UNDP India

International Recovery Platform

ISDR
International Strategy for Disaster Reduction

Guidance Note on Recovery

CLIMATE CHANGE

The Guidance Notes on Recovery: Climate Change was developed as collaboration between the International Recovery Platform (IRP) and United Nations Development Programme India (UNDP-India). IRP acknowledges the leading work of Sanjoy Bandyopadhyay, the consultant who facilitated the development of this Guidance Note, Sanjaya Bhatia, Knowledge Management Officer of IRP (UNISDR), and Liz Maly, the climate change focal person of IRP. In addition, many individuals and agencies contributed to the consultative process of workshops, peer reviews and the sharing of good practices and lessons learned from tools and country specific case studies. In particular, the guidance and expertise of Milen Dyoulgerov (DRM and Adaptation Coordinator, World Bank) was instrumental. For a full list of acknowledgements please see Annex 4

IRP was conceived at the World Conference on Disaster Reduction (WCDR) in Kobe, Hyogo, Japan in January 2005. As a thematic platform of the International Strategy for Disaster Reduction (ISDR) system, IRP is a key pillar for the implementation of the Hyogo Framework for Action (HFA) 2005-2015: Building the Resilience of Nations and Communities to Disasters, a global plan for disaster risk reduction for the decade adopted by 168 governments at the WCDR. The key role of IRP is to identify gaps and constraints experienced in post disaster recovery and to serve as a catalyst for the development of tools, resources, and capacity for resilient recovery. IRP aims to be an international source of knowledge on good recovery practice. IRP promotes “Build Back Better” approaches that not only restore what existed previously but also set communities on a better and safer development path and support development of enhanced recovery capacity at regional, national, and sub-national levels with particular focus on high-risk low-capacity countries.

UNDP is the UN's global development network, advocating for change and connecting countries to knowledge, experience and resources to help people build a better life. UNDP does not represent any one approach to development; rather, its commitment is to assist partner governments in finding their own approaches, according to their own unique national circumstances. The goal of the organization is to help improve the lives of the poorest women and men, the marginalized and the disadvantaged. UNDP works in the following areas: Democratic Governance, Poverty Reduction, Crisis Prevention and Recovery, Environment and Energy, HIV and Development.

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Introduction

Purpose

There is currently an abundance of documents, plans and policies that address common issues faced in the mitigation, preparedness and relief phases of natural disaster management. Yet for disaster recovery planners and policy makers, there is no cohesive documented body of knowledge. It is conceded that preventive measures are vital to reducing the more costly efforts of responding to disasters. Nevertheless, in the post disaster situation, the availability of knowledge products reflecting the practices and lessons learned is critical for effective and sustainable recovery. Unquestionably, a wealth of experience and expertise exists within governments and organizations; however the majority of this knowledge is never documented, compiled, nor shared. Filling this knowledge gap is a key objective of the International Recovery Platform and the Guidance Notes on Recovery: Climate Change, along with its companion booklets, are an initial attempt to begin building a knowledge base on disaster recovery. IRP hopes that this collection of the successes and failures of past experiences in disaster recovery will serve to inform the planning and implementation of future recovery initiatives.

Audience

The Guidance Notes on Recovery: Climate Change is intended for use by policymakers, planners, and implementers of local, regional and national government bodies and all other organizations interested or engaged in facilitating a more relevant, sustainable, and risk-reducing recovery process.

Content

The Guidance Notes on Recovery: Climate Change draws from documented experiences of past and present recovery efforts, collected through a desk review and consultations with relevant experts. The collected materials are presented in the form of cases, loosely organized under several key issues and approaches. The document provides analysis of many of the cases, highlighting key lessons and noting points of caution and clarification. The case study format has been chosen in order to provide a richer description of recovery approaches, thus permitting the reader to draw other lessons or conclusions relative to a particular context.

The document organizes the material loosely around the following issues:

1. Climate resilient livelihoods

2. Climate resilient infrastructure

3. Stronger institutions for climate resilient recovery

4. Community based approaches for climate resilience

5. Health and climate change

Implementing adaptation plans and strategies is a vital next step in recovery programs, but is not an easy task for the decision maker. It is difficult for a manager responsible for post disaster recovery to understand how to integrate climate change predictions into the recovery planning. Where does the process start? The Implementation Guide in Chapter 7 attempts to provide some tools which can facilitate these decisions.

Definitions as used in the document

Climate change: Refers to a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. (IPCC 2007)

Note that the definition of climate change used in the United Nations Framework Convention on Climate Change is more restricted, as it includes only those changes which are attributable directly or indirectly to human activity. (UNISDR, 2004)

Adaptation: refers to adjustments in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts. It refers to changes in processes, practices, and structures to moderate potential damages or to benefit from opportunities associated with climate change. (IPCC TAR, 2001; Compiled by Dr. Barry Smith- Chapter 18, page number 879).

It is recognized that while certain activities or projects presented in the Guidance Notes have met with success in a given context, there is no guarantee that the same activity will generate similar results across all contexts. Cultural norms, socioeconomic contexts, and myriad other factors will influence the process and outcome of any planned activity. Therefore, the following case studies are not intended as prescriptive solutions to be applied, but rather as experiences to inspire, to generate contextually relevant ideas, and where appropriate, to adapt and apply.

Chapter 1

Why Consider Climate Change in Recovery?

The climate is changing. This is no longer an issue to be debated. Climate change is a global problem, but it affects people in different locations differently. In spite of mitigation efforts, certain levels of climate change are inevitable due to the greenhouse gases that have already been emitted. Climate change is a key causative factor in increased heat waves, floods, droughts, intense tropical cyclones, and higher sea levels. Susceptibility to these hazards is also increasing due to continuing poverty and social vulnerability, poorly planned urbanization, environmental degradation, and population growth. These impacts will fall disproportionately on developing countries, and particularly the poorest of those. Climate change adaptation is therefore not an option but a necessity, and even more so in post-disaster recovery programs.

Adaptation to climate change is already taking place, but on a limited basis. In spite of the adverse impacts of climate change, people have adopted a variety of successful adaptive and mitigation strategies which are worth sharing. For example, communities have long adapted to the impacts of climate by modifying existing practices, employing traditional practices that include crop diversification, changing the period or duration of fishing and hunting seasons, raising awareness and education of relevant issues, developing social networks, installing irrigation and water management systems, promoting disaster risk management, and purchasing insurance. Thus, we need to considerably alter the way we approach future recovery programs and find ways to mainstream climate change adaptation.

Climate change adaptation and disaster risk reduction efforts share a common characteristic: they are not sectors in and of themselves, but must be incorporated in the post-disaster recovery phase into the policies of other sectors, such as agriculture, water resources, health, land use, the environment, finance, and planning. There are also linkages with other policies, most notably poverty eradication, health, education, and planning for sustainable development. In most of the past recovery initiatives, the above-mentioned policy fields were pursued largely in isolation from one another. However, many countries are seeing the shortcomings of such a vertical approach, and are now looking for ways to incorporate climate change adaptation and disaster risk reduction into their development planning. However, it is local governments that are really taking the initiative to deal with the two issues in a coherent way.

Climate change and adaptation

In recent years, the world has experienced many disastrous climatic events. There is a great deal of documentation highlighting very alarming findings on global warming. For example, the arctic region has recorded winter temperature increases of 3-4oC and severe reductions in sea-ice areas, and there has been widespread melting of glacial ice and snow caps, such as at the Himalayan glacial retreat at Gangotri in India and Nepal. There has been an increase in global average temperatures as well as cases of extreme temperatures, as exemplified by heat waves in France and Spain. There is evidence of an increase in intense tropical cyclone activity in the North Atlantic, and precipitation has increased considerably in central Asia, northern Europe, and the eastern parts of North and South America. Sea levels are rising in Bangladesh, the Maldives, and Kiribati, while rainfall has declined in the Sahel region of Africa, the Mediterranean, southern Africa, and parts of southern Asia (IPCC, 2007).

