CHAPTER 3

Early warning, early action: bridging timescales

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In the face of rising risks and rising uncertainties, effective early action is more important than ever. What the examples below will show is that such early action works best when it spans a range of timescales, not just providing a more rapid response to a disaster, but also anticipating it days, hours, months, years and even decades in advance, and over time reducing the risk of a range of hazards. That bridging of timescales is the key to early warning and early action: "routinely taking action before a disaster or health emergency happens, making full use of scientific information on all timescales" (International Federation, 2008).

This chapter shows how information on all timescales can inform such early action and highlights challenges in putting longer-term early warnings to use. Those challenges are being overcome. Practical early action, based on early warnings at all timescales, does pay off, reducing risks and saving lives.

A growing knowledge base for early action

Action on all timescales is possible, informed by an ever-growing range of early warnings. Global computer models and satellite images, regional centres of expertise, national meteorological offices and other government agencies, local field reports and community observations – they all allow us to better understand what risks are appearing, and what is likely to happen given what we have learnt so far. This allows us to anticipate a wide range of threats much more effectively than before. At the shortest timescales, a warning of an impending storm can help us to evacuate ahead of the disaster. At intermediate timescales, a seasonal forecast based on El Niño may give us a 'heads up' that the upcoming storm season could be particularly severe or that a continuing drought could result in food insecutity. At the longest timescales, future climate change scenarios, along with other trends such as urbanization, environmental degradation and population growth, present an early warning of rising risks.

However, no early warning has any effect without early action. Numerous examples illustrate how reliable information about predicted hazards was not sufficient to avert a disaster, including rapid-onset events like Hurricane Katrina in the United States, as well as slow-onset ones such as the food crisis in Zimbabwe (see Chapter 5, Box 5.3).

With the shortest timescales, a key example of early action is evacuation, removing people and assets from threatened areas. In some cases however, such as Cyclone

Photo opposite page: Some of the worst floods in decades affected Ghana in 2007. Although the floods were forecast, no early action was taken. Here, Ghanaians have to wade across a flooded river, carrying their bikes, to reach the market.

Nargis, evacuation is hardly an option, given not only the topography and the large distances involved, but also the lack of evacuation logistics (transport and planned locations for evacuation, for example) and the local infrastructure. This brings us to the actions on longer timescales – that is, to prepare for an effective response on the shortest timescales and to reduce risk by enhancing the reliance of communities and societies. Over years or even decades, such disaster risk reduction may include adjusting development plans and establishing, upgrading and enforcing land zoning, building codes and infrastructure standards, but also working closely with local communities to assess and address the risks they face – particularly when these risks are rising. Depending on the type of risk and local circumstances, many risk reduction measures can be taken, ranging from planting trees to reducing the occurrence of landslides, to disease awareness and prevention campaigns, to water harvesting and storage systems to cope with periods with little rain. In terms of disaster preparedness, early action also includes updated contingency planning, logistics and volunteer mobilization.

Early action to reduce risk also covers all levels. At the most local level, a household can store food in higher places with the onset of a flood or, on a longer timescale, construct a house on stilts. Likewise, a farmer can conserve water or plant drought-resistant crops in anticipation of drought conditions. Simple brochures, such as the *Safety at home* and *Safety in the community* materials distributed by the American and Bulgarian Red Cross, are very effective in helping people to protect themselves and their family in times of disaster, and similar information exists for use in schools and the workplace. Basic public health education also saves lives (see Boxes 3.1 and 3.2) and related programmes lead to early action (see Box 3.3).

Box 3.1 Disaster risk reduction: listening to the voices of children

When floods, hurricanes, earthquakes and other disasters strike, it is often children with their fragile bodies and minds who are most vulnerable to death and injury, and to the traumas of separation and abandonment if family members are scattered or killed. They are especially vulnerable also to the longer-term effects of disasters, such as intensified poverty, hunger and disease.

On average, children make up more than half of all people requiring immediate help in crisis situations, and the international child rights and development organization Save the Children estimates that around 175 million children a year will be affected by disasters over the next decade (Save the Children, 2008).

Many countries recognize this special vulnerability of children, and now include teaching about natural hazards and disaster preparedness in their school curricula. About 40 per cent of countries responding to a United Nations survey at the World Conference on Disaster Reduction, held in Kobe, Japan, in 2005, said that they provided such education. There are also many stories of children taking the initiative in helping their families when crises happen because of what they have learnt in school (see Box 3.2 on earthquake drills in Iran).

Take, for example, Tilly Smith, an 11-year-old schoolgirl from the south of England who was on holiday with her family in Phuket, Thailand, when the tsunami struck on 26 December 2004. Having learnt about tsunamis in geography class just two weeks previously, Tilly, who was on the beach with her mother, father and sister, recognized the 'sizzling' froth on the surface of the sea as a danger sign and urged her family to leave immediately. Her father relayed Tilly's warning to the lifeguard who cleared the beach before the waters began to rise. Everyone who had been on that particular stretch of shore survived, and Tilly gives credit to her geography teacher. "If it wasn't for Mr Kearney I'd probably be dead and so would my family. So I'm quite proud that he taught me that at the time he did," she says. Education can make the difference between success and failure, and sometimes life and death, says Andrew Kearney, and there is no substitute for it. "Without education people are powerless; with education, as can be seen here, they are very powerful in terms of directing their own lives" (UNISDR, 2005).

Besides national efforts, there are some highly imaginative international programmes aimed at raising awareness among young people about natural hazards. One example is an educational kit developed jointly by the United Nations Children's Fund and UNISDR, which includes a board game, *Riskland* (UNISDR, 2004). By answering questions about hazards, players advance along the winding paths on the board and pick up information about how to reduce those hazards along the way. The kit can be adapted to reflect local conditions and is already available in six languages, including Haitian Creole and Nepali, with 15 more language versions in the pipeline.

Another innovative programme is GLOBE (Global Learning and Observation to Benefit the Environment), a worldwide community of teachers, schoolchildren and scientists, connected via the internet. Launched in the United States in 1995 with the key aims of enhancing "environmental literacy and stewardship" and inspiring "the next generation of scientists", GLOBE now involves more than 20,000 schools and 40,000 specially trained teachers in 110 participating countries. Using materials developed by GLOBE for classroom and field activities, pupils and teachers collect data for international research projects identified by scientists, who act as mentors. Since 2001, for example, schools in the Canadian Arctic, where the effects of global warming are particularly dramatic, have been monitoring the weather and the state of the snow and ice, as well as timing the seasons by events such as bud burst and the first hatching of insects. The children are encouraged to talk to hunters' and trappers' associations and to share whatever they find out with their communities as well as supplying the data to climate scientists.

Starting in 2011, GLOBE will run a special campaign on climate change and hopes to draw in 1 million schoolchildren worldwide, with a key aim of empowering them and their communities to take action on climate-related environmental issues. However, since the 2005 Kobe conference, there has been growing recognition that children could and should be playing an even more active role in disaster prevention, and that they should have a voice in policy-making.

