9

GREEN GUIDE TO

DISASTER RISK REDUCTION

GREEN RECOVERY AND RECONSTRUCTION: TRAINING TOOLKIT FOR HUMANITARIAN AID

The Green Recovery and Reconstruction Toolkit (GRRT) is dedicated to the resilient spirit of people around the world who are recovering from disasters. We hope that the GRRT has successfully drawn upon your experiences in order to ensure a safe and sustainable future for us all.

9
GREEN
GUIDE TO

DISASTER RISK REDUCTION

Charles Kelly, Consultant

NOTE TO USERS: The Green Recovery and Reconstruction Toolkit (GRRT) is a training program designed to increase awareness and knowledge of environmentally sustainable disaster response approaches. Each GRRT module package consists of (1) training materials for a workshop, (2) a trainer's guide, (3) slides, and (4) a technical content paper that provides background information for the training. This is the technical content paper that accompanies the one-day training session on integrating environmentally sustainable approaches into disaster risk reduction.

ACKNOWLEDGEMENTS

Project Manager	Jonathan Randall, World Wildlife Fund
Training Specialist	Paul Thompson, InterWorks LLC
Creative Director	Melissa Carstensen, QueenBee Studio
Advisory Committee	Erika Clesceri, U.S. Agency for International Development Veronica Foubert, Sphere Christie Getman, American Red Cross Ilisa Gertner, American Red Cross Chris Herink, World Vision Emma Jowett, Consultant Charles Kelly, Consultant Robert Laprade, American Red Cross Anita van Breda, World Wildlife Fund

Expert Reviewers

Joseph Ashmore, Consultant
Rick Bauer, Oxfam-UK
Gina Castillo, Oxfam-America
Prem Chand, RedR-UK
Scott Chaplowe, International Federation of Red Cross and Red Crescent Societies
Marisol Estrella, United Nations Environment Programme
Chiranjibi Gautam, United Nations Environment Programme
Toby Gould, RedR-UK
Tek Gurung, United Nations Environment Programme
Yohannes Hagos, American Red Cross
James Kennedy, Consultant
Earl Kessler, Consultant
John Matthews, World Wildlife Fund
Andrew Morton, United Nations Environment Programme
Radhika Murti, International Union for Conservation of Nature
Marcos Neto, CARE
Jacobo Ocharan, Oxfam-America
Judy Oglethorpe, World Wildlife Fund
Robert Ondrusek, International Federation of Red Cross and Red Crescent Societies
Adrian Ouvry, Danish Refugee Council
Megan Price, RedR-UK
Catherine Russ, RedR-UK
Graham Saunders, International Federation of Red Cross and Red Crescent Societies
Ron Savage, U.S. Agency for International Development
Hari Shrestha, Save the Children
Rod Snider, American Red Cross
Margaret Stansberry, American Red Cross
Karen Sudmeier, International Union for Conservation of Nature
Nigel Timmins, Tearfund
Muralee Thummarukudy, United Nations Environment Programme
Anne-Cécile Vialle, United Nations Environment Programme

Special Thanks

The development of the GRRT has truly been a collaborative process and could not have been done without an extraordinary team of international experts from the humanitarian and environmental sectors. Over the course of a two-year development process, the GRRT was built on the diverse experiences of over 15 technical authors and training specialists, over 30 expert reviewers, and a dedicated team of graphic designers and copy editors. Special thanks go to Paul Thompson whose depth of experience in humanitarian training helped to shape this project and whose commitment made it a reality. Thanks to Anita van Breda, Robert Laprade, and Ilisa Gertner for their insight, ideas, and time spent reviewing many rounds of drafts. Special acknowledgement goes to the participants of the GRRT pilot workshops in Sri Lanka and Indonesia for all of their excellent feedback. Special thanks also goes to Gerald Anderson, Marcia Marsh, Alicia Fairfield, Achala Navaratne, Julia Choi, Bethany Shaffer, Owen Williams, Brad Dubik, Leah Kintner, Tri Agung Rooswiadji, Tom Corsellis, Eric Porterfield, Brittany Smith, Sri Eko Susilawati, Jan Hanus and Manishka de Mel. *–Jonathan Randall, WWF*

MODULE 9: GREEN GUIDE TO DISASTER RISK REDUCTION

Table of Contents

1 Introduction 1

1.1 Module Objectives 1

1.2 The Green Recovery and Reconstruction Toolkit 1

1.3 Intended Audience 1

1.4 Module Key Concepts 1

1.5 Module Assumptions 2

1.6 Key Module Definitions 3

2 Project Cycle and Disaster Risk Reduction 4

3 Linking the Environment with Disaster Risk Reduction 6

4 Integrating the Environment into Disaster Risk Reduction Assessments and Design 9

5 Ecosystem-Based Activities for Reducing Disaster Risk 13

6 Environmental Implications of Disaster Risk Reduction Activities 18

Annex 1. Relevant Agencies and Sources of Information 21

Glossary 23

Acronyms 30

1 INTRODUCTION

1.1 Module Objectives

This module is intended to increase the knowledge of disaster risk reduction (DRR) specialists with respect to the integration of environmental considerations in disaster preparedness, mitigation, risk assessment, and risk reduction.

Specific learning objectives for this module are as follows:

1. Describe the ways in which disaster risk and environmental conditions are linked.
2. Integrate environmental issues into typical disaster risk reduction assessments.
3. Identify a set of ecosystem-based activities that can reduce risk and enhance disaster risk reduction programs.
4. Describe how disaster risk reduction activities can have negative impacts on the environment and how these impacts can be mitigated.

1.2 The Green Recovery and Reconstruction Toolkit

This is Module 9 in a series of 10 modules comprising the Green Recovery and Reconstruction Toolkit (GRRT). Collectively, the GRRT modules provide information and guidelines to improve project outcomes for people and communities recovering from disaster by minimizing harm to the environment and taking advantage of opportunities to improve the environment. Module 1 provides a brief introduction to the concept of green recovery and reconstruction to help make communities stronger and more resilient to future disasters by integrating environmental issues into the recovery process. GRRT Module 2 provides guidance on how project design, monitoring, and evaluation can better incorporate and address environmental issues within the typical project cycle. GRRT Module 3 builds upon Module 2, focusing specifically on assessment tools that can be used to determine the environmental impact of humanitarian projects regardless of the type of project or sector. GRRT Modules 4, 5, and 6 pertain specifically to building construction, with Module 4 focusing on site planning and development, Module 5 on building materials and the supply chain, and Module 6 on building design and construction management. GRRT Modules 7 through 10 provide sector-specific information to complement Modules 2 and 3, including livelihoods, disaster risk reduction, water and sanitation, and greening organizational operations.

1.3 Intended Audience

Module 9 is intended for DRR managers, planners, and field staff; hazard-risk assessment teams; and other practitioners responsible for planning and implementing post-disaster recovery and reconstruction efforts.

1.4 Module Key Concepts

1. **DRR and the environment are linked.** In many cases, the root cause of disaster risk is a degraded environment. The use of environmental management to reduce disaster impact is often less costly, more effective, and more socially sustainable than more traditional structural measures. When structural disaster risk reduction activities are used, however, it is critical that they address

environmental sustainability so that future risk is not increased and neighboring communities are not adversely affected.

2. **Risk assessments should include environmental considerations and participatory involvement of disaster-threatened communities.** There are a number of procedures and tools used for a participatory assessment of disaster risk, including capacity and vulnerability assessment and community-based disaster risk assessment. Root cause analysis is essential to an understanding of the underlying causes of vulnerability, and to addressing these causes in the risk reduction process. In order to address root causes of disaster risk, it is important to consider the extent to which a community's disaster risk is linked with environmental management practices (e.g., increased flood risk that is caused by the conversion of natural landscapes to agricultural areas). The use of participatory assessment tools is critical for successful risk reduction, as it is individual communities and members who are directly affected by disaster risk and who need to take action to reduce this risk. It is unlikely that risk reduction efforts will be successful without local participation and support during the assessment stage. In terms of environment-based risk reduction, local participation is critical to success, as environment-based approaches require a holistic approach and may require short-term reductions in access to natural resources. Such efforts will not succeed without local agreement.
3. **There is a set of ecosystem-based activities for risk reduction that should be considered alongside more conventional, infrastructure-based activities.** A few examples include stabilizing hillsides with vegetation, creating open spaces to absorb floodwaters, and restoring mangrove cover for coastal protection against storm surge. These approaches can be an integral part of disaster risk reduction planning that would also include early warning systems, response capacity, and infrastructure-based approaches.
4. **Environment-based DRR should be integrated into development programming as well as pre- and post-disaster humanitarian action.** Much of disaster management involves actions that reduce the risk from immediate disaster impacts, such as warning and evacuation systems, capacity building, and structural measures to limit hazard impacts (e.g., embankments and flood-prevention walls). DRR needs to be an integral part of humanitarian action and development programming, where potential risks are identified and addressed through the action provided. These longer-term risk assessment and reduction efforts should include the environment as a source both of hazards and the means to reduce or avoid disaster impacts.

1.5 Module Assumptions

This module is intended to increase the knowledge of DRR specialists with respect to the integration of environmental considerations in risk assessment and risk reduction. The workshop participants are expected to have a strong grounding in DRR, including knowledge of community-based disaster risk assessment and reduction tools and procedures. The authors of this module acknowledge that there is a variety of terminology describing the elements of disaster risk management. This module focuses on the environmental issues associated with the risk assessment process and risk reduction activities (i.e., mitigation).

1.6 Key Module Definitions

The following are key terms used in this module. A full list of terms is contained in the Glossary.

Climate change: The climate of a place or region is considered to have changed if over an extended period (typically decades or longer) there is a statistically significant change in measurements of either the mean state or the variability of the climate for that place or region. Changes in climate may be due to natural processes or to persistent anthropogenic changes in atmosphere or in land use.

Disaster preparedness: Activities designed to minimize loss of life and damage; organize the temporary removal of people and property from a threatened location; and facilitate timely and effective rescue, relief, and rehabilitation.

Disaster risk: Potential disaster losses in lives, health status, livelihoods, assets, and services that could occur to a particular community or a society over some specified future time period. Risk can be expressed as a simple mathematical formula: Risk = Hazard X Vulnerability. This formula illustrates the concept that the greater the potential occurrence of a hazard and the more vulnerable a population, the greater the risk.

Disaster risk reduction: The practice of reducing disaster risks through systematic efforts to analyze and manage the causal factors of disasters, including reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events.

Ecosystem: Dynamic complexes of plants, animals, and other living communities and the nonliving environment interacting as functional units. Humans are an integral part of ecosystems.

Hazard: A potentially damaging physical event, phenomenon, or human activity that may cause the loss of life or injury, property damage, social and economic disruption, or environmental degradation. Hazards can include latent conditions that may represent future threats and can have different origins: natural (geological, hydrometeorological, and biological) or induced by human processes (environmental degradation and technological hazards).