If the current trends in climate change continue, there is every possibility that temperature extremes, heat waves, droughts and heavy precipitation events will occur more frequently. Globally, it is the poor who tend to be more dependent on climate-sensitive resources for their livelihoods. Natural resources and the environment are being impacted negatively (degraded) by climate change. Vulnerability to future disasters will be determined by both climate change and poverty factors, as well as the ability of people to take action to minimize the negative impacts and maximize any benefits from such changes. For example, the poorest of the poor people in India, Bangladesh, Pakistan, and many other Asian countries are already forced to stay in the most disaster-prone areas, such as flood plains, low-lying and unprotected coastal areas, and eroded hillsides. Even modest changes in climatic hazards will quickly push households beyond their ability to flexibly adapt and cope with the situation.

Climate change must be considered in long-term development planning because in many contexts, current activities may irreversibly constrain future adaptation to the impacts of climate change. Consider, for example, the destruction of coastal mangroves or the development of human settlements in CRZ areas that are likely to be particularly exposed to climate change. It is important to consider near-term policies in such instances, in addition to the long-term implications of climate change.

Societies have a long record of managing the impacts of climate-influenced or weather-related events. It is relatively difficult for individuals or communities to mitigate climate change, but it is easier for them to adapt to its effects locally as the impacts become more important and more urgent. However, regardless of the scale of mitigation efforts that are undertaken over the next two to three decades, additional adaptations will have to be made to reduce the adverse impacts of projected climate change and variability. Adaptations can reduce vulnerability, especially when they are embedded in broader policy initiatives during post-disaster recovery and in development programs. The integration of adaptation processes may be factored into the program and projects of the country program cycle of the

UN/bilateral donor agencies, or the five-year planning processes of national governments, or it may start with the initiation of post-disaster recovery needs assessments, conducted as part of a recovery program. International donors and national governments should ensure that climate-friendly measures form a core part of any recovery planning effort. For example, when bridges and highways are rebuilt after a disaster, or when energy systems and services in coastal areas are being restored after a tropical cyclone, they should be designed and built through a partnership that includes climate experts and the development community (OECD, 2009).

Local level experience in adaptation and recovery

Adaptation refers to adjustments in ecological, social, or economic systems in response to actual or expected climatic upheavals and their effects or impacts. It refers to changes in processes, practices, and structures adopted to moderate potential damage or to maximize benefits from opportunities associated with climate change. For example, quantitative information on global warming at the local level is mostly unavailable, but is very important for convincing individual households to adapt any new techniques or processes in making their planning decisions. This demands an approach to adaptation that manages uncertainties and fosters adaptive capacity. Adaptation is therefore not a choice between reducing general vulnerability and preparing for specific hazards, such as floods. Rather, adaptation requires both, in an ongoing process of change whereby people can make informed decisions about their lives and livelihoods in a changing climate (Pettengell, 2010).

Adaptations vary according to the system in which they occur, who undertakes them, the climatic stimuli that prompts them, and their timing, functions, forms, and effects. Adaptation to climate change has the potential to substantially reduce many of the adverse impacts associated with it and to enhance the beneficial impacts. A practical means of coping with changes and uncertainties in the climate, including variability and extremes, is cultivating the ability to adapt. Enhancing adaptive capacity is necessary for reducing vulnerability and increasing resilience to the adverse impacts of climate change.

Recovery impacts are best observed and understood at the local level. Looking at outcomes at the local level allows disaster managers and practitioners to understand the actual impacts of recovery decisions made at higher levels, allowing them to see how recovery policies, programs, and projects are implemented on the ground and what they actually deliver to people. Are individuals and households able to strengthen their livelihoods, improve their quality of life, and reduce their vulnerability to future climate change shocks and stresses?

Understanding local contexts and engaging local actors during recovery

Global climate change is translated into localized phenomena in response to local natural features and other environmental, economic, and socio-political factors. For example, an increase in global mean temperature manifests locally as hotter days, more intense storms, less rainfall, or changes in the onset date of monsoon seasons and the length of growing seasons. These climatic changes in turn affect local livelihood activities, economic enterprises, health risks, and other factors. Vulnerability and climate change adaptive capacity are context-specific; thus, they are realized locally. Anticipated or actual climate change impacts shape adaptation decision-making and actions. Individual and household decisions about livelihood strategies and investments (e.g., crop selection, equipment purchases, skills training, and contingency planning) represent real-life demonstrations of adaptation.

Challenges to recovery planning

In many developing countries, communities are regularly exposed to tropical cyclones, storm surges, floods, droughts, heat waves, and other non-climatic disasters like earthquakes, landslides, and tsunamis. In coastal regions and island countries with long monsoon-affected coastlines and a number of major river deltas, the effects of climate change and sea level rise, combined with increasing coastal development and limited land use planning practices, increase these communities' disaster risks and their capacity to adapt to climate change. However, once a disaster is declared, a relatively short period of time exists in which to plan and initiate recovery operations. The task is huge but the operation window is narrow. This period is a dynamic, urgent, under-resourced time when critical decisions concerning complex issues with long-term consequences must be made. Delays in recovery programming can compound the damaging impacts of a disaster, such as when livelihood assets must be sold to meet basic survival needs.

The other ongoing challenge is that concerns regarding poverty alleviation and national food security will continue to dominate development agendas for the foreseeable future. Indeed, food security crises that are partially induced by climate change will reinforce the need for immediate action for reducing poverty. The link between poverty and hunger in a changed climate scenario can be expected to become a major driving force in decision-making. A failure to adapt climate change priorities to the sustainable recovery agenda for livelihoods and food security may further aggravate the considerable lack of understanding that exists in developing countries for the climate change agenda.

Climate-Resilient Recovery (CRR)

The climate is a resource in itself, and it affects the productivity of other critical resources, such as crops and livestock, forests, fisheries, and water resources. Natural fluctuations in the climate, such as those related to the El Niño and/or La Nina phenomena, may cause widespread disruptions in society's ability to exploit resources, and even to survive. In addition to natural climate variability, long-term climate trends and climate change are already having a discernible impact on development. A clear example is the close link between rising temperatures in the Himalayas and the incidence of glacier retreat and increased risk of potentially catastrophic glacial lake outburst flooding. A diverse range of development activities, from the design of hydropower facilities to rural development and settlement policies, will need to adapt to such impacts.

Large-scale post-disaster recovery choices in habitat and infrastructure also have a significant impact on local and overall climate patterns. Over-construction contributes to the formation of urban heat islands; deforestation and changes in land use can influence regional temperature; and increases in greenhouse gas concentrations and rainfall patterns as a result of industrial activity are responsible for large-scale climate change.

Though the impacts of climate change are not yet equally obvious everywhere, future projections and scenarios of the future impacts can in many cases justify ensuring that adaptation responses are built into planning. This is the case because (1) it can be more cost effective to implement adaptation measures early, particularly for long-lived infrastructure, and (2) present development actions may irreversibly affect future adaptation to the impacts of climate change. Examples include the destruction of coastal mangroves and the building of human settlements in coastal areas that are likely to be particularly exposed to climate change.

Climate-resilient recovery framework

Basic post-disaster recovery strategies aim to meet the goal of 'build back better' through the recovery process. This refers to the opportunity to improve institutions, infrastructure, and quality of life rather than merely restoring them to pre-disaster conditions. The primary objective of "build back better" is to reduce pre-existing vulnerabilities.

For the purposes of achieving recovery while considering climate change adaptation, 'build back better' can be understood to mean:

- Enhancing the resilience of communities to future climatic change events,
- Creating a stronger infrastructure,
- Strengthening institutions against the eventualities of climate change, and
- Enabling sustainable recovery.

NOTE: Typically, recovery initiatives to address or to respond to climate change have been embedded in broader policy initiatives related to such topics as livelihood diversification, biodiversity conservation, the environment, and disaster risk management. Therefore, many of the observations and interpretations presented in these cases might reflect an interaction between climate change and other factors, rather than being the result of climate change alone. An important criterion for the inclusion of cases was that any observations or responses included in recovery initiatives or development programs had to be adopted as deliberate responses to climate triggers.

Weather and climate related disasters account for over two-thirds of all disaster events and their significance is likely to increase with global warming. A majority of climate change impacts will happen through intense climate variability, with changes such as heavy rainfall, reduced precipitation, more frequent cyclonic depressions or shifting of snow lines with direct implication for disaster risks. This may also add to the degradation of natural resources, damage to infrastructure and food shortages upon which livelihoods are based. All of these impact the longer-term resilience of communities against disasters.