"The UN Convention on the Rights of the Child quite clearly states that children have a right to participate in decisions that affect their future," says Nick Hall, who manages the child-centred disaster risk reduction programme (CC-DRR) for the international development and child rights organization Plan, a pioneer of this approach along with a handful of other agencies, including ActionAid, the Institute of Development Studies in the UK and Save the Children.

They have formed the Children in a Changing Climate coalition. "Children also have a right to protection, and underlying everything is our conviction that we should be working to realize their rights as best we can," says Hall. "But an added stimulus for Plan is the recognition that disasters in the world are getting worse and more frequent, and that most of the development work we do in 49 countries is seriously threatened by disasters."

Today Plan has CC-DRR projects in nine countries. One of the best established is in El Salvador, the most densely populated country in Central America and also one of the most disaster-prone. Floods and landslides are a huge threat in the hurricane season, because the small, overcrowded country has been virtually stripped of trees. To try to address this specific issue, children in one community are planting trees. In another, they are planting a type of tough, deep-rooted grass to try to stabilize denuded hillsides.

A project starts with children, ranging in age from 8 or 9 to late teens and recruited from one of the many youth groups that Plan works with in and out of school, undertaking a risk-mapping exercise to identify the threats to themselves and their communities. This stimulates discussion about how the risks can be managed, particularly by the young people themselves. "Because their experiences and perceptions of risk are different from adults, children often come up with things that adults wouldn't notice," says Hall, underscoring the value of giving children a voice in their own affairs. "In one village in El Salvador, besides the obvious hazards, the children identified bars as a danger to kids because of drunken men around, and a dark area of woodland on the road out of the village that was risky for girls because of sexual harassment."

The Children's Emergency Committee in one village, Petapa, identified the improper dumping of litter as a major hazard that spreads disease, causes contamination and often blocks waterways. They now run clean-up campaigns in cooperation with the adult committee. They also persuaded the village authorities to put a railing alongside the path to their school that has a steep drop to one side. And when they identified the unregulated extraction of sand and stones from their river as a cause of erosion and flooding, they ran a campaign of direct action, blockading the road, erecting placards and pleading with lorry drivers who came to collect materials. On one occasion some youths, buoyed by past achievements and the fire of conviction, climbed on to a lorry roof until the driver agreed to leave.

Asked by an external review team what they would say to other children about disasters that may occur in their communities, members of Petapa's Children's Emergency Committee cited the following key points (Mitchell et al., 2008):

- Disasters are not natural; get yourselves organized.
- We've expressed ourselves and we respect ourselves.
- We were told as children that we couldn't make a difference, but we can.

When asked what would make them safer, they said strong houses, safe shelters, a fire brigade, telephones and knowledge. They also said trustworthy police and trust in young people.

In the Philippines, a children's group supported by Plan was similarly empowered to persist in their campaign to have their school moved to a safer site when their analysis showed that it was particularly vulnerable to landslides. Many parents, unconvinced by the confusing evidence of risk and concerned that their children would have to travel to a different community each day, opposed the move. But the children went them-

selves to the meteorological department to gather the information that won them their case, and together with their parents they erected a temporary school under canvas in a safe site until a new building was put up.

The children's groups in Plan's programme have access to small grants of up to US$ 500 to take their ideas forward. This part of the programme is designed in large part to allow children to demonstrate their abilities and build their credibility in the eyes of sceptical and resistant adults. Such attitudes are a major challenge to CC-DRR programmes, which recognize that to make a real and lasting impact children also need a place in mainstream discussion and policy-making forums concerned with disasters.

Plan's staff, therefore, have parallel tasks: to work directly with children and to work with relevant adults to create an enabling environment for children's participation in disaster risk reduction. This involves meetings and workshops with everyone from parents, teachers and local authority figures, to government officials and the media.

"If you're looking at children as advocates for change, you need to ask what are the advocacy opportunities? And what better one than the climate change negotiations, because that really does affect their future," says Nick Hall. Representatives from a few children's groups attended the conferences in Bali, Indonesia, in 2007 and Poznan, Poland, in 2008. They paved the way for a bigger role at the international climate conference to be held in Copenhagen in December 2009, when a delegation of around 30 children will attend.

"Whenever there's a crisis in a negotiation, everyone says: 'Don't forget it's our children's future that we're talking about'," explains Hall. "We're saying, 'Well, yes it is, so let's give them a chance to speak'." ■

Box 3.2 Earthquake drills for Iranian students

Located in one of the most active seismic regions of the world, the Islamic Republic of Iran has experienced many destructive earthquakes, which cause many fatalities and injuries as well as major destruction of buildings. Earthquakes such as the one in Bam on 26 December 2003 show that children are among the most vulnerable groups in society.

Iran has a very young population with 36 per cent aged less than 19 years, so it is vital to instil a 'safety culture' from an early age. Iran is the only country to hold a nationwide earthquake drill once a year for all students.

Children and schools are the key components in the country's earthquake risk reduction activities. Such activities not only help their safety during earthquakes, but can also play an effective role in the dissemination of knowledge and preparedness among the society and family.

A young boy was interviewed on Iranian TV after the Bam earthquake. "Were you hurt?" the interviewer asked him. "No," he replied, "I was in a safe place… in the corner of my room… we had learnt [about this] in school before."

The annual earthquake safety drill for students has been developed by Iran's International Institute of Earthquake Engineering and Seismology (IIEES), with the main objectives of improving and increasing the children's skills, response and preparedness as well as becoming 'safety messengers' in their homes and family. The idea was first tested in 1995 in five primary schools (one in each region of the country) but it was decided that, due to the lack of awareness among young children and textbook education,

the planned programme was not suitable for primary-school level. In 1997, after the programme was revised, it was tested in three high schools in Tehran. A second drill then took place in all 1,059 high schools in Tehran. After a comprehensive evaluation of the first three drills and further revision of the programme, a fourth drill was carried out in 15,499 high schools in Iran simultaneously on 29 November 1998.

The level and type of activities of the drill have been continuously updated and its coverage expanded. Since November 2003, the drills are held annually on 29 November in all 154,804 Iranian schools, from primary level upwards, with more than 14.3 million students taking part. If 29 November should fall on a holiday, the drill takes place on either the day before or the one afterwards.

For some time before national drill day, educational materials such as posters and drill guidelines are produced and distributed to schools, and for one week beforehand, various educational and scientific programmes about earthquakes and safety are broadcast on radio and TV. This includes a special TV programme on the drill itself.

On the morning of 29 November, the 'earthquake and safety' alarm is broadcast for 30 seconds on national and regional radio. This marks the start of the drill when all students perform the correct procedure of 'drop, cover and hold'.