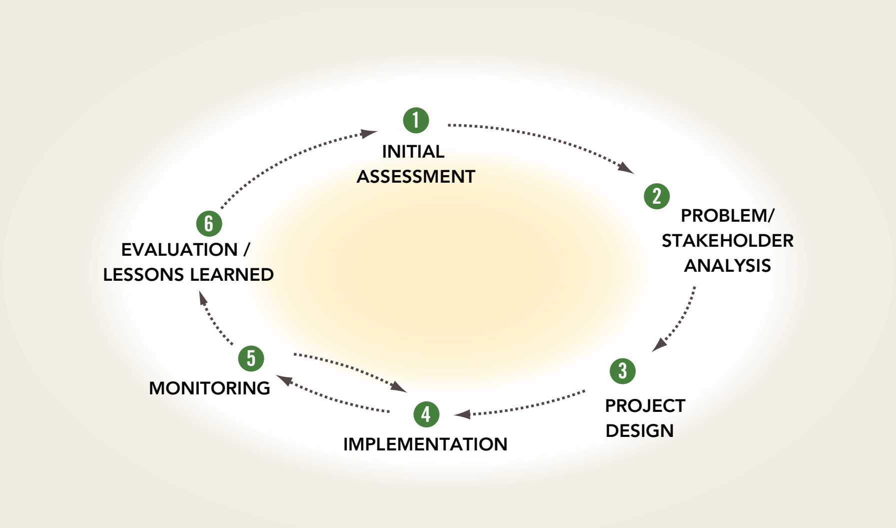
Resilience: The capacity of a system, community, or society potentially exposed to hazards to adapt, by resisting or changing, in order to reach and maintain an acceptable level of functioning and structure. This is determined by the degree to which the social system is capable of organizing itself to increase its capacity for learning from past disasters for better future protection and to improve risk reduction measures.

Vulnerability: *Human* vulnerability is the relative lack of capacity of a person or community to anticipate, cope with, resist, and recover from the impact of a hazard. *Structural or physical* vulnerability is the extent to which a structure or service is likely to be damaged or disrupted by a hazard event. *Community* vulnerability exists when the elements at risk are in the path or area of the hazard and are susceptible to damage by it. The losses caused by a hazard, such as a storm or earthquake, will be proportionally much greater for more vulnerable populations, e.g., those living in poverty, with weak structures, and without adequate coping strategies.

2 PROJECT CYCLE AND DISASTER RISK REDUCTION

In planning and carrying out their disaster response activities, many humanitarian agencies follow a standard project management cycle, as shown in Figure 1.

FIGURE 1: STANDARD PROJECT MANAGEMENT CYCLE



The focus is often on DRR in disaster preparedness (e.g., early warning, evacuation planning) and in post-disaster response (integrating DRR into recovery). DRR should be integrated into all stages of disaster response and development activities.

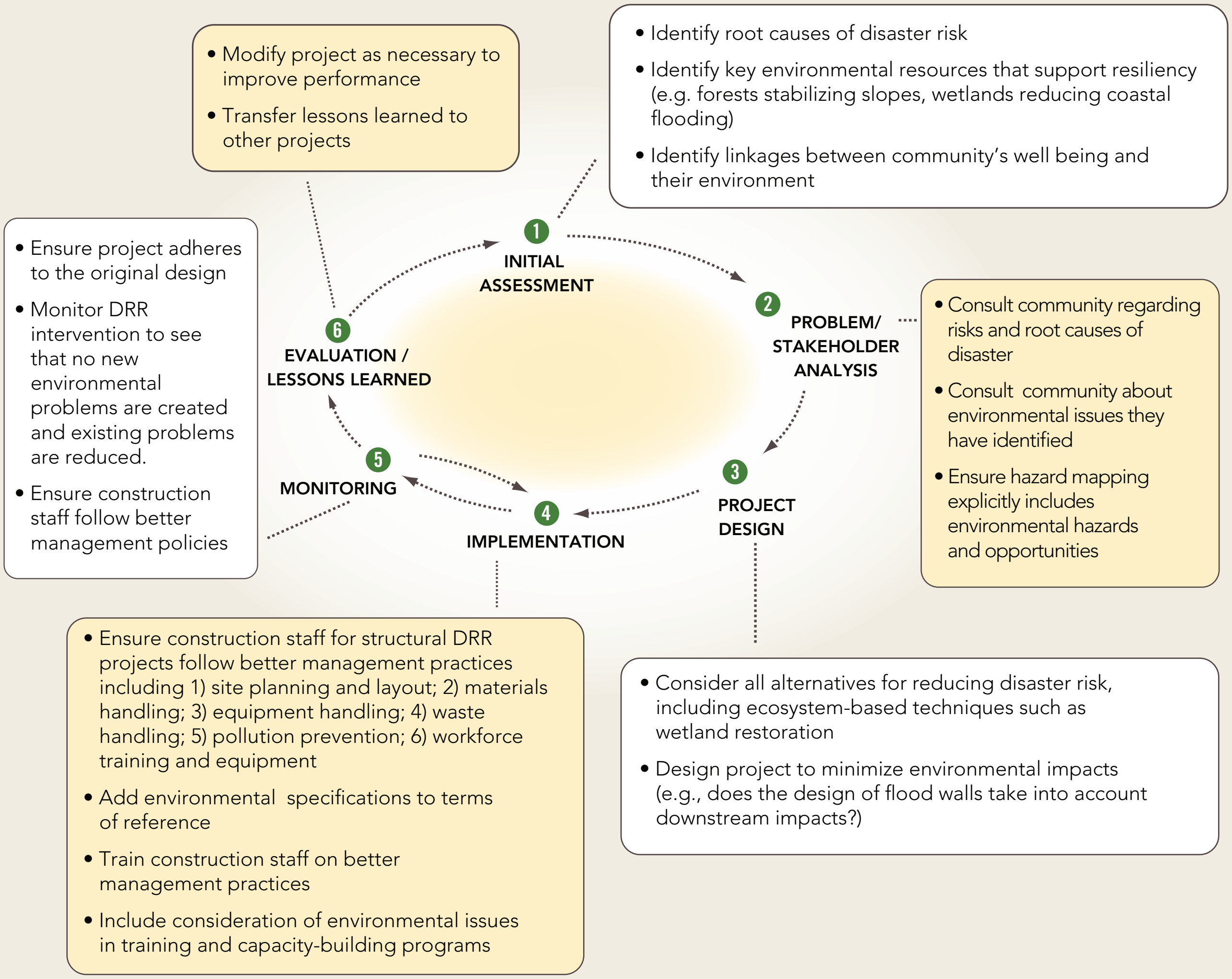
In developing DRR projects, there are opportunities throughout the project cycle for introducing and reinforcing the principles of environmental sustainability as shown in Figure 2.

At the Initial Assessment phase, it is important to understand the root causes of the disaster risks facing a community and to determine if there are environmental links. For example, if a community identifies flooding as a hazard, examine if there are environmental factors, such as deforestation, that are contributing to the risk. Similarly, if there are environmental factors that are strengthening resilience, such as the availability of natural resources (e.g., fish) for livelihoods, these should be noted as well. A more detailed discussion about integrating the environment into Disaster Risk Reduction Assessments is contained in Section 3.

During the Problem/Stakeholder Analysis phase, it is important to engage a wide range of relevant stakeholders, the community in particular, to better understand the environmental context and the major actors in the project area. This will also help with buy-in for the long-term success of the project. Communities should be asked, specifically, what environmental issues are most important to them. In addition, environmental expertise should be accessed from NGOs, as well as from government environmental and natural resource ministries to better understand local context and increase participation in DRR.

During the Project Design and Implementation phases, the project designers should be sure to consider all of the alternatives for reducing disaster risks, including structural and nonstructural solutions. Ecosystem-based solutions such as mangrove rehabilitation should be considered as part of this process. The environmental impacts of implementing a DRR project (such as building a flood wall or raising houses) should be considered and minimized in order to reduce future risk and vulnerability.

FIGURE 2: PROJECT CYCLE WITH OPPORTUNITIES FOR INTRODUCING ENVIRONMENTAL SUSTAINABILITY PRINCIPLES INTO DISASTER RISK REDUCTION PROJECTS



During the Monitoring phase, the project should be reviewed to ensure that it meets the original specifications of the design and the project performance objectives. The results of the Monitoring phase can be used by project managers to adapt the project as needed during implementation. For example, if a sea wall project is helping one community but increasing flooding in a neighboring community, then the project should be adapted as necessary. The Monitoring phase also informs the Evaluation phase (e.g., midterm and final evaluations) to track the project's progress in meeting objectives. Specific indicators in the project logframe and/or Monitoring and Evaluation plan related to environmental sustainability will help to ensure that the project achieves its sustainability objectives. The integration of DRR into projects is a more cost-effective and efficient way to reduce the impacts of disasters and improve the environmental sustainability of the recovery and reconstruction process.

3 LINKING THE ENVIRONMENT WITH DISASTER RISK REDUCTION

The environment has a significant role to play in reducing the risk of disasters and reducing the impact of disasters once they occur. Well-managed ecosystems can reduce the risk of hazards, such as landslides, flooding, avalanches, and storm surges.[1] Many disasters are either caused or exacerbated by environmental degradation. For example, the creation of drought conditions and the relative severity and length of time the drought lasts are mainly natural phenomena. But drought conditions may be exacerbated by environmental degradation resulting from poor cropping patterns, overgrazing, the stripping of topsoil, poor conservation techniques, depletion of both surface and subsurface water supplies, and unchecked urbanization.[2] Similarly, the root causes of many human conflicts are conflicts over natural resources, such as timber in Liberia, water in Bolivia, and diamonds in Sierra Leone.[3]

Protecting and restoring ecosystems is a project activity that disaster risk reduction managers can use alongside of other DRR techniques like the construction of drainage infrastructure, early warning systems, and training and capacity building. For instance, wetlands can be used as flood-retention areas – a use similar to their natural function – or vegetation can be used to stabilize erosion-prone slopes. **Environment-based risk reduction interventions can have a lower cost and lower maintenance requirements than do traditional engineered interventions, such as concrete floodwalls. According to the World Bank, investments in preventive measures, including maintenance of healthy ecosystems, are seven-fold less costly than the cost incurred by disasters.[4]**

The extent to which an ecosystem will buffer against natural hazards and contribute to reducing risk depends on the ecosystem's health and the intensity of the event. Degraded ecosystems can sometimes still play a buffering role, although to a much lesser extent than fully functioning ecosystems.[5]

---

1 Sudmeier-Rieux, K. and N. Ash. 2009. *Environmental Guidance Note for Disaster Risk Reduction: Healthy Ecosystems for Human Security*. Revised Ed. Gland: IUCN.