Both disaster risk reduction and climate change adaptation initiatives aim at reducing the impacts of shocks by anticipating future risks and addressing vulnerabilities. However, to make recovery intervention successful in handling changing risks due to climate change DRR initiatives should ensure that actions do not increase vulnerability to climate change in the medium to long-term, for example rebuilding in coastal areas which will be impacted by sea level rise in the future. Thus, in development planning, climate change risks will need to be considered systematically along with disaster risk reduction in order to strengthen adaptation measures.

Enhancing Climate-Resilient Livelihoods in Recovery

Chapter 2

Approach 1: Post-disaster recovery needs assessment & targeting for livelihood recovery

Livelihood recovery of the poor is a complex issue, and resources are shrinking while the demand for recovery support is increasing year after year. Depending on the resources of time and money available to an agency, the best approach is often to formulate targeting strategies. Many of the post-flood recovery strategies that follow have been understood for some time.

In recovery, the targeting strategy adopted to reach vulnerable people effectively needs to be flexible enough to adapt to different phases and interventions. Targeting can be by area (i.e., geographic targeting), or by group (i.e., administrative targeting). It can mean letting an individual or family decide for themselves if they want to participate (self-targeting), or letting the community decide who will benefit from an intervention and who will not (community-based targeting). Climate-change-induced disasters like droughts are better identified using geographical coverage. Future climate change scenarios could strengthen geographic targeting capabilities. Thus, geographic targeting during long-term recovery correctly identifies the largest number of needy households. However, it does not identify the most food/nutrient unsecured households as it does not represent individual villages/communities and households. The best approach is often a combination of targeting strategies, depending on the information available and on an agency's resources of time and money (WFP, 2006b; WB/IFPRI, 2002).

NGO assessments, including independent assessments, were generally positive with regard to the impact of the 1998 Bangladesh post-flood recovery program, especially for those whose work included the provision of seeds, livestock and housing. The overall success of NGOs in the recovery phase (Case 1) can be attributed to long-term involvement in the affected areas, which meant that local organizations were able to accurately identify the most vulnerable people. For example, a distressed persons list was developed in consultation with village committees, beneficiary selection was monitored by a field team, and attempts to corrupt the process were for the most part contained by the strong leadership of the partners and the transparency of the objectives and standards of their programs. Coordination and community participation were considered effective, and attention to gender equality was reasonable (Russell, 2000).

Case 1: Flexibility in flood recovery programs: Key to BRAC's success in Bangladesh

The Bangladesh Rural Advancement Committee (BRAC), the largest NGO in Bangladesh, provides some 3 million poor individuals, mainly women, with loans for productive purposes. A number of evaluations over the last five years have shown that BRAC is effective in development work in terms of reducing poverty in a sustainable fashion. BRAC's response to the floods was funded by seven donors and continued until July 1999, covering 55 districts, with a total cost for the recovery phase of some US$680,000. It assisted about 850,000 flood-affected women from landless and marginal farming households. Since most development activities were suspended, BRAC diverted its staff to recovery activities. The strategy used by BRAC was to assist targeted people so that they could quickly get back to their own homes and/or return to their regular income-generating activities. The main sectors that BRAC worked in were agriculture, particularly the provision of seeds, social forestry, and sericulture, poultry, fisheries, sanitation, and shelter. Most of these activities fed into longer-term development programs that BRAC was already running.

Some of the constraints faced by BRAC point to areas which require further attention as part of an overall response. There was a lack of local varieties of rice, mustard seed, and organic fertilizer. The price of seeds went up in the post-flood period. Seedlings were not available in the local markets, and had to be purchased from government and local agencies that import seeds.

BRAC is praised in external monitoring reports for providing recovery aid in kind, not cash. Thus recipients could immediately plant the grains and vegetables, rather than losing time trying to obtain these inputs in the marketplace.

One of the main lessons from this good practice example is that NGOs with an ongoing development program are most likely to be effective in the recovery phase at targeting poorer households and supporting their livelihoods (Russell, 2000).

Sources: BRAC (2000) Flood Relief and Rehabilitation Project. July 1998-July 1999. Phase ending report. Dhaka: BRAC, mimeo.

Lessons

- The overall recovery success of NGOs can be attributed to their long-term involvement in the affected areas. This means that local organizations were able to accurately identify the most vulnerable people and their needs, and to redesign the intervention as the recovery process was unfolding in ways that would reduce future
- In the post-flood recovery stage, up-scaling pre-existing development programs of NGOs and development agencies provide greater opportunities

to mainstream risk reduction into development.

Recovery Needs Assessment

When the emergency is largely over and some stability has returned to the lives of the affected population, it is worth taking the time to carry out an additional needs assessment. In order to prioritize communities' and individuals' needs under a climate change scenario, a detailed needs assessment (possibly a second one conducted after the initial needs assessment for emergency intervention) with reference to recovery with adaptation options should be carried out at the start of the recovery phase. It could also be used as a means of attempting to understand ways of more effectively building climate-resilient livelihoods. At this point, an RNA conducted in consultation with the affected population could considerably improve the recovery project, particularly in terms of promoting climate-resilient adaptation (Beck, 1994). This needs assessment initiative will result in the formulation of a long-term recovery program in each sector and geographic area, identifying opportunities from both climate change adaptation and risk reduction perspectives. It will also help to inform and guide the decision-making process within the donor community with regard to commitments and pledges for recovery, covering the initial and transitional humanitarian phases, through to contributions channeled through reconstruction conferences, consultative groups, and other resource mobilization mechanisms.

Case 2: Government Ownership in Needs Assessment: Key to the Recovery Program in Mozambique

Mozambique offers an example of a post-conflict country faced with major natural disasters – drought, famine, floods (Just the drought of 1908-85 caused more than 100,000 deaths). It also offers an example of recovery in an extremely poor and primarily subsistence livelihood population, but in a country favored by donors and receiving substantial amounts of both relief and recovery assistance.

Recovery was seen by the government as an opportunity to move parts of the country forward, acting as an engine for development. The World Bank and the government rapidly conducted an overall damage and needs assessment after the 2000 floods in order to move the agenda swiftly away from emergency relief to recovery. Recovery should not merely restore the previous level of development but promote activities that will lead to reductions in the vulnerability of the population and infrastructure to future disasters. Several ministries and agencies at the national and local levels undertook more detailed assessments for program planning purposes based on a feeling that beneficiary participation in assessment and program design was not given a high priority. The appeal document and CD-ROM produced for that meeting held at the International Reconstruction Conference, Rome on May 3-4, 2000 had strong government ownership, with additional support provided by UNDP and the World Bank. In the appeal, the government stressed its commitment to maintain macroeconomic stability. Recovery expenditures were included in an additional government budget, which was separate from the main budget, to avoid imbalances with ongoing programs. The government aimed to ensure that recovery income and expenditures would have a neutral impact on the national budget. The negative economic impacts of the floods were offset by the positive response to the donors' conference. By 2001 the country had returned to high annual levels of GDP growth, and the economic impact of the 2000 and 2001 disasters was not seen as a major economic factor in the medium-term (Wiles et al., 2005). It seems to work favourably for generating donors fund for Mozambique flood recovery.

Mozambique's recovery from the 2000 floods generally appears to have been effective and well handled. Needs assessments related to the water resources sector sometimes go beyond current flood recovery and include considerations regarding the vulnerability of water resources to climate change. The 2000 floods in Mozambique demonstrated clearly that it is possible to make an impact and carry out extensive recovery activities when the disaster is high profile and large amounts of money are donated to the affected populations. The funding available through the recovery programs made it possible not only to repair or replace existing infrastructure, usually to higher standards, but also to build new facilities where none existed before. A very positive feature of Mozambique's recovery work has been the rehabilitation and reconstruction of damaged infrastructure. However, climate events in Mozambique such as those that occurred in 2000 and 2007, undermined years of development effort and the adverse impact of future climate change may further slow Mozambique's development. At the national level, there is a need to further integrate climate resilient adaptation measures into recovery needs assessment efforts and the implementation of future recovery interventions.

Sources: World Bank (2005).