In order to ensure the successful implementation of the drills, the School Safety Drill Council was formed, consisting of representatives of the ministries of education, of science, research and technology, and of the interior, the national broadcasting organization, the Red Crescent Society of the Islamic Republic of Iran and the IIEES.

After conducting the drill, every province provides the council in the IIEES with comprehensive reports on the different activities related to the drill such as school competitions, media coverage, educational activities (producing films, books, games, etc.). The council acknowledges the best reports and practices. ■

Box 3.3 Early action to avoid deaths from heatwaves in France

In 2003, France suffered the hottest summer in 50 years. That year, an exceptionally severe heatwave claimed more than 15,000 lives. After this tragedy, the public authorities established the national heat emergency plan, which is activated every year from 1 June to 31 August, in order to reduce the risk of deaths from heatwaves.

The French Red Cross, in its role as auxiliary to the public authorities and with its 45,000 volunteers and 556 health and social facilities, was mobilized in a large-scale operation in the summer of 2003 (helping vulnerable people, distributing water, assisting health facilities and emergency services). Since then, it has played an active part in implementing the national plan. Based on its own heat emergency guide and plan, it prepares and implements a series of actions in coordination with the public authorities and in accordance with local resources and needs.

The French government's national heat emergency plan is updated every year and proposes information, warning and general organizational procedures. The current plan establishes three levels of action to be implemented during the summer period, according to the intensity and length of heatwaves.

Seasonal monitoring level 1. This level is active for the entire duration of the heat emergency plan and involves the implementation of climate and health monitoring procedures by

state services. The staff concerned ensure that surveillance, mobilization and warning systems are working properly and implement the mechanism to identify vulnerable people. The French Red Cross conducts a census of people who are deemed most at risk, defines options for action and works in cooperation with the district authorities to register people at risk.

Warning and action level 2. In the event of a heatwave, action is taken in the affected areas, on the recommendation of the Minister of Health. Once this level comes into operation, the French Red Cross mobilizes its resources in readiness for a rapid response as soon as it is required and, at the request of the local authorities, implements the planned actions.

Maximum mobilization level 3. In the event of a heatwave with serious health implications affecting a large part of the country and complicated by side effects that could undermine public order (for example, electrical failure or drought), the Prime Minister takes the decision to requisition all necessary resources to deal with the disaster and puts the Minister of the Interior in charge of efforts to manage the heatwave. At this level, the French Red Cross, at the request of the public authorities, launches the actions it has undertaken to implement for this level and is ready to act when required.

The national heat emergency plan established by the Ministry of Health provides for French Red Cross intervention at various levels. It plays a vital role in strengthening solidarity and dealing with the problem of isolated vulnerable people, particularly those most at risk from the effects of a heatwave. It also mobilizes its volunteers to carry out specific activities, targeting the most vulnerable sectors of the population by:

- encouraging isolated elderly and disabled people to register with their district authorities
- reinforcing or establishing social emergency medical service (EMS) rounds
- opening air-conditioned day centres for homeless people
- making home visits to isolated elderly people

As auxiliary to the public authorities, the French Red Cross makes its teams of volunteers available to assist in operations, such as:

- strengthening and supporting telephone help lines
- supporting hospital emergency services
- supporting EMS and fire-fighting teams
- distributing water to motorists stranded when motorways are blocked
- providing volunteers to assist in opening public air-conditioned places

When necessary, the French Red Cross can provide reinforcements to assist the staff of homes for the elderly, children's nurseries, home care services and emergency shelters, including those run by the Red Cross as well as by other institutions.

The French Red Cross also carries out prevention efforts to raise public awareness (for example, providing advice on how people can protect themselves in a heatwave, such as drinking plenty of fluids and using a fan), particularly at first-aid posts, and distributes water in crowded places, such as tourist sites.

Although the mild summers of 2007 and 2008 did not require specific action to be taken, in 2006 the French Red Cross mobilized its network to deal with the effects of extremely high temperatures (level 2 or 3), deploying over 3,500 volunteers.

Efforts focused primarily on assisting homeless people and isolated elderly people, supporting establishments and services, such as homes for the elderly and hospital emergency services, and providing first-aid teams.

On 17 July 2006, the public authorities in western France activated level 2 of the heat

emergency plan. The stifling streets of the town of Saumur were deserted, and the local Red Cross branch started on its rounds of elderly people living on their own. Sophie, Catherine and Monique, the three volunteers on duty that day, prepared their battle plan. The most problematic cases were to be dealt with on the first day, focusing on the most vulnerable sectors of the population, including those who are completely on their own, those who are no longer in full possession of their faculties and those who have serious medical conditions. On recognizing the Red Cross uniform, an elderly lady opened her door quickly. In the dim interior of her pleasant, impeccably kept apartment, 87-year-old Suzanne invited the volunteers to sit down for a moment in her living room. "I'm so happy to know that someone is thinking of me. You can't imagine how hard it is and how much my heart is warmed by what you do," she said. ■

At the largest scales, the international community, including the major development agencies, can adjust financing mechanisms to provide funding for disaster risk reduction and response ahead of disasters, rather than only after the fact, and mobilize new and additional financing to address the rising risk of climate change. Governments can, for instance, review land-use plans and establish stronger building codes to reduce risk or facilitate effective preparedness and response, including through laws facilitating regional and international disaster assistance. Humanitarian organizations can mobilize resources ahead of a disaster to reduce its impacts (see Box 3.4) and support local capacity to reduce risk.

Box 3.4 Disaster Relief Emergency Fund

The International Federation is in the process of strengthening its entire early warning, early action system from improved forecasting and analysis of data to efficient early warning systems at community level, in collaboration with partners such as IRI, NASA and the Red Cross Red Crescent Climate Centre. In its discussion paper *Ways Forward on Humanitarian Financing* in 2008, the Inter-Agency Standing Committee commented: "Humanitarian preparedness stands to gain most from improved localized response capacities." It also underlines that emergency funding mechanisms cannot always support local response or emergency preparedness.

