2 Understanding risk reduction – the theory

Before an effective community-based disaster risk management plan can be developed, we need to understand the terminology and conceptual models which lie behind this approach. Many terms are used in this book, each with its own meaning in DRR. The practical ways of reducing risk can only be developed if the causes of those risks have been understood. This section will introduce the following:

- Terms and definitions
- The Disaster Cycle
- The Disaster Crunch Model
- The Release Model
- The Hyogo Framework
- Disasters and development
- Disaster risk, climate change and environmental degradation

2.1 Terms and definitions

A full set of terms and definitions appears later in this publication (see Glossary). However, as a starting point, 11 definitions are given below to aid understanding of how these terms are used in a DRR context.

CAPACITIES Strengths or resources (present in individuals, households and communities) which increase ability to prepare for, cope with and recover from a hazardous event.

CLIMATE CHANGE ADAPTATION (CCA) CCA is in practice very similar to DRR, and consists of actions taken to increase resilience to weather-related hazards (made worse by climate change).

DISASTER The result of a hazard's impact on a vulnerable community, causing damage to life, assets or livelihoods in a way which exceeds the community's capacity to cope.

DISASTER RISK REDUCTION Measures taken to reduce losses from a disaster, ie reducing exposure to hazards, reducing vulnerability and increasing capacity.

EMERGENCY RESPONSE A set of activities implemented soon after a disaster, designed to save lives, reduce suffering and promote speedy recovery, building on the remaining capacities of the community.

HAZARD An extreme event or occurrence which has the potential to cause injury to life and damage to property and the environment.

MITIGATION Measures taken in advance of a disaster, aimed at reducing the adverse impact of the hazard on people, property and the environment.

PREPAREDNESS Activities which increase people's ability to predict, prepare for, respond to and recover from the effects of a hazard.

REHABILITATION Rebuilding of housing, livelihoods and social structures damaged by a disaster, ideally to a standard which will resist the impact of a similar hazard in future.

RISK The probability of something negative happening in the future which will cause suffering, harm and loss.

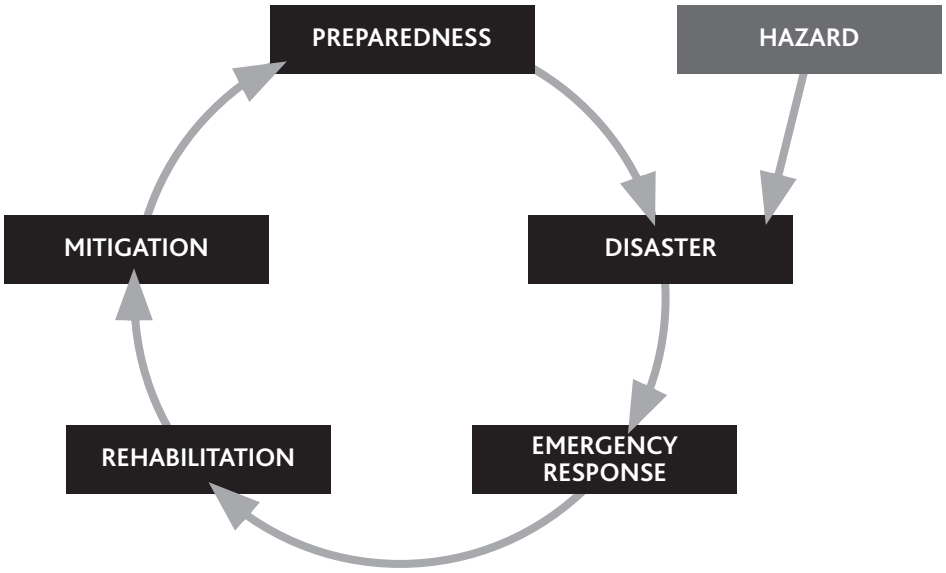
VULNERABILITY A condition or set of conditions which reduces people's ability to prepare for, withstand or respond to a particular hazard.

A more complete set of definitions and terms can be found in the UN International Strategy for Disaster Reduction (UNISDR) document *Terminology on disaster risk reduction* (2009).

2.2 The Disaster Cycle

The Disaster Cycle is a widely used model to show the sequence of activities which often follow a natural or man-made disaster. It recognises that disasters tend to recur in the same place, with a 'return period' of perhaps a few weeks, or maybe 50 to 100 years, depending on the nature of the hazard. With the advance of climate change, certain types of weather-related disaster are likely to occur more frequently and more intensely than in the past.