Approach 2: Community-based needs assessment and targeting (CBT)

Need assessments at the community level should inform targeting criteria and, in turn, suitable program activities. In community-based targeting (CBT), consulting communities in a slow-onset crisis can provide valuable inside information, resources, and coping strategies for sharing available resources and identifying interventions that build on community priorities and capacities during recovery program implementation. At the very least, agencies must be aware of existing community-based organizations and self-help mechanisms. Interventions must strive to strengthen these, as in the case of Seed Banks set up by SOS Sahel during the 1997 drought emergency in Ethiopia, which were still in operation after the drought of 2004-05 (SOS Sahel, 2006). SOS Sahel facilitated traditional funeral associations to design, implement, and evaluate the project, increasing local ownership. CBT can reduce agency costs associated with administrative targeting. Decentralized accountability is more likely when the community has some role and responsibility in monitoring and evaluating the recovery program.

Case 3: Community-based targeting in drought: Indonesia

In Indonesia after the 1999 drought related to El Niño, WFP worked with local NGOs to implement a formal survey and CBT to target urban slum dwellers affected by high food prices and having difficulties accessing enough food. CBT worked best in relatively homogeneous slums, while unregistered slum dwellers risked being overlooked. Living nearby didn't mean they were necessarily considered part of the 'community' by others in the neighborhood (WFP, 2000).

CBT works best:

- In stable, non-conflict situations; where communities are cohesive and well defined,
- Where relatively large wealth differentials exist within communities,
- Where not all wealth groups are equally affected by food insecurity,
- When targeting a fairly large proportion of the community,
- When agencies can identify reliable community representatives accountable for targeting the most vulnerable, and
- When agencies prioritize monitoring and capacity building.

Previous experiences demonstrate that biases can silently influence targeting for a variety of reasons. For example, it is difficult to select the beneficiaries of recovery assistance that is delivered by NGOs particularly when those NGOs have previously carried out development work in the affected communities. In addition, when the government and military play a strong role in response and reconstruction activities, effective and impartial targeting may be a problem where institutionalized discrimination is embedded in rehabilitation and reconstruction efforts (Cosgrave and Herson, 2008). The problematic targeting during the Pakistan response to the 2005 earthquake led to discrimination against households headed by women, and the needs of Afghan refugees who lacked Pakistani identity cards were largely overlooked (Cosgrave and Herson, 2008). This demonstrates the need for gender-sensitive targeting. During the Bangladesh flood response of 1998 some agencies offset the bias of targeting to beneficiaries who were already part of their regular programming by delivering flood relief by area, and selecting beneficiaries within those areas with the assistance of village leaders, or local relief committees (Young and Associates, 2000). Using local knowledge to identify the poor can be a rapid and effective method of targeting. In Orissa, limited knowledge of the local context among only a few aid agencies, and limited knowledge of the wider social economic profile of the poor, led to inaccurate targeting of people's particular needs. Some of the most vulnerable people did not appear in the relief and recovery databases so they were not targeted (IMM, 2001). However, this approach proved to be especially useful during the response to Hurricane Mitch (Espacios consultores SA, 2000).

Regardless of the targeting strategy used, more successful targeting outcomes are associated with the following:

- People who benefit from a project can talk from first-hand experience about project outcomes and impacts. At the same time, they may have a vested interest in seeing the project continue and thus may be less likely to criticize the project or discuss problems. Developing monitoring systems that seek information from less biased sources can be a way around this. For example, SCUK in Zimbabwe involved children in the monitoring of the use of distributed relief (SCUK, 2005b).
- A multi-agency structure and inter-agency dialogue, where government and non-government organizations are included in making targeting decisions.
- An appeal process communicated clearly to communities: who to appeal to, how appeals should be carried out, and how appellants can expect to be treated (DFID, 2006b). Women's access to the appeal process is very important, as women are often under social pressure not to complain. Appeals need to be documented in order to track individual cases and to monitor whether certain groups are systematically excluded or favored.
- Adjustments to the targeting process to make it more responsive to local realities. Adaptation of guidelines should be encouraged (not penalized), and well documented to promote transparency (DFID, 2006b; Oxfam, 2002).
- Effective monitoring of the outcomes of targeting after distribution.

For further information, please consult:

www.savethechildren.org.uk/scuk_cache/scuk/cache/cmsattach/2008_CMTD_for_web.pdf

www.ifpri.org/pubs/cp/targettransfers.htm,
www.alnap.org/publications/gs_handbook/index.htm

Approach 3: Agricultural livelihood coping strategies

Reviving the agricultural economy is a crucial aspect of livelihood recovery. It is therefore expected that a significant element of livelihood recovery will focus on post-disaster agricultural rehabilitation and recovery.

Various desk review have shown that the majority of those who are affected by climate change are poor farmers and fishers in predominantly agricultural societies, who need recovery support after cyclones, typhoons, floods, drought, and coastal flooding. In many developing countries, there is a lack of consistent understanding of the issue of livelihood recovery after floods. During post-disaster livelihood recovery, poorer households usually take such steps as cutting back on non-food expenditures (this may last for a year after the peak of the floods), selling their assets, including small livestock, and borrowing to purchase food and cover other expenses. This is of particular importance due to the insufficient availability of credit. Poorer households are forced to take exploitive loans from moneylenders or wealthier neighbours. Another constraint is the general lack of information disseminated to the community on the recovery as opposed to that disseminated during the emergency/relief phase. Additionally, there is very limited discussion of any wider potential impacts of the recovery of the infrastructure, for example the likely socio-economic benefits, gender equality, or climate change and environmental impacts. Notably, more consideration is needed today in the planning of infrastructure in the recovery phase to ensure suitable attention to the issues mentioned above.

There are three major challenges in livelihood recovery that climate change brings to bear on rural communities:

- undermined sustainability of current livelihood strategies;
- increased pressure on already depleted natural resource bases; and
- increased disaster risk from climate hazards.

Effective adaptation must therefore bring sustainable livelihoods, natural resource management, and disaster risk reduction approaches to secure and enhance assets within the scope of climate change analysis. Agriculture is also a major economic, social, and cultural activity. Importantly, agriculture in its many different forms and locations remains highly sensitive to climate variations, the dominant source of the overall inter-annual variability of production in many regions, and continuing sources of disruption to ecosystem services. For example, the El Niño Southern Oscillation phenomenon, with its associated cycles of droughts and flooding events, explains the regional yield variation in various crops (Ferries, 1999; Oxfam, 2009a).

Local communities are large storehouses of knowledge and experience on coping with climatic variability and extreme weather events. They have always aimed to adapt to variations in their climate. To do that, they have made arrangements based on their resources and knowledge, which they have accumulated through their past experiences with the climate and recent weather patterns. This includes times when they have also been forced to react to and recover from extreme events, such as floods, droughts, and hurricanes. Thus, traditional knowledge can help provide efficient, appropriate, and time-tested ways of devising and enabling adaptation to climate change in communities that are feeling the effects of climate changes due to global warming. Several examples of local coping strategies are mentioned in recent publications (UNFCCC 2006b, 2006c, 2007a, 2007b). For example, farmers on Timor Island have developed their own varieties of major staple crops to adapt to erratic rainfall and cyclones and to ensure food security.

In Africa, Asia, South America, and Australia rural farmers have been practicing a range of agricultural techniques as coping strategies and tactics to enable sustainable food production and food security, and to deal with extreme events. These include intercropping and crop diversification, use of home gardens, diversification of herds and incomes (e.g., the introduction of sheep in place of goats in Bara province in

Western Sudan), pruning and fertilizing to double tree densities and prevent soil erosion in semi-arid areas (e.g., Senegal, Burkina Faso, Madagascar, and Zimbabwe), manipulation of land use leading to land use conversion (e.g., a shift from livestock farming to game farming in Southern Africa), and water conservation techniques to cope with arid conditions (such as the Zaï technique in Burkina Faso, khadin in Rajasthan in India, and tank irrigation in southern India). African farmers dig pits in the soil to collect organic material carried by the wind during the dry season. At the start of the rainy season, farmers add organic matter from animals, which attracts termite activity resulting in termite tunnels that can collect rain deep enough so that it does not evaporate, thus increasing soil fertility. In many locations tribal and individual movements and migration are also identified as adaptation options.