The International Federation's Disaster Relief Emergency Fund (DREF), while providing emergency funding as start-up funds for major response operations, also has the flexibility and rapidity to fund small-scale local disaster response and emergency preparedness. Red Cross and Red Crescent Societies can request grants to allow them to prepare for response to imminent crises, whether for forecasted weather-related events, to fight the outbreak of epidemics or to prepare for civil unrest or population movement. The eligible costs are listed as:

- mobilization and equipment of volunteers, including transport costs, per diems, visibility items
- activation of community early warning procedures
- evacuation of people at risk

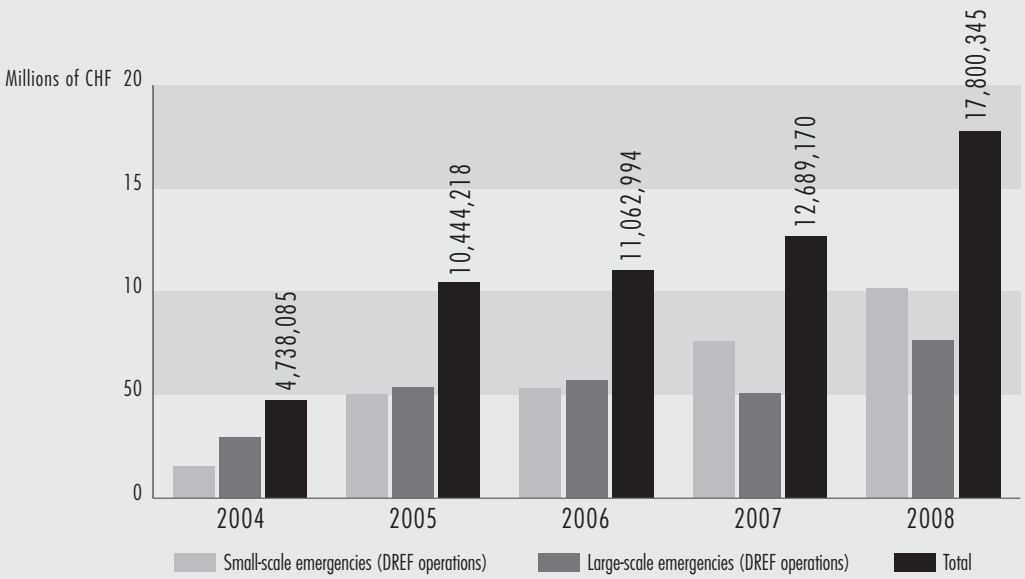
- preparation of shelters
- pre-disaster assessment of capacity to respond to imminent crisis
- activation and implementation of existing contingency plan
- pre-positioning of relief supplies, logistics and human resource assets
- provision and pre-positioning of additional resources, both human and material
- communications (both telecommunications and media)

DREF has been used in the past to prepare for imminent crises, in hurricane preparedness and, for example, in Guinea at the beginning of 2007, for the implementation of contingency plans for population movement following growing civil unrest. Emergency preparedness allowed the Red Cross Society of Guinea to save many lives and to be acknowledged for its humanitarian work by the government, military and members of the public.

In 2008, better access to forecasting and data led to several pre-emptive large-scale operations to prepare for expected damage from excessive rainfall, including in West and Central Africa in July (as outlined in Box 3.5). However, while DREF underwrote the operation to a level of 483,000 Swiss francs, donors have not supported the emergency appeal sufficiently to allow the allocation to be reimbursed to the fund. This may indicate that donors are not yet able to find or use funding to support emergency preparedness.

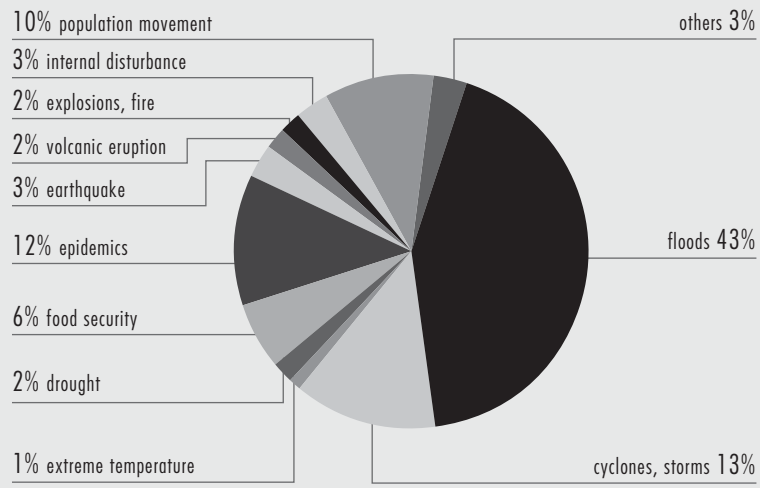
Since 2004, the use of DREF has grown from 4.7 million to 17.8 million Swiss francs in 2008. The biggest increase is in grants for small-scale disaster response as Figure 1 below shows. The majority of operations funded in 2007 and 2008 are in response to weather-related disasters. It is here that the International Federation anticipates using DREF more and more to support early action and to allow communities to act ahead of disasters and reduce injuries and the loss of life and property. ■

Figure 1 DREF allocations by type 2004–2008



Source: International Federation, 2009

Figure 2 DREF 2008 – types of operations



Source: International Federation, 2009

Risks and uncertainties: the case for bridging timescales

But how do all these time and spatial scales and different types of information fit together? Or more fundamentally, do they really need to fit together? Wouldn't it be good enough if development planners focus on development, humanitarian actors on disaster preparedness and response, and local communities just prioritize their own well-being? Couldn't we ignore climate change when we worry about early warning for impending cyclones? And likewise, couldn't we tackle long-term trends in risk by addressing basic vulnerabilities, rather than by preparing for response?

Indeed, vulnerability to natural hazards is often so obvious that some people ask why we even bother to worry about trends in risks or scientific information about changing hazards. When more and more people crowd into slums on dangerous flood plains, we don't need scientific information for a diagnosis of rising flood risks. When population growth in pastoral areas results in increasing numbers of cattle, overgrazing and land degradation, which then threatens food security, we do not need to know about changes in the local climate to understand why people are at risk and what sort of solutions would be needed. When a coastal road has been rebuilt three times in 20 years exactly as it was before due to storm and flood damages over two decades, we don't need scientific evidence to understand that we need a different approach. All of these examples demonstrate that information by itself is not the

panacea. In many cases, the general diagnosis is clear: we need to tackle fairly obvious vulnerabilities in order to address the rising risks.

But increasingly, faced with significant trends in hazards and impacts, risk reduction and disaster preparedness based on past experience no longer suffice. In Bangladesh, many villages are used to occasional – although sometimes deadly – flooding. However, in some areas, communities have reported that floods seem to be arriving faster and fiercer than 30 years ago. In one village, a small ditch that can often be crossed in one jump becomes a severe barrier in time of flood; children and elderly people in particular get caught in the rising waters before they even reach a shelter. A very simple bamboo bridge, over that normally insignificant ditch, now saves lives. This bridge was only built when people realized, in the context of a community consultation supported by CARE, that current and future floods might come faster and stronger than before. Most of the time, this bridge would not be necessary, but once villagers recognized the changing nature of hazards, it made perfect sense to them to construct it.

Another example comes from Mozambique. In 2000, the Limpopo River basin experienced very strong rainfall for many days as a result of cyclones. Experts knew that it would result in serious flooding of a magnitude never experienced before by rural communities downstream. That warning reached only a few communities, as most of them had no electricity or radio – and even some that did receive the warning did not evacuate.

