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Ecosystems, Livelihoods and Disasters

An integrated approach to disaster risk management

Ecosystem Management Series No.4

Karen Sudmeier-Rieux, Hillary Masundire
Ali Rizvi and Simon Rietbergen, Editors

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Ecosystems, Livelihoods and Disasters

An integrated approach to disaster risk management

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An integrated approach to disaster risk management

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(University of Moratuwa, Sri Lanka), Hillary Masundire (Department of Biological Sciences, University of Botswana), Ainun Nishat (Director, IUCN Bangladesh Country Office), Tilak Ranaviraja (then Chairman of Task Force for Relief (TAFOR)/ Secretary, Ministry of Public Security, Law and Order, Sri Lanka).

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Preface

As this publication goes to print, the world is in the midst of recovering from some of the greatest natural disasters on record. When the Indian Ocean tsunami hit the coasts of South and Southeast Asia and East Africa in December 2004, the world was stunned. Never before had a natural disaster of such proportions struck so many people, and so many countries simultaneously. The lack of preparedness contributed to the overwhelming devastation.

In June, 2005, in the wake of this disaster, the World Conservation Union's (IUCN's) Sri Lanka Country Office and Commission on Ecosystem Management organized a three-day workshop, "Applying an Ecosystem Approach to Post-Disaster Reconstruction and Restoration." The workshop brought together a diverse group of government officials involved in emergency response efforts, along with experts on ecosystem management and restoration, communication and education. It also involved humanitarian organizations such as CARE and OXFAM, and resource persons from Bangladesh and Central America, as well as Sri Lanka. The joint learning venture that this diverse gathering embarked on provided the inspiration for this publication.

As communities around the Indian Ocean started to recover from the tsunami, one of the worst hurricane seasons on record hit the Gulf of Mexico, followed by the earthquake that hit Pakistan and Kashmir, the earthquake and volcanic eruption in Java and the 2006 tsunami in Indonesia. The impacts of these disasters will continue to affect people and biodiversity and shape land management decisions for decades.

While natural hazards such as hurricanes or tsunamis cannot be controlled, they need not always lead to disaster: we can manage their impact by reducing vulnerability and improving preparedness. We can also manage the aftermath of such disasters to avoid further environmental damage and hazardous or unsanitary conditions for recovering populations.

But this can happen only if we integrate both livelihoods and environmental issues into disaster response efforts and risk reduction strategies. This is particularly important for poor communities, often resident on marginal lands, which are at greatest risk from natural disasters.

The purpose of this publication is to provide recommendations for making disaster risk reduction strategies more effective. A comprehensive approach to disaster management involves a number of actors and actions outside the expertise and realm of environmental organizations. In the direct aftermath of a disaster, saving lives and

providing for safety and basic needs is clearly the domain of emergency professionals and humanitarian agencies. As the focus turns to human livelihood recovery, clean-up, and preparing for future hazards, however, considerable negative long-term consequences can arise from neglecting environmental concerns.

Although many existing environmental guidelines, laws and policies are relevant to post-disaster emergency response and reconstruction efforts, they are rarely applied in times of crisis. In many cases they are not integrated with the procedures of humanitarian agencies and others involved in emergency response, who are generally the first on the ground. They also cannot be easily utilised by non-specialists.

The way forward is clear: organizations and professionals involved in humanitarian assistance and in environmental management need to work together more closely to develop workable solutions and bring about real integration on the ground. This publication summarises some of the key lessons we have learned from the work we have jointly undertaken following recent disasters in Asia and Latin America. We hope it will inspire relief and development agencies and conservation organizations to form similar partnerships elsewhere, and to share the lessons learned from their efforts.

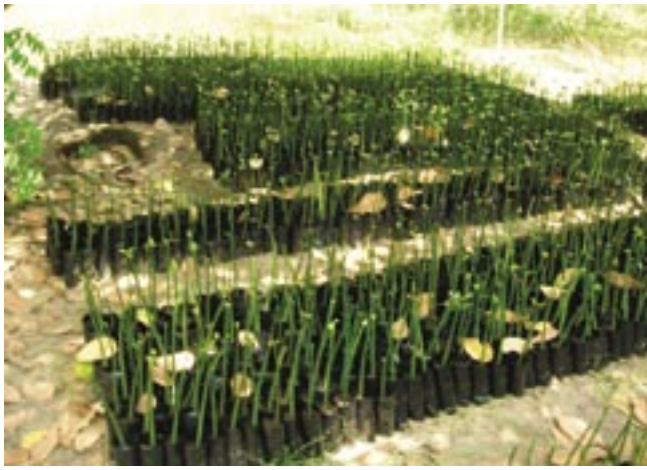
Ibrahim Thiaw
Acting Director General,
The World Conservation Union
(IUCN)

Nick Osborne
Country Director,
CARE International,
Sri Lanka

Frank R. Rijsberman
Director General,
International Water
Management Institute (IWMI)

Executive summary

Vulnerability to natural disasters continues to increase, severely compromising the achievement of poverty alleviation goals in many developing countries. A more effective approach is needed to reduce the impacts of these disasters. This publication proposes an approach that integrates ecosystem management, development planning and risk reduction strategies to reduce disaster impacts and improve both livelihoods and biodiversity outcomes.



Mangrove seedlings in Sri Lanka.
©IUCN/Channa Bambaradeniya

Ecosystem management can contribute to more effective reduction of disaster risk in two major ways. Well-managed ecosystems can mitigate the impact of most natural hazards, such as landslides, hurricanes and cyclones. In addition, productive ecosystems can support sustainable income-generating activities and are important assets for people and communities in the aftermath of a disaster. For ecosystems to make these contributions, it is essential that they be factored into relief and rebuilding efforts in the post-disaster response phase. Not taking care of critical ecosystems after a major disaster can cause significant economic and environmental losses, and impose hardships on already vulnerable communities.

Dunes, barrier islands, mangrove forests, and coastal wetlands are natural shock absorbers that protect against coastal storms. Nature provides these valuable services for free, and we should take advantage of them rather than undermining them.

Abramovitz, 2001

The Ecosystem Approach can make a valuable contribution to managing disaster risk and mitigating the impacts of disasters. An ecosystem approach to disaster risk reduction is one where ecosystems make a key contribution to enhancing people's livelihoods. The Ecosystem Approach is an effective strategy to manage or restore ecosystems and their services while focusing on human livelihood needs.

The environmental sector needs to act in conjunction with the humanitarian and emergency sectors to make real changes in how they prepare for and manage future natural disasters.

Fishing boat damaged by the 2004 tsunami, Koh Phra Thong, Thailand.
IUCN Photo Library © IUCN/Jeff McNeely

This publication deals with natural disasters and the ways in which ecosystems can reduce their impact.[1] Although the term "natural disasters" is used to describe hazards such as flooding, extreme temperatures, earthquakes, hurricanes, mudslides and volcanic eruptions, it is increasingly becoming a misnomer. Scientific evidence points to human-induced climate change as the underlying cause of the rise in hydro-meteorological events over the past decade.

Natural disasters are increasing in number and intensity and taking a terrible toll in human lives and social and economic infrastructure (Table 1 and 2; Figure 1). Most disasters are exacerbated by poor development planning and human-caused vulnerability. They also severely compromise poverty alleviation goals.

Table 1. Number of natural disasters, 1930–2006

	1930-39	1940-49	1950-59	1960-69	1970-79	1980-89	1990-99	2000-06
Drought	14	49	n/a	53	125	196	151	185
Earthquake	30	45	46	70	98	197	263	190
Epidemic	2	3	2	37	59	122	350	413
Extreme temperature	2	n/a	8	9	15	40	94	140
Famine	2	1	n/a	2	3	12	47	9
Flood	12	12	81	156	265	537	800	984
Insect infestation	1	1	n/a	n/a	5	48	11	16
Slide	5	4	21	26	54	105	148	126
Volcano	3	7	10	12	23	32	52	32
Wave/surge	4	n/a	4	6	3	3	10	16
Wildfire	1	3	1	8	26	62	100	102
Windstorm	38	52	121	211	291	558	741	647
Total	114	177	294	590	967	1,912	2,767	2,860

Source: The OFDA/CRED International Disaster Database: www.em-dat.net; Université Catholique de Louvain–Brussels–Belgium (see endnote 3)

More effective and comprehensive disaster risk reduction strategies are needed that decrease people's vulnerability to the impacts of natural disasters. A comprehensive approach to disaster risk reduction should include several components:

- integrating risk reduction into ecosystem management and development planning;
- post-disaster strategies that focus on community livelihood recovery while minimizing damage to the ecosystems that are essential for livelihood security;
- an emphasis on ecosystems as natural barriers;
- community preparedness.

Table 2. Occurrence of category 4 and 5 hurricanes, 1975-89 and 1990-2004

Source: Webster et al. 2005

	1975–1989		1990–2004	
Basin	number	percent of total	number	percent of total
East Pacific Ocean	36	25	49	35
West Pacific Ocean	85	25	116	41
North Atlantic	16	20	25	25
Southwestern Pacific	10	12	22	28
North Indian	1	8	7	25
South Indian	23	18	50	34

Integrating disaster risk reduction can occur only if people and organizations in various sectors make a collaborative effort. What is needed is an integrated effort by emergency, humanitarian and environmental agencies. This publication explains why this is necessary and provides guidance on how this integration can be achieved in practice, in order to better manage disaster risk and reduce the impact of disasters on people's livelihoods.

The Millennium Ecosystem Assessment (2005)[2] produced clear evidence that ecosystems such as coral reefs, mangroves, wetlands and mountain forests, in addition to supporting people's day-to-day livelihoods, are also important in mitigating the impact of natural hazards. Analysis of recent disasters — such as the December 2004 Indian Ocean tsunami and the hurricanes that struck North and Central America in September and October 2005 — demonstrates the importance of habitat protection and natural resource management in decreasing our vulnerability to extreme events. Unfortunately, these factors are often not taken into account in development plans and disaster clean-up operations. This leads to increased vulnerability to future hazards and loss of biodiversity.

Investing in ecosystem management and restoration is essential to help disaster-ridden societies alleviate poverty and achieve economic growth. Conversely, not taking ecosystem management into account in disaster preparedness and post-disaster situations can increase the vulnerability of people's lives and livelihoods.

Although many existing environmental guidelines, laws and policies are relevant to post-disaster emergency response and reconstruction efforts, they are rarely applied in times of crisis. In many cases they are not integrated with the procedures of humanitarian agencies and others involved in emergency response, who are generally the first on the ground. Neither can they be easily utilised by non-specialists.

Some guidelines are too cumbersome to apply in a post-disaster context. The Sri Lanka government discovered this after the Indian Ocean tsunami when it urgently needed to identify temporary settlements for over 600,000 homeless people. The exigency of the task made it impossible to carry out Environmental Impact Assessments (EIAs) at all sites, and capacity to carry out rapid environmental assessments (REAs) was not available.

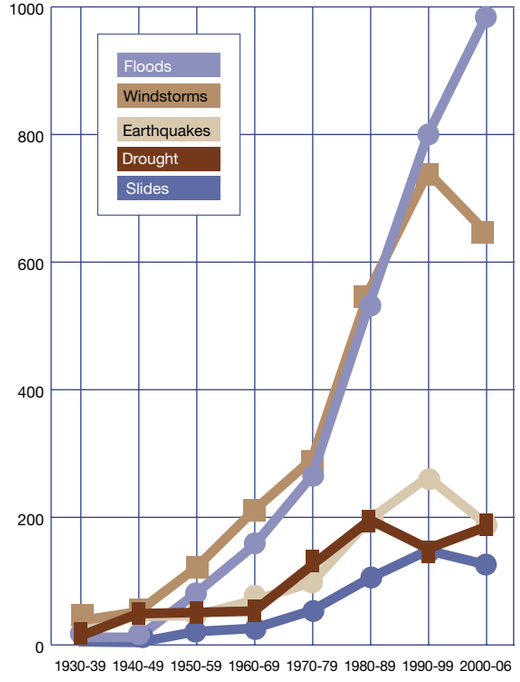


Figure 1. Number of certain types of disasters, 1930–2006

Source: The OFDA/CRED International Disaster Database: www.em-dat.net; Université Catholique de Louvain - Brussels - Belgium (see endnote 3)

Although one could argue that environmental issues might not be the main focus during a disaster, environmental concerns — along with poor governance of natural resources — are part of the underlying causes of many, if not most, humanitarian crises. The solution to these crises is not more, or more detailed, environmental guidelines. Making existing guidelines more available may help somewhat, but they will still have limited impact. Rather, the aim should be to integrate basic environmental issues into the operations of emergency response agencies — some of whom have already made some headway with this — and to provide basic environmental training to relief and reconstruction staff. Furthermore, emergency procedures have to be devised that will facilitate the accelerated implementation of key environmental provisions in post-disaster situations. For example, rapid environmental assessments could have helped to reduce the environmental impacts — such as flooding, water contamination and human-animal conflicts (Ranaviraja and Bambaradeniya, pers. comm.) — that currently affect Sri Lanka's transitional camps.