In its simplest form, the cycle can be expressed as follows:



EMERGENCY RESPONSE PHASE This contains activities designed to save and preserve the lives of survivors, eg search and rescue, medical care, temporary shelter, emergency food rations. Needs are particularly acute during the first 48 hours after a rapid-onset disaster; during this time, many survivors may die if not given the assistance they require.

REHABILITATION This phase is sometimes divided into early and later recovery, and includes the restoration of housing, livelihoods, social systems and infrastructure. Activities such as

restoring water supply, rebuilding schools or re-establishing medical services easily merge into development, as replacements are generally better than the ones destroyed.

MITIGATION AND PREPAREDNESS are forward-looking, pre-disaster activities. They assume a future recurrence of the hazard and seek to reduce the scale of suffering next time. Mitigation activities might include planting alternative crops, building stronger houses or improving water supply. Preparedness might include contingency planning, warning systems or stockpiling some emergency goods. (For more examples, see Appendix B, page 92.)

RISK REDUCTION AND THE DISASTER CYCLE The main disadvantage of the Disaster Cycle is that it suggests a linear, chronological sequence of activities, with mitigation and preparedness always following rehabilitation. In practice, future risk reduction should be integrated into all parts of the cycle, beginning with the emergency response. If risk reduction is delayed until later (ie mitigation and preparedness), then opportunities for reducing future risk may be lost and the vulnerabilities which existed before the disaster may already have been rebuilt. Good DRR will break the cycle by empowering the community to cope with future hazards.

Examples of risk reduction in emergency response and rehabilitation include the following: (*activities marked with an asterisk* can also be described as CCA measures.*)

- **Relief distributions** Men and women in the community identify needs and solutions; use of surviving capacities and social structures.
- **Cash-for-work (CFW) or food-for-work (FFW) projects** These activities can be used not just to clear up debris but also to rebuild embankments,* dig flood diversion or irrigation channels* or construct small cross-dams;* community participation in selection and supervision of CFW/FFW activities is essential. Cash distributions are being used more frequently in extreme situations, with the proviso that care is taken to explain to beneficiaries that the cash is a 'one-off' intervention. However, this may still encourage dependency and a creative opportunity to reduce further risk may be missed.
- **Reconstructing houses** Careful selection of safe sites after risk assessments; adopting hazard-resistant designs,* materials* and orientation* of houses.
- **Restoring livelihoods** Consideration of new, less disaster-prone livelihoods,* and how to make them 'disaster-proof'; introduction of new crops* and/or livestock types.*
- **Ensuring water supply** Careful attention to location* and design* of hand-pumps, ensuring they are above flood levels; ensuring water points and pipes can resist flash flood or earthquake damage where relevant.
- **Provision of drought- or flood-resistant seeds* for planting** These may be particular varieties of an existing crop, or an alternative crop which can cope better with conditions of water shortage or water excess.

The PADR methodology can be incorporated into the recovery process, usually at the end of the emergency response phase, so that the rehabilitation activities can be based on the PADR findings and included in action plans.

PADR can also be used as part of pre-disaster planning in areas where no disaster has occurred for a while (eg earthquake zones). This is sometimes difficult, as the community's memory of a disaster will be weaker if 50 years or more have passed since the last big earthquake.

2.3 The Disaster Crunch Model

Disasters are not random or isolated events. They are usually the result of a natural or man-made hazard impacting a vulnerable population. This diagram shows how hazard and vulnerability combine to squeeze or 'crunch' a population, causing a disaster.

A **hazard** (defined on page 15) may be a natural phenomenon, such as an earthquake, a drought or a cyclone, or it may be the result of human activity, such as conflict or an industrial accident. Human activity often influences the intensity of natural hazards. For example, cutting trees may locally exacerbate the duration and impact of a drought. Climate change is also increasing the frequency and severity of extreme weather-related hazards, which now affect wider areas.

A **vulnerability** (defined on page 16) is usually a long-term weakness in some aspect of community life, for example, housing, agriculture or water supply. When a hazard impacts a vulnerable community, there is likely to be a disaster. The size of the disaster will be determined by the strength of the hazard and the degree of vulnerability.