Case 4: Rice in the Weeping Plain: Climate Change Adaptation in Thailand

Yasothorn, one of the 10 poorest provinces of Thailand, is part of the legendary 'Weeping Plain,' named after its barren landscape. Almost 90% of people living in Yasothorn Province are farmers. Most farms in Yasothorn are rain-fed, with no irrigation facilities. Jasmine rice is light-sensitive and has to be grown during particular months of the year. When there is no rain, rice plants are left to wither in the scorching sun

In 2007, farmers in Yasothorn Province, in northeast Thailand, experienced the longest dry spell during a rainy season in decades. The dry spell, lasting from June until late August, reduced crop yields, lowering farmers' income and reducing their food security. The Meteorological Department suggests that the dry spell that occurred in 2007 is not a one-time phenomenon, but part of a gradual trend that has developed in the past decade, due to rising temperatures and changes in rainfall patterns caused by climate change. The reduction in the frequency of depressions was significant, because without them tropical storms and typhoons do not provide enough rain during the dry season. Rainfall records for Yasothorn in the last decade show that the rains are arriving later and later each year, from a few days late to many weeks. When seasons start late and rain does not fall, the impact on rice yields is significant. Combined with increases in temperature, this means that Thailand's biggest production hub suffers greatly. Irregular weather in the form of hot and cold spells also causes pest attacks on rice crops and fungal disease, reducing the quantity and quality of the crops. In 2007, Earth Net Foundation (ENF), a partner of Oxfam, was working with farmers' groups in Yasothorn on a pilot climate-change adaptation project for organic rice and on-farm water management systems. Compared with conventional chemical-based farming, organic farming is less dependent on off-farm inputs, requires less energy, and is more environmentally sound. In 2008, Yasothorn was hit by drought – the worst in 57 years. The drought, which began in June and continued until the end of August, made rice cultivation very difficult. The problem was exacerbated by rain during the harvesting months, which drowned many of the rice crops in the low-lying plains that had managed to survive the drought.

Manoon Phupa, a farmer who joined the project, creatively designed his own windmill pump from old billboard cut-outs to drain and irrigate water from a new well that Oxfam helped to build. The new well, in addition to his existing pond, was used to flood his paddy fields during the prolonged dry spells. He also constructed dikes inside his paddy fields to drain water from the pond to supply the paddies. Not only has he learned how to grow rice with limited water, he has also diversified his food crops to include vegetables and fruit. Even though the droughts in 2008 were more severe than in previous years, Manoon's water management system has helped him achieve higher yields of both jasmine rice and sticky rice for his household's consumption, with a surplus for the market. During the drought in 2008, peasants used this efficient water management system, and were able to provide water for jasmine and sticky rice, which performed better. Manoon used a windmill-powered pump to supply the paddies with water during the drought period. Their on-farm water-supply system is simple, energy-efficient, and convenient even for women and children to use. Despite the year's harsh conditions, 89% of participating farmers were able to maintain an output of rice that was at least sufficient for their own household consumption, with some households producing a surplus to sell at market. Overall rice production fell by almost 16 percent, a stark contrast to the 40 percent decrease in production experienced by farms that did not take part in the project.

The experiences from drought affected areas showed that at the same place drought events often occur with such frequency that people have no time to recover before another drought hits. Results from case studies show that systemic changes in resource allocation, such as targeted diversification of production systems, organic farming, and better natural resource utilization perform better than current intensive agricultural practices. In Yasothorn, intensive agricultural practices using chemical fertilizers led to losses of 50–90 percent in 2008. Experimentation results show that organic rice plants are physically healthier and stronger than non-organic plants, and organic fields are also more fertile and can retain more moisture compared to chemically fertilized fields. Hence, more consideration needs to given to organic-farming households, as they produce better yields than their chemical-intensive counterparts.

There are many potential adaptation options available if marginal changes are made to existing agricultural systems, and these are often variations of existing climate risk management. We show that the implementation of these options is likely to have substantial benefits under moderate climate change for some cropping systems and that they can be potentially incorporated into recovery planning and implementation. However, there are limits to their effectiveness under more severe climate change scenarios, potential GHG mitigation, and longer term climate-resilient recovery.

Source: http://www.oxfam.org.uk/resources/policy/climate_change/climate-change-case-study-thailand.html.

Lessons

- Access to information is key. While the farmers were well aware that the weather was changing, they needed the external input about climate change to be able to make informed decisions about their future activities.
- These solutions can only be implemented in an enabling environment, which in this case involved NGO grants and technical support.
- Finally it can be concluded that national adaptation planning must therefore consider the processes that can provide the information, services, and enabling environment to communities living in poverty to adapt to climate change.

Many agricultural interventions emphasizing various water usage and water conservation strategies including terracing, surface water and groundwater irrigation, and diversification in agriculture, are appropriate measures for dealing with drought. In Latin America, local coping strategies include a variety of agricultural practices, ecosystem protection measures, and methods to adapt to extreme events. Farmers in Peru have been using an ancient irrigation and drainage system known as ‘waru waru’, or raised field agriculture, which makes it possible to bring into production the low-lying, flood-prone, poorly drained lands found all over the Altiplano. The shallow canals provide moisture during droughts and drainage during the rainy season. When filled with water they also create a microclimate that acts as a buffer against night time frosts. The waru system provides farmers with greater harvest security and reduces the risks associated with frosts and drought. In Mexico, the Cajete Terrace agro-ecosystems have been in place for three thousand years in the hillside regions in Tlaxcala. In these rain-fed corn–bean–squash agro ecosystems, food is grown on steep erosion-prone slopes. Rainfall is concentrated between May and September and often occurs in sudden downpours. Sloping terraces feed excess water into tanks (cajetes). The water, which would otherwise not be absorbed into the soil, is collected inside the tanks and slowly percolates into the surrounding soil after the rain has ended. Eroded soils are also trapped inside the tanks, preventing soil loss down the slope. Nutrient rich soils from inside of the tanks are later gathered and distributed to the fields.

In changing climate situations, successful agricultural recovery interventions in post-disaster contexts (following cyclones, floods, and droughts) generally include the supply of specific varieties of seeds (see Case 1), which may differ depending on the response phase, available effective crop growing period, and the development of key saline embankments.

Case 5: Adaptive rice farming system in Thailand

In Orissa, the large volumes of standing water in most areas after the 1999 super-cyclone necessitated the use of particular local varieties of seeds with a longer maturation period of up to 180 days. Many communities expressed concerns about the damage of saline intrusion in some of the coastal villages and the need to restore key saline embankments to avoid additional water intrusion and further damage (UNDP, 2002). Once again, good practices point to the need to consult with communities, especially regarding the varieties of seeds that are most suitable for the local context given the established local practices and changes in the soil environment as a result of the flood waters. This seems to have been overlooked during the cyclone and flood response in Mozambique (Wiles et al., 2005).

Rural communities and cultures in many countries have successfully developed by mastering the ability to adapt to climatic conditions. However, in the last few decades there has been dramatic growth in the human population. This has led to increased input costs, and is imposing unprecedented pressures on natural ecosystems and on existing agricultural production systems. In addition to this pressure, societies are expected to face changes in the climate, such as more floods and drought events, at an unprecedented rate. Given their very tenuous economic scenarios, farmers around the world have been struggling to maintain their incomes by continuously trying to increase yields in their production systems. But these higher producing systems have often become more vulnerable to climate variability and climate change. Agricultural production systems are in immediate need of effective adaptive strategies to overcome these expected.

Some of the following case studies address crops, fisheries, and livestock separately, and have been conducted with the intent of identifying innovative management practices better able to cope with climate change and variability. Although these studies have proven very valuable in advancing the understanding of the existing interactions of climate with agriculture, efforts should be made to work toward large-scale application at the farm level, integrating production activities.

Case 6: Floating gardens: Adaptation to floods in Bangladesh

First, a floating raft is built using water hyacinth, which is a type of hydro plant (plants which grow in water). The rafts vary in size, depending on the space available and the size of the family. They may be 15- 50m long, about 2m wide, and around 1m deep.

Natural compost is added to the raft and allowed to decompose. The structure of the floating raft is strengthened with bamboo.

Vegetables seeds are then planted. In the rainy season, cucumber, eggplant (aubergine), and different types of gourd vegetables (e.g., okra) are planted along with herbs (e.g., basil) and spices (e.g., turmeric). In the winter season, beans, tomatoes, cauliflower, cabbage, potatoes, radishes, carrots, and onions are grown, as are herbs and spices such as ginger, mustard, and chili.

A fence can be put round the floating garden to protect the vegetables from rats, ducks, and other predators. Once the raft is built, it is tied to a post to keep it from floating away when the flood waters come. As the land floods, the raft will float up and the vegetables will be safe.