CARE is helping 13 potter families in the village of Thalaluvilla, Sri Lanka rebuild their livelihood.s The 2004 tsunami destroyed kiln ovens, pottery wheels, storage racks and other tools of their trade.
©Robert Go, CARE

Reconstructing livelihoods, while traditionally the domain of development planning, also depends on environmental factors, including post-disaster waste management and mitigation using natural and artificial barriers. These activities need to be coordinated with land-use decisions. Reducing the impact of future disasters involves mapping hazards (using ecosystems to buffer these risks), enforcing zoning regulations, and building capacity. Ecosystem management, development planning and disaster risk management need to be integrated and institutionalized at regional, national and local levels in order to have a real on-the-ground impact in reducing the risk of natural disasters.

How the book is structured

This publication is divided into three sections. The first section provides five reasons why it is important to integrate ecosystems and long-term livelihoods concerns into disaster risk reduction:

- **Reason 1.** It can decrease vulnerability to natural disasters. There is mounting evidence that climate change is increasing the frequency of extreme hydro-meteorological events such as heat and cold waves, tropical hurricanes, windstorms, flooding and mudslides (IPCC 2001). Serious human consequences are escalating due to the greater number of people in high-risk areas such as floodplains, coastal areas, small islands and steep slopes.
- **Reason 2.** Natural disasters have a high cost. Natural disasters have a negative impact on economic growth and disproportionately affect the poor. They have an incommensurate impact on less developed countries and poor populations, impeding progress toward achieving Millennium Development Goals.

- **Reason 3.** It costs less to prevent disasters than it does to fix the damage they cause. Natural barriers are cost-effective insurance against many types of natural disasters. Preventing loss is significantly less expensive than reconstituting livelihoods, and prevention measures need to be mainstreamed into disaster risk reduction. Such measures include investing in ecosystems such as sand dunes, mangrove belts, coral reefs, wetlands and use of forested slopes as barriers. Community preparedness and reducing population vulnerability through development planning are also important.
- **Reason 4.** At-risk populations depend on ecosystem services for their livelihoods. Poor populations are more vulnerable to natural disasters; they depend on environmental resources for protection and livelihoods. Therefore, investing in natural barriers and mainstreaming disaster risk and ecosystem management in development planning is likely to make a major contribution to the goal of achieving sustainable livelihoods for the poor.
- **Reason 5.** Natural disasters and the responses to them have a negative impact on biodiversity. Disasters can affect biodiversity through the spread of invasive species, mass species mortality and loss of habitat. Poorly planned post-disaster response and reconstruction work often do more damage to biodiversity than the disaster itself. This in turn threatens the ecosystem services — including food and medicinal plants and animals, clean water and air and buffers from extreme natural events — that are critical to people's livelihoods (see point 4 above).

The second section provides information about the Ecosystem Approach and how its application can contribute to reducing the risk of disasters and to alleviating the impacts of disasters when they do occur.

The third section offers eight practical recommendations for implementing an integrated approach to disaster management. Each of these recommendations is illustrated by one or more examples from the field:

- **Recommendation 1.** Invest in effective early warning and preparedness measures.
- **Recommendation 2.** Establish effective emergency response procedures which include a basic three-point environmental contingency plan (protecting water supplies, safeguarding hazardous materials, and protecting critical ecosystems for human well-being and biodiversity).
- **Recommendation 3.** Engage in rapid environmental assessments and post-disaster clean-up operations that include minimum environmental standards to minimize long-term recovery problems.
- **Recommendation 4.** Integrate long-term development planning — particularly related to site selection, demand for construction materials, waste management and zoning — into recovery and reconstruction initiatives;
- **Recommendation 5.** Rehabilitate and restore ecosystems for livelihoods. Invest in restoring and maintaining ecosystems for protection, provisions and biodiversity and ensure the participation of local people in this work.
- **Recommendation 6.** Invest in mitigation strategies to strengthen natural and artificial defences and invest in local capacity-building;
- **Recommendation 7.** Coordinate risk reduction measures at the regional, national and local levels; and
- **Recommendation 8.** Institutionalize and integrate ecosystem-based management, development planning and disaster management.

A glossary, list of resources, references, and a list of presentations from a workshop organized in June 2005 by IUCN's Commission on Ecosystem Management are provided at the end of the book.

In search of shelter, Balakot area, Pakistan.
© IUCN/Karl Schuler

Ecosystems matter to disaster risk reduction, and they can be managed to reduce disaster risk more effectively. Ecosystems provide valuable protective services, including buffers such as mangrove forests and coastal wetlands. Better management of ecosystems can assist disaster-ridden societies in alleviating poverty and achieving economic growth. Taking ecosystem management into account in disaster preparedness and post-disaster situations can decrease the vulnerability of people's lives and livelihoods.

There are five reasons to integrate ecosystem-based management in disaster risk reduction and development planning:

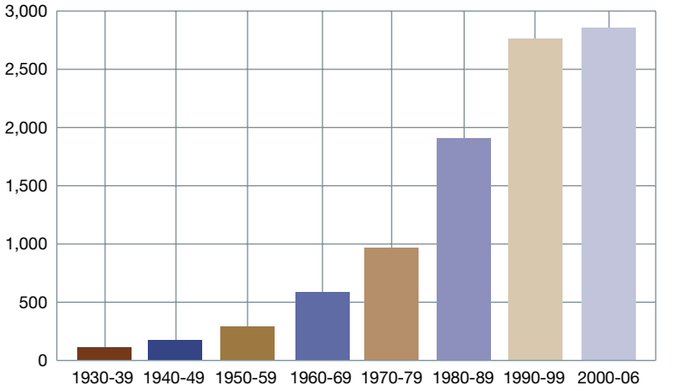
1. It can decrease vulnerability to natural disasters.
2. Natural disasters have a high cost.
3. It costs less to prevent disasters than it does to fix the damage they cause.
4. At-risk populations depend on ecosystems for their livelihoods.
5. Natural disasters and the responses to them have a negative impact on biodiversity.

Reason 1. It can decrease vulnerability to natural disasters

Although uncertainty surrounds the extent to which climate change will affect weather patterns in the coming years, most scientists accept that there will be increases in air temperature and sea surface temperature, rises in sea level, changes in rainfall and more extreme weather conditions (IPCC 2001, Watson et al. 2001). Climate change takes two main forms: a shift in average climate conditions — known as slow onset changes — and an increase in sudden extreme events (Tompkins et al. 2005). Natural disasters due to hydro-meteorological conditions are on the rise *(see Figure 2)*, especially extreme hot and cold spells, tropical hurricanes, flooding events and mudslides (IPCC 2001). Although less deadly than earthquakes, hydro-meteorological hazards directly affect large numbers of people and their livelihoods: an estimated 157 million people in 2005, up by 7 million compared to 2004.[3] Natural disasters affect human health and biodiversity as well as agriculture, water resources and coastal and marine resources.

Figure 2. Number of natural disasters, worldwide: 1930–2006

Source: The OFDA/CRED International Disaster Database: www.em-dat.net; Université Catholique de Louvain–Brussels–Belgium (see endnote 3)



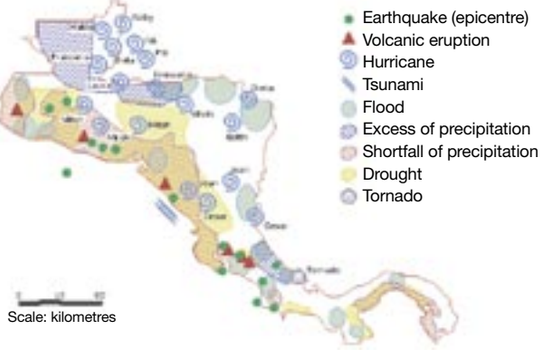
The serious human consequences of these extreme natural events are also increasing due to the greater number of people in high-risk areas such as floodplains, coastal areas, small islands and steep slopes. Nearly three billion people — almost half of the world's population — live in coastal zones (ISDR 2004). Many of these areas were settled long ago and continue to be densely populated, as they provide either fertile soils or proximity to the resources that people need to sustain their lives (Map 1).

Populations adapt their livelihoods to hazardous conditions in spite of the risk because most of them do not have an alternative. People have always found ways to adapt to new situations, although climate change is creating unprecedented human consequences. It forces already vulnerable populations to quickly adapt to new and greater risks that affect them and their livelihoods.

Map 1. Principal disasters in Central America, 1960–2001

Map 1 provides a visual summary of the many natural hazards that have faced Central America from 1960 until 2001. Since 2001, the region has been struck by Hurricane Ivan (2004), Hurricane Jeanne (2004) (which mainly struck the Caribbean, causing mudslides and 1,800 deaths in Haiti), and Tropical Storm Stan (2005; *see Case Study 2*) causing some 1,500 deaths across the region mainly due to heavy rains. Hurricane Beta struck Nicaragua in October 2005 with minor damage.

Map produced by CEPREDENAC, 2001; updated from A. Lavell 1998 and A. Arenas 1999. Translation of legend by IUCN, Gland. In Giusto-Robelo, 2005

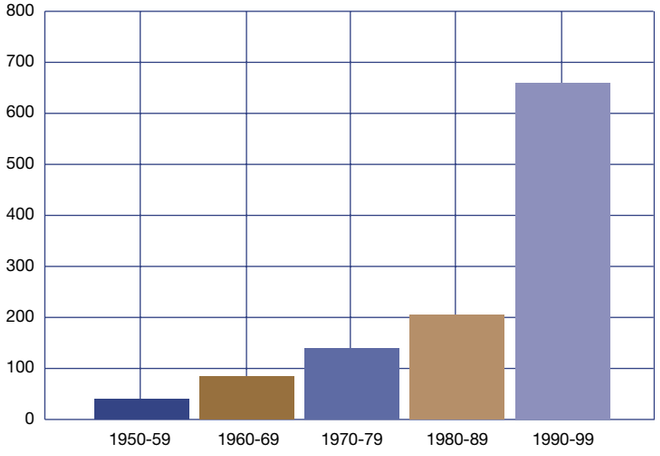


Reason 2. The high cost of natural disasters

Natural disasters have a negative impact on economic growth and a disproportionate effect on the poor. According to the reinsurance giant Munich Re (a member of the U.N. Inter-Agency Task Force on Disaster Reduction) the number of major disasters has quadrupled between 1980 and 1990 compared to 1950-1959. Economic losses (Figure 3) were 14 times higher, a total of US$ 660 billion (ISDR 2004; UNDP 2004).

Figure 3. Losses in U.S. billions of dollars (2002 values) from major disasters

Source: Munich Re, in UNDP 2004



These numbers largely reflect losses incurred in industrialized nations. Hurricane Andrew, for example, was one of the most costly because many U.S. coastal properties were insured, whereas few people in developing countries have insurance. According to the United Nations Development Programme (UNDP 2004), although absolute levels of economic loss are greater in developed countries, due to the far higher density and cost of infrastructure and production, less-developed countries suffer higher levels of relative loss when seen as a proportion of Gross Domestic Product (GDP). For example, losses from the 1997-1998 El Niño event in the U.S. amounted to US$ 1.96 billion or 0.03 percent of GDP. The economic losses in Ecuador due to El Niño were US$ 2.9 billion, which represented 14.6 percent of GDP (ISDR 2004). As a result, in 1998 and 1999 Ecuador suffered reduced or negative growth (7 percent negative annual GDP in 1999). The 1982-83 El Niño event resulted in a 3 percent negative annual GDP, and the 1987 earthquake caused a 6 percent negative annual GDP (see Figure 4).

The 2005 Atlantic hurricane season was one of the most active and longest ever on record, with 27 hurricanes, the strongest recorded storm in July (Dennis), the most intense cyclone ever recorded (Wilma), one of the costliest ever recorded (Katrina: US$100 billion) and the first hurricane to hit Spain (Vince) since the existence of written records. In 1998, Hurricane Mitch, one of the worst hurricanes in 200 years,

caused 11,000 deaths, 460,000 homeless and direct and indirect losses of US$ 6.0 billion in Central America. Forecasters predict that future hurricane seasons will be as active or more active (Giusto-Robelo 2005).

Statistics and insurance claims alone do not fully convey the economic impact of disasters. Nor do the figures adequately reflect the millions of poor people whose lives are indirectly disrupted by the economic impact of natural disasters. Some people have a greater relative risk because social or economic inequalities create more vulnerable everyday living conditions (ISDR 2004).

Artisanal fishing in Chiapas, Mexico
IUCN Photo Library © IUCN/Enrique Lahmann

Disasters can wipe out the gains of economic development, affecting any achievements made in reaching Millennium Development Goals. The size of a nation's economy, the proportion of its land area exposed to hazard and the degree of diversity in its economy all contribute to disaster risk (UNDP 2004). In Viet Nam, even in "normal" years, flooding destroys an average 300,000 tonnes of food (IFRC 2001).