People in this region had previously been able to predict floods successfully by observing ants. Ants build their homes underground; when groundwater rises, they leave their nests – and people know that the water is rising. On this occasion, the flood came so rapidly there was no time for the groundwater to rise or for ants to react before the river overflowed. A person who had heard the experts' alert drove to another village to tell them to evacuate, but the local chief asked why he should believe that early warning. Since the time of his ancestors, floods had only occurred after ants left their homes. This time the ants had not moved and yet a stranger had come to his village asking everyone to leave at once. As in most of the Limpopo valley, many people did not evacuate. About 700 people drowned (Red Cross Red Crescent Climate Centre, 2007). While in many other cases traditional knowledge is still very valuable, in more and more areas it is becoming increasingly unreliable because past experience does not necessarily apply to present and future risks. Only by establishing a long-term dialogue with communities, building on past knowledge but also explicitly addressing changes in risk, can short-term early warnings become truly effective.

Likewise, when redesigning a coastal road, it no longer suffices to base the design, monitoring and maintenance on past experience. For instance, analysis by the Asian Development Bank (ADB) of infrastructure in several Pacific island countries identified significant changes in return periods of extreme flood events over the coming years (for instance, from 1-in-20 years at present to 1-in-5 years by 2050). Such

changes significantly affect the optimal design of the infrastructure, such as a stretch of road at Kosrae in the Federated States of Micronesia (ADB, 2005). Some changes in design and planning are 'no-regrets options' which will pay off regardless of the precise details of how climate change will materialize – land-use planning and associated regulations, building codes and infrastructure standards as well as community development projects, all contribute to risk reduction even under the current climate. However, they become much more effective and sustainable when they incorporate current and future climate extremes and variations.

These cases demonstrate that trends in risk are relevant for efforts to reduce the impacts of disasters, and we need to use the early warnings about changing risks in our early actions.

Table 3.1 Timescales for early warning, early action

Example 1

Flash flood	Example of early warning	Example of early action
Years	Increasing risk of extreme rainfall events due to climate change Deforestation on hillsides increasing risk of flash floods Increasing population in slums in areas at high flood risk	Continually update risk maps and identify changing vulnerable groups, community-level activities to reduce risk through concrete actions like reforestation, reinforcement of houses, etc.
Months (seasonal)	Forecast of strongly above-average rainfall for the coming season	Revisit contingency plans, replenish stocks, inform communities about enhanced risk and what to do if the risk materializes, e.g., clear drains
Weeks	High ground saturation leading to high probability of flash floods during next high rainfall event	Alert volunteers and communities, meet with other response agencies to enable better coordination, closely monitor rainfall forecasts
Days	Forecast of heavy rainfall that may result in flash flood	Prepare evacuation, mobilize volunteers, get warnings and instructions out to communities at risk
Hours	Very heavy rainfall almost surely leading to flood	Evacuate

Example 2

Cyclone/ hurricane/ typhoon	Example of early warning	Example of early action
Years	Risk of intense cyclones rising due to climate change More people moving to areas vulnerable to cyclones	Continually update risk maps and identify changing vulnerable groups, recruit additional volunteers, establish new areas of work, work with communities to assess and reduce risk, establish early warning communication systems, evacuation routes and shelters
Months (seasonal)	Forecast of above-average cyclone activity for the coming season	Revisit contingency plans, replenish stocks, inform communities about enhanced risk and what to do if the risk materializes
Weeks	Forecast of likely development of cyclones in a particular stretch of ocean	Alert key staff, pay extra close attention to potential storm warnings
Days	Forecast of a cyclone that is likely to hit a stretch of coast (but not yet where it will make landfall)	Prepare evacuation, mobilize volunteers, get warnings and instructions out to communities, clear trees from around houses, stock batteries, torch, food supplies, radio, etc.
Hours	Cyclone warning: cyclone is about to hit your city	Evacuate to shelters

Example 3

Drought	Example of early warning	Example of early action
Years	Rising risk due to climate change, increase in population in fragile areas, land degradation (for instance, due to overgrazing)	Continually update risk maps and identify changing vulnerable groups, establish new areas of work, work with communities to assess and reduce risk, share successful techniques for adapting
Months (seasonal)	Forecast of food insecurity based on factors such as below-average rainfall, below-average harvests, rising food prices and government instability	Coordinate with government and World Food Programme (WFP), revisit contingency plans, inform communities about enhanced risk and risk mitigation strategies
Weeks	Reports of food shortages in a particular region	Coordinate with government and WFP, distribute food

Example 4

Malaria	Example of early warning	Example of early action
Years	Rising risk of malaria in areas that were malaria free in the past, due to rising temperatures	Continually update risk maps and identify changing vulnerable groups, establish new areas of work, work with communities to assess and reduce risk
Months (seasonal)	Forecast of enhanced risk of malaria outbreaks in particular areas, based on rainfall and temperature (as observed and forecast for the coming months)	Coordinate with government and World Health Organization, revisit health plans, prepare local health and care facilities, sensitize communities about enhanced risk, distribute bed nets
Weeks	Reports of malaria outbreaks in a particular region	Sensitize communities, facilitate access to treatment

Risk assessment and early warning as a basis for early action

Such action, of course, first requires a good understanding of baseline risks and vulnerabilities. Global databases, such as the Centre for Research on the Epidemiology of Disasters' (CRED) EM-DAT and MunichRe's NatCat, and analyses such as that of natural hazard hotspots (Dilley et al., 2005), reveal patterns of past hazards and vulnerabilities that pinpoint high-risk areas and can help to prioritize risk reduction efforts. At a more local scale, the underlying patterns of risk exhibit far more variable characteristics, with risk varying considerably within very small areas. The most vulnerable groups of people, such as migrants moving from rural areas into the cities, often end up in the most risky areas. Accurate risk maps, showing people and assets at risk, can be a key tool to inform plans and activities.

In principle, in the face of changing risks, such assessments should consider not just past data, but also include future projections. This applies to the global and national assessments in the hotspots study, but equally to tools and practices at the local level. Participatory risk assessments, such as the Red Cross Red Crescent's vulnerability and capacity assessment, contain many elements that already look at trends in risk as experienced locally and can be a useful instrument to help communities address rising risks themselves. However, they do not systematically integrate relevant scientific information on such trends. Efforts to improve these linkages are under way, but it has proved difficult to create capacity among facilitators, often Red Cross Red Crescent volunteers, to convey the relevant information adequately to communities. It is especially challenging to go beyond a few pilot cases, where facilitators can be hand-

picked and trained one-on-one by experts, to the large number of such dialogues that are needed (van Aalst, Cannon and Burton, 2008).