2 International Institute of Rural Reconstruction and Save the Children USA. 2007. *Leaving Disasters Behind: A guide to disaster risk reduction in Ethiopia*. Nairobi and Addis Ababa.

3 Homer-Dixon, Thomas. 1999. *Environment, scarcity, and violence*. Princeton: Princeton University Press.

4 World Bank. 2004. *Natural Disasters: Counting the Cost*. Press release, March 2, 2004.

5 Sudmeier-Rieux, K. and N. Ash. 2009. *Environmental Guidance Note for Disaster Risk Reduction: Healthy Ecosystems for Human Security*. Revised Ed. Gland: IUCN.

PAKISTAN: EARTHQUAKE AND LANDSLIDES

"In this once-remote region, loss of green cover from commercial logging, local cutting, and overgrazing has made the land less compact and less able to retain water, which now rushes easily down mountainsides to set off slides that some call 'ecological land mines.'" Nithin Sethi, of the Delhi-based Centre for Science and Technology

"If there had been more trees, we would not have lost as much. The impact would not have been as great. It is our mistake." Qayoon Shah, teacher at the Jabla village school

Pakistan's geographical position makes it subject to a number of natural hazards, of which flooding, earthquakes, cyclones, and drought/heat waves are the most significant. The earthquake hazard in the Himalaya Mountains is particularly high, due to tectonic movement. Scientists had been predicting a major earthquake in the region for several years, a prediction that came tragically true on October 8, 2005, when Pakistan experienced one of the greatest natural disasters in the region in recorded history. The epicenter of the earthquake, which measured 7.6 on the Richter scale, was in the district of Muzaffarabad, in Azad Jammu Kashmir (AJK), but its effects were felt over an area of approximately 30,000 km^2 in AJK and the North Western Frontier Province (NWFP).

The October earthquake, being natural in origin, was unavoidable. However, the extent of damage that was caused to human life and property could be attributed to socio-ecological causes, having its roots in policies and actions related to human use of the mountains and their natural resources. Despite the known likelihood of major earthquakes hitting the region, there has been little thought given to mitigation of impacts, and the vulnerability of Pakistan to disaster has been exacerbated by unchecked urban development and extensive deforestation. Large parts of the area affected by the earthquake, for example, have lost considerable forest cover over the last few decades as a result of encroachment, illegal logging, and agriculture – increasing the likelihood of landslides. Today, forests cover about 11 percent of AJK compared with nearly 30 percent in 1947; in NWFP, a study in the Hazara Division found a 52 percent decline in forest resources between 1967 and 1992. AJK is particularly known for its high-quality cedar wood, which had been generating income from timber for decades until a government decision to ban felling in 1997. However, the extraction of "dead, decayed, or diseased" trees allowed deforestation to continue, and with fines for illegal felling at less than US$10 a tree, many villagers continue to use wood for building and fuel.

The commitment of the government of Pakistan to increase the country's area of natural forests has been stated in several policy documents such as the National Environmental Policy 2005 and the Pakistan Poverty Reduction Strategy Paper (PRSP-2003); however, activities on the ground do not always seem to be in line with this policy (e.g.. a proposed development project within the only remaining intact area of the Blue Pine ecosystem in one of the best remaining Himalayan temperate forest areas in Punjab).

The effect of human interference on the environment, and in particular depletion of the forest cover, was studied in relation to landslides around Dehra Dun and Mussoorie in Uttar Pradesh in the Indian part of the Himalaya. Land use and land cover data for a period of 60 years were analyzed. The study found that forested areas accounted for only 9 percent of landslide occurrence, whilst about 60 per cent of the landslides were in nonforested areas that were forested in 1930. That forest clearing accelerates erosion, and thus causes landslides in mountainous terrain, has been discussed for more than a century.

The restoration of vegetation cover will take a long time to decrease landslide risk. A study of the environmental changes in three severely degraded watersheds in the Chamoli district (Central Himalaya) has concluded that even after 20 years of restoration, there is only a marginal reduction in landslide activity. In this case, the stabilization process of the active landslide zones seems to have been quite slow due to the presence of sheared carbonate rocks. Any restoration of forest areas in these highly vulnerable areas will thus have to consider the best way to achieve stabilization as quickly as possible. Experts have suggested that although natural regeneration should be used as much as possible, the plantation and direct sowing of trees, shrubs, and pasture herbs and grasses will enhance the revegetation process of the bare soil. Land-use planning is therefore a key issue in the creation of any kind of environmental stability in the area. Although restoration of forest resources is important, one of the most important land use decisions that needs to be made is the effective protection of the forest cover that remains.

Source: Stolton, S., N. Dudley, and J. Randall. 2008. *Natural Security: Protected areas and hazard mitigation.*

While the use of the environment has considerable scope in risk reduction, two significant challenges exist. First, environment-based risk reduction needs to be grounded in the best possible understanding of the natural environment and the local context. Structural DRR methods such as floodwalls and storm channels require engineering expertise. Similarly, environment-based risk reduction requires consultation with environmental specialists. For instance, use of wetlands to manage flooding needs to incorporate a clear understanding of the frequency, duration, magnitude, and return period of the floods to be managed. If these factors are not accurately included in the design of a risk mitigation activity, then the activity may not, in fact, fully mitigate the expected floods. The result is a false sense of safety and the likelihood of needless loss of life and livelihoods when flooding does occur.

Second, risks change as society and the environment change. For instance, increased urbanization can increase the likelihood of flash flooding even in areas where river flooding may have been managed in an environmentally sustainable manner. As a result, risk reduction interventions need to be designed for change and periodically reviewed to ensure that they remain effective against targeted, newly emergent risks, including changes in socioeconomic and political systems.

If efforts to reduce disaster risks do not take into account the impact on the environment, root causes of risk that link to the environment, and the sustainability of risk reduction activities, risk reduction efforts will likely fail. Risk reduction efforts themselves need to be screened for environmental consequences, because poorly planned risk reduction activities can have negative impacts on the environment and will adversely impact people by increasing risk and vulnerability.

When conducting a disaster risk reduction assessment, it is important to consider the environmental factors that contribute to vulnerability. As shown in this picture from Pakistan after the 2005 earthquake, temporary shelter has been located in a hazard-prone area within a riverbed. Environmental factors that could contribute to vulnerability in this picture include modification of the river upstream that can increase flooding downstream, removal of vegetation along the riverbanks that can increase river flow and velocity, and steep slopes that increase the risk of landslides.
© Karl Schuler/IUCN-Pakistan

4 INTEGRATING THE ENVIRONMENT INTO DISASTER RISK REDUCTION ASSESSMENTS AND DESIGN

As defined by the UN International Strategy for Disaster Reduction, a disaster risk reduction assessment is a method for determining the nature and extent of risk. A DRR assessment analyzes potential hazards and evaluates existing conditions of vulnerability that could pose a potential threat or harm to people, property, and livelihoods, as well as the environment on which these things depend.[6] The assessment typically consists of three components: 1) a hazard assessment to determine the characteristics, frequency, forewarning, duration, causes, and effects of hazards facing a community (e.g., drought, flood, wildfire); 2) a vulnerability assessment to determine who and what is vulnerable, their level of vulnerability (e.g., high, moderate, low), and the underlying reasons for the vulnerability (e.g., 15 families are highly vulnerable to flood damages because they live alongside a stream channel); and 3) a capacity assessment to determine a community's existing capacities to cope with a hazard and any gaps in the capacities. In addition to these three standard components, most disaster risk reduction assessments include an action plan specifying what types of activities need to be undertaken to increase a community's capacity to respond to threats and reduce its vulnerability. The disaster risk facing a community is typically defined as the potential disaster losses, in lives, health status, livelihoods, assets, and services, that could occur to a particular community or a society over some specified future time period. Risk can be expressed as a simple formula: Risk = Hazard X Vulnerability.

At each stage in the typical disaster risk reduction assessment process, there are opportunities to integrate environmental concerns in order to ensure the long-term sustainability of the DRR intervention. These are described in the following table.

TABLE 1: ENVIRONMENTAL INTERVENTION POINTS IN THE DRR PROCESS

DRR COMPONENT	ENVIRONMENTAL INTERVENTION POINTS
HAZARD ASSESSMENT	Hazards are potentially dangerous or damaging events that negatively affect lives, property, and/or activities. Hazards can be divided into natural hazards (e.g., earthquakes, floods, wildfires, epidemic diseases) and human-made hazards (e.g., conflict, industrial pollution from nuclear or chemical wastes, and environmental degradation). A hazard assessment should examine **root causes** of these hazards to see if they are related to environmental management. For example, if communities identify that flooding is a concern, the hazard assessment team should determine if environmental factors such as deforestation, road construction, urbanization, or topsoil removal are contributing to the root cause of the disaster. This type of analysis will reveal opportunities for addressing root causes by implementing ecosystem-based DRR activities as further described in Section 5.

6 U.N. International Strategy for Disaster Reduction. Terminology of disaster risk reduction. www.unisdr.org/eng/library/lib-terminology-eng%20home.htm (Accessed on April 1, 2010)

DRR COMPONENT	ENVIRONMENTAL INTERVENTION POINTS
VULNERABILITY ASSESSMENT	Vulnerability is the degree to which individuals, households, communities, or geographical areas are likely to be affected by disaster when hazardous events occur. Communities living in hazard-prone areas may be made susceptible because of physical factors (e.g., location and disaster-resistance of buildings), weak social organization, limited economic opportunities, political processes, and other factors, including the integrity of natural resources.[7] When conducting the vulnerability assessment, project planners should be sure to consider the environmental factors of vulnerability. These include: **Extent of natural resource depletion in the area.** If livelihoods are based on natural resources such as fish, and fish stocks have been depleted, then it will be harder for fishermen to recover their livelihoods after the disaster, and they and their families will be more vulnerable. Similarly, if building materials such as timber and sand are already locally depleted, it will be costly and time consuming to reconstruct infrastructure after a disaster. Local communities will be dependent on outside suppliers for critical needs. **Loss of resilience of the ecological systems.** Coastal vegetation and wetland buffers can play important roles in the protection of coastal communities from storm surge during cyclones and other storm events. If these systems are degraded, then communities will be more vulnerable to disaster impacts. **Exposure to toxic and hazardous pollutants.** Populations that have been under exposure to toxic or hazardous pollutants prior to the disaster will have added difficulty recovering because their health may already be compromised. Disaster events may also further distribute these pollutants within the community and environment, resulting in contamination of soil and water resources.
CAPACITY ASSESSMENT	Capacities are a combination of all the strengths and resources available within a community, society, or organization that can reduce the level of risk, or the effects of a disaster. They can include the physical, institutional, social, or economic means as well as skilled personal or collective attributes such as leadership and management.[8] The capacity assessment represents an opportunity for DRR project managers to identify the root causes of hazards and to see if there are linkages with environmental management. If it is determined that environmental degradation is contributing to hazard risk, then the capacity assessment can help determine what physical, institutional, social, or economic means can be used or enhanced, through DRR interventions, to address this problem.
ACTION PLANNING	Most assessments are undertaken with the idea that they will lead to action. With respect to integrating the environment into DRR action plans, there are two main points to consider: 1. In all DRR activities, project planners should make sure that the intervention does not negatively impact the environment, in keeping with the principles of "Do No Harm." This is particularly the case for infrastructure-based DRR activities, such as road construction, dam building, drainage systems, floodwalls, seawalls, and building relocations. 2. DRR project planners should consider ecosystem-based activities for reducing disaster risk. These include such things as implementing restoration programs (e.g., mangrove planting), setting aside conservation areas (e.g., establishing coastal and river buffer zones), and raising awareness about the importance of good environmental management.