In terms of the toll on human lives, there is also considerable geographic variation in the impact of natural hazards. Asia was affected by approximately 43 per cent of all natural disasters during the 1990s but accounted for almost 70 per cent of lives lost. Floods in China affected 200 million people during El Niño periods of 1991–1992 and 1997–98 (ISDR 2004). In relative terms, however, Africa is the worst-affected region, due to the impact of drought, epidemics and famine (ISDR 2004).[4]

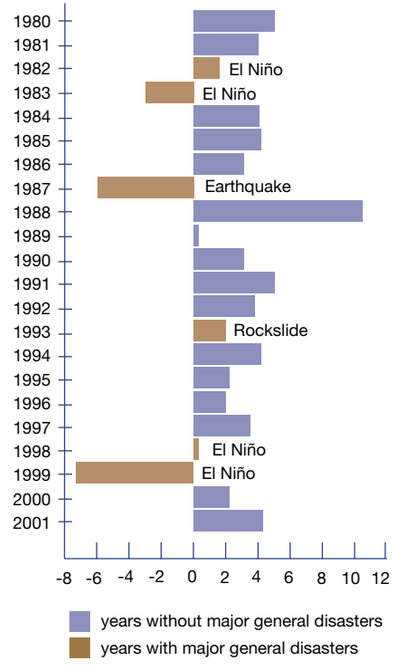


Figure 4. Effect of natural disasters on GDP, Ecuador: 1980–2001

Source: ISDR 2004 (PRECUPA/SDC project, Central Bank of Ecuador, 2002)

The number of deaths is directly linked to the type of disasters that occurred over the past decades. Floods and droughts can have a devastating effect on large numbers of people and their economic livelihoods but are less likely than earthquakes and wind-storms to cause loss of life. Economic damage also does not reflect the large number of uninsured people in developing countries who are affected by hydro-meteorological disaster events.

Reason 3. It costs less to prevent disasters than it does to fix the damage they cause

A number of organizations — such as the ProVention Consortium,[5] The International Red Cross and Red Crescent societies, the U.N. International Strategy for Disaster Reduction, Central America's Coordination Centre for Natural Disaster Prevention (CEPREDENAC) and the Asian Disaster Preparedness Centre — are making the case that prevention is an ethical and cost-effective way to address the increasing frequency of natural hazards. Several assessments demonstrate that investing in risk management can deliver significant socio-economic benefits (Twigg 2004; World Bank 2004).

- The World Bank and the U.S. Geological Survey estimate that economic losses worldwide from natural disasters in the 1990s could have been reduced by $280 billion if $40 billion had been invested (Box 1) in preventative measures (World Bank 2004).
- Switzerland long ago recognized the value of forests in protecting people, settlements and important economic assets (roads, industries, infrastructure, tourism) against avalanches and landslides. The protection afforded by forests was estimated to save US$ 2–3.5 billion per year (ISDR 2004).
- After the 1993 floods in the U.S. midwest, the government bought out flood-prone residents and moved them to areas outside the 100-year flood plain. This reduced flood claims in subsequent flood events. The buyout initiative resulted in a significant reduction in the number of claims to the National Flood Insurance Program and made land in flood plains available for other purposes.

Rather than spending scarce funds on emergency relief and reconstruction, it is more cost-effective to invest in enhancing ecological protective systems. This will, however, require long-term objectives and planning. In the long run, economic sustainability, hazard mitigation and enhanced risk assessment — utilizing appropriate tools — will have environmental benefits (ISDR 2004).

Box 1 Investing in disaster reduction

The World Bank estimates that every dollar invested in disaster reduction measures saves seven dollars in losses from natural disasters.

World Bank, 2004

Protective values of ecosystems

Ecosystems provide valuable protective services (Box 2). Forest cover reduces soil erosion and landslides; sand dunes and mangrove forests protect against wave surges; and wetlands mitigate the impacts of flooding.[6] The degree of protection provided by ecosystems depends on a number of factors, especially their resilience to stress and the intensity of the storm or flooding event (Folke et al. 2002). If ecosystem services are damaged or destroyed, substantial costs must be incurred to restore or replace them. In addition to being insurance against natural disasters, which particularly benefits poor populations, ecosystems can bring a significant return on investment:

- A study of the value of conserving upland forests that form the watershed for the Vohitra River in Eastern Madagascar estimated the net present value (NPV)[7] of protection benefits at $126,700. This value arises from the reduced costs of flooding and the increased net market value when less paddy is damaged by flooding (Emerton and Bos 2004).
- Sri Lanka's Muthurajawela marsh, a coastal peat bog covering some 3,100 hectares, is an important part of local flood control. The marsh significantly buffers floodwaters from the Dandugam Oya, Kala Oya and Kelani Ganga rivers and discharges them slowly into the sea. The annual value of these services was estimated at more than $5 million, or $1,750 per hectare of wetland area (Emerton and Bos 2004).

Drought in Mauritania.
IUCN Photo Library © IUCN/Ibrahim Thiaw

- In Malaysia the value of intact mangrove swamps for storm protection and flood control has been estimated at US$ 300,000 per km, which is the cost of replacing them with rock walls (Ramsar Convention on Wetlands 2005).
- The 40,000 hectares of managed mangrove forest in Matang, West Malaysia yield $10 million in timber and charcoal and over $100 million in fish and prawns every year (Talbot and Wilkinson 2001).
- Mangrove forests in southern Thailand provide an estimated $3,679 NPV per ha in coastline protection and stabilization (Suthawan and Barbier 2001).
- Shoreline stabilisation is also important for inland rivers. In the eastern United Kingdom, the loss of vegetation along riverbanks was estimated at US$ 425 per metre of bank. This is the cost of maintaining artificial bank reinforcement to prevent erosion (Ramsar Convention on Wetlands 2005).

- Mangroves and other wetlands, as well as coral reefs, contribute to coastal protection, as they are able to dissipate wave energy (Talbot and Wilkinson 2001). In recent years, mangrove destruction has resulted in damage to the coastal road going into the Portland Ridge, Jamaica. Cesar (2000) estimated that the total coastal protection value was around US$3.55 million in NPV or nearly US$400,000 per year (with a ten percent discount rate).

The data are conclusive: natural barriers, particularly mature sand dunes, mangrove forests, wetlands and coral reefs, are an important part of shore protection and flood mitigation during hurricanes and tropical storms (UNEP-WCMC 2006; Danielsen et al. 2005; see Box 2). The amount of protection offered by a coral reef depends on how continuous it is, the tide and the depth of water (UNEP-WCMC 2006; Gourlay, 1994). In Sri Lanka, it has been estimated that with current rates of erosion and assuming that one km of reef protects five km of shoreline, one square km of coral reef can prevent 2,000 sq. metres of erosion per year (UNEP-WCMC 2006; Berg et al. 1998).

Damage assessments from the 2004 Indian Ocean tsunami concluded that there was significantly more damage to human lives and livelihoods where ecosystems had been disturbed, especially sand dunes, mangroves and coral reefs. (Dahdouh-Guebas et al. 2005; Danielsen et al. 2005). In Thailand, poorly planned tourist developments and fishing communities built close to the shore on flat, low-lying land and in wide, exposed bays with no coral reefs were the worst hit (EJF 2005; UNEP 2005). In Banda Aceh, Indonesia, one of the areas most devastated by the tsunami, large areas of mangroves had been converted to shrimp ponds. It is unclear, however, whether intact mangroves would have saved more lives (EJF 2005). Before the tsunami, it has been estimated that there were 36,597 hectares of fish/shrimp ponds (UNEP 2005).

Box 2 Protective functions of ecosystems

Coastal ecosystems

Mangroves, coral reefs and sand dunes significantly reduce shoreline erosion, lessening the impacts of cyclones, storms and tidal surges. Mangroves are also rich spawning grounds, and they filter upstream sediment that could otherwise smother coral reefs and sea grasses.

Marshes and swamps

Wetlands such as marshes and swamps are important for water storage, storm protection, flood mitigation, shoreline stabilization and erosion control.

Forests

Forests protect against landslides, erosion, floods and avalanches. They also buffer stream flow.

Case Study 1

Frequent cyclones and mangrove protection: Bangladesh

With the greatest population density on earth — 1000 people per sq. km in most areas and higher concentrations along the coasts — Bangladesh is a land-hungry country. It is also extremely vulnerable to yearly tropical storms. The country is home to the Bay of Bengal, the world's largest tide-dominated delta. Cyclonic storms hit the bay every monsoon season, with devastating impacts to its low coastline. These cyclones rework large amounts of the delta sediments, which constitute 80 percent of the Bangladesh land area.

Due to delta sedimentation, the rapidly changing eastern coasline does not support mangrove vegetation as diverse as that found on the more stable Sunderabans on the western coast. There, a rich mangrove forest provides three functions:

- it forms the basis of an important forest industry;
- it filters upstream silt; and
- it provides a rich spawning ground for fish and shellfish.

Extensive mangrove forests also provide protection during cyclones, and calm lagoons are a place of refuge for coastal populations. Severe population pressure has seriously affected the mangrove belt, however, reducing its ability to protect the coastline.

In 1991, a Bay of Bengal cyclone caused more than 138,000 deaths, mainly from drowning. Since then, the Bangladesh government has embarked on an ambitious mangrove reforestation programme called the Coastal Green Belt to extend the protective mangrove belt eastward. The programme is intended to demonstrate the high protective value of mangrove stands in reducing disaster risk. The goal is to protect vulnerable coasts with forest belts two km wide on at least a third of the coastline. Another third is designated for aquaculture, with the remainder intended for agriculture. So far more than 120,000 ha have been planted with high-quality mangroves. In the face of high population pressure, maintaining the mangrove belts will be the main challenge (Nishat 2005 and Talbot and Wilkinson 2001).

Mangroves.
IUCN Photo Library © IUCN/Nicolas Van Ingen and Jean-François Hellio

Reports from Simeuleu Island, which is only 41 km from the epicentre of the earthquake, indicate that the island was saved partly by its substantial mangrove cover, coral reefs and seagrass beds. It suffered only four deaths in the disaster (WI 2005).

Other studies indicate that for tsunamis, the buffering capacity of reefs and mangroves is more variable, possibly depending more on coastal bathymetry (Baird et al. 2005; UNEP-WCMC 2006). The Bangladesh coast, with its frequent cyclones, is a good example of the protective role of ecosystems *(see Case Study 1, page 15)*.

Reason 4. At-risk populations depend on ecosystem services for survival

The causes of vulnerability are as numerous as the causes of poverty. Vulnerability is a complex issue, rooted in a number of causes: poor governance, rapid urbanization, population growth and migration, social inequities, inequitable land tenure issues, uneven crop production, and unsustainable resource use (Borrini-Feyerabend et al. 2004). There are many examples of the correlation between environmental degradation and vulnerability:

- deforestation leads to soil erosion which increases the chance of landslides;
- draining of wetlands for agriculture leads to flooding;
- sand extraction from dunes for construction increases vulnerability to sea surges;
- conversion of mangroves for aquaculture increases vulnerability to cyclones and sea surges.

The World Bank has estimated that 80 percent of the poor in Latin American, 60 percent of the poor in Asia and 50 percent of the poor in Africa live on "marginal lands" (Twigg 2004). Paradoxically, many high-risk areas — coastal areas, low-lying floodplains, riverbeds and volcanic zones — offer good conditions for sustaining livelihoods. Either willing to accept a certain level of vulnerability, or unable to avoid it, people have always tried to manage risk by modifying their environment. They have built terraces to prevent landslides, irrigation canals to reduce drought, and sea walls to protect against storms. If poor populations live on marginal or high-risk land, it is because they often have no other choice. Richer populations, who are less dependent on the natural environment, tend to live on higher ground, away from high-risk areas. This is true in both developing and developed nations. Hurricane Katrina is a case in point: the poorest, most vulnerable citizens were affected most severely.

Fishing boats in Sri Lanka
©IUCN/Channa Bambaradeniya

Natural disasters include volcanic eruptions, hurricanes, earthquakes, tsunamis, floods, storms, dust storms, droughts, landslides, forest fires, hail and tornadoes. They are "natural" only to the extent that nature acts to trigger a disaster event. The extent of damage from a natural disaster closely correlates with levels of development and awareness of risk. It also corresponds to factors such as population preparedness, ability to self-organize and adapt to change, extent of habitats in high-risk zones, existence of early warning systems, and capacity of ecosystems and artificial barriers to mitigate impacts. The relative presence or absence of these factors determine a population's vulnerability to natural disasters (IISD/IUCN/SEI 2003). Several other factors also contribute to vulnerability (adapted from Zimmermann 2005):

- population growth and use of unsuitable areas (urban and rural);
- urbanisation and concentration of assets;
- environmental change (climate change and climate variability, deforestation, soil degradation).

People generally understand and value the protection offered by natural barriers such as sand dunes, mangroves, reef barriers and forested slopes. For example, coastal communities have traditionally used the quiet lagoons created by mangroves for protection during storms (UNEP-WCMC 2006). Ecosystems can provide cost-effective insurance against the full impact of a disaster. They are threatened, however, by high population pressure and/or poor governance. One tragic example is Haiti, where, over many years, high demand for firewood caused severe deforestation of hillsides. In 2004, Hurricane Jeanne caused 1,800 deaths in Haiti, mainly due to mudslides; on the other side of the island, in Dominican Republic, few deaths were reported except 400 in border town Jimani.

There are three requirements for disaster risk reduction strategies to be effective:

- they need to be mainstreamed into development planning;
- they must be multi-sectoral; and
- they must invest in ecosystem management.