One reason for that challenge is that we are not just facing rising risks across the board, we are also facing rising uncertainty. We know the climate is changing, but we do not yet know what precisely to expect in terms of changes in extremes in specific locations – scientists simply do not yet know. In many cases, the direction of the trend may be clear: a higher risk of heatwaves, more variability in rainfall, possibly more intense storms. In some places, climate scenarios provide quite precise and relevant information, for instance on a later start of the rainy season in parts of southern Africa. But in other places, such as large parts of West Africa, even the direction of the trend in average rainfall is uncertain. More generally, at any one place, the implications of general trends (such as average regional rainfall) for local risks (such as local flooding) can be quite unclear. Often, the main message may be: be prepared for more surprises. And that's where the early warnings at shorter timescales come in.

'Regular' weather forecasts and hydrological models do provide more precise knowledge for a specific response, at a timescale of hours or possibly days. Even highly anomalous weather events – much too infrequent and/or localized to obtain reliable statistics from climate models – can be forecast through regular weather forecasting systems. And unusually wet or warm seasons can sometimes be anticipated through the use of seasonal forecasts, which can bridge the short-term weather forecasts and long-term trends in risk. Such forecasts, which are getting better every year, can provide an indication, several months ahead, of likely average conditions and risks of extreme (although only for particular regions and sometimes also certain parts of the years).

For instance, the International Federation of Red Cross and Red Crescent Societies' West and Central Africa zone office has become increasingly concerned about the risk of increasing rainfall variability, in light of a series of heavy rainy seasons as well as general concerns about the rising uncertainties brought on by global climate change. So the zone office has been looking into more systematic use of climate information on shorter timescales. The region started monitoring and applying new tools developed in partnership with the International Research Institute for Climate and Society (IRI) at New York's Columbia University. An IRI intern spent several months in Dakar, Senegal, acting as a bridge between the providers of scientific information and those who could benefit from it and developing better ways of packaging information and using it for decision-making.

Based on that groundwork, the zone office was alerted by a seasonal forecast ahead of the 2008 rainy season, which showed a strongly enhanced risk of heavy rainfall and thus flooding (see Box 3.5). The International Federation used that information, well ahead of the season, to launch an emergency appeal based solely on the imminent threat of flooding in the coming months. Several National Societies were able

Box 3.5 West Africa: bridging timescales for more effective humanitarian flood response

In May 2008, the International Federation's West and Central Africa zone office in Dakar, Senegal, took advantage of the new partnerships with climate professionals on both sides of the Atlantic, including the African Centre of Meteorological Applications for Development (ACMAD) and IRI, to try to prevent history in West and Central Africa repeating itself.

The floods across Africa in 2007 – the continent's year of rains – were the worst in several decades. Hundreds of thousands of people were displaced in nearly 20 countries. Nearly 300 died as a direct consequence of the flooding.

In West Africa, Ghana suffered most. An estimated 400,000 people were affected in one way or another. "Ghanaians never experienced anything like [these] floods," said Mustapha Ali Idris, minister for Ghana's northern region.

A vast swathe of territory from the Atlantic coast to the Red Sea experienced very serious flooding. But part of the tragedy of the 2007 floods in West and Central Africa, emphasized Peter Rees, the International Federation's head of operations support, is that they were forecast.

The most authoritative voice on likely conditions for the July–September rainy season over West Africa emerges from an annual forum of international scientists that, in 2008, was held in the Niger capital, Niamey. The first relevant PRESAO (a French acronym for 'seasonal prediction in West Africa') forecast was issued by ACMAD on 21 May 2008, and warned of warm conditions over the tropical Atlantic, with a high probability of 'wet' and 'very wet' conditions.

"All sources – national, regional, international – converged and asserted with one voice that the upcoming season was highly likely to be much wetter than usual over most parts of West Africa," said Arame Tall, a Columbia University graduate student working on climate as an intern at the Dakar zone office. So when the International Federation's disaster management coordinator in Dakar, Youcef Ait-Chellouche, also noticed that forecasts pointed to above-average rainfall in essentially the same countries that were flooded in 2007, he acted quickly.

A wholly pre-emptive appeal for flood preparedness based on seasonal forecasts, the first of its kind, was issued by the International Federation on 11 July – worth nearly US$ 750,000 and covering the entire at-risk region. This appeal set a new precedent for donors and the disaster management community.

Even though IRI downgraded the risk slightly in its late July forecast, a whole series of flood events in West Africa quickly made these forecasts seem, to a lay person's eye, almost clairvoyant.

The emergency appeal and a revised version in September enabled the International Federation to provide, according to Ait-Chellouche, "tactical support to National Societies for action during disasters, especially with relief stocks positioned in Dakar, Accra and Yaoundé". In addition, regional disaster response teams were trained for flood response, and learned how to interpret six-day rainfall forecasts that could be used to monitor upcoming flood risks. Visas were requested and medical insurance acquired in advance, so that the teams could be mobilized within 24 hours of a flood emergency.

Based on past flood seasons, explained Ait-Chellouche, the zone office could anticipate the needs of affected people. They would be displaced and need good, drinkable water and household items. Houses would have to be rebuilt or repaired, water sources would be contaminated and sanitation facilities inoperable. Crops would be ruined and access to markets, healthcare and other essentials would be minimal due

to collapsed or submerged roads and other infrastructure. The risk of water-borne diseases and malaria would be increased. With this knowledge, the Red Cross Red Crescent was able take appropriate early action that enabled a rapid response when the floods arrived, through pre-positioned supplies, contingency plans and the ability to mobilize trained volunteers quickly.

"While there was no very big emergency, a series of widespread smaller emergencies occurred, especially in Benin and Togo – but together they are just as serious and difficult to manage," said Ait-Chellouche.

He went on to add: "Usually disaster managers have to 'run after the events' and try to do their best to adapt to emerging challenges. Climate information gives the disaster manager a sort of advance and anticipation and helps us to link disaster response to risk reduction activities and build a more integrated approach in disaster management."

Just at the end of the flood season, in September 2008, IRI issued its seasonal precipitation forecast for October, November and December, this time predicting above-average rainfall for the dry season.

The zone office held a community meeting to consider what might be at risk if the dry season was wetter than normal. Farmers quickly raised concerns for crops, mostly nuts and cereals that are typically dried outdoors in these months. If there was going to be rain during this period, the crops could easily rot, putting food security and livelihoods at risk.

In partnership with the World Food Programme and the Food and Agriculture Organization, the zone office identified the exact drying period for certain crops in the region. Staff then contacted regional National Societies, asking them to inform farming communities that rain was possible during the harvest drying time, and they should be prepared to cover or shelter their crops in case of rain, keeping an eye on short-term rainfall forecasts. This simple bit of information enabled many farmers to preserve their drying harvest. ■

to operate much more effectively than if they had just waited for the disaster to happen. The new use of seasonal forecasts, motivated partly by the concerns about increasing uncertainty in rainfall extremes in the face of climate change, resulted in the awareness of the upcoming heavy flood season, passed on from regional to national and local levels. This was followed by much closer monitoring of hydrological conditions and six-day rainfall forecasts, and a better response by several National Societies once the floods arrived – based on warnings and actions at all timescales.