7 International Institute of Rural Reconstruction and Save the Children USA. 2007. *Leaving Disasters Behind: A guide to disaster risk reduction in Ethiopia.* Nairobi and Addis Ababa.

8 UN International Strategy for Disaster Reduction. Terminology of disaster risk reduction. www.unisdr.org/eng/library/lib-terminology-eng%20home.htm (Accessed on April 25, 2010)

A full discussion of capacity and vulnerability analysis can be found on the ProVention Consortium Web site, together with a community risk tool kit and specific information on community-based disaster risk management.[9] Specific community-level risk mapping and risk management tools have been developed by the International Federation of Red Cross and Red Crescent Societies (IFRC) (Capacity/Vulnerability Analysis[10]), Oxfam,[11] and the Asian Disaster Preparedness Center,[12] among others.

In addition to the capacity and vulnerability analyses developed by DRR practitioners mentioned above, there have also been several tools developed by climate adaptation practitioners that address both climate change adaptation and disaster risk reduction in the context of better environmental management. A discussion of how to integrate climate change adaptation into disaster risk reduction can be found in the box on the following page.

The Community-Based Risk Screening Tool – adaptation and livelihoods (CRiSTAL)[13] is a tool designed to help project planners and managers integrate climate change adaptation and risk reduction into community-level projects.

---

9 www.proventionconsortium.org

10 www.ifrc.org

11 www.proventionconsortium.org/themes/default/pdfs/CRA/PCVA2002.pdf

12 www.adpc.net/v2007/Programs/CBDRM/Default.asp

13 www.cristaltool.org

Wildfire is one type of hazard that is typically considered in a disaster risk reduction assessment. The vulnerability and capacity components of the assessment should include an analysis of the natural resources upon which people's livelihoods depend that can help make communities more resilient in times of disaster. In this photograph, a Kobu tribesman in Sumatra, Indonesia, watches a burning jungle which has been used by generations for hunting and medicinal plants. © Mark Edwards/WWF-Canon

GUIDANCE FOR INTEGRATING CLIMATE ADAPTATION INTO DISASTER RISK REDUCTION ASSESSMENTS AND PROJECT DESIGN

The recovery and reconstruction period after disasters is an important opportunity for project planners to incorporate **climate adaptation** into their recovery activities to make projects more resilient to a changing climate and reduce future disaster risk. There are two main categories of climate adaptation: **facilitating transitions to new conditions, and building resilience and buying time** to adapt to extreme weather events. Facilitating transitions to new conditions is needed when what people once knew as "normal" is no longer the norm, such as occurs with changes in freshwater systems due to melting of snow packs and sea level rise. Building resilience to extreme weather events helps people and nature withstand shocks after extreme events such as severe storms, drought, or flood. In practice, one or both of these approaches may be needed in a particular part of the world; building resilience can be a short-term measure while in the longer term a transition is needed to a new state – buying time in order to facilitate change.

Many of the DRR measures proposed in this module can be applied to help build resilience to climate variability and climate change, once it has been ascertained how people and ecosystems are vulnerable to climate. Because of the difficulty in discerning day-to-day impacts of long-term changes at the local level, it is often more practical and efficient to prioritize immediate and short-term impacts. If communities build capacity to manage and reduce risks in the short term, they should be more empowered to take similar actions in the future. When developing adaptation strategies, it is important to find out what indigenous strategies already exist to withstand shocks, as well as to bring in new technologies that may help communities to cope with conditions they have never seen before (for example, new strains of crops or breeds of livestock that can withstand larger climate fluctuations; environmentally sound water conservation technologies for extreme droughts; or alternative livelihoods or energy technologies to take pressure off forests, enabling them to recover so that there is less risk of future landslides caused by more intense rainfall). In areas that have recently suffered flood damage, and that are expected to become more prone to flooding due to climate change, there is a good opportunity to develop zoning plans that accommodate larger floods in the future.

Microcredit and insurance are important ways to reduce risk in the context of climate change, and help tide people over future shocks so that they are less likely to fall back on the environment and use it in unsustainable ways. Equitable access to land and resources helps build resilience to climate change and enable poor households to withstand and recover from shocks. It is very important to promote good governance and strengthen community institutions – and to create early warning systems that are appropriate for local conditions.

Loss of natural resource species of local importance (for livelihoods, economic development, source of food security, or medicines) is a risk under climate change, as species ranges will shift with new conditions. We know that some areas act as refugia, enabling species to survive in a region when they disappear from surrounding areas: for example, a deep valley that is cooler than the surrounding areas, an area of higher ground, a section of coral reef with cooler currents, or an inland mangrove zone. Depending on local conditions, there may be needs and opportunities to set aside land or marine areas as refugia in which species can continue to survive, and where limited and sustainable harvesting may still be possible. If an integrated ecosystems-livelihoods vulnerability assessment has been done, it may indicate likely areas of refugia. Strong efforts should be made to conserve these refugia and their wild species.

Consider this climate adaption checklist when designing disaster risk reduction assessments and projects:

- ❑ Project planners have contacted local government officials or experts to determine the predicted impacts of climate change within the project area.
- ❑ The project includes specific measures to address predicted changes in climate extremes in the next 5-10 years (e.g., worsening drought, greater frequency of flooding, more intense cyclones).
- ❑ The project design considers the consequences of longer-term, regional climate change effects (e.g., heat stress from rising temperatures, reduced stream flow due to loss of snow pack, sea level rise from melting ice caps).
- ❑ Alternative activities have been considered in terms of their ability to account for future climate risks.

5 ECOSYSTEM-BASED ACTIVITIES FOR REDUCING DISASTER RISK

There is increasing interest in using ecosystem-based activities for the purpose of hazard impact management (e.g., wetland protection, establishment of coastal buffer zones, planting of vegetation) based on the concept that "ecosystem-based approaches can be equally or more beneficial than infrastructure or technology-based solutions."[14]

Healthy ecosystems can provide a suite of benefits to people and communities. These benefits or **ecosystem services** include **regulating services** such as regulation of floods, drought, land degradation, and disease; **provisioning services** such as food and water; **supporting services** such as soil formation and nutrient cycling; and **cultural services** such as recreational, spiritual, religious, and other nonmaterial benefits. Integrated management of land, water, and living resources that promotes conservation and sustainable use provides the basis for maintaining ecosystem services, including those that contribute to reduced disaster risks.

To be effective, the use of ecosystem-system based activities requires reliable data on hazard frequency as well as a good understanding of the ecological context, such as the geologic and hydrologic conditions of a given area as well as the plant-wildlife-human interactions that take place. These issues need to be addressed on a location-by-location basis, with decisions on the use of ecological resources arrived at through community consultations. Technical information on how to apply ecosystem-based DRR activities for a specific geographic area can be obtained through consultation with environmental specialists as well as government officials in the environmental, emergency management, and land use planning departments.

COPING WITH STORM FLOW IN MADAGASCAR: THE CASE OF MANTADIA NATIONAL PARK

There is mounting concern, supported by additional evidence from local communities, that the increasing deforestation rate is causing greater flooding in the eastern half of the island of Madagascar, where the monsoon rains are particularly severe.

Mantadia National Park, established in 1989 as an outcome of Madagascar's National Environmental Action Plan, includes the watershed of the Vohitra River. The establishment of the park helped reduce deforestation rates in the area. A study of the economic benefits of the park showed that the reduction in deforestation reduced stormflow and associated losses in farmer's productivity. The results indicated that conversion from primary to secondary forest caused a three-fold increase in storm flow, and conversion from secondary forest to agricultural areas caused up to 1.5 times greater flow. Thus, the analysis concluded that conversion from primary forest to agriculture can increase storm flow by as much as 4.5 times. The study quantified the benefits from forest protection within upper watersheds in terms of reduced crop damage from floods in agricultural plots in lower basins, and concluded that the net value of watershed protection (in 1997) was US$126,700 (to put this figure into perspective, the authors note that in 1991 Madagascar had per capita GNP of US$207).

Source: Stolton, S., N. Dudley, and J. Randall. 2008. *Natural Security: Protected areas and hazard mitigation.*

14 Sudmeier-Rieux, K. and N. Ash. 2009. *Environmental Guidance Note for Disaster Risk Reduction: Healthy Ecosystems for Human Security.* Revised Ed. Gland: IUCN.

Another way to view ecosystem-based activities is through a ridge-to-reef, or ridge-to-valley floor,[15] approach to risk assessment and management. By looking at **regional** environmental impacts beyond a community, this approach focuses on how local actions (e.g., a flood retention wall) impact a broader scale of communities and ecosystems. This approach also highlights needs and impacts that fall beyond the scope of community action, such as protection from glacial lake outbursts or coastal flooding. Addressing these needs may require significant advocacy with provincial or national governments, as well as consultations between communities within and downstream of the ridge-to-reef watershed.

This type of analysis can define an integrated structure of ecosystem-based risk reduction interventions across a number of communities and ecological zones. A ridge-to-reef approach reduces the possibility that risk reduction efforts in one location can increase risks in another; an integrated approach is presumed to be more sustainable and effective than a set of unconnected risk reduction interventions.

The following table, developed from the publication ***Natural Security,***[16] identifies some ecosystem-based disaster risk reduction interventions. The risk assessment results and community consultations are keys to identifying which intervention or interventions are most appropriate. Further, root cause analysis can identify issues of power and conflict that may influence the effectiveness and adoption of specific interventions.

It is important to note that ecosystem-based DRR interventions, like all DRR activities, reduce but does not remove risk. For instance, using forests to stabilize avalanche-prone slopes reduces the frequency of avalanches but not the fact that avalanches will still occur under specific conditions. DRR efforts should use multiple approaches to reduce risk, to ensure that the multifaceted social, economic, and environmental nature of risk is addressed and avoid overstating the extent to which risk is reduced through a particular action.