Consider the example of an earthquake. If a strong earth tremor occurs in a location where houses are of weak, traditional design, then damage and loss of life will be great. The weak houses create vulnerability, which means a strong hazard (the earthquake) will cause disaster.

In contrast, if the same earthquake occurs in a place with earthquake-resistant housing, the vulnerability level is much lower and disaster may be avoided.

There is evidence that climate change is increasing the vulnerability of poor people, as well as increasing the intensity of some hazards. For example, rural farmers who lose their land to rising sea level may migrate to highly vulnerable urban slums. In drought areas, failure of traditional food crops and consequent food shortages are becoming increasingly common.

REFLECTION

- **What hazards, of natural and human origin, occur in your country?**
- **Do these hazards result in disaster for some people or some areas but have little impact on others?**
- **Who are the most vulnerable – according to age, gender, ethnicity, education or livelihood – in your communities?**

Elements at risk

Human life has many different parts or 'elements', eg buildings, family networks, livelihoods and available natural resources. If these elements are in danger of being harmed by a hazard, they are known as 'elements at risk'. These fall into five categories:

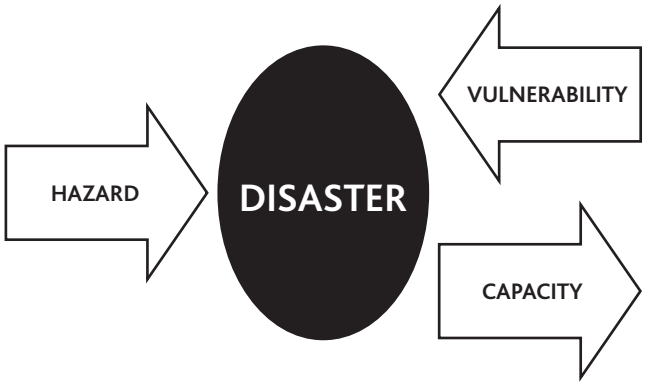
- Individual (male/female)
- Social (including spiritual)
- Natural
- Physical (including constructed)
- Economic

They are considered in more detail in Section 6.

Capacities

A community may have weaknesses, referred to as vulnerabilities, but it will also have strengths called capacities. These are found at community, family and individual level. Capacities create an ability to prepare for, respond to and recover from the impact of a hazard, reducing the damage and losses.

We can add capacity to the Disaster Crunch Model, as an arrow in the opposite direction, because capacities help to reduce pressure on the affected population:



Like vulnerabilities, capacities can vary greatly from country to country, from place to place (within a country) and from family to family. People with few capacities, such as the very poor, the landless or those from minority ethnic or religious groups, and all too frequently women and children, are likely to suffer more.

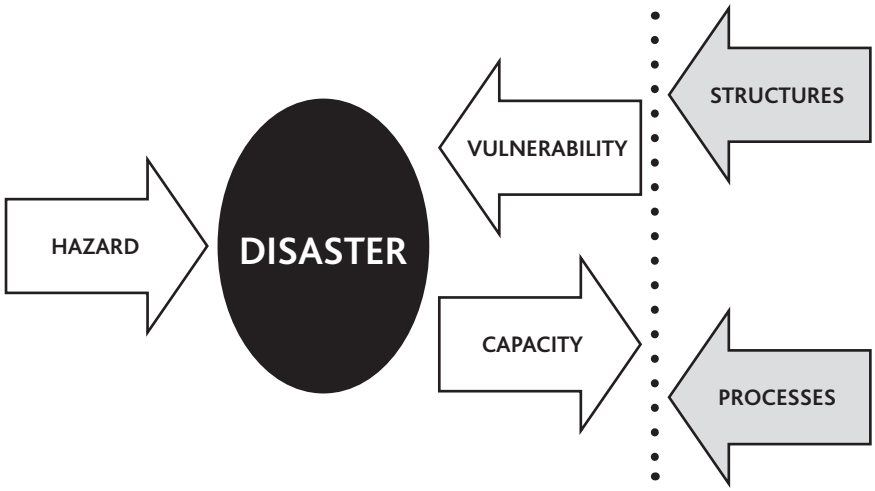
Capacities can also be found in the five different categories identified under 'Elements at risk'.