Challenges and opportunities

The potential for better use of early warnings at all timescales is clear, but of course their usefulness depends entirely on the specific context: the quality of the scientific information at various timescales, the type of risk being addressed and the local capacity to act, also in light of other priorities. Nevertheless, some general challenges and opportunities emerge.

Providers of scientific information

Many scientific agencies have a mandate to inform development plans and programmes, and are eager to support humanitarian organizations with new forecasts and tools. However, they often work in a rather supply-driven mindset. They present their information as a given and assume it is self-evidently relevant to the outside world. In practice, many of those early warning products are almost impossible to understand by non-experts. They are often overly technical, sometimes including large uncertainties. As a result, the raw products do not naturally lead humanitarian actors to a decision (such as, "Do we mobilize volunteers in light of the expected flood conditions?").

Cyclone Nargis hit Myanmar in May 2008 and left more than 135,000 dead. Warnings were given but early action was not possible.

Simon Mason, an IRI climate scientist, is very much aware of such difficulties. He recently showed a graph in a presentation to humanitarian workers and joked, "While a picture may say a thousand words, a scientific graph often says a thousand incomprehensible words." This is certainly true for many local Red Cross Red Crescent volunteers, who are the first to respond in times of disasters and also the ones with a long-term relationship of trust with local communities. These people

are the experts on local vulnerabilities, but they are not trained in the interpretation of scientific information. Even among technical staff at national headquarters of Red Cross Red Crescent Societies, in government ministries and in development or humanitarian agencies, several steps need to be taken to get from complex scientific forecasts to operational decisions. Scientists cannot make that translation for the end-users of their information, but neither can they expect the end-users just to pick up the raw science products and run with them. Instead, a continuous dialogue, initially filled with confusion, is needed between providers and users of the information, so that both sides understand its opportunities and limitations.

Challenges for humanitarian organizations

Clearly, the key challenge for humanitarian organizations is the rise in risks by itself. In that context, early warning, early action is not a challenge, but an opportunity. Many humanitarian agencies are aware that it is no longer enough to be prepared for the last disaster, without taking account of significant trends in risk. They are advocating for, and investing in, disaster risk reduction. They are also reviewing their preparedness and response mechanisms based on new information at a range of timescales: translating new information into operational decisions, reviewing contingency plans in light of trends in risk and updating standard procedures to integrate early warnings at longer timescales. None of this is trivial and the dialogue with knowledge providers is not always easy for action-oriented organizations, but it is happening.

People who work at the community level in particular face a special challenge. The example of the community in Mozambique waiting for ants to come out of the ground as their trusted early warning system shows that even a very certain warning based on credible scientific information, passed to a particular community in time, did not have the right effect. Traditionally, people have assumed that the effective functioning of early warning systems requires, firstly, prior knowledge of risks faced by communities and other users of the early warning information; secondly, a technical monitoring and warning service for these risks; thirdly, an effective strategy for dissemination of understandable warnings to those at risk; and finally, knowledge and preparedness to act (Traore and Rogers, 2006). Two additional elements are now needed: awareness that risks are changing (and which new risks may arise) and, especially, a way to communicate new knowledge about future conditions that can be understood and trusted. This requires a long-term dialogue with communities and local institutions that may not immediately trust outside information about one of the few things they consider themselves experts on – what to expect from the local weather and climate.

Such dialogues now need to be built into the work of humanitarian organizations working at community level. Many pilot programmes linking disaster risk reduc-

tion and community-based adaptation, sometimes supported by the Red Cross Red Crescent or international non-governmental organizations (NGOs), such as Practical Action, CARE, Cordaid and others, have demonstrated the effectiveness of such approaches. The challenge now is to scale up and reach beyond a few pilot communities.

Another more general challenge for humanitarian organizations links to that of donor agencies: mobilizing financial resources for early action, including long-term risk reduction and preparedness ahead of imminent disasters rather than just response after the fact.

Challenges for the donor community

Donor agencies, for their part, can no longer afford to provide funding for disasters primarily after the fact, for relief, recovery and reconstruction. The cost is rising and compromising regular development investments. Both development assistance and humanitarian action can be made more effective by increased emphasis on early action (see Box 3.6.)

Box 3.6 Early action pays

There are relatively few good quantitative economic analyses of the benefits of investments in early action. But where such analysis has been done, the evidence is overwhelming: the cost–benefit ratio of disaster risk reduction ranges from 1:2 to 1:4 (Mechler, 2005; several examples are also provided by the ProVention Consortium, 2009).

In the Pacific, for instance, the benefits of early action to reduce disaster risk to development are demonstrated by two cyclones in Samoa. In 1991, Cyclone Val caused damage of 230 per cent of real gross domestic product (GDP). Three years later, Cyclone Heta resulted in damages amounting to 'just' 9 per cent of GDP. This difference is, of course, partly caused by the track of the storm (even though Heta was in fact a more powerful storm at 170 knots compared to 140 for Val), but also by the investments in risk management after Val (World Bank, 2004).

According to the World Bank: "Shoreline protection systems designed to cyclone standards performed well, with relatively minor damage, compared to sub-standard coastal protection systems in adjacent areas" (Bettencourt et al., 2006).

Several analyses of risk management options for infrastructure and buildings in the Caribbean support that conclusion. For instance, the costs of adjustments in the design of a deepwater port in Dominica would have cost only 28 per cent of the repair costs after it was damaged by tropical storms (US Agency for International Development and Organization of American States, 1998).

For the United States, according to the US Multi-Hazard Mitigation Council: "On average, a dollar spent by FEMA [US Federal Emergency Management Agency] on hazard mitigation (actions to reduce disaster losses) provides the nation with about $4 in future benefits. In addition, FEMA grants to mitigate the effects of floods, hurricanes, tornados and earthquakes between 1993 and 2003 would save more than 220 lives and prevent almost 4,700 injuries over

approximately 50 years" (Multihazard Mitigation Council, 2005). And these analyses were not restricted to large-scale infrastructure. In case study analyses, community early warning systems resulted in benefit–cost ratios of the order of 17.9 (Freeport) and 3.5 (Jefferson County).

These results match similar analyses in developing countries. For instance, small-scale mitigation works in Nepal (building of check dams to prevent erosion and save land and crops), carried out by the Nepal Red Cross with support from the British Red Cross, provided a benefit–cost ratio of 18.6 (Venton et al., 2008).

For humanitarian response, there are very few clear quantitative analyses of the economic benefits of early action. Many key benefits come not just as cost–benefit analyses, but in terms of absolute numbers of lives saved and injuries avoided – a much more central measure of success for humanitarian organizations. A clear example is Mozambique, where substantial investments in disaster risk reduction and preparedness prevented a repeat of the disaster of 2000 when similar floods appeared in 2007 and 2008 – through mass evacuations.