Lessons

- Seedbeds can be prepared or arranged on floating platforms made of such plants as banana or bamboo plants.
- Seed containers can be kept hanging from the ceiling of the house and/or from the trees. Seeds may also be preserved in the houses of relatives who live on higher ground that is safe from flooding.

Climate-resilient fisheries' adaptations to floods

Inland fisheries are threatened by changes in precipitation and water management. The frequency and intensity of extreme climate events is likely to have a major impact on future fishery production in both inland and marine systems. Reducing fish mortality in the majority of fisheries is the principal feasible means of reducing the impacts of climate change. As climate change and climate variability have occurred throughout history, natural systems, and the fisheries based on them, have developed a capacity to adapt that will help them mitigate the impact of future changes. Future sustainable fisheries depend on the effective management of fishing activity, which in turn requires an understanding of the effects of climate change on the productivity and distribution of exploited stocks.

Floods and annual flooding are very common in many parts of Asia. However, recent experiences show that both the frequency and intensity of floods has increased, and every year many parts of those countries are devastated by floods and therefore suffer losses to their agricultural crops, livestock, and other assets. Several reports have shown that personal perceptions and scientific analysis both indicate that the seasonal cycles and rainfall patterns have changed across many parts of Bangladesh

(FAO, 2006; UNDP, 2007). The global circulation model (GCM) results predict an average temperature increase in Bangladesh due to climate change of 1.0ºC by 2030 and 1.4ºC by 2050. It also suggests that monsoon precipitation is likely to increase by approximately 7% by 2050, a situation that could cause increased flooding in the future.

Each year hundreds and thousands of traditional ponds drift due to floods. This results in the loss of fish, which in turn results in financial losses for poor fish farmers. Floods further aggravate situations in many countries like Bangladesh, India, Indonesia, and the Philippines, especially in coastal deltas where flooding combined with rising sea levels are affecting the livelihoods of people in the inland fisheries sector. Since 1980 commercial shrimp farming has been developed on a large scale. Since much of the land has been enclosed by shrimp farmers in these areas, people have been forced to adopt innovative alternate technologies. Sometimes, they are assisted by the government under post-flood rehabilitation and recovery programs. However, that assistance is constrained by the initial investment and technologies availability to farming communities. When land is limited due to floods, people face a constant threat of hunger. Why not try and use flooded land as a resource? This is an opportunity to develop a long-term solution to the problem. Therefore, adaptations to the changing hydrodynamic phenomena should be further explored and implemented in order to avoid or reduce the devastating effects of floods.

Cage aquaculture is a fish culture strategy that has been relatively recently adopted in such countries as Thailand, India, and Bangladesh. Fish are cultured in cages in open bodies of water such as rivers, canals and wetlands by individuals or communities (Case 7). Cage aquaculture gives local people access to common bodies of water. Cage aquaculture offers poor people the opportunity to make a living using household ponds and waterlogged areas for fish culture (McAndrew, 2002). A potential fish farmer can produce fish in an existing pond without destroying its sport fishing and without having to invest large amounts of capital for construction or equipment. This allows a potential farmer to try fish culture without unreasonable risks. The cages are made of metal nets and are sunk in a body of water. The cultured fish either feed on the nutrient properties of the water or are fed manually.

Case 7: Community-Based Fishing Scheme in Gaibandha, Bangladesh

In Bharar Daha, a village 8 km away from Gaibandha, the NGO Practical Action, is helping families who have been displaced by flooding and river erosion to rebuild their lives through a community-based fishing scheme. The scheme is benefiting 108 families, all of whom have been forced off their land and are now living on the government-built flood embankment. Before the scheme, the families relied on the income of men who would work as day laborers or rickshaw pullers. They would struggle to earn enough money during the annual floods when work is harder to find.

Under the community-based fishing scheme, the community formed a committee to run the scheme, and established a joint bank account. Fishers were granted a lease to use the local government-owned pond for their fishing activities, and this was only granted because of this community-based approach. Practical Action then carried out training in fishing techniques to help families earn additional income throughout the year, and particularly during the annual floods. The women of the community were trained in 'fish cage culture': using cages which are one cubic meter in size to breed tilapia for eating and selling on the market.

The advantages of cage aquaculture are:

- Many types of water resources can be used, including lakes, reservoirs, ponds, strip pits, streams, and rivers where fish otherwise could not be harvested;
- A relatively low initial investment , as all that is required is an existing body of water.
- It allows the use of public bodies of water for fish production and allows sport fishing ponds to be used for the culture of other species.

Lessons

- As part of the preparedness as well as the recovery support measures adopted for fish culture, raise the height of the banks of ponds that are at risk of inundation by floodwaters to protect fish from escaping. If possible, attach nets securely to the surface of the banks or to tree branches to keep fish from escaping.
- Catch the fish prematurely and prepare for cage aquaculture.

Fighting salinity through traditional practices

Sri Lanka has experienced an increase in temperatures and relatively low rainfall for an extended period over the last 20 years, leading to a decrease in ground water levels. At the same time, an increased sea level has also caused sea water intrusion into coastal lagoons and estuary systems, causing the destruction and slow change of existing habitats. Salt water in Sri Lanka's coastal rice fields is a problem that is certain to get worse as sea levels rise.

Forgotten types of indigenous rice may offer a home-grown solution to the increasing soil salinity. There are around 2,000 traditional rice varieties in Sri Lanka. Many are very high in nutritional value and have medicinal properties, and most are resistant to extreme drought conditions, diseases, and pests. These varieties were traditionally grown using natural inputs such as organic manure, and no chemical fertilizers or pesticides were used. Farmers have worked on a number of trials on various rice varieties of traditional and modern rice which are saline-tolerant, temperature-resistant, and pest-resistant to see if they could withstand salinity.

Case 8: A new lease on life in Hambantota with traditional salinity-resistant rice

For rice farmers in Dehigahalanda, in the Hambantota district of southern Sri Lanka, increased salinity in their water-logged fields was a grave problem causing their yields to drop steeply. Some were getting less than half the expected yield. The farmers could not find a viable solution for the creeping salinity, which was aggravated by the 2004 Indian Ocean Tsunami and a lack of fresh irrigation water, and feared that eventually their fields would be left barren.

One such farmer was 40-year old S. Ranjith. Nearing desperation, his local farmers' organization tried to appeal to various government institutions about their plight, but with little success. Today Ranjith has managed to reverse his destiny. He is even producing seed paddy out of his one-and-a-half acre field. The secret of his success does not lie in complicated engineering feats or advanced science, but in long-forgotten traditional rice varieties that have an age-old ability to resist high salinity in soil and water.

Together with 16 other local farmers, Ranjith conducted trials using 10 different varieties of traditional rice through a program conducted by the National Federation of Traditional Seeds and Agri-Resources and supported by a leading NGO. For the first time, the farmers were given the choice of 'variety selection' and asked to score the different rice types according to crop duration, plant height, grain quality, and yield. The four highest scoring of the ten varieties were then promoted through farmer organizations as hardy, saline tolerant and high quality rice that were well suited for coastal rice paddies.

Ranjith has cultivated his field for the third time with traditional varieties, shunning the hybrids promoted by the country's agricultural departments. His inputs are low-organic manure and less chemical pest control. Although traditional rice does not produce the yields of hybrid varieties, his profits remain high. Traditional rice is purchased at a higher price by the Federation and there is high consumer demand today for these rare rice types. The application of organic fertilizer has begun to ease the soil salinity problem as well.

"We were on the verge of abandoning our fields. The introduction of traditional rice has given a new lease on life to us and these fields," said Ranjith who is now a certified traditional rice grower and seed producer.

Source: http://practicalaction.org/disaster-reduction/climatechange_ricebiodiversity

Approach 4: Protect indigenous varieties to improve livelihoods and biodiversity

Case 9: Surviving the Friaje: Freak freeze conditions in Peru

The indigenous communities living high up in the Andes (4,000 - 4,500 meters above sea level) are some of the poorest and most vulnerable people in Peru. These isolated rural communities are often forgotten, and receive little or no government help. There is practically no vegetation at this altitude and communities are highly susceptible to adverse weather conditions. They depend entirely on alpacas and potatoes for both their livelihood and staple diet.