Reason 5. Natural disasters and responses to them have a negative impact on biodiversity

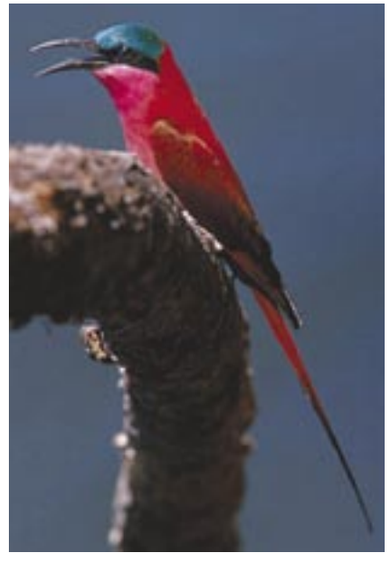
Ecosystems provide a number of vital services — including medicinal plants, clean water and air and buffers from extreme natural events — and biodiversity is the foundation upon which ecosystems are built. Biodiversity includes the number and array of species present in an ecosystem. Many aspects of the stability, function, and sustainability of ecosystems depend on biodiversity (Tilman 1997). Biodiversity is

fundamental to maintaining an ecosystem's health in response to stress, disturbance or other environmental changes (SER International 2004). Some stressors can actually maintain ecosystem integrity by preventing the establishment of other species that are not adapted to these stress events (SER International 2004). Examples include the tidal influx of saline water that maintains salt marsh ecosystems, and the localized wild fires that maintain prairie grasslands.

Most healthy ecosystems can rebound naturally from a stress event if it is not prolonged or repeated. Human-induced stresses, however, such as loss of habitat, unsustainable forest practices, overgrazing and extreme hydro-meteorological events resulting from climate change, lead to irrevocable disturbance to ecosystems. This in turn can cause irreversible loss of biodiversity. Changes in ecosystems will affect the supply of water, fuel wood and other services that affect human health and agricultural production (IPCC 2001). Extreme climate conditions will lead to reduced biodiversity, reduced ecosystem protection, and inevitably, increased human vulnerability to natural hazards.

Damage to biodiversity can be caused by the clean-up after a disaster, as well as by the disaster itself. In the aftermath of the 2004 tsunami, a number of inappropriate clean-up methods, along with resettlement of disaster victims in environmentally fragile areas, had serious impacts on ecosystems and the recovery of human livelihoods. Dumping debris in coastal wetlands blocked drainage, increased human disease and reduced the production of fish and other goods upon which local people depend. Bulldozing of beaches and improper ecosystem rehabilitation led to the spread of invasive species. Using unsustainable sources of building materials — sand from dunes essential to coastal protection, cement from coral reefs and wood from coastal forests — led to the loss of biodiversity and increased people's vulnerability to future disasters.

Avoiding loss of biodiversity, especially in the aftermath of a disaster, requires significant pre-disaster planning and effective management of natural resources. Protecting biodiversity is not only a solution to more effective disaster risk reduction, it is also another reason to improve post-disaster management.



Southern Carmine Bee-eater (Merops nubicoides)
© Håkan Liljenberg

The Ecosystem Approach

The Ecosystem Approach can help to manage resource use more effectively and contribute to reducing the risk and impact of disasters. It is a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way. The Ecosystem Approach puts people and their natural resource use practices squarely at the centre of decision-making.

Local fishermen repair nets in the Rio Grande de Buba, Guinea-Bissau
IUCN Photo Library © Philippe Tous

Because of this, the Ecosystem Approach can be used to seek an appropriate balance between the conservation and use of biological diversity in areas where there are both multiple resource users and important natural values. It is therefore of relevance to professionals and practitioners active in farming, forestry, fisheries, protected areas, urban planning and many other fields.

The IUCN Commission on Ecosystem Management (CEM) works on furthering the Ecosystem Approach and provides practical assistance in applying the Ecosystem Approach in the field (Shepherd 2004).

The Ecosystem Approach was endorsed by the fifth Conference of the Parties at the Convention on Biological Diversity (COP-5 in Nairobi, Kenya; May 2000/Decision V/6) and has been incorporated in national CBD plans around the world. It comprises five steps (adapted from Shepherd, 2004):

- Step A Determining the main stakeholders, defining the ecosystem area, and developing the relationship between them.
- Step B Characterizing the structure and function of the ecosystem, and setting in place mechanisms to manage and monitor it.
- Step C Identifying the important economic issues that will affect the ecosystem and its inhabitants.
- Step D Determining the likely impact of the ecosystem on adjacent ecosystems – or applying adaptive management across spatial units.
- Step E Deciding on long-term goals, and flexible ways of reaching them – or applying adaptive management over time.

Why apply the Ecosystem Approach to disaster management?

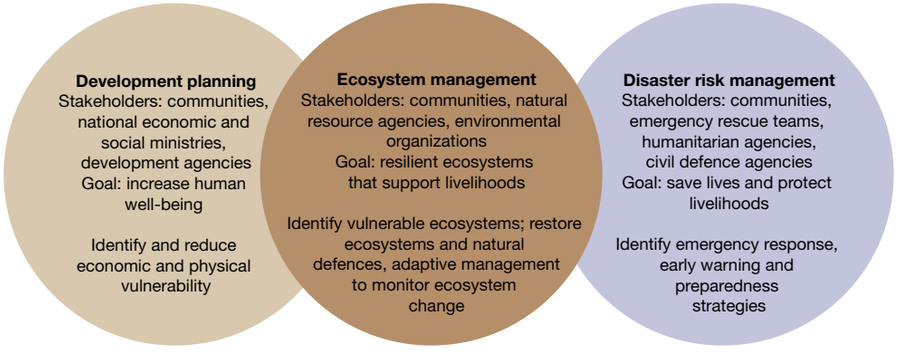
The ecosystem approach has several benefits:

- it ensures the rapid recovery of ecosystems on which local livelihoods depend.
- it avoids disaster responses that have a negative impact on ecosystem recovery.
- it enhances communities' capacity to recover their livelihoods.
- it brings the greatest improvements to present-day livelihoods while minimizing the impact of future disasters (Masundire 2005).

The Ecosystem Approach is considered one of the most promising strategies to manage or restore ecosystems and their services while focusing on human livelihood needs. It is a relatively recent concept and the tools for its application are still evolving. Promoting increased investment in ecosystem management and restoration will require the building of coalitions with non-environmental groups. Many of these organizations have started to recognize the importance of ecosystems in disaster prevention.

Figure 5 illustrates the connections between ecosystem management, development planning and disaster risk management. Although they each have their own specific set of stakeholders, goals and actions, a number of goals and actions are inter-related, such as the overarching objectives of saving lives, human well being and supporting livelihoods.

Figure 5. Using the Ecosystem Approach to ensure long-term sustainability



Long-term sustainability must be integrated into all aspects of disaster risk management: emergency response, post-disaster clean-up, livelihood recovery, ecosystem restoration for livelihoods and mitigation strategies. Efforts should be coordinated locally, nationally and regionally. Development planning, ecosystem management and disaster management should be institutionalised.

How to implement an integrated approach

This section offers concrete examples of how to implement an integrated approach to disaster management:

A boy and a donkey carrying wood in Guatemala.
IUCN Photo Library © IUCN/Jim Thorsell

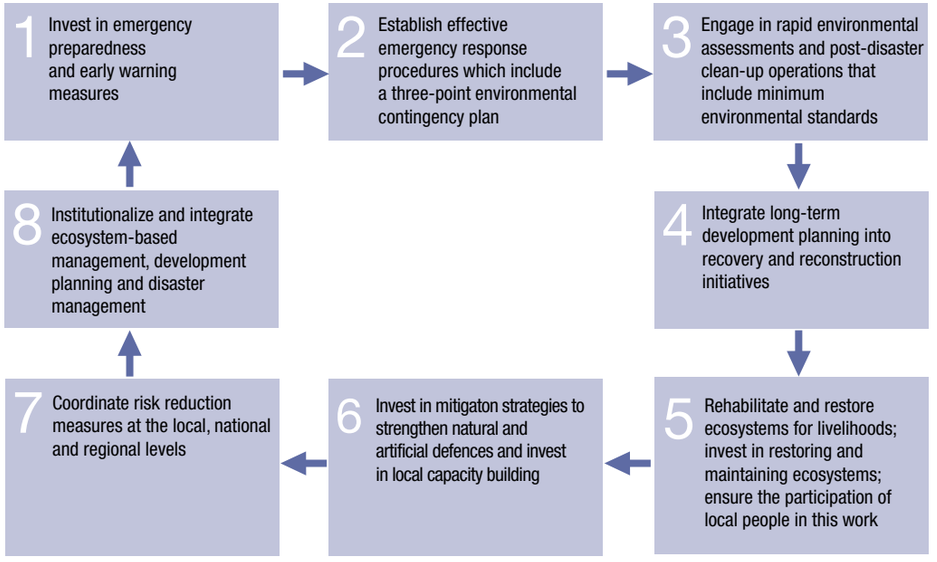
- **Recommendation 1.** Invest in effective early warning and preparedness measures;
- **Recommendation 2.** Establish effective emergency rescue procedures which include a basic three-point environmental contingency plan (protecting water supplies, safeguarding hazardous materials, and protecting critical ecosystems for human well-being and biodiversity);
- **Recommendation 3.** Engage in rapid environmental assessments and post-disaster clean-up operations that include minimum environmental standards to minimize long-term recovery problems;
- **Recommendation 4.** Integrate long-term development planning — particularly related to site selection, demand for construction materials, waste management and zoning — into recovery and reconstruction initiatives;
- **Recommendation 5.** Rehabilitate and restore ecosystems for livelihoods. Invest in restoring and maintaining ecosystems for protection, provisions and biodiversity and ensure the participation of local people in this work;
- **Recommendation 6.** Invest in mitigation strategies to strengthen natural and artificial defences and invest in local capacity-building;
- **Recommendation 7.** Coordinate risk reduction measures at the regional, national and local levels; and
- **Recommendation 8.** Institutionalize and integrate ecosystem-based management, development planning and disaster management.

Background

In spite of advances made in predicting and warning of natural disasters, they often strike unexpectedly. Their magnitude or their timing may be unforeseen. The extent of damage they cause is inversely correlated to a community's degree of emergency preparedness and access to early warning. In the hours and days following a disaster, speed is key to saving lives and is the main focus of the emergency response. It is often during this chaotic time that considerable environmental damage is done. This reduces the prospect of livelihoods being able to make a rapid recovery.

Disaster management can be made more effective by integrating ecosystem management strategies and tools (Figure 6). A simple three-point environmental emergency contingency plan is required. In order for such a plan to be effective it will require significant pre-disaster preparation, coordination and communications by professionals in civil defence, emergency response units, and environmental and humanitarian agencies.

Figure 6. Integrated disaster risk management cycle



Source: Adapted from Dolcemascolo 2004

Once the immediate focus has turned from saving lives to clean-up and recovery, it is possible to act quickly while still respecting minimum environmental standards for waste management. This requires pre-disaster training, coordination and the ability to conduct rapid environmental assessments (Box 5). The same process can be applied when establishing temporary or transitional shelters. The goal is to avoid further environmental damage that will slow the long-term recovery of livelihoods. Activities that can worsen environmental problems include dumping waste materials in wetlands (creating flooding and disease-ridden swamps), and situating temporary shelters on sensitive sites (creating human-animal conflicts, sanitation and water contamination problems).

Several concerns mark the reconstruction phase:

- selecting sites for temporary and permanent housing;
- obtaining materials from sensitive ecosystems, such as coastal sand dunes, coastal forests or steep slopes;
- waste management; and
- enforcing zoning regulations.

Because of the immediate livelihood needs, trade-offs are difficult to avoid. Waiting for sustainably harvested timber may worsen a difficult housing situation; importing sand may considerably raise costs. Reusing materials from damaged buildings can reduce the need for new building materials but can also increase costs. It is important to resolve these issues. Unsustainable management of the reconstruction phase can have serious long-term ramifications, increasing a population's vulnerability to future disasters. Enforcing minimum environmental standards for site selection and materials can promote the long-term recovery of livelihoods and reduce risk.

Ecosystem rehabilitation and restoration are key components of livelihood recovery. Once the initial damage has been assessed, the next step is to include stakeholders in restoring the ecosystems on which they depend for food, supplies and protection. Progress toward recovery needs to be monitored and adjusted, taking into account factors such as invasive species and demand for materials.

Disasters typically force people to reassess and adapt their living conditions to reduce their future risk. Mitigation strategies should be both structural (natural and/or artificial) and non-structural (capacity-building). Structural adaptation strategies include restoring protective ecosystems such as mangroves, rebuilding houses on pillars, erecting protective dikes, or voluntary relocation to higher ground. Voluntary relocation implies a number of land tenure issues, often with loss of rights for the poor.[8] Non-structural capacity-building strategies include improving disaster coordination, stocking emergency supplies, establishing simple flood gauges, and enhancing communications.