Impacts, vulnerabilities and capacities linked with common hazards

HAZARD TYPE	IMPACT	VULNERABILITY	CAPACITY
Flood	Women/children die	Poor swimmers	Ability to swim
	Houses destroyed	Weakly built houses	Better building designs
	Crop losses	Fields in low-lying areas; no embankments	Flood-resistant crops or dry-season crop options
	Animals drowned	No safe higher land	Safe refuge areas
Drought	Health problems	Lack of clean water	Year-round hand-pump
	Crop losses	No irrigation system	Drought-resistant varieties
	Animals die	No grazing land available	Fodder storage
Cyclone	Human deaths	Lack of warning or preparation	Local contingency plan
	Houses destroyed	Weak house construction	Strong house design
	Crop losses	No barrier to tidal surge	Good embankment
Earthquake	Human deaths	Lack of knowledge	Good awareness about earthquakes
	Houses destroyed	Weak house construction	Seismic resistance in house design
	Livelihoods stopped	Dependence on one livelihood	Several livelihoods

Dynamic pressures – structures and processes

Wider factors affect the vulnerabilities and capacities of a community. These factors include powerful people and social structures, and the processes through which they influence the community.



Structures can include:

- traditional leadership bodies (eg village elders)
- religious groups (eg church or mosque committee)
- government departments (eg for health or agriculture)
- businesses (eg a sugar plantation or mining company)
- powerful individuals (eg a wealthy landowner)

Each of these structures has policies or implements activities which affect the people in the community, making them more or less vulnerable to hazards. Processes can be positive or negative. Here are some examples of **positive** and **negative** processes associated with the commonly found traditional leadership system of village elders and for a commercial flower farm:

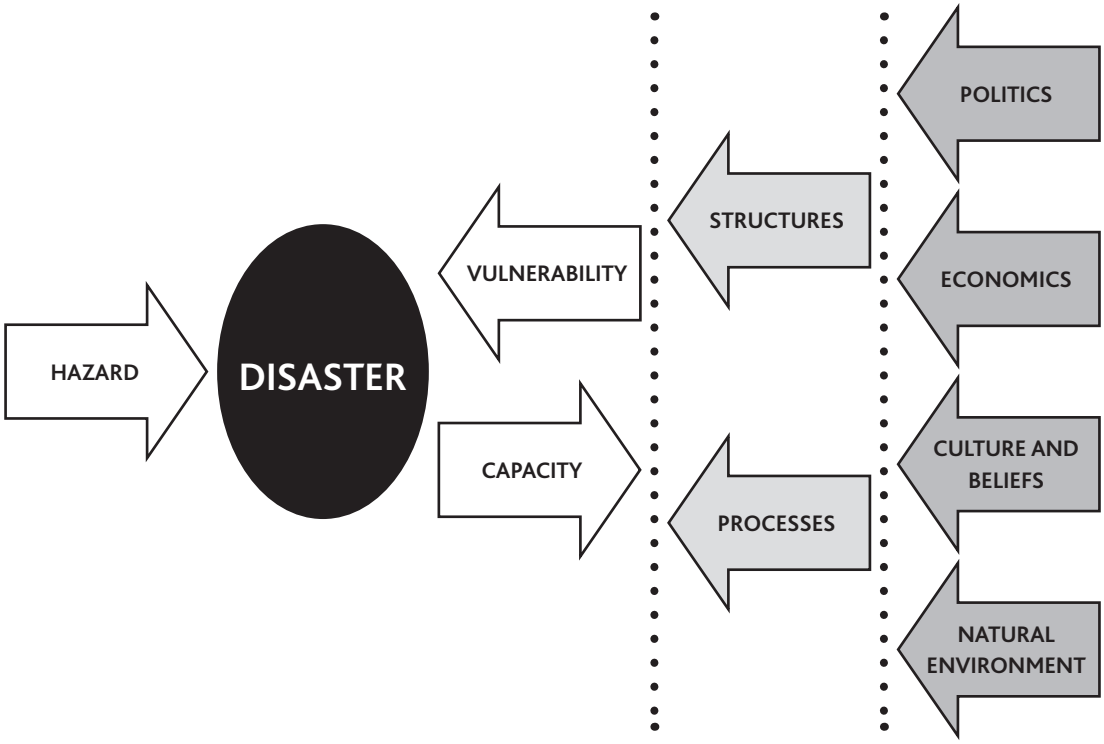
STRUCTURE	NEGATIVE PROCESS – INCREASING VULNERABILITY	POSITIVE PROCESS – REDUCING VULNERABILITY
Village elders	The decisions of a male–dominated group may favour the men, and possibly overlook the priorities/needs of women. Elders may show bias, or may live outside the village and not provide leadership in a crisis.	Elders might include representatives from all sections of the community. They may recognise the needs and capacities of women, settle disputes impartially, promote cooperation and provide clear leadership in times of disaster.
Flower farm	Heavy demand for water may reduce availability of water for poor farmers nearby.	It may provide jobs and wages. It brings foreign currency into the country.