The effects of climate change have already taken an increasing toll on the poorest and the most remote communities in the Andes, many of whom live 4,000 meters above sea level. The "Friaje" of recent winters, a phenomenon of intense cold never experienced so extremely before, is challenging highland communities' abilities to survive. In 2003, when temperatures dropped to -35^{o}C, 50 children died and as many as 13,000 people suffered severe hypothermia, bronchitis, and pneumonia. An estimated 50 - 70% of alpacas perished and many more were left exhausted and prone to disease.

Growing nutritious food using hydroponic systems

When the cold hits, and the land dries up, what little vegetation there is blows away. Barley grains fetched from the valley floor - with the help of healthier alpacas - are grown in a trough of water. The barley is milled, enriched with syrup, and formed into blocks. Needing only sunlight and water the whole process takes just two weeks. These high energy blocks of barley keep the alpacas healthy and strong when no other food is available.

Protecting indigenous potato biodiversity

There are 256 varieties of potato that can survive the harsh conditions of the high Andes. Practical Action is helping families living at altitudes of 3,800 ft. to maintain this crucial biodiversity by developing varieties of local potatoes, as well as improving technical aspects of production. A revolving fund for accessing native potato seeds and seeders for local production has been established. Ongoing technical assistance is being established through the training of 40 Quechuan farmers, chosen by the community themselves, as technological leaders. These methods ensure people are able to get enough to eat, as well as to earn an income at local markets. The project is benefiting 600 peasant families in the Quechuan communities living in the high areas of Canchis, Sicuani, and Cusco and it is hoped that the project will ultimately be able to reach 1,500 families in total.

> *"As a farmer, I knew very little about plagues. I had no idea where they came from or what their lives were like. Now I know about the lives of these harmful insects and I have learned new sowing techniques. I am becoming a field researcher and am now applying some of the practices that I learned at the training sessions. I can also explain many of the practices that I learned from my parents and grandparents, which I realize are very valuable, because I know they are good."*
>
> *-Abrahan Quito Apaza, farmer from the Pumarorcco community.*

Source: http://practicalaction.org/disasterreduction/climatechange_friaje

Approach 5: Climate-proof livelihood recovery through asset protection

Livestock replacement

In terms of asset protection, the supply of replacement livestock, livestock fodder, and health treatment for surviving animals has proved to be an important component of livelihood recovery interventions in the aftermath of cyclones, floods, and droughts (Case 10). Restoring small farm livestock activities is also seen as one intervention that quickly helps livelihood recovery and improves food security. In Orissa, the replacement of livestock, including the provision of cows, poultry, goats, and buffalos, as well as livestock fodder, proved to be very effective in livelihood recovery (IMM, 2001).

Case 10: Livestock asset recovery in drought, Anantapur

Ownership of livestock, especially in arid, semi-arid and other non-congenial rain-fed settings, is a critical component of livelihood security. Being more drought resistant than crops, livestock can provide a safety net against drought, spreading the risks and providing a more even stream of income to eliminate seasonal hunger. But there is mounting evidence that increased reliance on livestock dry land pastures could be counterproductive if it leads to further over grazing and land degradation.

International experience shows that there are arid lands where rainfall fluctuations occur (a) from year to year; and (b) in cycles of dry years followed by wetter years. It is difficult to formulate strategies and grazing management plans to cope with such variability. The light stocking required to match average rainfall can reduce the risk of forage deficit and financial loss due to death and starvation of animals in low rainfall years. However, this implies lower incomes in good years, although conserving forage may produce healthier animals that command higher prices.

Instead, livestock policies in arid areas should facilitate rapid destocking in bad years through opportunistic herding strategies that rapidly adjust grazing pressures to ecological conditions, instead of assuming that a single stocking rate will be appropriate for all years. But the larger message is that sustainability of livestock management must be enhanced in volatile environments by developing support systems for water-resilient livestock systems and paying close attention to ecosystem productivity and sustainability.

In areas such as Anantapur, farmers tend to have a large number of small ruminants, which, though drought resilient, can be more damaging to pastures. However, the market for this produce is growing. Sheep and goats comprise roughly 70% of the livestock population in these areas, with the remainder serving as milch animals. There is much global evidence of the pasture damage that can occur with an overreliance on goats. The strategy used by the smallholder mixed (crop-livestock) communities is to purchase animals during the rainy season, when fodder is available, and sell them during the summer season when there is a shortage of fodder. But the greater incidence of drought in recent years has contributed to a sharp decline in livestock populations. There is a need for biomass intensification targeting small ruminants in these rain-fed areas for more secure and productive livestock systems. Other solutions include promoting the production of fodder-yielding crops, the development of fodder banks, and the chopping of fodder by farmers under rain-fed or irrigated conditions to overcome the shortage of green fodder during rabi, when the rainy season ends. Agriculture-embedded livestock systems have a strategic advantage and yield multiple benefits.

Source: World Bank (2008)

Approach 6: Climate friendly natural resource use in recovery

Case 11: Improving farm income in semi-arid Brazil: Photo-voltaic water pumping systems

Pintadas Solar is a pilot project in Pintadas, a municipality of 11,000 inhabitants located in the interior of the state of Bahia, Northeast Brazil. The region is characterized by a semi-arid climate with hot temperatures, very little precipitation, sandy soil, and extended periods of drought, which are increasing due to climate change.

The community of Pintadas, in the Bahia state of Brazil, is suffering increasingly severe droughts linked to climate change. There is a high demand for legumes from local and national markets, and a potential to cultivate a greater area of land for this purpose, but opportunities to expand local agricultural practices in this direction are restricted by the absence of an efficient, cost-effective irrigation system. Further, the high insulation rate of the area makes it extremely suitable for effective solar energy systems. This project seeks to improve agricultural productivity in this increasingly drought-prone region through the implementation of a more efficient system of irrigation which uses a photo-voltaic (solar) energy system, which is sustainable and feasible in terms of use and maintenance by the local community. This project is a sustainable, technological approach to adapting to and mitigating climate change. The project consists of the installation of an electric water pump powered by solar photovoltaic (PV) energy and connected to a drip-irrigation system on a family farm in Pintadas.

The project has fostered an integrated development approach to community adaptation and mitigation to climate change by articulating the use of water efficiency and clean energy technologies to improve agricultural practices to enhance food security and generate income. Links with the growing biofuel industry are also being made.

Approach 7: Composting: a futuristic adaptation and mitigation initiative for solid waste management

Solid waste management is a common, as well as a primary, environmental concern for many cities in developing countries. The open dumping of solid waste is a typical problem, but often local urban agencies and municipalities do not have the financial capacity to establish and operate sanitary landfills. To address these problems, many cities are promoting the 3Rs (reduce, reuse, and recycle) concept and trying to reduce the amount of waste generation at the source rather than later at the end-of-pipe phase. Composting organic waste is both an adaptation and mitigation initiative. This can also prevent greenhouse gas emissions at the final disposal site to some extent. An exceptional example is Surabaya City in Indonesia, which has posted outstanding achievements in successfully reducing the amount of waste generated by targeting organic waste first, rather than implementing a comprehensive 3Rs program, and promoting composting practices throughout the city by actively involving various stakeholders. The city has become noticeably cleaner and greener in a short period of time, as acknowledged by many residents. Its achievements were honored with the Adipura Award (Clean City Award) from the central government (IGES, 2009).

Case 12: Community solid waste management model in Surabaya City, Indonesia

Surabaya City, the second largest city in Indonesia with a population of three million, has successfully reduced its waste generation by more than 20% over a short period of time. The city has intensively promoted composting practices by setting up more than a dozen composting centers and distributing thousands of compost baskets to residents, and has actively involved residents and community groups in waste reduction activities by co-organizing a community cleanup campaign with local NGOs, private companies and the media. This model may be considered one of the options that can be replicated in small cities. Surabaya's achievement exemplifies how a city can reduce a large amount of waste in a few years by primarily targeting organic waste, which usually makes up more than half the amount of municipal solid waste, and mobilizing internal resources, specifically its residents, community groups, NGOs, and private companies.

Surabaya's success came in three critical stages. First, an efficient solid waste management model was developed in one community. The composting center started producing good quality compost (using the Takakura Method) in large quantities from separately collected organic waste from the community. This method was further modified for use at each household over a period of a few months. Some households started producing compost from kitchen waste using compost baskets provided by Pusdakota and used the product for plants and flowers. Many households followed suit, which changed the mindset of residents and discouraged the dumping of waste on streets and in creeks. As a result, the community became greener and cleaner.