A new road built across the mouth of a lagoon, Sri Lanka.
©IUCN/Channa Bambaradeniya

Coordinating risk reduction strategies at local, national and regional levels requires significant communication within and across sectors. Successful examples include Central America's Central Coordination Centre for National Disaster Prevention (CEPREDENAC) and the Asian Disaster Preparedness Centre. In addition to their disaster response activities, these organizations have established coordination centres and communication strategies for coordinating risk reduction. They communicate at the local, national and regional levels.

Increasingly adverse climate conditions present new risks and challenges to human safety and national security, and governments, development organizations and humanitarian agencies are reconsidering their land-use plans and development actions. Because poverty, vulnerability and environmental conditions are intertwined, efforts to reduce disaster risk will only be effective in the long-term if they are integrated and institutionalized. In South Africa, Australia and Viet Nam, several national strategies and humanitarian agencies have integrated risk management with land-use planning. South Africa has created legal mechanisms for institutionalizing disaster risk reduction at local and national levels. Viet Nam has a national plan for the environment and sustainable development that includes disaster risk reduction. It includes measures to combat the effects of climate change, as well as integrated management of watersheds, catchment areas and floodplains through forest management, and soil and water conservation (ISDR 2004).

In order to integrate and institutionalize disaster risk reduction, significant investments are needed to design and test tools, and to build the capacity of stakeholders to use them effectively. Ecosystem-based management offers a set of holistic and system-based tools that can be applied to long-term pre-disaster risk reduction management, as well as more sustainable post-disaster management.

Recommendation 1. Early warning and preparedness

Emergency preparedness and early warning systems generally fall outside the expertise of environmental organizations such as IUCN. At the same time, disaster response planning is essential to minimizing environmental damage. Risk awareness may enable a community to reassess its living conditions by enforcing buildings, relocating people or avoiding the use of scarce resources should disaster strike. Experience in previous disasters reveals the importance of effective coordination and communications between forecasting agencies, national and local governments, and local volunteer networks. International, regional and national cooperation can develop state-of-the-art early warning systems but it is the preparedness of local communities that will limit the impact of a disaster (Box 3).

Box 3

Community-based disaster preparedness in Mozambique

Matasse is a rural community of 2,000 people threatened by flooding. Last year, the Mozambique Red Cross (CVM) initiated a project in community-based disaster preparedness. CVM emphasizes the importance of respecting local tradition and involving villagers to ensure that projects will succeed. They arranged community meetings to describe the project and to recruit volunteers.

The volunteers were trained to analyse potential hazards and identify ways of preparing the community to save lives and livelihoods. They drew up a history of past disasters — charting a pattern of droughts and floods back to 1939 — and recorded how people coped with them. The volunteers also made a seasonal calendar, indicating the times when villagers were most vulnerable to poverty and illness.

Then, with Red Cross help, the volunteers explored their surroundings, visually identifying its key features. They mapped resources, infrastructure and possible risks and hazards. These risk maps covered residential and farming areas and identified those sites most exposed to flooding, as well as the best places of refuge.

This process helped identify a series of objectives. High-priority mitigation activities included planting trees to halt erosion near the riverbank, and constructing a secure community hall to serve as a store for pre-positioned relief stocks and household goods in the event of disaster. High-priority preparedness objectives included recruiting and training new volunteers, rescue training and distribution of radios to improve early warning.

Source: IFRC 2002

Local capacity to prepare for natural disasters should include these components:

- local contingency and risk reduction plans, complemented by early-warning capabilities;
- risk mapping and sustained intensive public education about risk;
- advocacy on civil protection programmes, including awareness-raising through forums, symposiums, dialogues, and drills and exercises, such as National Disaster Consciousness Month in the Philippines (Bildan 2003);
- human resource development programmes, including training in emergency management;
- providing radios to remote communities and vulnerable populations;
- conducting training at national and local levels;
- establishing locally adapted early warning systems;
- planning and drilling in emergency procedures;

- training local volunteers in evacuation and first aid;
- building environmentally safe housing;
- establishing community safe houses, stocked with provisions; and
- building environmentally safe roads, bridges and port infrastructure.

Examples of successful preparedness and early warning systems include Cuba, which evacuated more than 700,000 people in November 2001 as Hurricane Michelle hit the island with wind speeds of up to 220 km per hour. The national hurricane preparedness plan and early warning system is practised and tested every year before the start of the hurricane season. Upon early notice from the Institute of Meteorology, the evacuation involved all actors, from official authorities to companies and cooperatives, deploying thousands of civil defense workers and vehicles for evacuation (ISDR 2004).

Recommendation 2. Effective emergency response procedures

Once a natural disaster has struck, it is too late to effectively prepare or design emergency evacuation plans. Preparedness is essential. At that point, speed and saving human lives is the first priority, and it is the domain of emergency and humanitarian professionals. Even at this critical stage, however, it is possible and advisable to integrate basic environmental concerns into emergency procedures. Making the emergency response more effective will avoid mistakes that can have costly long-term consequences on human health and livelihood recovery.

A basic environmental emergency contingency plan should be complementary to the principal focus of saving lives and should significantly assist the recovery process. It should focus on three main concerns:

1. protecting water supplies. This means no dumping of debris in water recharge areas, as well as situating sanitation facilities away from wells and other water flows, and paying attention to well-water contamination and, if necessary, well cleaning.
2. safeguarding hazardous materials, including asbestos roofing, chemicals and fertilizers. Rather than rushing to clear them away, it is better to wait until they can be properly handled.
3. protecting ecological high-value areas, such as sites of national or international value, areas critical to local livelihood recovery and sites that could create conflict between people and wildlife. Identify the high-priority measures to protect wildlife and ecosystems that will require special attention immediately prior to, during, and after a natural disaster. Objectives and goals should be addressed at national and local levels, and at international levels by countries with shared inland and coastal border regions and shared marine areas.

Case Study 2

Timeline, Tropical Storm Stan: Central America

IUCN's Water and Nature Initiative was caught in the midst of Tropical Storm Stan in Mexico, Guatemala and El Salvador, beginning October 4, 2005.

During the emergency: IUCN provided assistance for the population by evacuating people and transferring them to shelters and Red Cross. There was a lack of access and communications services (electricity, phone and e-mail) and it was difficult to find shelter, food and potable water. Staff established a connection with the Municipal Emergency Committee, and held daily meetings to assess damage.

48 to 72 hours after: Meetings were held with the municipal Civil Protection operations centres to evaluate the contingency and actions to be taken. The level of water in rivers was monitored. Assistance was provided to transport people to shelters and obtain urgently needed food supplies. Meetings were held with the Natural Resources Inter-institutional Coordinating Body to assess damage and determine what actions should be taken. A search was carried out to locate community leaders.

96 hours to 10 days after: Three metric tonnes of food donations received by the National Commission on Protected Areas (CONANP) was distributed in the zone using project vehicles. Talks were held at shelters for hurricane victims to discuss the zone's water problems. Project partners provided logistical support to transport and distribute donated food and clothing to municipalities and local partner organizations of the project. Specialists visited the project area to assess what was needed to re-establish supplies of drinking water.

11 to 20 days after: Arrangements were made with CONANP to obtain 30 metric tonnes of provisions, to be distributed by the Municipality of Cacahoatán (where the project has its headquarters). Pilot projects in the zone were assessed, and some damage assessments were completed. Proposals for the rehabilitation of potable water systems throughout the area were sent to donors.

Current and future actions: IUCN projects will be restructured in the three countries to take risk management into account. Pilot projects that were not affected are being continued, taking social, economic and environmental vulnerability into consideration.

Source: IUCN Mesoamerica, 2005. ms. Tropical Storm Stan in Mesoamerica: Synopsis of actions taken by IUCN in the region.

Tapachula, Mexico during the first hours of Tropical Storm Stan.
© IUCN/Oscar Palomeque

Recommendation 3. Rapid assessments and post-disaster clean-up

Post-disaster clean-up efforts can be as harmful to the environment as the disaster itself, through careless handling of hazardous materials, dumping of debris, the spread of invasive species, and the destruction of habitats and protective ecosystems (Box 4). Often clean-up is conducted quickly in the chaos followed by the initial emergency phase, and is difficult to regulate and coordinate. In Sri Lanka, for example, following the 2004 tsunami, foreign armies were inappropriately clearing and dumping debris. As well as all the challenges created by the tsunami, the local authorities had to deal with these operations (Ranaviraja pers. comm.). Effective clean-up requires that standards be established — before a disaster strikes — that are widely understood and followed.

Once the transition has been made from the urgent life-saving phase, a number of timesaving tools for recovery can assist governments in the post-emergency phase:

- establishing an "environmental help-desk" within emergency response units;
- guidelines for solid waste management; and
- guidelines for Rapid Environmental Assessments (Box 5).

Box 4

Environmental concerns in the aftermath of crises

The idea of considering the environment as part of humanitarian assistance might seem illogical. The midst of a humanitarian crisis may not look like the best time to start trying to address environmental issues; trying to combine environmental action with humanitarian aid could jeopardise both. Still, not considering the environment during a humanitarian crisis risks a number of significant negative outcomes. The environment is a major contributing factor to the origins of most humanitarian crises.

Failing to consider the links between the crisis and the environment means that humanitarian aid will be based on an incomplete and incorrect understanding of the crisis. A likely result is that the aid will do less good than intended, or could actually worsen or prolong the crisis. The concentration of Kosovo refugees in Kukes in Albania, for example, exceeded local waste-handling capacities. As a result, refuse tips overflowed and raw sewage was dumped into stream courses.

At the same time, humanitarian assistance can improve environmental conditions. Following urban fighting, for example, an intervention using food for work in a clean-up campaign can be an effective way of improving the local environment, as well as getting food to the needy.

Source: Kelly 2004

If temporary shelter situation is adequate, permanent rebuilding should be delayed until a Rapid Environmental Assessment (REA) can be conducted *(see Box 5)*. It is important to follow any existing laws and policies that relate to environmental management and protection.

Avoid clearing ecologically sensitive sites such as mangroves, scrubland or forests. Also avoid filling in lowland wetlands and building in watershed areas.

Destruction can be minimized by clearing only the essential minimal area for each building. Natural watercourses, watershed areas, flood plains, etc. must not be blocked by construction.

Efforts should be made to restore and conserve ecosystems as part of the reconstruction process. Adequate sanitation and drainage construction should also be a part of the project (adapted from IUCN 2005a).

Box 5

Rapid Environmental Assessments

A time of crisis does not lend itself to formal Environmental Impact Assessments; the priority is saving lives. Environmental trade-offs are not inevitable, however. Rapid Environmental Assessments (REAs) can highlight environmental issues and quickly provide data for decisions on site selection of temporary housing, waste management, water issues and disposal of hazardous materials.

The Benfield Hazard Research Centre at University College London and CARE International have collaborated to develop and test a process to conduct rapid environmental impact assessments in disasters and other crisis situations. The REA process is designed to provide non-specialists with the means to quickly identify salient environmental issues. It uses a subjective process, which incorporates the perspectives of organizations (e.g. NGOs, local government) and communities on the most important environmental issues related to the crisis. The REA process is designed for use in the first 120 days after the crisis, after which routine EIA procedures should be possible.

Source: www.benfieldhrc.org/rea_index.htm

Recommendation 4. Re-establishing sustainable livelihoods

The focus of an emergency phase soon shifts to relief operations and restoring human livelihoods. Many humanitarian organizations are accustomed to operating with a sense of urgency, compounded by media pressure, with budgets and donor timelines often established based on this notion of urgency (Delaney, Kaul and Miller 2004). After the 2005 earthquake in Pakistan, for example, as the clock ticked toward winter the need for rapid temporary housing was vital. The challenge for governments and humanitarian organizations becomes not only how to assist in a speedy manner but also, how to do it well. First-hand accounts of reconstruction efforts from the 2004 Indian Ocean tsunami demonstrate that this is difficult to achieve (Box 6 and 7).

Long-term recovery receives less media attention than the initial emergency and is more complex and difficult. It also attracts less funding. Without technical assistance to improve on what was there before, people may actually increase their vulnerability to the next disaster. The quest for quick resettlement may lead to hasty decisions and miscalculations, which can hinder long-term recovery. The reconstruction phase involves a number of difficult trade-offs and environmental challenges:

- Site selection: Quick resettlement without minimum reconstruction guidelines may lead to flooding, human-animal conflicts, sanitation problems and water contamination.
- Demand for construction materials: Using unsustainable materials from protective ecosystems such as sand dunes and mangroves can lead to increased disaster risk and reduced ecosystem services for communities.
- Zoning regulations: These protect communities from hazards and delineate valuable areas such as beachfronts or wetlands.

Disregarding zoning regulations during a crisis may place undue pressure on resources and expose communities to unnecessary risk. Also, a crisis can provide a pretext for inequitable land distribution that favours initiatives such as tourism development over land-use rights for the poor.

Box 6 Reconstruction efforts in Sri Lanka

This is a first-hand account of the challenges to reconstruction efforts in Sri Lanka, one year after the tsunami.