REFLECTION

- **What structures create vulnerable conditions in our local area?**
- **What processes create vulnerable conditions in our local area?**
- **What structures and processes create capacities in our local area?**

Underlying causes

The structures and processes considered above often have deeper roots, known as 'underlying causes'. These causes are frequently deeply embedded in culture, custom or belief, or they operate from power bases many miles away from the community concerned. They fall into four main categories:



POLITICS The national government may provide resources to a particular district or withhold them, often for political reasons (eg the voting preferences of that district's population!). A government's motivation for action is often a desire to retain power at the next election.

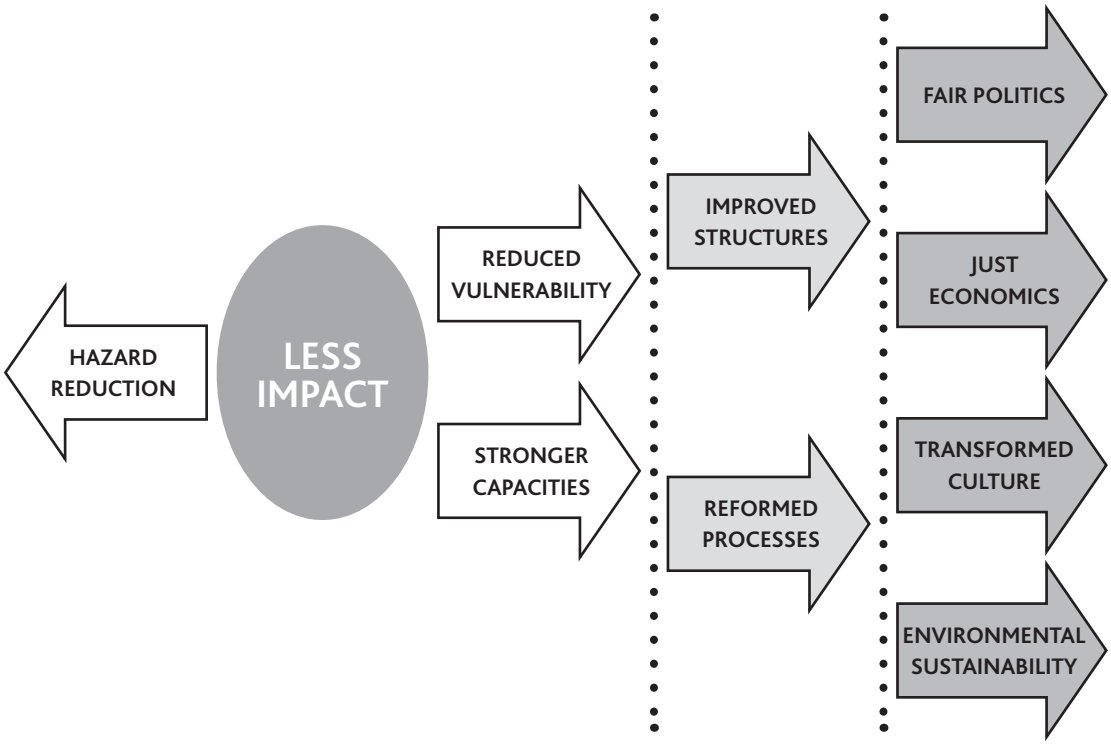
ECONOMICS National government has to make decisions on spending priorities, for example health and agricultural services may be underfunded if more spending is directed towards defence or debt repayment. Also, the prices of internationally traded commodities such as coffee, sugar or cotton will influence the price farmers receive for their cash crops.

CULTURE AND BELIEFS A culture which attributes disaster to the bad behaviour of spirits may not be willing to embrace measures to reduce disaster risk. Culture also influences farming practices: those who traditionally adopt slash-and-burn agriculture will increase their vulnerability to both drought and flood, as the loss of trees affects local climate and increases runoff of rainwater. A male-dominated culture may place a low value on women, which will increase their vulnerability. For example, when evacuation is urgently required, women may be unable to leave their house without a male relative to escort them.