---

15 Ridge-to-reef refers to taking into consideration the environmental conditions from ridge-top to offshore reef (or valley bottom) in planning sustainable interventions to limit negative environmental impacts. Specifically included in this approach is the impact of human occupation of a watershed, including use of forest resources, as well as farming, mining, and other types of land use.

16 Stolton, S., N. Dudley, and J. Randall. 2008. *Natural Security: Protected areas and hazard mitigation.*

TABLE 2: SELECT ECOSYSTEM-BASED HAZARD MITIGATION ACTIONS[17]

HAZARD	ECOSYSTEM-BASED MITIGATION ACTION
FLOODING, INCLUDING RIVER, FLASH, AND SHEET FLOODING	Establish or reestablish overflow space in marshes, estuaries, and open land to reduce size and speed of flooding.
	Create retention ponds in up-slope areas (near top of drainage) to hold back and slow run-off.
	Reduce speed of run-off to reduce flows leading to flooding by planting vegetation and/or by stabilizing slopes through bioengineering.
	Reduce vegetation blocking drainage routes to speed drainage.
	Use channel plugs (rocks and brush to slow water flow) and riprap (rocks to protect channel banks) to slow flows in streams and occasional water channels.
STORM SURGE	Create or reestablish barriers against surge flow from the ocean. The barriers can be permeable (e.g., forests) to reduce the speed and intensity of surges, or impermeable (e.g., natural sand dunes) to stop surges.
LANDSLIDES AND OTHER DOWN-SLOPE MOVEMENTS OF ROCKS AND SOILS	Stabilize slopes with vegetation.
	Change land use to reduce erosion potential (e.g., from cropping to orchards).
	Establish impact zones with little or no human occupation.
AVALANCHE	Stabilize slopes with vegetation.
	Establish impact zones with little or no human occupation.
DROUGHT	Use drought-resistant vegetation for food production, commercial use, and environmental management (e.g., trees for shade).
	Increase soil quality to increase moisture retention during dry periods.
	Use crop diversity and intercropping to reduce impact of dry conditions on mono-crops.
	Maintain agriculture diversity and include wild foods and other indigenous sources of food in agricultural systems.
	Use low- or no-till methods to limit water loss and wind erosion.
	Maintain areas of natural vegetation intermixed with fields to reduce pest impacts.
	Reduce or ban burning of natural vegetation to maintain land cover and reduce evapotranspiration.

HAZARD	ECOSYSTEM-BASED MITIGATION ACTION
HIGH WINDS	Use indigenous vegetation adapted to regenerate following high-wind events.
	Plant wind-resistant vegetation near buildings to reduce impact of high winds.
	Plant trees and bushes to break flow of winds to reduce wind erosion.
HEAVY RAINFALL/HAIL	Use indigenous vegetation for shade and food production to reduce damage caused by impacts.
	See methods above under *Flooding* for dealing with run-off and flooding.
EROSION	Use indigenous vegetation to maintain soil on slopes and areas subject to erosion.
	Construct berms, bunds, and compost pits along contours of erosion-prone hills/slopes to trap or slow the flow of eroded soil.
	See *High Winds* above on wind erosion.
EARTHQUAKE	Increase spacing between buildings to reduce impact of building collapse.
	Create open areas to serve as refuge following earthquakes. These areas can be used as parks, floor channels, or other public space between earthquakes.
FIRE	Encourage indigenous vegetation if this vegetation is considered to be fire resistant, and reduce the presence of non-fire-resistant vegetation where possible.
	Reduce vegetation load near buildings and habituated areas and avoid the use of non-fire-resistant vegetation in fire-prone areas.
	Reduce vegetation load in forests and wooded areas at risk of burning through controlled burning and/or mechanical treatment, including hand labor to trim trees and bush.

GOOD PRACTICES FOR RISK REDUCTION USING ECOSYSTEMS

- ❑ Maintain natural ecosystems, such as coastal mangroves, coral reefs, floodplains, forest, etc., to help buffer against natural hazards
- ❑ Maintain traditional cultural ecosystems that have an important role in mitigating extreme weather events, such as agroforestry systems, terraced crop growing, and fruit-tree forests in arid lands
- ❑ Provide an opportunity for active or passive restoration of such systems where they have been degraded or lost[17]
- ❑ Promote policies for the protection of ecosystems for the purpose of disaster risk reduction, climate change adaptation, and the other services ecosystems provide

17 Stolton, S., N. Dudley, and J. Randall. 2008. *Natural Security: Protected areas and hazard mitigation.*

REDUCING FIRE DISASTERS THROUGH ECOSYSTEM MANAGEMENT IN THE MEDITERRANEAN

Fire is the main cause of forest loss in the northern Mediterranean, with considerable impact on properties and livelihoods. An average of over 400,000 ha is burnt each year, with a massive 751,798 ha burnt in 2003 alone. National strategies allocating major efforts and resources to firefighting (e.g., buying of hydroplanes and helicopters) have proved to be inefficient in the growing trend of large-scale devastating fires. An integrated fire management strategy should be based on a risk reduction management framework aiming to increase ecological and social resilience to adapt to the complex interrelation between the predicted increase of heat waves and the human-induced impacts on natural ecosystems. In April 2008, IUCN, WWF, FAO, and other partners agreed on a common position – the Athens Statement – for climate change adaptation in Mediterranean forest conservation and management, with a special focus on increasing resilience to major disturbances.

A new forest fire strategy was adopted in Lebanon through a participatory process with the Lebanese government, incorporating a climate change adaptation goal: **Reducing the risk of intense and frequent forest fires whilst allowing for fire regimes that are socially, economically and ecologically sustainable.** IUCN is building ecological and social resilience to climate change impacts in high-fire-risk landscapes by doing the following:

- developing a participatory planning process to design landscape patterns resilient to fire and prevent land use changes that may alter the landscape's traditional mosaic structure and increase fire risk (e.g., the current trend of intensification of pine plantations);
- identifying fuel reduction opportunities through traditional and innovative land uses (e.g., promoting livestock grazing in high-fire-risk areas);
- developing and exploring opportunities to help adopt fire resilient land uses and landscape patterns (e.g., innovative management systems, economic incentives);
- the ecological restoration of healthy forest conditions diversifying forest land with a higher number of native resprouting species, which regenerate better after fire; and
- preventive forest practices and fuel management aiming at reducing high-forest-fuel litter and the landscape susceptibility to fires.

Source: Regato, P. 2008. *Adapting to Global Change - Mediterranean Forests.* Gland, Switzerland and Malaga, Spain: IUCN.

6 ENVIRONMENTAL IMPLICATIONS OF DISASTER RISK REDUCTION ACTIVITIES

DRR seeks to reduce the risk of harm from disasters. However, the implementation of activities defined by disaster risk assessments, or by interventions presumed to reduce risk, itself has a risk of doing harm if the activities do not address environmental sustainability. For instance, a risk reduction intervention to build concrete floodwalls in one location may exacerbate flooding in another location. These "downstream" or unintended impacts are often not incorporated into the planning of DRR interventions.

As a result, DRR activities should be subject to an Environmental Impact Assessment (EIA) to ensure that harm will not be done or, where harm may occur, that mitigation activities are taken and are acceptable to those targeted by the assistance.

The principal aim of Environmental Impact Assessment (EIA) is "to give the environment its due place in the decision-making process by clearly evaluating the environmental consequences of a proposed activity before action is taken. The concept has ramifications in the long run for almost all activity because sustainable development depends on protecting natural resources which are the foundation for further development."[18]

EIA aims to predict environmental impacts at an early stage in project planning and design, find ways to reduce adverse impacts, shape projects to suit the local environment, and present the predictions and options to decision makers. With EIA, both environmental and economic benefits can be achieved, such as reductions in the costs and duration of project implementation and design, avoidance of treatment/clean-up costs, and compliance with the mandatory requirements of some environmental laws and regulations.

The context of a classic EIA is often understood to be a non-disaster situation. In such situations, an EIA is often mandated by law for major infrastructure, commercial, industrial, or residential development proposals. It is a widely recognized environmental management tool for mainstreaming the environment into development projects, and has been made mandatory by legal systems in many countries. The EIA process does not have to be a lengthy one, and there are EIA tools that have been specifically developed for the humanitarian setting, such as the Environmental Stewardship Review for Humanitarian Aid (ESR) described below and in GRRT Module 3, Green Guide to Environmental Impact Assessment Tools and Techniques. Many existing DRR assessment tools can also be modified to include EIA components in order to streamline the process. For example, a Community Vulnerability Assessment (CVA) can include a section that clearly examines the environmental impacts of the proposed action items and suggests ways to minimize the environmental impacts.

MINIMIZING THE ENVIRONMENTAL IMPACT OF DRR ACTIVITIES

There are several environmental impact assessment tools available for DRR project planners and managers to determine the environmental impact of their proposed project and take steps to minimize these impacts. One such tool is the Environmental Stewardship Review (ESR) for Humanitarian Aid that was developed by World Wildlife Fund (WWF) and the American Red Cross. The ESR is meant to operate at the project level to analyze how the project may impact or be impacted by environmental factors such as air quality, water quality, water supply, hazardous resources, and natural resources. A full discussion of this topic, and a sample ESR, is contained in GRRT Module 3, Green Guide to Environmental Impact Assessment Tools and Techniques.

18 Gilpin, Alan. 1995. *Environmental Impact Assessment – Cutting Edge for the Twenty-First Century.* Cambridge: Cambridge University Press.

DRR interventions seek to reduce risk by reducing either hazard impacts or vulnerability levels. Hazard impact reduction often involves efforts to directly modify the environment, such as building a dam to reduce the impact of drought. The environmental impact of the dam is not just about the placement of a new artifact – the dam – in the environment, but is also related to the sourcing of the resources needed to build the dam (e.g., construction of rock quarries and sand extraction from rivers) and the impact of retained waters on river and onshore environmental conditions (e.g., increased malaria or changes in aquatic flora and fauna).

A physical structure built to reduce risk is generally referred to as a *structural intervention*. Interventions such as warning systems, which may also have direct or indirect links to the environment, are generally referred to as *nonstructural interventions*. Ecology-based risk reduction interventions, such as the establishment of wetlands for flood-water retention, are generally considered to be structural interventions, although they may involve less engineering and resource mobilization (e.g., creation of borrow pits[19]) than do more traditional, engineered structures (e.g., flood barriers).

Vulnerability reduction often involves nonstructural activities with a strong focus on building capacity to avoid a disaster (e.g., evacuation planning) or respond to a disaster (e.g., training in first aid). The process of addressing the root causes of vulnerability may also involve actions that have a direct impact on the environment.