I was in the Batticaloa district for a couple of days and the situation there is quite bad. The recent heavy rains are causing floods in many areas. This is mostly due to mismanagement during the site selection. Many transitional camps are right on the watercourses or at the water bodies. Some transitional shelters have been set up in low-lying areas, such as the Vaharai region, which were already prone to heavy flooding. In many cases the rainwater is being blocked by human settlements from being drained into the sea, as is the case in Kallady and Kaluwanchikudy. Moreover, most of the camps set up by the INGOs [involved] clearing the forests. (A similar situation is being reported from most tsunami-hit areas of the country.) Snakebites are not an uncommon occurrence while elephants invade camps often as their habitats have been encroached upon. Many communities' major expense is not for food but for buying firecrackers to keep the elephants away. Moreover, many natural drains have been blocked due to the tsunami sand shifting. Even for the construction of new permanent shelters, many sites have been allocated in ecologically sensitive areas.

Ali Rizvi, IUCN-Asia, pers. comm.

Case Study 3

Post-tsunami green and brown assessments: Sri Lanka

The Government of Sri Lanka, with funding from the United Nations Environment Programme, mobilized a team of local scientists from various universities to carry out rapid green and brown environmental assessments. They studied ecosystem damage, the protective role of natural ecosystems, soil and water contamination, disease risks and salinisation.

The assessments found low to moderate damage to natural ecosystems, with moderate to high damage from clean-up operations, contamination by salt water and toxins and problems related to reconstruction. These were some of their findings: the tsunami created over 500 million kg of rubble, an enormous challenge for the solid waste management system; debris and sand from the tsunami and clean-up operations were dumped in wetlands and water bodies, blocking drainage and increasing the chance of waterlogging, loss of farmland, and increased water-borne diseases; some resettlement activities (poor site selection, mining sand dunes, poor sanitation, haphazard mangrove clearing) caused more damage than the tsunami itself; new settlements were established in or near protected areas and other ecologically sensitive sites such as elephant corridors; and increased demand for sand and wood for reconstruction and other building materials put enormous pressure on natural resources.

Source: Ranaviraja 2005

IUCN specialists conducted Rapid Environmental Assessments (REAs; *see Box 5*) to assess damage to marine and shoreline ecosystems and coastal biodiversity. These early assessments provided decision-makers with crucial information for formulating priorities for livelihood recovery and ecosystem rehabilitation. Their main findings were as follows: damage to the coastal stretch was patchy; there was a clear correlation between damage to inland areas and human modifications in the beachfront; mangrove stands facing the tsunami waves were affected; sandy beaches had been eroded; salt marshes, mangrove and coastal grasslands were covered with sand and marine sludge; managed landscapes such as home gardens were affected; mass mortality of estuarine and freshwater fish and mollusks was evident; and invasive alien plant species had spread.

Mature sand dunes were especially effective as protective barriers. Intact broad mangroves, coastal scrub and rock outcrops also acted as buffers. Mangrove swamps, lagoons, estuaries and salt marshes absorbed seawater and reduced its suction force as it receded.

Source: Bambaradeniya 2005

Sea sand mixed with rubble, Sri Lanka.
© IUCN/Channa Bambaradeniya

- Waste management: Hasty dumping of debris in fragile ecosystems can contaminate water, cause flooding and create breeding grounds for mosquitoes and disease.

A number of lessons have been learned from previous disaster reconstruction efforts (adapted from Houghton, 2005):

- Relief and recovery will initially need to proceed in parallel;
- Long-term recovery will depend on agencies' ability to integrate development planning into recovery and reconstruction;
- Organizations working on recovery and reconstruction need to look beyond returning to the status quo. Instead they should address the root causes of vulnerability; for example, by improving infrastructure and livelihood opportunities;
- Existing local development plans should form the basis for recovery. If these are inadequate, disaster relief operations and reconstruction activities may need to incorporate environmental concerns, carefully taking into account those needs that the community has identified.

Box 7

Reconstruction hazards, Sri Lanka

We are witnessing greater damage from the reconstruction efforts than from the tsunami itself, especially: haphazard clearing of mangroves, mining of sand dunes and inappropriate dumping of debris, causing water contamination and blocked drainage canals. Invasive species, such as prickly pear cacti, water hyacinth and cattail, brought in with the tsunami, are choking the lagoons and encroaching on native vegetation. To exacerbate the situation, NGOs without sufficient technical knowledge are replanting invasive species, with potentially devastating consequences for the local ecology. Unfortunately, many opportunistic individuals are using the disaster to profit at the expense of communities.

On the positive side, when we have cleared debris, mangrove stands are recovering naturally. Another piece of good news is the establishment of two turtle sanctuaries, the first in Sri Lanka. One is the most important breeding ground in Sri Lanka for the critically endangered Leatherback turtle *(Dermochelys coriacea)*; the other is an important breeding ground of the Green turtle *(Chelonia mydas)*.

Channa Bambaradeniya, IUCN Sri Lanka, pers. comm.

Recommendation 5. Rehabilitating and restoring ecosystems

Ecosystems need to be rehabilitated or restored in order to re-establish livelihoods. Investing in environmentally sustainable management is more cost-effective than restoring an ecosystem (Box 8). Healthy ecosystems are also more resilient to naturally occurring stresses such as storms and sea surges. Recurring human-induced stresses can weaken a healthy ecosystem to the point that it can no longer offer the services it once did.

Box 8

Rehabilitation vs. restoration

Rehabilitation: Most of the key ecological processes and functions are re-established and some but not all of the former biodiversity is recovered.

Restoration: All of the key ecological processes and functions are re-established and all of the original biodiversity is re-established.

Source: IUCN 2005b

Once a stress has been removed, however, many ecosystems recover naturally. Recent reports from Sri Lanka suggest that once debris has been cleared, mangroves start generating naturally *(see Box 7)*. In some cases, though, rehabilitation can be slow and difficult (Check 2005); the reefs most seriously damaged by the 2004 tsunami may take five to ten years to recover (UNEP-WCMC 2006).

Ecosystems provide valuable benefits to communities, including protection, food security, shelter and income. Restoration of an ecosystem is an important step in livelihood recovery. Restoration efforts can be counterproductive, however, if the wrong species are planted, or if species are planted in the wrong places. In Sri Lanka, for example, a number of NGOs started replanting mangroves as part of the post-tsunami recovery. These efforts have had disappointing results when people used non-native species, planted in areas unsuitable for mangroves or didn't get input from local people (Check 2005; Bambaradeniya, pers. comm.).

Approaches that involve local people and expertise have a greater chance of achieving lasting results. In three states in India, 33 villages have worked with forestry officials since 1993 to restore 1,500 hectares of mangroves. So far, three-quarters of the seedlings have survived, double the rate achieved by other projects. The communities saw the benefits of their work when the trees buffered the impact of the tsunami (Check 2005).

High flood risk is present at a temporary camp along the Neelum River, Muzzafarabad.
© Urs Bloesch

A number of guidelines should be followed (adapted from IUCN 2005a) before embarking on ecosystem rehabilitation:[9]

- species are very site specific and not all areas are suitable for replanting;
- carry out restoration with reference to existing national laws;
- ensure that all relevant stakeholders are involved (local communities, government departments) and are given the opportunity to make informed decisions;
- rehabilitation activities should strive to provide direct livelihood benefits in an equitable manner;
- prevent the spread of invasive species if possible; use native species when replanting;
- because of the unpredictability of ecological and social processes, an adaptive management approach is recommended.

Adaptive management

Adaptive management is a systematic process of continually improving management policies and practices by learning from the outcomes of existing programmes. It comprises several key factors:

- A good monitoring program: This should act as an early warning system for creeping degradation that tells the manager or community when adverse changes or trends are beginning to develop. It can also reveal when management has been successful and interventions can be accelerated. Different circumstances will require different approaches to establishing effective monitoring.
- A focus on key processes: These include rates of plant growth in new reforestation areas, erosion rates, coral growth, sedimentation rates, groundwater salinity, run-off rates and sea temperature change. Changes in general properties, such as the health of an ecosystem in buffer areas, are another consideration.
- Simplicity: This will minimize the need for skilled technical experts.
- Cost effectiveness: This will allow many observation or monitoring points to be established.
- Identification of triggers for action: Data should not be collected for their own sake but instead should be used to identify when to take action and change management practices.

Adaptive management and monitoring need one organization to carry out the monitoring and another to act on the information gathered. These may be local community-based organizations, nongovernmental organizations, government agencies or a combination of these. Monitoring programmes, if not already in place, should be established on the understanding that they may last at several years or more (IUCN 2005b). For information on coastal monitoring programmes, see Box 9.

Case Study 4

Mangrove planting by the Viet Nam Red Cross: Viet Nam

An environmental preservation project was undertaken by the Thai Binh branch of the Viet Nam Red Cross. It was designed to address livelihood and protection issues affecting the people living on the coast in Thai Thuy district of Thai Binh province.

Eight to ten typhoon storms strike the coast of Viet Nam annually. This creates tidal flooding that often breaches sea dykes and causing economic losses to the local people engaged in aquaculture.

The project created 2,000 hectares of mangrove plantations. These serve two important purposes:

- the trees provide a buffer for the sea dyke system, reducing water velocity, wave strength and wind energy. This helps protect human life, coastal land and physical assets.
- the plantations contribute to the production of valuable exports such as shrimp and crabs, high-value species of marine fish and molluscs. They also support the culture of seaweed for agar and alginate extraction. This offers new employment opportunities, which helps vulnerable people improve their livelihoods.

An evaluation of the project reported: "By helping to protect the sea dykes, the mangroves are contributing to the economic stability of the communes. All members of the community stand to benefit as their homes, livestock and agricultural land are better protected from the risk of flooding. Poor families, with little money to repair or replace material losses from storm damage, are the greatest potential beneficiaries."

Two months before the project evaluation the project area was struck by the worst typhoon in a decade. The lack of significant damage to the sea dyke and aquaculture pond systems in Thai Thuy provided the best possible indicator of the effectiveness of the mangroves.

Source: Adapted from IFRC 2005

A group of Vietnam Red Cross volunteers from Hai Phong branch makes a routine check of the growth of the mangrove trees.
© Yoshi Shimizu, IFRC

Recommendation 6. Investing in mitigation strategies

Even after ecosystem rehabilitation gets underway it will take time for natural defences to be restored. It can take months or years before ecosystem processes and functions are re-established. In some cases — for example, if the disaster was severe enough to change watercourses, beach morphology, or slope gradients — ecosystems may never fully return to their pre-disaster state.

In the meantime, while letting nature heal and reinforcing natural defences (Box 10), it may be necessary to investigate alternative mitigation strategies. The use of adaptive management techniques *(see page 34)*, structures such as dykes and revetments, and mechanical soil stabilizing techniques should be considered.

Box 9 Coastal monitoring programmes

An effective coastal monitoring programme should address two key points: the nature of the problem; and the methods that can specifically provide the information necessary to address it.

The programme should be based on remote sensing that monitors changes in ecosystem baseline data over time. Such data can be used to assess the rate at which coastal sand dunes are moving, or at which mangroves are being lost.

It does not need to be elaborate. It can be adapted to the value placed on the data and the ecosystem and the urgency of the situation. High-value areas may require greater and more regular data collection.

It should also monitor side effects, such as the effect of coastal engineering on shoreline ecosystems. Frequent monitoring may be needed to determine what is cause and what is effect.

Indicators with high ecological relevance are not always good early warning indicators. A system response can be different from individual responses, especially for complex coastal ecosystems. Indicators are often species specific; generic indicators need to be interpreted carefully.

Data management and reporting processes are critical. Incomplete or inexact data or inadequate sampling and reporting can undermine the program.

The Ramsar Convention (Ramsar 2005) provides guidance for developing monitoring programmes.

Source: Max Finlayson, pers. comm.

Box 10 Ecosystems as coastal defences

Coral reefs provide offshore breakwaters: They reduce the impacts of sea surges and tropical storm waves before they reach the shoreline (UNEP-WCMC 2006). A reef's ability to buffer the effects of tsunamis is more variable, depending on coastal bathymetry (Baird et al. 2005).

Sand dunes act as revetments or dikes: These protect the coastal zone and prevent tsunami waves from moving inland (UNEP-WCMC 2006).

Mangrove forests act as revetments or dikes: Depending on their health and extent, mangrove forests can mitigate 70-90 percent of the energy from wind-generated waves (UNEP-WCMC 2006; Danielsen et al. 2005).

Source: Adapted from Hettiarachchi 2005

Physical/structural mitigation

Mitigation strategies can be either physical/structural or non-structural. Physical mitigation strategies include wave breaks and levees; drainage works (where roads, settlements, and arable land are vulnerable to landslide and flooding following heavy rains); and small-scale embankments, dams, canals, and drainage systems to protect arable and grazing land from flood and tidal waves in coastal areas (Delaney, Kaul and Miller 2004).

Structural mitigation strategies include constructing safer housing and relocating people who live in particularly hazardous areas; enforcing building standards to protect public safety; relocating roads and other infrastructure; and retrofitting community buildings, especially schools, to improve safety and durability. Building codes should apply to new construction as well as the retrofitting of existing structures (ISDR 2004).

There are two main concerns when building mitigation structures:

- they may impede or damage natural processes. A careful assessment needs to determine whether such structures are worth the trade-offs (e.g. wave breaks may impede natural sand deposition and accelerate beach erosion).
- they should not be constructed using materials from vulnerable ecosystems. This includes grinding coral mined from reefs to make cement for building wave breaks.