NATURAL ENVIRONMENT There are aspects of climate, soil type and geography which affect vulnerability. For example, steep hillsides will influence what type of farming practices are used, and increase the likelihood of landslides. Human activity is constantly degrading the natural environment, making it more fragile and less able to resist extreme weather.

2.4 The Release Model

In order to reduce disaster risk, the directions of the arrows in the Disaster Crunch Model need to be reversed, signifying the release of the pressure that previously caused a disaster. The resulting picture might look like this:



Changing the direction of the arrows is not always easy and requires activities at local, national and international levels. Some examples are given below.

HAZARD REDUCTION There are ways of reducing the occurrence, frequency or strength of some hazards. For example, construction of embankments or channel dredging can reduce flooding. Trees can be planted to offset drought, or to stabilise soils which are liable to being eroded. Advocacy can be used to influence politicians to do more to counter climate change and its effect on weather-related hazards.

REDUCED HAZARD IMPACT Some of the 'elements at risk' can perhaps be strengthened to reduce disaster risk. For example, tube-well pipes can be raised to keep hand-pumps free of flood water, extra open-well rings can be added and sealed, houses can be strengthened or built on stilts. (More detailed lists of suitable interventions are in Appendix B on page 92.)

REDUCED VULNERABILITY A risk assessment process will identify specific vulnerabilities, and measures can be taken to reduce them. For example, inadequate warning systems can be improved, poor farming practices can be changed or alternative livelihoods can be introduced. The most vulnerable groups of people should be targeted first.

STRONGER CAPACITIES Communities will always have some capacities which they use in times of disaster – for example, local knowledge of naturally occurring wild foods (for times of food crisis), or banana trees (for boats). If the existing capacities can be strengthened, the impact of hazards is reduced. New capacities can also be developed, for example, selecting and training volunteers, developing new skills or simply providing more boats.

IMPROVED STRUCTURES AND REFORMED PROCESSES Dynamic pressures can act in a positive or negative way (see Section 7.1). The PADR process should determine the negative ones – and action plans can then attempt to change them. For example, pressure from a farming community may increase the output of a government agricultural extension worker, or modify the harmful activity of a commercial flower farm (see Section 8.7).

UNDERLYING CAUSES Underlying causes are perhaps the hardest to change because they are often so deeply rooted. Advocacy with local or national government officials may bring increased government resources to an area. Teaching from the local pastor or other religious leader may help to change harmful superstitious beliefs. Advocacy at international level may reduce the debt burden or make some contribution towards preventing further climate change.

2.5 The Hyogo Framework for Action

The Hyogo Framework was a key document emerging from the UNISDR conference on reducing disaster risk, held in Japan in January 2005. It was accepted by 168 governments and has five key components:

The Hyogo Framework for Action 2005–2015

- Ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation.
- Identify, assess and monitor disaster risks – and enhance early warning systems.
- Use knowledge, innovation and education to build a culture of safety and resilience at all levels.
- Reduce the underlying risk factors.
- Strengthen disaster preparedness for effective response at all levels.

The purpose of the framework is to describe the fivefold nature of the actions required to reduce the suffering associated with disasters. Action is required at all levels – from international cooperation on issues such as warning systems down to contingency planning at community and family level which enables people to respond to those warnings.

Progress on implementing the framework has been slow (as of 2011), but it has become a useful tool in planning DRR projects and a valuable asset for advocates, urging governments to give higher priority to risk-reducing activity.

2.6 Disasters and development

For much of the world's population, hazards are part of everyday life. Each time a person lights a fire to cook, there is the risk of injury to children or of the house catching fire. Where communities live on flood plains or volcanic slopes to benefit from fertile soils, there are risks associated with flooding or volcanic eruption. Risks become a part of life.

When designing new development projects, we must take note of these risks. For example, planning an agricultural programme on a flood plain without considering the impacts of flooding invites failure. Similarly, building houses and schools in a known earthquake zone without earthquake resistance is foolish. Development has to be appropriate, taking full account of the context, including the likely hazards.

Disasters sometimes reveal inappropriate development, because it becomes clear that a known hazard was not taken into account. Lessons can be learned. Why were people vulnerable? What

can be done to reduce that vulnerability? These questions often point to issues of wealth, power and the underlying values of the society – the issues considered in this publication as underlying causes of disaster.

