. It didn't stop until it hit the cliffs a kilometre inland.

Luckily it was winter. About 60 people died, mostly watchmen and their families, plus some farmers living close by on the coastal plain. "If it happened in summer, 8,000 to 10,000 would have died here," said Red Cross volunteer Carlos Franco, surveying the broken buildings and watching a handful of men who had returned to build the chalets, bars and brothels on which their income once depended. Watchman Raul Rojas stood beside the only thing left from his house, one block from the beach – a porcelain toilet bowl.

While Rojas has stayed behind in the ruins of La Punta, most of the permanent residents have gone. They now live on a deserted hillside eight kilometres from their old homes. Almost all of them are women and children living near the roadside in tents, most of them former farm labourers and maids of the holiday homes and hotels. This refugee encampment is called Alto Cerillo. "We are too scared to go back to our old homes, especially the children; we will never return," they said. Up here they have no permanent homes, only a weekly tanker to provide water. They lack access to schools or jobs or churches or markets, and are entirely reliant on food aid.

Are these people expected to stay here? "It's a temporary place till we find an appropriate permanent relocation," civil defence chief Rodriguez said. But city officials said the settlement was permanent. "The city is expanding. Eventually it will come out to meet them," said Alfredo Mezo of the charity Caritas, which is helping them.

Again the suspicion is that some of the land from which people have been removed "in their own interest" is being slated for new resort developments. Certainly the provincial mayor Enrique Gutierrez did not back up Rodriguez's claim that everybody should leave the resort zone because of its high-risk designation. The council won't help rebuild the homes of the poor who lived there, but nor will it stop the rich rebuilding. "We are not going to think that way," said Gutierrez.

Are the refugees really better off camped up on the hill rather than down on the shoreline? Mezo shrugs. "It doesn't really matter. Their homes are destroyed and their jobs are gone. This is their new life." ■

Some believe this is not an unreasonable strategy, but José Aquino of CARE in Lima takes a different view. "Last time, we had a lot of problems getting materials, especially medicines to cope with epidemics, to the flooded zones because the roads were obstructed." The approach may need to be different depending on whether the likely impact is flood or drought. While floods happen suddenly, droughts have a cumulative effect more resembling a socio-economic crisis than a conventional natural disaster. Aquino's concerns may be justified – in late March 2002, NOAA's administrator warned that "the Pacific Ocean is heading toward an El Niño condition". Meanwhile Peruvian officials said anchovies normally present in Peru's cold coastal waters were being replaced by tropical species – a classic response to El Niño conditions.

Quantifying risk

Risk mapping is an increasingly popular activity among civil defence planners. The idea is to identify places most in need of preparedness for disasters. And, in the worst places, to relocate communities. But what risks do you map, and how do you quantify risk? Three examples from Peru illustrate the point.

All around southern Peru, geologists have drawn up detailed maps of earthquake risks in the aftermath of the 2001 quake and the coastal tsunami that accompanied it. But for a lucky accident of timing, thousands could have died in the tsunami that struck the southern Peruvian resort of La Punta after the quake in June (see Box 2.3). The new risk maps now designate the resort a high-risk zone. But while quakes in the continental shelf off the Peruvian coast do occasionally cause tsunamis (the last hit this area of coast in 1873), these events are quite localized. There seems little basis for saying that this resort is any more at risk than any other low-lying stretch of the country's coastline. If La Punta is abandoned, maybe the whole coast should be.

But while tsunamis seem to attract undue attention, volcanic eruptions are largely ignored. The biggest city in southern Peru, Arequipa, sits in a valley surrounded by three large volcanoes. Locals say that one of them, El Misti, has been smoking regularly since the seismic convulsion that caused the quake. Could it be about to "blow"? It is 500 years since the last major eruption. According to vulcanologists at Indiana State University, it remains a "considerable hazard" to the city, which has extended up valleys that would carry any lava flow. A major eruption would not only rain debris and lava on Arequipa, it could also break a major hydroelectric dam on its slopes and unleash a tide of water on the city. Yet according to civil defence chief Rodriguez, El Misti does not feature in the risk mapping. "We don't have a plan for that. But maybe we will," he said.

Equally out of fashion is concern about the risk of floods and mudslides from glacial lakes high in the Andes. Back in 1970, in one of Peru's worst-ever disasters, a lake

of melt water which formed at the foot of an Andean glacier burst its banks after a small earthquake and rushed down a mountain valley, engulfing an estimated 60,000 people, half of them in the town of Yungay.

After 1970, Peru's leading hydroelectric company, ElectroPeru, began to survey most of the country's glacial lakes. In 40 cases, it has employed engineers to siphon off the water from potentially dangerous lakes. But five years ago, says glaciologist Cesar Portocarrero, it stopped the work, arguing that it was a government responsibility. "This is really dangerous. With global warming rapidly melting the country's glaciers, the risks of a new disaster are rising. New lakes are forming all the time. We no longer have them mapped, so the risk of another big disaster grows all the time." One high-risk area, he believes, is among the glaciers around Salkantay mountain near the Inca ruins of Machu Picchu. Luckily no lakes burst there during the 2001 quake.

Furthermore, the mapping exercises that are carried out tend to focus solely on hazard risks, but are blind to the other socio-economic factors which influence the potential effects of disasters. Quantification of risks is not complete without assessing both the vulnerabilities and capacities of those populations exposed to natural hazards.

Culture of risk reduction

Unfortunately, disaster mitigation and preparedness are in many ways still the "poor relations" of the aid world – neglected and under-resourced. But in a region where thousands lose their lives every year to recurrent disasters, where El Niño damage can regularly cost countries 10 per cent of their gross domestic product and where catastrophes such as Mitch put back economic development by 20 years, nations badly need more sophisticated coping strategies for disaster.

Reducing the deadly effects of disasters in Latin America has two aspects – one longer term, one shorter term:

- **Build risk reduction into every development plan and policy.** This long-term priority will reduce vulnerability to disasters great and small. Simply championing economic development and poverty reduction is not enough. Development may sometimes exacerbate disasters – by degrading the natural environment, for instance, or moving people from quake-proof shanties to quake-vulnerable high-rise apartments.
- **Invest more resources now into disaster preparedness.** Ensuring development policies are more risk resilient will take decades – but disasters will continue to hit the region every year. More investment in disaster preparedness initiatives is urgently needed in the short-term, to ensure all exposed communities are less vulnerable to disasters. Priority measures – often very inexpensive – to improve disaster preparedness include: risk and vulnerability mapping, disaster awareness

and education, early warning and evacuation systems, stockpiling relief materials, training in response skills, and planning from community to national to regional levels to ensure sound coordination of disaster response.

The example of Hurricane Michelle shows that protecting citizens from disaster has more to do with political will and good organization than with material wealth. "Cuba has lessons for the rest of us," argues Ben Wisner, because of its "investment in basic needs and social capital such as the training of neighbourhood activists [and] scientific capacity such as Havana's weather institute and public health services."

Disasters undermine social and economic development. To ignore the chance to invest more in disaster preparedness is to fail gravely those at risk, and will undermine their efforts to fight their way out of poverty.

A culture of risk reduction needs to cut across the activities of both the disaster and development professions, as well as vulnerable communities and their governments. Riches alone won't save anyone from disaster. Yet you can be poor and still be well informed and well prepared.

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