School in the accumulation area of Mount Pinatubo, Philippines.
© Markus Zimmermann

Non-structural mitigation

Non-structural mitigation includes local contingency and risk reduction plans, early-warning capabilities and training. These initiatives can provide an opportunity to invest in local capacity building. Knowledge is power, and providing information about storm-related risks in vulnerable zones can save lives. Methods of obtaining and providing information include risk mapping, risk assessment studies, and — most importantly — broadly communicating information about risk. The International Red Cross and Red Crescent societies have developed Vulnerability and Capacity Assessments to enhance their capacity to reduce and respond to natural disasters (IFRC 2002). The International Federation of Red Cross Societies (IFRC) has used this tool to enhance community capacity to self-monitor flood risks, construct a secure community hall to serve as a store for relief stocks, and train volunteers in rescue training and vulnerability mapping (IFRC 2002). Other non-structural disaster mitigation strategies are covered on page 36.

Strategies for local capacity building

It is important to establish, through wide stakeholder participation, the capabilities of vulnerable communities to respond to natural disasters. They may need assistance with the following aspects:

- local monitoring of environmental conditions as early warning system;
- local leadership training;
- community awareness of natural hazard risks and hazardous living conditions; and
- community awareness of protective ecosystem services and strategies to restore and protect them (e.g. restoration of mangroves, sand dunes, river banks) (IUCN 2005a).

Through participation with local stakeholders and resource people, disaster preparedness plans should be formulated for vulnerable populations such as coastal communities, people at risk from droughts and those at risk from floods and landslides. These plans must be practical; they should cover, among other components, early warning systems, rapid and effective communication of warnings, evacuation routes, evacuation shelters, and rapid and planned relief operations.

Where infrastructure and buildings need to be built or rebuilt, attention must be given to strengthening them against recurrent natural disasters. Risk-sharing mechanisms should be established at local levels, such as village funds, micro-financing, insurance and community safe houses with provisions (Zimmermann 2005).

Case Study 5

CARE's capacity-building: Sri Lanka

CARE International takes the comprehensive view that disasters do not happen in isolation. Its aim is to look further than the immediate need and instead work with communities on long-term sustainable development programmes. CARE takes a three-part approach to emergency response: disaster preparedness and prevention; rapid response at the onset of a disaster; and post-disaster recovery.

Rapid response to current disasters is the immediate work, but it is only the beginning. The effects of disasters are felt for a long time and CARE's work continues well after the television cameras have gone home. It is committed to working with local communities to rebuild and avoid similar suffering in the future.

Local Initiatives for Tomorrow is one of CARE-Sri Lanka's programmes for capacity building. The main activity is a "farmer field school." It is geared to the main development issues facing communities, such as food production, micro-finance, income generation, low-input agricultural techniques and managing resources.

The programme has a technical as well as an institutional aspect, connecting communities to local and national resources and civil society structures. Communities who participated in the field school were better prepared for the post-disaster situation; they had established connections and learned to solve problems. They were better able to organise their own post-disaster response and recovery than communities who had not participated in the programme (www.careinternational.org.uk; Greg Chapman, pers. comm.).

CARE is helping 13 potter families in the village of Thalaluvilla, Sri Lanka.
© Robert Go, CARE

Agricultural strategies for reducing risk and vulnerability include crop diversification, use of drought-resistant species, irrigation and soil conservation techniques (such as zero-till or contour farming) and biological control techniques (Delaney, Kaul and Miller 2004). Rainwater harvesting can be an efficient means of collecting drinking water.

Communities that are resilient in the face of disasters are those with diverse economic bases; that is, they are not dependent on just one activity. They have strong self-management systems, including management zoning to regulate future development and resource development. They also have infrastructure that provides for alternate options (including multiple access roads and more than one water supply system) and health systems located in safe areas (IUCN 2005b).

Recommendation 7. Coordinating disaster risk reduction measures

Regional activities

Natural disasters know no boundaries. Regional cooperation can pool resources, supporting technical assistance for monitoring climate conditions, emergency training and disaster preparedness and providing region-wide early warning systems (Figure 7). Several regional organizations exist, such as CEPREDENAC in Central America, South Africa's National Disaster Management Centre and the South Pacific Applied Geoscience Commission (CHARM) framework for the Pacific. As a result of the 2004 tsunami, the Indian Ocean Tsunami Warning and Mitigation system is being developed (Stone and Kerr 2005). Regional strategies share several components:

- preparedness and contingency planning;
- early warning and vulnerability information systems;
- response activities and recovery strategies;
- planning and conducting of joint projects, such as research and networking;
- building capacities and developing human resources in areas of concern;
- sharing information, best practices, and disaster management resources;
- promoting partnerships among various stakeholders, including those in other countries; and
- promoting advocacy, public awareness and education programmes related to disaster management.

Source: Adapted from ISDR 2004

Case Study 6

The Coordinating Centre for the Prevention of Natural Disasters in Central America

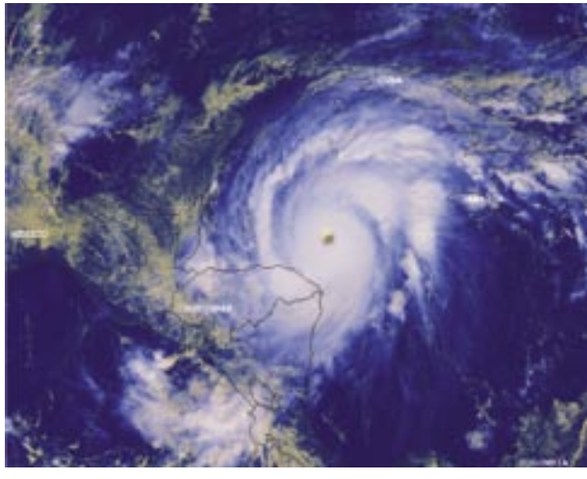
Hurricane Mitch, in 1998, was one of the worst tropical hurricanes to hit Central America in recorded history. In its aftermath, the Coordinating Centre for the Prevention of Natural Disasters in Central America (CEPREDENAC) was established, becoming the official specialized organization for risk and disaster reduction strategies in Central America.

CEPREDENAC pursues a cross-sectoral approach to natural risk reduction by coordinating with other regional agencies in the fields of agriculture, health, housing, drinking water, nutrition, environment, energy and education.

Its primary activities include institutional strengthening, early warning and specific plans, strengthening local capacities, research and information and mutual support in disaster situations. Each country has its own cross-sectoral platforms, national plans and national emergency operation centres.

CEPREDENAC has published guidelines for the introduction of risk management practices in rural development projects throughout the region and now works with the private sector, promoting risk reduction issues in Central American development agencies. In 2001, it created a Local Level Risk Management Programme to encourage local capacity-building in the area of risk reduction and preparedness.

Satellite photo of Hurricane Mitch.
Source: Giusto-Robelo, 2005



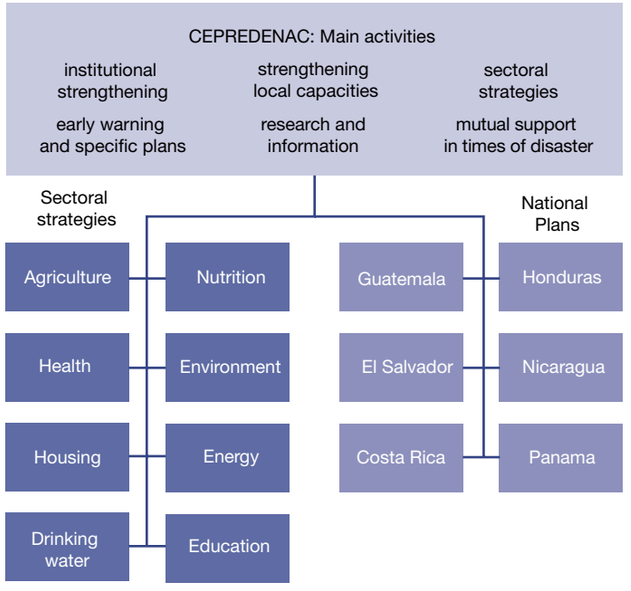


Figure 7. Regional plan, Central America

Source: Adapted from Giusto-Robelo 2005

National activities

National governments need to do what is necessary to increase disaster preparedness and response coordination. Governments have the capacity to create policy and legal frameworks that will support risk reduction (Twigg 2004). In reality, however, many governments do not have the resources for long-term planning or effective coordination with local-level government and civil society.

Humanitarian and donor agencies need to work with governments to build their capacity to prepare for and react to natural disasters. National disaster risk reduction plans should be environmentally compatible, socially acceptable and economically efficient (Zimmermann 2005).

Local activities

Although national and regional coordination are necessary for efficient disaster preparation and response, the real test comes at the local level. If communities are not prepared, the national or international response may not be as effective. A study of recent humanitarian relief efforts concludes: "communities must be helped to help themselves, and emphasis should be placed on building on their own coping and survival mechanisms" (Houghton 2005).

Case Study 7

An integrated approach to risk management: El Salvador

The Lower Lempa River Valley in El Salvador covers 850 square km and has a population of 30,000–40,000 people, living in approximately 90 villages and small towns. The area is fertile and agriculturally productive. Seasonal floods occur regularly, but few reports of disastrous floods were recorded before the 1990s.

Since the end of hostilities between the government and the Farabundo Marti National Liberation Front (FMLN) in 1992, land in the area has been given over to ex-combatants, and many poor families have been relocated there. Many of the new inhabitants are from urban centres and were put in flood-prone areas. Institutional and political divisions led to quite different approaches to environmental management being adopted on the two sides of the river.

In 2000, a project began to coordinate disaster risk reduction and sustainable development in the valley. It was based on the concept that disaster risk could only be addressed in the context of the everyday insecurity experienced by the 70 percent of the local population who lived below the poverty line. A broad-based diagnosis of the situation, with extensive community participation, led to a portfolio of project proposals that addressed disaster and development needs:

- improved woodland management to support a natural buffer to floods and sustainable economic exploitation;
- a training programme on risk management for local organizations and communities;
- strengthening of local early-warning systems;
- land-use planning and community reorganization, including improved access to public services and workplaces, and emergency operations;
- construction of safer housing and relocation of people living in particularly hazardous areas; and
- clean water supply systems and hygiene projects (Lavell 2003).

Children wading in floodwaters, El Salvador.
© IUCN/Julián Orozco

Affected populations need to be empowered by being including in decision-making and having a sense of community ownership (IUCN 2005a). Creating awareness about changing weather patterns and recurring natural disasters is essential. Community monitoring of environmental conditions such as flooding can provide an effective early warning system that is adapted to local conditions. Construction of community safe houses provides places of refuge that are able to withstand high winds and flooding. The availability of radios can also significantly reduce community vulnerability, as can education about changing weather patterns and hazardous living conditions.

Recommendation 8. Institutionalizing and integrating disaster risk reduction

Ecosystem management, development planning and disaster management — traditionally separate — are becoming increasingly intertwined. A culture of coordinated disaster risk reduction is slowly gaining momentum. Organizations promoting disaster risk reduction are found all over the world and include, among many others, CARE International, the International Federation of Red Cross and Red Crescent societies, Central America's CEPREDENAC, the World Bank's ProVention, the United Nations International Strategy for Disaster Reduction and the Asian Disaster Preparedness Center. Many national disaster management organizations include the management of ecosystems as part of their preparedness plans, although more effort will be required before such strategies become mainstream.

Over the past three decades, a similar evolution incorporated environmental concerns in development through the sustainable development model. Today, humanitarian and donor agencies list sustainable resource management among their priorities but few of them include risk reduction initiatives (Dolcemascolo 2004). In order to be effective, both ecosystem management and risk reduction need to be integrated at the national and local levels. Regional organizations such as CEPREDENAC are often well placed to support risk reduction, helping countries make the most of their resources and avoid duplicating efforts.

All the good intentions in the world will not create the frameworks necessary to avoid or limit the next major disaster. Unfortunately, it often takes an extreme event before international attention and national awareness are great enough to make people coordinate their efforts. In the aftermath of the 2004 tsunami, Sri Lanka formed a Ministry of Disaster Management, followed by a disaster management centre (Ranaviraja pers. comm.).

Case Study 8

IUCN's response to the 2005 earthquake: Pakistan

The October 8 earthquake was the worst natural disaster in Pakistan's history. According to UN relief agencies, this disaster was worse than the 2004 tsunami, both in the number of people affected and the logistical challenges it presented: high altitudes, rugged terrain, near-inaccessibility of many affected areas, onset of winter and number of injured with multiple fractures and head injuries.

Initial relief measures

IUCN immediately instituted a Pakistan Earthquake Relief Fund. IUCN's Pakistan National Committee was mobilized to coordinate relief work among members. Some members, especially Sungi Development Foundation, Strengthening Participatory Organizations and the Sarhad Rural Support Program, were in the forefront of relief initiatives by civil society.