For instance, reducing the risk of drought and food insecurity can involve tree planting and intercropping, contouring to retain rainfall, installing water pumps for plant nurseries, and providing credit to buy improved seed varieties and fertilizer. Each of these interventions has an impact on the environment, and some of them can be negative if not managed properly; this is the case, for example, with overpumping ground water or excessive application of fertilizer.

Post-disaster recovery and reconstruction interventions have trade-offs in terms of environmental impacts: Increasing crop production with chemical fertilizers can lead to contaminated drinking water and fish die-offs. Environmental reviews should be conducted in order to determine the positive and negative environmental consequences of undertaking a recovery and reconstruction project.

Where these reviews are effective and are complemented by ongoing monitoring of environmental conditions, the chance that DRR efforts will have an unanticipated negative impact on the environment is reduced.

---

19 A borrow pit is a location where soil or sand is taken for use elsewhere in construction.

COST EFFECTIVENESS OF ECOSYSTEMS AS NATURAL BUFFERS TO COASTAL PROTECTION IN INDONESIA.

- One hotel in West Lombok has spent US$880,000 over a seven-year period to restore a 250-meter stretch of beach that had been damaged by past coral mining.
- More than US$1 million has been spent in Bali to protect 500 meters of coastline that is no longer protected by coral reefs.

When marine and coastal ecosystems are degraded and these important coastal defense functions are lost, high economic costs can arise as the examples above from Indonesia describe. Along Indonesia's coastlines, the value of marine and coastal ecosystems in decreasing vulnerability to risks and disasters accrues mainly through damage costs avoided – and these averted losses are typically substantial. A study in Bintuni Bay, West Papua, valued mangroves at US$600 per household per year based on their ability to control erosion. A variety of values have been calculated for the coastal protection functions of coral reefs in Indonesia, depending on their location: Reefs adjacent to sparsely populated areas where agriculture is the main activity have been valued at US$829/km (based on the value of agricultural production that would be lost), reefs adjacent to areas of high population densities at US$50,000/km (based on the cost of replacing housing and roads), and reefs in areas where tourism is the main use at US$1 million/km (based on the cost of maintaining sandy beaches). In total, Indonesia's coral reefs are estimated to have a value of some US$314 million for coastal erosion prevention.

Source: Sudmeier-Rieux, K. and N. Ash. 2009. *Environmental Guidance Note for Disaster Risk Reduction: Healthy Ecosystems for Human Security*. Revised Ed. Gland: IUCN.

In addition to valuable roles in coastal protection and erosion control, mangrove forests serve as habitat for a variety of fish and shellfish critical to livelihoods and food security in tropical regions. Through these ecosystem services, a healthy mangrove forest can reduce the vulnerability of a community both before and after a disaster event.
© Jurgen Freund/WWF-Canon

ANNEX 1. RELEVANT AGENCIES AND SOURCES OF INFORMATION

The following organizations and publications provide additional resources that elaborate on the concepts presented in this module.

Organizations

ActionAid: ActionAid is a non-profit organization committed to fighting poverty worldwide. ActionAid's approach to climate mitigation and disaster risk reduction is focused on the effects of climate change and disasters on the rural poor and other vulnerable groups. *www.actionaid.org*

Asian Disaster Preparedness Center (ADPC): The Asian Disaster Preparedness Center (ADPC) is a non-profit organization supporting the advancement of safer communities and sustainable development through the implementation of programs and projects that reduce the impact of disasters upon countries and communities in Asia and the Pacific. Especially relevant to this module is its Community-Based Disaster Risk Management Program. *www.adpc.net*

Emergency Capacity Building (ECB) Project: The ECB Project is a collaborative effort of seven leading humanitarian organizations that aims to improve the quality and effectiveness of humanitarian efforts. ECB offers numerous publications on disaster risk reduction topics, including case studies and pilot project reports. *www.ecbproject.org*

International Federation of Red Cross and Red Crescent Societies (IFRC): IFRC is a leading humanitarian organization that stresses disaster management as one of its core areas. IFRC provides a variety of publications and approaches to risk reduction and disaster response and preparedness. *www.ifrc.org*

Prevention Web: Prevention Web is an information source managed by UN/ISDR that provides current news and information related to disasters and disaster risk reduction around the world. *www.preventionweb.net*

Tearfund: Tearfund is a Christian humanitarian organization that indentifies environmental restoration and disaster reduction as two of its core issue areas. CEDRA (Climate change and Environmental Degradation Risk and Adaptation assessment) is an assessment tool designed to help humanitarian workers in developing countries assess and understand environmental hazards as they relate to disaster risk reduction. CEDRA is available through Tearfund's International Learning Zone Web site. *tilz.tearfund.org*

United Nations International Strategy for Disaster Reduction (ISDR): The ISDR is a system of partnerships under the UN banner with the goal of global disaster risk reduction. ISDR releases a variety of tools, publications, statistics, and other information about disaster risk reduction. *www.unisdr.org*

Publications

Cutter, S. Ed. 1994. *Environmental Risk and Hazards.* Englewood Cliffs: Prentice Hall.

Cutter, S. and E. Arnold. 1993. *Living With Risk: The Geography of Technological Hazards.* New York.

De Dios, H. 2002. *Participatory Capacities and Vulnerabilities Assessment: Finding the link between disasters and development.* Oxfam Great Britain.

ECB Project. 2007. *Emergency Capacity Building Pilot Projects: Promising Practices for Risk Reduction.*

IUCN. 2007. *Disaster Risk, Livelihoods and Natural Barriers, Strengthening Decision-Making Tools for Disaster Risk Reduction: A Case Study from Northern Pakistan.*

La Trobe, S. and P. Venton. 2003. *Natural Disaster Risk Reduction: The policy and practice of selected institutional donors.* Tearfund.

Miththapala, S. 2008. *Integrating Environmental Safeguards into Disaster Management: a field manual.* 3 vols. IUCN.

Shepherd, G. Ed. 2008. *The Ecosystem Approach: Learning from Experience.* IUCN.

Stolton, S., N. Dudley, and J. Randall. 2008. *Natural Security: Protected areas and hazard mitigation.*

Sudmeier-Rieux, K., H. Masundire, A. Rizvi, and S. Rietbergen. Eds. 2006. *Ecosystems, Livelihoods and Disasters: An integrated approach to disaster risk management.* IUCN.

Sudmeier-Rieux, K. and N. Ash. 2009. *Environmental Guidance Note for Disaster Risk Reduction: Healthy Ecosystems for Human Security.* IUCN.

Twigg, J. 2001. *Sustainable Livelihoods and Vulnerability to Disasters.* Benfield Hazard Research Center.

UN/ISDR. 2004. *Living with Risk: A global review of disaster reduction initiatives.*

Wisner, B. 2004. *At Risk: Natural Hazards, People's Vulnerability, and Disasters.* London: Routledge.

GLOSSARY

The following is a comprehensive list of the key terms used throughout the Green Recovery and Reconstruction Toolkit. In some cases, the definitions have been adapted from the original source. If no source is given, this indicates that the module author developed a common definition for use in the toolkit.

Anaerobic Filter (or Biofilter): Filter system mainly used for treatment of secondary effluent from primary treatment chambers such as septic tanks. The anaerobic filter comprises a watertight tank containing a bed of submerged media, which acts as a support matrix for anaerobic biological activity. For humanitarian aid agencies, the prefabricated biofilters that combine primary and secondary treatment into one unit can provide a higher level of treatment than do traditional systems such as precast cylindrical septic tanks or soakage pit systems. Source: SANDEC. 2006. *Greywater Management in Low and Middle Income Countries.* Swiss Federal Institute of Aquatic Science and Technology. Switzerland.

Better Management Practices (BMPs): BMPs are flexible, field-tested, and cost-effective techniques that protect the environment by helping to measurably reduce major impacts of growing of commodities on the planet's water, air, soil, and biological diversity. They help producers make a profit in a sustainable way. BMPs have been developed for a wide range of activities, including fishing, farming, and forestry. Source: Clay, Jason. 2004. *World agriculture and the environment: a commodity-by-commodity guide to impacts and practices.* Island Press: Washington, DC.

Biodiversity: Biological diversity means the variability among living organisms from all sources, including inter alia, terrestrial, and marine and other aquatic ecosystems, as well as the ecological complexes of which they are part; this includes diversity within species, between species, and of ecosystems. Source: United Nations. Convention on Biological Diversity. www.cbd.int/convention/articles.shtml?a=cbd-02 (Accessed on June 18, 2010)

Carbon Footprint: The total set of greenhouse gas emissions caused directly and indirectly by an individual, organization, event, or product. For simplicity of reporting, the carbon footprint is often expressed in terms of the amount of carbon dioxide, or its equivalent of other greenhouse gases, emitted. Source: Carbon Trust. Carbon Footprinting. www.carbontrust.co.uk (Accessed on June 22, 2010)

Carbon Offset: A financial instrument aimed at a reduction in greenhouse gas emissions. Carbon offsets are measured in metric tons of carbon dioxide-equivalent (CO_2e) and may represent six primary categories of greenhouse gases. One carbon offset represents the reduction of one metric ton of carbon dioxide or its equivalent in other greenhouse gases. Source: World Bank. 2007. *State and Trends of the Carbon Market.* Washington, DC

Climate Change: The climate of a place or region is considered to have changed if over an extended period (typically decades or longer) there is a statistically significant change in measurements of either the mean state or the variability of the climate for that place or region. Changes in climate may be due to natural processes or to persistent anthropogenic changes in atmosphere or in land use. Source: UN International Strategy for Disaster Reduction. Terminology of disaster risk reduction. www.unisdr.org/eng/terminology/terminology-2009-eng.html (Accessed on April 1, 2010)

Construction: Construction is broadly defined as the process or mechanism for the realization of human settlements and the creation of infrastructure that supports development. This includes the extraction and processing of raw materials, the manufacturing of construction materials and components, the construction project cycle from feasibility to deconstruction, and the management and operation of the built environment.

Source: du Plessis, Chrisna. 2002. *Agenda 21 for Sustainable Construction in Developing Countries.* Pretoria, South Africa: CSIR Building and Construction Technology.

Disaster: Serious disruption of the functioning of a society, causing widespread human, material, or environmental losses which exceed the ability of the affected society to cope using only its own resources. Disasters are often classified according to their speed of onset (sudden or slow) and their cause (natural or man-made). Disasters occur when a natural or human-made hazard meets and adversely impacts vulnerable people, their communities, and/or their environment. Source: UNDP/UNDRO. 1992. *Overview of Disaster Management*. 2nd Ed.

Disaster preparedness: Activities designed to minimize loss of life and damage; organize the temporary removal of people and property from a threatened location; and facilitate timely and effective rescue, relief, and rehabilitation. Source: UNDP/UNDRO. 1992. *Overview of Disaster Management*. 2nd Ed.