Both effectiveness and efficiency do matter, and it is clear that in many cases, early action helps on both fronts. And earlier action, based for instance on seasonal forecasts of a heavy flood season rather than a flood occurring just hours after a warning, holds particular potential for cost savings and increases in effectiveness. For instance, a seasonal forecast may allow the purchase, and pre-positioning in flood-prone areas, of water purification tablets and other flood emergency supplies months in advance. They can then be shipped to likely affected areas based on a six-day forecast, and immediately put to use just before and during the actual emergency.

In contrast, the traditional response, waiting for the emergency to occur and then flying in the tablets from much further away, not only takes longer, but also results in higher procurement and transportation costs. As an example, preliminary analyses of the 2008 West Africa flood response by Red Cross Societies in the region, which was supported by a regional preparedness appeal based on a seasonal forecast of likely extreme rainfall, suggest that the combined cost of preparedness and response per beneficiary was about a third lower than the costs of response alone in 2007, the previous heavy flood season (Braman, 2009). ■

Regular development financing should, first, pay more attention to risk reduction – as an investment opportunity with good development benefits rather than just an additional upfront cost. Ideally, such investments would be integrated in regular sectoral development investments or community-level livelihoods programmes. Indeed, many countries have affirmed their commitment to risk reduction through the Hyogo Framework for Action, supported by the United Nations International Strategy for Disaster Reduction (UNISDR). International mechanisms such as the Global Facility for Disaster Reduction and Recovery are starting to address some of the need for additional investments in risk reduction, particularly by mainstreaming it into regular development. Compared to disaster damages and spending on relief, recovery and reconstruction, however, such efforts still remain limited.

There are also implications for humanitarian financing. The rising number of disasters (see Chapter 5, Figure 5.1, and CRED data in Annex 1) leaves the humanitarian departments in donor agencies little flexibility: every dollar available is needed for immediate humanitarian relief, the demand for which has been growing steadily.

Even though the disaster risk reduction agenda is often also part of these departments' responsibility, their most appropriate response to the rising risks should not be to reallocate the financial support that is needed for humanitarian assistance but rather to become advocates for risk reduction, financed through regular development investment channels.

An additional reason to look for other channels for funding for risk reduction, and not just the humanitarian aid departments in development agencies, is that these do not have the links to central sectoral development planning that are required to integrate risk reduction properly. Also, their funding modalities are focused on short relief projects rather than sustainable risk reduction. Even the World Bank, which does not provide relief immediately after disasters but plays a major role in post-emergency reconstruction, has concluded that despite the increased awareness for the need for risk reduction just after a disaster, such reconstruction projects may not always be the best vehicle for risk reduction investments, due to their limited duration and the (justified) focus on simply getting infrastructure back in place and the economy back on track (World Bank Independent Evaluation Group, 2006).

But besides becoming better advocates for disaster risk reduction, donors should ensure that every single dollar spent on relief is spent as effectively as possible. This can be achieved by better use of early warning information for early action in terms of disaster preparedness and response. Such action does require additional flexibility in humanitarian financing. Donors should support continuous revision of contingency plans and updates of emergency stocks in strategic locations. More importantly, they should finance preparedness based on credible warnings of imminent hazards, hours, days, sometimes even months ahead of an expected event, well before the graphic media headlines. In some cases, early action may even prevent a hazard from ever becoming a disaster. What should count is that more lives are saved and more adverse consequences avoided, often at lower cost.

However, when supporting such early action, donors should also accept some uncertainty. A few hours in advance, meteorologists usually know quite well where and when a large storm will hit – but by then it may be too late for some of the most effective actions. With a few more hours' or even days' anticipation, there may be signs of an extreme event becoming more likely, allowing preparations for a much more effective response. Several months in advance, the best information available may say that a storm season is very likely to be relatively intense, with an increased risk in all areas that could potentially be hit – not where and when a disaster will occur. But there is

no need to wait for that complete certainty. Knowing that a risk is substantially higher than normal does justify a higher level of alert, particularly preparing to take early actions that will be useful regardless of when and where the disaster strikes (which may include seemingly mundane measures such as getting visas for trained responders from neighbouring countries to accelerate response or establishing emergency stocks within a region at risk).

Such early action, based not on information about disasters already unfolding but early warnings of imminent crisis, saves more lives and livelihoods, but also results in more cost-effective relief operations. For instance, water purification tablets save lives by preventing the spread of water-borne diseases after flood events. Stocks of such tablets established at strategic locations in a region ahead of an expected heavy flood season will, once somewhere in the region is flooded, not only reach the intended beneficiaries faster, but also at much lower cost than if they were to be flown in with a dedicated cargo flight from an international hub. However, acting on risk information only, rather than responding after a disaster, does mean that the early warning will sometimes get it 'wrong'. For instance, a forecast of an 8 per cent likelihood that there will be an especially heavy flood season or hurricane-force winds at a certain time and place means simply that these conditions are very likely to occur. There is no certainty. In fact, based on this forecast, we actually expect the predicted conditions not to happen in 20 per cent of the cases. This is a risk: will people still respond the next time around if nothing happened after the previous warning? The only solution is to be honest and explicit about the uncertainties, but not to let that stand in the way of decisive early action. Typically, such early action in the face of uncertainty would include awareness-raising, closer monitoring of emerging hazards, as well as no-regrets measures which remain of use even if the immediate risk does not materialize, such as capacity-building, emergency stocks and community-based risk reduction – all of which reduce the potential impact of future hazards for years to come.

Conclusion

Practical early action, based on early warnings at all timescales, pays off. There is no crystal ball to predict far into the future when and where individual disasters will occur, but there is a lot we do know. It is like rolling a dice: we never know when a particular number will appear, but at some point every number comes up. Confronted with global warming and growing vulnerability, we also know the dice is loaded. A growing range of early warnings can tell us how, by predicting patterns, trends and seasonal risk of individual events. Early action, making the best use of that full range of information, offers the best hope of beating the odds, anticipating the upcoming sides of the loaded dice.

This chapter and Box 3.6 were written by Maarten van Aalst, associate director of the Red Cross Red Crescent Climate Centre. Box 3.1 was written by Sue Armstrong, a UK-based

writer on health and science. Farokh Parsizadeh, research associate at the International Institute of Earthquake Engineering and Seismology, Iran, wrote Box 3.2. David Marcon, who is national health promotion officer at the French Red Cross's Social Welfare Department, contributed Box 3.3. Elizabeth Soulié, at the International Federation in Geneva, wrote Box 3.4. Box 3.5 was written by Alex Wynter, a freelance journalist working for the Red Cross Red Crescent Climate Centre, with inputs from Youcef Ait-Chellouche, disaster management coordinator for the International Federation's West and Central Africa zone office, and Lisette Braman, consultant to the zone office and the Red Cross Red Crescent Climate Centre.

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