Preliminary assessments and coordination

An Organization-Level Assessment (OLA) of environmental damage was carried out with CARE and WWF. A Community-Level Assessment (CLA) followed, conducted in the field with CARE. A Field Mission to North West Frontier Province (NWFP) and Azad Jammu and Kashmir (AJK) produced a Preliminary Environmental Assessment Report. An Earthquake Team was put in place. Extensive discussions were held with key organizations — government, donors, UN and international relief agencies — to ensure that environmental concerns were integrated into relief work and reconstruction and rehabilitation plans.

Assessing risks and needs

IUCN then carried out two field missions to make a more detailed assessment of environmental risks and needs. The report evaluated environmental risks and ranked them – wherever possible — in terms of severity and number of people affected. It also evaluated environmental needs and suggested future actions, including more effective land-use and zoning plans; enforcement of updated building codes and guidelines; and mainstreaming of multiple hazards and environmental risks into all development sectors, policies and procedures. The report called for a comprehensive natural disaster risk management framework for mountain areas, stressing the need for collaboration among government, civil society and academia to design and implement such a framework.

Source: "Earthquake in Pakistan: An Assessment of Environmental Risks and Needs Based on IUCN Field Missions to NWFP and AJK November 19–26 and December 4–7, 2005" (www.iucn.org/en/news/archive/2006/01/report_eq_pakistan.pdf).

Destroyed home in Battagram, Pakistan.
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Various actions can help integrate environmental and disaster reduction policies (adapted from ISDR 2004 and Zimmermann 2005):

- Assess the environmental causes of vulnerability;
- Assess environmental actions that reduce vulnerability;
- Monitor natural processes (e.g. drought and flood) and establish early warning systems;
- Consider the effects on ecosystem services (e.g. the impacts of draining wetlands on flood regimes) in decision-making processes;
- Establish partnerships for and regional approaches to land use and nature conservation;
- Establish alternatives to conflicts over the alternative uses of resources;
- Provide advice and information to involve people in enhancing ecosystem protection (e.g. community stewardship of mangrove forests);
- Consider the economic benefits of the services that ecosystems provide to disaster risk reduction (e.g. the benefits of investing in wetlands restoration as a buffer for floods);
- Create economic and legal incentives to include ecosystem services in disaster risk reduction (e.g. incentives or disincentives to avoid exploitation of resources from protective sand dunes, mangrove forests and coral reefs);
- Enforce environmental regulations, particularly those that may reduce population vulnerability (e.g. zoning laws, protection of key ecosystems, solid waste management);
- Strengthen ecosystem management to include disaster risk reduction (e.g. watershed management, integrated coastal management, protected area management).

Legislating disaster risk reduction is often the key to effective institutionalization. South Africa has legislated integrated development plans (IDPs) that promote the integration of disaster and risk management considerations by balancing social, economic and ecological considerations. The IDPs are five-year strategic plans prepared by municipalities, requiring annual consultation with communities and stakeholders. The plans have a legal status and supersede all other initiatives that guide development at the local-government level (ISDR 2004). Planning needs to be institutionalized at the local, national and regional levels, each with appropriate types of framework and set of goals.

Conclusion

As natural disasters strike populations around the world with increasing frequency and intensity, the humanitarian community, donor agencies and public sector institutions involved with development and emergency response face a tremendous challenge. This publication is intended to enrich existing approaches to disaster risk reduction through an emphasis on the importance of ecosystem management in mitigating the impacts of natural disasters on communities and in enhancing post-disaster recovery. This requires major investments in ecosystems as protective and productive infrastructure.

Many ecosystems that fulfil important protective functions can also generate significant livelihood benefits, especially for the poor. This reduces the need for compromises between short- and long-term development objectives. Mangroves, for example, have been shown not only to reduce the impact of cyclones, but to contribute to day-to-day livelihood benefits by providing habitat for fish and shellfish. Floodplains buffer the impact of floods, and often provide highly productive land for agriculture and livestock.

In order to ensure that investments in ecosystem management are effective, a variety of new disaster risk reduction tools and approaches need to be designed and tested. They must integrate environment and long-term development considerations, and build the capacity of stakeholders to use them effectively. New tools and approaches are particularly needed to accomplish the following tasks:

- incorporating basic environmental contingency guidelines for post-emergency response locally, nationally and regionally;
- empowering communities to carry out sustainable disaster risk management and stewardship of protective ecosystem services, e.g. by helping them develop indicators for the protective functions of ecosystems;
- institutionalizing risk reduction measures and ecosystem management at national and regional levels and natural-disaster preparedness and capacity building at the local level, e.g. through developing methods for the economic valuation of various land-use alternatives, including both protective and productive functions; and
- developing strategies for adapting to rapidly changing climate conditions, especially for the poor.

The Ecosystem Approach can help in managing resource use more effectively and contributing to reducing the risk and impact of disasters. It places human needs at the centre of biodiversity management, aiming to manage the ecosystem based on the multiple functions that the ecosystem performs and the various uses that are made of these functions. It does not aim to maximize short-term economic gains; its goal is to optimize the use of an ecosystem without damaging it *(www.iucn.org/ecosystems)*.

The environmental community needs to act in conjunction with the humanitarian and emergency sectors to bring about real change in how organizations prepare for natural disasters and manage their consequences. This publication provides some concrete suggestions for working together with disaster relief and recovery professionals in the field. By combining various perspectives and expertise, people will be better prepared to reduce the human suffering and environmental devastation caused by the increasing number of disasters around the world.

Glossary

Adaptive management: a systematic process of continually improving management policies and practices by learning from the outcomes of existing programmes.

Biodiversity: The variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems (Convention on Biological Diversity).

Disaster: A serious disruption of the functioning of a community or a society causing widespread human, material, economic or environmental losses which exceed the ability of the affected community or society to cope using its own resources (ISDR 2004).

Disaster vs. hazard: "Strictly speaking, there is no such thing as a 'natural' disaster, but there are natural hazards, such as cyclones and earthquakes. The difference between a hazard and a disaster is an important one. A disaster takes place when a community is affected by a hazard (usually defined as an event that overwhelms that community's capacity to cope). In other words, the impact of the disaster is determined by the extent of a community's vulnerability to the hazard. This vulnerability is not natural. It is the human dimension of disasters, the result of the whole range of economic, social, cultural, institutional, political and even psychological factors that shape people's lives and create the environment that they live in" (ISDR 2004).

Disaster Risk Reduction: People and institutions involved in preparedness, mitigation (e.g. reinforcing building structures, improving public awareness about disaster risks), and prevention activities (e.g. planting trees to stabilize riverbanks) associated with extreme events. These include hazard forecasting and immediate relief efforts for major disasters resulting from floods, cyclones and, in some cases, pollution events (adapted from IISD/IUCN/SEI 2003).

Disaster Response Planning: Adequate disaster preparedness requires a response plan which includes, e.g., contingency planning for prevention, as much as possible, and minimization of the adverse effects on people that can occur by release of hazardous, dangerous, and toxic chemicals/materials that can be accidentally released during a natural disaster (Christich pers. comm).

Ecosystem Approach: A strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way. It was endorsed by the fifth Conference of the Parties at the Convention on Biological Diversity (COP-5 in Nairobi, Kenya; May 2000/Decision V/6).

Ecosystem benefits: Ecosystems provide benefits to communities that have economic value, including protection, food security, shelter and income.

Ecosystems: Also known as natural systems, they include sand dunes, mangrove belts, coral reefs and wetlands.

Ecosystem services: The goods and services provided by healthy ecosystems, including medicinal plants, clean water and air, and protection from extreme natural events.

EIA: Environmental Impact Assessment.

Hazard: A potentially damaging physical event, phenomenon or human activity, which may cause the loss of life of injury, property damage, social and economic disruption or environmental degradation (ISDR 2004). *See also disaster vs. hazard.*

Mitigation: Structural and non-structural measures undertaken to limit the adverse impact of natural hazards, environmental degradation and technological hazards (ISDR 2004).

Net present value (NPV): A measure of project desirability of profitability; the sum of discounted net benefits and costs of a project.

Preparedness: Specific measures taken before disasters strike, usually to forecast or warn against them, take precautions when they threaten and arrange for the appropriate response (such as organising evacuation and stockpiling food supplies). Preparedness falls within the broader field of mitigation (Twigg 2004).

Prevention measures: These include investing in ecosystems such as sand dunes, mangrove belts, coral reefs, wetlands and use of forested slopes as barriers.

REA: Rapid environmental assessment.

Rehabilitation (of ecosystems): Most of the key ecological processes and functions are re-established and some but not all of the former biodiversity is recovered.

Restoration (of ecosystems): All of the key ecological processes and functions are re-established and all of the original biodiversity is re-established.

Risk (hazard + vulnerability x probability): The probability of harmful consequences, or expected loss (of lives, people injured, property, livelihoods, economic activity disrupted or environment damaged) resulting from interactions between natural or human induced hazards and vulnerable/capable conditions (Tompkins et al. 2005).

Vulnerability: A set of conditions and processes resulting from physical, social, economic and environmental factors, indicating the susceptibility of a community to the impact of hazards (ISDR 2004).

Resources

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Sphere Project (www.sphereproject.org). The Sphere Project was launched in 1997 by a group of humanitarian NGOs and the Red Cross and Red Crescent movement. The organization has developed a handbook, *The Humanitarian Charter and Minimum Standards*.

UNEP's Post-tsunami Rehabilitation and Reconstruction strategy: www.gpa.unep.org/tsunami/

United Nations Development Programme: www.undp.org/bcpr/disred/rdr.htm

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IUCN/CEM June 2005 Workshop presentations

This publication draws extensively on "Applying an Ecosystem Approach to Post-Disaster Reconstruction and Restoration," a workshop organized in June 2005 by IUCN's Commission on Ecosystem Management. The workshop brought together a diverse group of government officials involved in emergency response, along with experts on ecosystem management and restoration, communications and education. It also involved humanitarian organizations and IUCN representatives from a wide geographic range, including Sri Lanka, Bangladesh and Central America.

Channa Bambaradeniya, IUCN Sri Lanka: Ecosystem Damage Assessment as an input to Post-tsunami Restoration and Reconstruction in Sri Lanka.

Greg Chapman, CARE Sri Lanka: CARE Sri Lanka's Perspective re: Demands for Environmental Guidance in Post-Disaster Situations.

Dolf De Groot, Environmental Systems Analysis Group, Wageningen University: Economic Value of Protective Services Provided by Ecosystems.

Darshani De Silva, UNDP: United Nations Framework on Environmental Support and Demands in Post-Tsunami Context.

Max Finlayson, International Water Management Institute, Sri Lanka: Experiences with communicating environmental messages in the water sector.

Geronimo Giusto-Robelo, CEPREDENAC: Disaster Risk Reduction: a regional approach, Central America — Lessons learned from post-Hurricane Mitch experience.

Samantha Hettiarachchi, University of Moratuwa, Sri Lanka: The role and use of coastal ecosystems in conserving the coast in post disaster rehabilitation.

Hillary Masundire, Dept. of Biological Sciences, University of Botswana: Applying an Ecosystem Approach to Post-Disaster Rehabilitation and Restoration.

Ainun Nishat, IUCN Bangladesh: The Role of Mangroves in Combating Storm Surges: Examples from Bangladesh.

Tilak Ranaviraja, Chairman of Task Force for Relief (TAFOR)/Secretary, Ministry of Public Security, Law and Order, Sri Lanka: Post-Tsunami Responses on ecosystem protection in Sri Lanka.

Endnotes

1. It does not target technological disasters, which require a different type of pre- and post-disaster planning.

2. The Millennium Ecosystem Assessment (MA) is the most extensive study to date of the linkages between the world's ecosystems and human well-being. The assessment is a four-year, US$21-million programme designed by a partnership of United Nations agencies, international scientific organizations, and development agencies, with guidance from private sector and civil society groups, including IUCN.

3. Data accuracy on disasters is reliable from 1973, the year when the Office of Foreign Disaster Relief (U.S.) began compiling data and the Centre for the Reseach on the Epidemiology of Disasters (CRED) was created.

4. In addition, Africa suffers from violent conflicts that aggravate the consequences of natural disasters. These conflicts cannot be seen separately from the change in environmental conditions in which they occur.

5. ProVention was launched by the World Bank as a global partnership of governments, international organizations, academic institutions, private and civil society dedicated to increasing the safety of vulnerable communities and reducing the impact of disasters in developing countries.

6. For information on other ecosystem services, see Millennium Ecosystem Assessment 2005 and Mainka, McNeely and Jackson 2005.

7. Net present value is a measure of project desirability of profitability: the sum of discounted net benefits and costs of a project.

8. For a more extensive discussion of entitlements and natural resources, see for example, Borrini-Feyerabend et al. (2004).

9. See for example, the Society for Ecological Restoration (www.ser.org); Mangrove Action Project www.earthisland.org/map/); IUCN – Sri Lanka "Series on Best Practice Guidelines" www.iucn.org/info_and_news/press/tsunami-guidance-info.pdf.

IUCN
The World Conservation Union

The World Conservation Union (IUCN)

Ecosystem Management Programme
Rue Mauverney 28
CH-1196 Gland
Switzerland

Tel: + 41 22 999 02 15
Fax: + 41 22 364 97 20
ecosystems@iucn.org

www.iucn.org/ecosystems

World Headquarters