Disaster Risk: Potential disaster losses in lives, health status, livelihoods, assets, and services that could occur to a particular community or a society over some specified future time period. Risk can be expressed as a simple mathematical formula: Risk = Hazard X Vulnerability. This formula illustrates the concept that the greater the potential occurrence of a hazard and the more vulnerable a population, the greater the risk. Source: UN International Strategy for Disaster Reduction. Terminology of disaster risk reduction. www.unisdr.org/eng/terminology/terminology-2009-eng.html (Accessed on April 1, 2010)

Disaster Risk Reduction: The practice of reducing disaster risks through systematic efforts to analyze and manage the causal factors of disasters, including reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events. Source: UN International Strategy for Disaster Reduction. Terminology of disaster risk reduction. www.unisdr.org/eng/terminology/terminology-2009-eng.html (Accessed on April 1, 2010)

Ecosystem: Dynamic complexes of plants, animals, and other living communities and the nonliving environment interacting as functional units. Humans are an integral part of ecosystems. Source: UN. Convention on Biological Diversity. www.cbd.int/convention/articles.shtml?a=cbd-02 (Accessed on June 18, 2010)

Ecosystem Services: The benefits that people and communities obtain from ecosystems. This definition is drawn from the Millennium Ecosystem Assessment. The benefits that ecosystems can provide include "regulating services" such as regulation of floods, drought, land degradation, and disease; "provisioning services" such as provision of food and water; "supporting services" such as help with soil formation and nutrient cycling; and "cultural services" such as recreational, spiritual, religious, and other nonmaterial benefits. Integrated management of land, water, and living resources that promotes conservation and sustainable use provides the basis for maintenance of ecosystem services, including those that contribute to the reduction of disaster risks. Source: UN International Strategy for Disaster Reduction. Terminology of disaster risk reduction. www.unisdr.org/eng/terminology/terminology-2009-eng.html (Accessed on April 1, 2010)

Embodied Energy: The available energy that was used in the work of making a product. Embodied energy is an accounting methodology used to find the sum total of the energy necessary for an entire product life cycle. Source: Glavinich, Thomas. 2008. *Contractor's Guide to Green Building Construction: Management, Project Delivery, Documentation, and Risk Reduction.* John Wiley & Sons, Inc: New Jersey.

Environment: The complex of physical, chemical, and biotic factors (such as climate, soil, and living things) that act upon individual organisms and communities, including humans, and ultimately determine their form and survival. It is also the aggregate of social and cultural conditions that influence the life of an individual or community. The environment includes natural resources and ecosystem services that comprise essential life-supporting functions for humans, including clean water, food, materials for shelter, and livelihood generation. Source: Adapted from: *Merriam Webster Dictionary, "Environment."* www.merriam-webster.com/netdict/environment (Accessed on June 15, 2010)

Environmental Impact Assessment: A tool used to identify the environmental, social, and economic impacts of a project prior to decision making. It aims to predict environmental impacts at an early stage in project planning and design, find ways and means to reduce adverse impacts, shape projects to suit the local environment, and present the predictions and options to decision makers. Source: International Association of Environmental Impact Assessment in cooperation with Institute of Environmental Assessment. 1999. *Principles of Environmental Impact Assessment Best Practice.*

Green Construction: Green construction is planning and managing a construction project in accordance with the building design in order to minimize the impact of the construction process on the environment. This includes 1) improving the efficiency of the construction process; 2) conserving energy, water, and other resources during construction; and 3) minimizing the amount of construction waste. A "green building" is one that provides the specific building performance requirements while minimizing disturbance to and improving the functioning of local, regional, and global ecosystems both during and after the structure's construction and specified service life. Source: Glavinich, Thomas E. 2008. *Contractor's Guide to Green Building Construction: Management, Project Delivery, Documentation, and Risk Reduction*. Hoboken, New Jersey: John Wiley & Sons, Inc.

Green Purchasing: Green Purchasing is often referred to as environmentally preferable purchasing (EPP), and is the affirmative selection and acquisition of products and services that most effectively minimize negative environmental impacts over their life cycle of manufacturing, transportation, use, and recycling or disposal. Examples of environmentally preferable characteristics include products and services that conserve energy and water and minimize generation of waste and release of pollutants; products made from recycled materials and that can be reused or recycled; energy from renewable resources such as biobased fuels and solar and wind power; alternate fuel vehicles; and products using alternatives to hazardous or toxic chemicals, radioactive materials, and biohazardous agents. Source: U.S. Environmental Protection Agency. 1999. Final Guidance on Environmentally Preferred Purchasing. *Federal Register*. Vol. 64 No. 161.

Greening: The process of transforming artifacts such as a space, a lifestyle, or a brand image into a more environmentally friendly version (i.e., "greening your home" or "greening your office"). The act of greening involves incorporating "green" products and processes into one's environment, such as the home, workplace, and general lifestyle. Source: Based on: Glavinich, T. 2008. *Contractor's Guide to Green Building Construction: Management, Project Delivery, Documentation, and Risk Reduction.* Hoboken, New Jersey: John Wiley & Sons, Inc.

Hazard: A potentially damaging physical event, phenomenon, or human activity that may cause the loss of life or injury, property damage, social and economic disruption, or environmental degradation. Hazards can include latent conditions that may represent future threats and can have different origins: natural (geological, hydrometeorological, and biological) or induced by human processes (environmental degradation and technological hazards). Source: UN International Strategy for Disaster Reduction. Terminology of disaster risk reduction. www.unisdr.org/eng/terminology/terminology-2009-eng.html (Accessed on April 1, 2010)

Impact: Any effect caused by a proposed activity on the environment, including effects on human health and safety, flora, fauna, soil, air, water, climate, landscape and historical monuments, or other physical structures, or the interaction among those factors. It also includes effects on cultural heritage or socioeconomic conditions resulting from alterations to those factors. Source: United Nations Economic Commission for Europe. 1991. *The Convention on Environmental Impact Assessment in a Transboundary Context.* www.unece.org (Accessed June 22, 2010)

Indicator: A measurement of achievement or change for the specific objective. The change can be positive or negative, direct or indirect. They provide a way of measuring and communicating the impact, or result, of programs as well as the process, or methods used. The indicator may be qualitative or quantitative. Indicators are usually classified according to their level: *input* indicators (which measure the resources provided), *output* indicators (direct results), *outcome* indicators (benefits for the target group) and impact indicators (long-term consequences). Source: Chaplowe, Scott G. 2008. *Monitoring and Evaluation Planning*. American Red Cross/CRS M&E Module Series. American Red Cross and Catholic Relief Services: Washington, DC and Baltimore, MD.

Integrated Water Resources Management: Systemic, participatory process for the sustainable development, allocation, and monitoring of water resource use in the context of social, economic, and environmental objectives. Source: Based on: Sustainable Development Policy Institute. Training Workshop on Integrated Water Resource Management. www.sdpi.org (Accessed June 22, 2010)

Life Cycle Assessment (LCA): A technique to assess the environmental aspects and potential impacts of a product, process, or service by compiling an inventory of relevant energy and material inputs and environmental releases; evaluating the potential environmental impacts associated with identified inputs and releases; and interpreting the results to help make a more informed decision. Source: Scientific Applications International Corporation. 2006. Life Cycle Assessment: Principle's and Practice. Report prepared for U.S. EPA.

Life Cycle Materials Management: Maximizing the productive use and reuse of a material throughout its life cycle in order to minimize the amount of materials involved and the associated environmental impacts.

Life Cycle of a Material: The various stages of a building material, from the extraction or harvesting of raw materials to their reuse, recycling, and disposal.

Livelihoods: A livelihood comprises the capabilities, assets (including both material and social resources), and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks and can maintain or enhance its capabilities and assets both now and in the future, without undermining the natural resource base. Source: DFID. 1999. *Sustainable Livelihoods Approach Guidance Sheets.* London: Department for International Development.

Logframe: Logical framework, or logframe, analysis is a popular tool for project design and management. Logframe analysis provides a structured logical approach to the determination of project priorities, design and budget and to the identification of related results and performance targets. It also provides an iterative management tool for project implementation, monitoring and evaluation. Logframe analysis begins with problem analysis followed by the determination of objectives, before moving on to identify project activities, related performance indicators and key assumptions and risks that could influence the project's success. Source: Provention Consortium. 2007. *Logical and Results Based Frameworks.* Tools for Mainstreaming Disaster Risk Reduction. Guidance Note 6. Geneva, Switzerland.

Primary Wastewater Treatment: Use of gravity to separate settleable and floatable materials from the wastewater. Source: National Research Council. 1993. *Managing Wastewater in Coastal Urban Areas.* Washington DC: National Academy Press.

Project Design: An early stage of the project cycle in which a project's objectives and intended outcomes are described and the project's inputs and activities are identified.

Project Evaluation: Systematic and impartial examination of humanitarian action intended to draw lessons that improve policy and practice, and enhance accountability. Source: Active Learning Network for Accountability and Performance in Humanitarian Action (ALNAP). Report Types. www.alnap.org (Accessed June 25, 2010)

Project Monitoring: A continuous and systematic process of recording, collecting, measuring, analyzing, and communicating information. Source: Chaplowe, Scott G. 2008. *Monitoring and Evaluation Planning.* American Red Cross/CRS M&E Module Series. American Red Cross and Catholic Relief Services : Washington, DC and Baltimore, MD.

Reconstruction: The actions taken to reestablish a community after a period of recovery subsequent to a disaster. Actions would include construction of permanent housing, full restoration of all services, and complete resumption of the pre-disaster state. Source: UNDP/UNDRO. 1992. *Overview of Disaster Management.* 2nd Ed.

Recovery: The restoration, and improvement where appropriate, of facilities, livelihoods, and living conditions of disaster-affected communities, including efforts to reduce disaster risk factors. Source: UN International Strategy for Disaster Reduction. Terminology of disaster risk reduction. www.unisdr.org/eng/terminology/terminology-2009-eng.html (Accessed on April 1, 2010)

Recycle: Melting, crushing, or otherwise altering a component and separating it from the other materials with which it was originally produced. The component then reenters the manufacturing process as a raw material (e.g., discarded plastic bags reprocessed into plastic water bottles). Source: Based on: Glavinich, Thomas E. 2008. *Contractor's Guide to Green Building Construction: Management, Project Delivery, Documentation, and Risk Reduction.* Hoboken, New Jersey: John Wiley & Sons, Inc.

Resilience: The capacity of a system, community, or society potentially exposed to hazards to adapt, by resisting or changing, in order to reach and maintain an acceptable level of functioning and structure. This is determined by the degree to which the social system is capable of organizing itself to increase its capacity for learning from past disasters for better future protection and to improve risk reduction measures. Source: UN International Strategy for Disaster Reduction. Terminology of disaster risk reduction. www.unisdr.org/eng/terminology/terminology-2009-eng.html (Accessed on April 1, 2010)

Response (also called Disaster Relief): The provision of emergency services and public assistance during or immediately after a disaster in order to save lives, reduce health impacts, ensure public safety, and meet the basic subsistence needs of the people affected.