Food crises are often the result of long-term failures in development, producing chronic food insecurity and extended slow-onset disaster. Good development and effective DRR are both needed if such crises are to be avoided in the future.

Any community that has successfully lived in a location for some time has already found ways of surviving the most common hazards. People often cope well with frequent hazards, but are less likely to plan well for hazards that happen less frequently. A developmental approach to disasters should seek to make maximum use of local knowledge, and to build on capacities developed over many generations.

2.7 Disaster risk, climate change and environmental degradation

Scientists agree that climate change is causing an increase in the frequency and severity of floods, droughts and storms, together with an increase in events associated with rising temperatures and sea levels. Climate change also describes slow but insidious change in living conditions (eg in temperatures, sea level and weather patterns). Such changes are potentially more harmful than the sudden-onset disasters, as they undermine traditional livelihoods, exacerbate food insecurity and create water shortages.

Climate change is better understood now than it was a few years ago, and projections are available for many countries (see www.climateonestop.net). Based on current experience and future projections, National Adaptation Programmes of Action have been drawn up by less developed countries, and many other countries have developed National Communications on Climate Change. Local adaptation projects are under way in some places, but many more will be needed. Climate change is already significantly affecting water supplies, health, land usage and most aspects of life. Livelihoods based on agriculture are particularly affected.

The UN advises that nine out of ten disasters are climate-related. It follows, therefore, that more extreme climatic events will lead to more disasters. DRR measures seek to reduce the level of vulnerability and to minimise the disruptive effects of hazards by building more resilient communities. As the magnitude of climate extremes increases, the need for effective and flexible DRR will become more acute.

CCA and DRR have much in common. Activities once termed DRR are now being called CCA. The floating vegetable gardens and rice seedbeds of Bangladesh are just one example. Piles of water hyacinth plants, enclosed by bamboo frames, are allowed to decompose and compress. Seeds are planted in these fertile beds, which float upwards in the frames if the area floods. It is a coping mechanism for an age-old problem, but even more necessary as those floods become more frequent and more severe.

Alongside climate change and increasing disaster risks, environmental degradation is also happening. Minerals are being exploited, trees are being felled at alarming speeds, animal and

plant species are being destroyed, air is being polluted and groundwater is being abstracted at unsustainable rates. This degradation of the environment is usually caused by human activity, but can be made worse by climate change. For example, tree cutting may increase soil erosion, exacerbated by increased rainfall, or more rain falling within a short time interval.

Adaptation to these changes is also taking place, and is termed **ecosystems based adaptation** (EBA) or **environmental degradation adaptation** (EDA). An example might be the creation of water diversion channels along the contour lines of slopes cleared of trees.

The Tearfund resource *Environmental assessment* has diagrams of three interlocking circles (pages 57–59), showing the interrelated impacts of natural hazards, climate change and environmental degradation. Suggested adaptation measures are shown and many of them are of relevance to all three phenomena.

Most people in vulnerable communities will not distinguish between DRR, CCA and EDA. They are all strategies for coping with environmental hazards that create risks for people, property, livelihoods, biodiversity and natural resources. It is not always helpful or necessary to make distinctions between shocks caused by climate change, environmental degradation or other hazards. It is much more important to understand the threat and its causes and to plan an appropriate response – to the hazards of today but also those that can be predicted in the future. The best approach is to build up characteristics which will help communities to cope with extreme events in the future, whatever their source (see Section 8.6).

Additional Tearfund publications

- *CEDRA (Climate change and Environmental Degradation Risk and Adaptation assessment)* 2009
- Roots 13 – *Environmental sustainability* 2009
- *Environmental assessment* 2009

CEDRA looks specifically at climate change and how projected changes in a particular area may affect all types of projects being implemented in that locality. It also describes how to assess different adaptation options and to choose between them. The *Environmental assessment* tool looks at the potential impacts a single project may have on the environment and how to reduce those impacts.

Another useful publication on CCA and DRR is:
Linking climate change adaptation with disaster risk reduction (Tearfund and IDS, 2008)

On community resilience:
Characteristics of a disaster-resilient community, by John Twigg (2nd Edition, 2010)

REFLECTION

- **How is climate change affecting the types of disaster and the frequency and intensity of disasters in your country?**
- **What evidence do you see that environmental degradation is taking place in your country?**
- **Is any action being taken to reduce degradation?**