Comment: Disaster response is predominantly focused on immediate and short-term needs and is sometimes called disaster relief. The division between this response stage and the subsequent recovery stage is not clear-cut. Some response actions, such as the supply of temporary housing and water supplies, may extend well into the recovery stage.

Source: UN International Strategy for Disaster Reduction. Terminology of disaster risk reduction. www.unisdr.org/eng/terminology/terminology-2009-eng.html (Accessed on April 1, 2010)

Reuse: The reuse of an existing component in largely unchanged form and for a similar function (e.g., reusing ceramic roof tiles for a reconstructed house). Source: Based on: Glavinich, Thomas E. 2008. Contractor's Guide to Green Building Construction: Management, Project Delivery, Documentation, and Risk Reduction. Hoboken, New Jersey: John Wiley & Sons, Inc.

Secondary Wastewater Treatment: Use of both biological (i.e., microorganisms) and physical (i.e., gravity) processes designed to remove biological oxygen demand (BOD) and total suspended solids (TSS) from wastewater. Source: National Research Council. 1993. *Managing Wastewater in Coastal Urban Areas*. Washington DC: National Academy Press.

Site Development: The physical process of construction at a building site. These construction-related activities include clearing land, mobilizing resources to be used in the physical infrastructure (including water), the fabrication of building components on site, and the process of assembling components and raw materials into the physical elements planned for the site. The site development process also includes the provision of access to basic amenities (e.g., water, sewage, fuel) as well as improvements to the environmental conditions of the site (e.g., through planting vegetation or other environment-focused actions).

Site Selection: The process encompasses many steps from planning to construction, including initial inventory, assessment, alternative analysis, detailed design, and construction procedures and services. Site selection includes the housing, basic services (e.g., water, fuel, sewage, etc.), access infrastructure (e.g., roads, paths, bridges, etc.) and social and economic structures commonly used by site residents (e.g., schools, clinics, markets, transport facilities, etc.).

SMART Indicator: An indicator that meets the SMART criteria: **S**pecific, **M**easurable, **A**chievable, **R**elevant, and **T**ime-bound. Source: Based on: Doran, G. T. 1981. There's a S.M.A.R.T. way to write management›s goals and objectives. *Management Review:* 70, Issue 11.

Sustainable Construction: Sustainable construction goes beyond the definition of "green construction" and offers a more holistic approach to defining the interactions between construction and the environment. Sustainable construction means that the principles of sustainable development are applied to the comprehensive construction cycle, from the extraction and processing of raw materials through the planning, design, and construction of buildings and infrastructure, and is also concerned with any building's final deconstruction and the management of the resultant waste. It is a holistic process aimed at restoring and maintaining harmony between the natural and built environments, while creating settlements that affirm human dignity and encourage economic equity. Source: du Plessis, Chrisna. 2002. Agenda 21 for Sustainable Construction in Developing Countries. Pretoria, South Africa: CSIR Building and Construction Technology.

Sustainable development: Development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Source*:* World Commission on Environment and Development. 1987. *Report of the World Commission on Environment and Development: Our Common Future*. Document A/42/427. www.un-documents.net (Accessed June 22, 2010)

Tertiary Wastewater Treatment: Use of a wide variety of physical, biological, and chemical processes aimed at removing nitrogen and phosphorus from wastewater. Source: National Research Council. 1993. *Managing Wastewater in Coastal Urban Areas.* Washington DC: National Academy Press. p. 58

Vulnerability. *Human* vulnerability is the relative lack of capacity of a person or community to anticipate, cope with, resist, and recover from the impact of a hazard. *Structural or physical* vulnerability is the extent to which a structure or service is likely to be damaged or disrupted by a hazard event. *Community* vulnerability exists when the elements at risk are in the path or area of the hazard and are susceptible to damage by it. The losses caused by a hazard, such as a storm or earthquake, will be proportionally much greater for more vulnerable populations, e.g., those living in poverty, with weak structures, and without adequate coping strategies. Source: UNDHA. 1997. *Building Capacities for Risk Reduction.* 1st Ed.

Watershed: An area of land that drains down slope to the lowest point. The water moves through a network of drainage pathways, both underground and on the surface. Generally, these pathways converge into streams and rivers that become progressively larger as the water moves downstream, eventually reaching a water basin (i.e., lake, estuary, ocean). Source: Based on: Oregon Watershed Enhancement Board. 1999. *Oregon Watershed Assessment Manual.* www.oregon.gov Salem.

ACRONYMS

The following is a comprehensive list of the acronyms used throughout the Green Recovery and Reconstruction Toolkit.

ADB	Asian Development Bank
ADPC	Asian Disaster Preparedness Center
ADRA	Adventist Development and Relief Agency
AECB	Association for Environment Conscious Building
AJK	Azad Jammu Kashmir
ALNAP	Active Learning Network for Accountability and Performance in Humanitarian Action
ANSI	American National Standards Institute
BMPS	best management practices
BOD	biological oxygen demand
CAP	Consolidated Appeals Process
CEDRA	Climate Change and Environmental Degradation Risk and Adaptation Assessment
CFL	compact fluorescent lamp
CGIAR	Consultative Group on International Agricultural Research
CHAPS	Common Humanitarian Assistance Program
CIDEM	Centro de Investigación y Desarrollo de Estructuras y Materiales
CO	Country Office
CRISTAL	Community-based Risk Screening Tool – Adaptation and Livelihoods
CRS	Catholic Relief Services
CVA	community vulnerability assessment
DFID	Department for International Development
DRR	disaster risk reduction
EAWAG	Swiss Federal Institute of Aquatic Science and Technology

ECB	Emergency Capacity Building Project
EE	embodied energy
EIA	environmental impact assessment
EMMA	Emergency Market Mapping and Analysis Toolkit
EMP	environmental management plan
ENA	Environmental Needs Assessment in Post-Disaster Situations
ENCAP	Environmentally Sound Design and Management Capacity Building for Partners and Programs in Africa
EPP	environmentally preferable purchasing
ESR	Environmental Stewardship Review for Humanitarian Aid
FAO	Food and Agriculture Organization
FEAT	Flash Environmental Assessment Tool
FRAME	Framework for Assessing, Monitoring and Evaluating the Environment in Refuge Related Operations
FSC	Forest Stewardship Council
G2O2	Greening Organizational Operations
GBCI	Green Building Certification Institute
GBP	Green Building Programme
GIS	geographic information system
GRR	Green Recovery and Reconstruction
GRRT	Green Recovery and Reconstruction Toolkit
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit
GWP	Global Water Partnership
HQ	headquarters
HVAC	heating, ventilation, and air conditioning
IAS	International Accreditation Service
IASC	Inter-Agency Standing Committee

IAIA	International Association for Impact Assessment
IBRD	International Bank for Reconstruction and Development
ICE	Inventory of Carbon and Energy
ICT	information and communication technology
IDA	International Development Association
IDP	internally displaced peoples
IDRC	International Development Research Centre
IFC	International Finance Corporation
IFRC	International Federation of Red Cross and Red Crescent Societies
IFMA	International Facilities Management Association
ILO	International Labour Organization
IPCC	Intergovernmental Panel on Climate Change
IRC	International Rescue Committee
ISAAC	Institute for Applied Sustainability to the Built Environment
ISDR	International Strategy for Disaster Reduction
ISO	International Standards Organization
IT	information technology
ITDG	Intermediate Technology Development Group
IUCN	International Union for the Conservation of Nature
ISWM	integrated solid waste management
IWA	International Water Association
IWMI	International Water Management Institute
IWRM	integrated water resource management
IWQA	International Water Quality Association
IWSA	International Water Supply Association

KW H	Kilowatt hour
LCA	life cycle assessment
LEDEG	Ladakh Ecological Development Group
LEED	Leadership in Energy & Environmental Design
M&E	monitoring and evaluation
MAC	Marine Aquarium Council
MDGS	Millennium Development Goals
MSC	Marine Stewardship Council
NACA	Network of Aquaculture Centers
NGO	non-governmental organization
NSF-ERS	National Science Foundation - Engineering and Research Services
NWFP	North Western Frontier Province
OCHA	Office for the Coordination of Humanitarian Affairs
PDNA	Post Disaster Needs Assessment
PEFC	Programme for the Endorsement of Forest Certification
PET	Polyethylene terephthalate
PMI	Indonesian Red Cross Society
PVC	Polyvinyl chloride
PV	photovoltaic
REA	Rapid Environmental Assessment
RIVM	Dutch National Institute for Public Health and the Environment
SC	sustainable construction
SCC	Standards Council of Canada
SEA	Strategic Environmental Impact Assessment
SIDA	Swedish International Development Agency

SKAT	Swiss Centre for Development Cooperation in Technology and Management
SL	sustainable livelihoods
SMART	Specific, Measurable, Achievable, Relevant, and Time-bound
SODIS	solar water disinfection
TRP	Tsunami Recovery Program
TSS	total suspended solids
UN	United Nations
UNDHA	United Nations Department of Humanitarian Affairs
UNDP	United Nations Development Programme
UNDRO	United Nations Disaster Relief Organization
UNEP	United Nations Environment Program
UNGM	United Nations Global Marketplace
UN-HABITAT	United Nations Human Settlements Programme
UNHCR	United Nations High Commissioner for Refugees
UNICEF	The United Nations Children's Fund
USAID	United States Agency for International Development
USAID-ESP	United States Agency for International Development- Environmental Services Program
VROM	Dutch Ministry of Spatial Planning, Housing and the Environment
WEDC	Water, Engineering, and Development Centre
WGBC	World Green Building Council
WHO	World Health Organization
WWF	World Wildlife Fund

Soon after the 2004 Indian Ocean tsunami, the American Red Cross and the World Wildlife Fund (WWF) formed an innovative, five-year partnership to help ensure that the recovery efforts of the American Red Cross did not have unintended negative effects on the environment. Combining the environmental expertise of WWF with the humanitarian aid expertise of the American Red Cross, the partnership has worked across the tsunami-affected region to make sure that recovery programs include environmentally sustainable considerations, which are critical to ensuring a long-lasting recovery for communities.

The Green Recovery and Reconstruction Toolkit has been informed by our experiences in this partnership as well as over 30 international authors and experts who have contributed to its content. WWF and the American Red Cross offer the knowledge captured here in the hopes that the humanitarian and environmental communities will continue to work together to effectively incorporate environmentally sustainable solutions into disaster recovery. The development and publication of the Green Recovery and Reconstruction Toolkit was made possible with support from the American Red Cross.