Second, Surabaya City scaled up the project by adopting the same composting method at existing composting centers, establishing new centers, and distributing thousands of compost baskets to residents. Local NGOs set up a network of community environmental leaders called environmental cadres, who teach the residents how to produce compost from daily kitchen waste using the baskets. Pusdakota purchases the compost produced by basket users at IDR700 (USD0.07) per kilogram, which enables a household to earn an income of IDR4,200 (USD0.42) a month by processing one kilogram of organic waste a day, as about 20 percent of the input ends up in the final product. Some people scale up their composting activities to increase their income by collecting additional organic waste from other households, gardens, and streets, or instead by selling seedlings, herbs, and vegetables grown with the compost.

Third, the city, in collaboration with NGOs, private companies, and the media, organized a community cleanup campaign called the Green and Clean Campaign. The campaign grew popular due to the widespread media coverage in local papers and on TV programs, and thanks to the festival-like award ceremony.

Constraints:

It is not easy to secure a market for compost and often demand fluctuates seasonally. In fact, Pusdakota stores a large stock of compost in a work space which could otherwise be used for increased production. Another challenge for NGOs and community groups is covering the capital costs of establishing a composting center. These are the two main reasons why there is still only one community composting center in Surabaya even after years of success by Pusdakota.

Source: IGES, 2009.

This example shows that Surabaya's success was achieved by highlighting the significant environmental benefits of reducing GHG gas emissions in a climate change situation by adapting a simple eco-friendly composting practice at the local level. Countries which need to purchase carbon credits, including industrialized countries, may consider this option by taking into account the positive impacts. However, at present, the composting project is not registered as a CDM project but it will surely be a potential CDM initiative in the future. If a CDM methodology specialized for the Surabaya model is developed, agreed upon by all stakeholders, and approved, the implications would be enormous, as it has tangible co-benefits (social and environmental impacts) and the potential to be replicated in many other cities.

Approach 8: Innovations in livelihood sector recovery

Recent studies have implicated climate change-induced floods and droughts as the primary agents in human migration, cultural separation, and population dislocation. Human migration due to climate change and environmental stress is a well established survival strategy across continents, including Africa, Eurasia, South America, and Australia.

Each year thousand of households are affected by floods in Bangladesh, India, Sri Lanka, Indonesia, Vietnam, and other countries. The apparently infertile soil is left behind after floodwaters recede, leaving sand and silt to cover the land. By simply digging holes in these sandy residues and filling them with manure, compost, and vegetable seeds, residents have shown that crops can thrive. In addition to producing a high yield and being packed full of health benefits, crops like pumpkins can be stored for up to a year, providing a crop for either consumption or sale during times when employment opportunities are low.

Case 13: Hope for Climate Change Refugees in Bangladesh

There is new hope for stretches of land across the vast delta where three great rivers meet. Bangladesh is prone to flooding. In addition to experiencing monsoon rains, the slow cooking of the earth's atmosphere, according to theory, will release more water from Himalayan glaciers above the flatlands of Bangladesh. Climate change, say scientists, also means higher tides in the Bay of Bengal. The result is trillions more liters of water sloshing over the country, depositing billions of tons of sediment.

The new village of Amader Bandhan stands on a sandbar about 190 miles northwest of Bangladesh's capital Dhaka in the district of Gaibandha, and consists of 100 half-brick, half-tin homes. Its population is drawn from the ranks of the country's climate change refugees.

In the last 18 years, Gaibandha had seen floods that used to only occur once every 100 years or once every 50 years. These are not freak events but reflect a pattern of significant change. Bangladesh has to cope with much more devastating floods much more often (Ramesh, 2007). Nowhere is the climate change impact more broadly felt than in the *chars* of Gaibandha, islands of sediment in watery channels, created by the swell of the rivers, monsoon rains, and sand carpeting, which can leave once fertile land useless. Local people have always faced seasonal loss in this ever-shifting terrain. But global warming has accelerated this cycle of disaster.

Due to recurrent sand casting, the land was unable to support crops, but dedicated NGO activists introduced a ‘pit system’ of agriculture on riverbanks. Holes were dug in the sand and filled with compost and mud. Sweet gourds were planted, providing vegetables that can be pickled and sold during the monsoon, when the prices rise. Each family gets 50 pits. Usually when the rains come it is a disaster for them, but now they will be able to save for hard times.

Lesson

- The sandbar and other innovative technologies, such as floating gardens and fish farming, can have a huge impact on the livelihoods of people who are likely to suffer increased stress due to climate-induced disasters in flood-prone areas in future.

Case 14: Vertical Vegetable Gardens in Sri Lanka

People displaced by war in Sri Lanka enrich their diets by planting vertical vegetable gardens that are resource efficient, cheap to establish, and even portable. For farmers in the north and east of Sri Lanka, achieving food and livelihood security seemed impossible in the midst of war and unrest in that region. By the time the war finally ended in May 2009, many of these farmers had become internally displaced persons (IDPs) residing in camps far from the lands they once cultivated. WFP provided dry rations for IDPs. Fresh vegetables were lacking because they were logistically difficult to supply. Working in Vavuniya District in the northeast, the International Water Management Institute (IWMI) provided a solution to this challenge.

Planting vertical vegetable gardens, or vegetable towers, is an innovation promoted by the International Network of Resource Centers on Urban Agriculture and Food security (RUAF Foundation, www.ruaf.org), of which IWMI is a member. IWMI is also the regional coordinator of the RUAF-Cities Farming for the Future Program in South Asia.

Setting up a vertical vegetable garden is simple and quick. A recycled poly sack is filled with a mixture of earth, sand, and cow dung. A pipe with spirally placed holes or a plastic bottle with little holes in it is inserted into the middle of the sack. Bigger holes are made on the sack at intervals, where leafy vegetables, tuber crops or others vegetables are planted. Several types of vegetables can be grown on one sack. Generally, creepers and root vegetables are planted on top of the sack, and others grow from the sides. Okra, aubergine (eggplant), tomato, radish, carrot, long bean, snake gourd, bitter gourd, capsicum, and chili have been successfully grown.

The vertical garden is irrigated by simply pouring water into the pipe or plastic bottle, from which it gradually seeps into the soil in the sack. The technique saves water because it is administered in trickles. Kitchen wastewater can be used, as it is already rich in nutrients. The sacks occupy very little space. If a person shifts to another location, as do many IDPs, the garden can come along. Labor for maintenance is minimal compared with a traditional vegetable garden. The cost of setting up a vertical vegetable garden measuring 48 centimeters in diameter and 168 centimeters tall is US$10.

Having received permission for implementation from the Sri Lankan government, IWMI and the Department of Agriculture trained agricultural extension staff and schoolchildren and set up several demonstration plots. The technology was enthusiastically received by trainees, and 200 of the 300,000 IDPs were selected for initial implementation. As IWMI is a strong advocate of gender equality and many of its projects have a gender component, the Institute is especially pleased that many women have shown an interest in vertical gardens. Women in Sri Lanka, especially in rural areas, play a key role in procuring food and water for households, and IWMI assists in identifying and evaluating water-saving technologies and best practices.

Source: CGIAR, 2010, website accessed on 28 May 2010
http://www.cgiar.org/monthlystory/may_27_2010.html

Lesson

- Vertical gardens are appropriate in any developing country with limited land or water resources and have potential also in developed countries where people prefer to grow their own vegetables.

For further information please see:

http://www.bothends.org/strategic/localcontributions_bangladesh.pdf

http://maindb.unfccc.int/public/adaptation/adaptation_casestudy.pl?id_project=19

http://ruaf-asia.iwmi.org/

www.iwmi.org/Topics/Gender

Adapting to Climate Change: Build Stronger Infrastructure to Reduce Risk

Chapter 3

Approach 1: Flood-resilient building in recovery

Following any sudden disaster, the permanent infrastructures that link industrial centers with major areas of primary products and local livelihood activities, such as roads, railroads, and waterway networks, are affected most. The coastal and island regions face the fury of cyclones, storms, coastal flooding, and other disasters. Even without climate change, these regions of many countries are already severely affected by climate variability and extremes, and they remain vulnerable to future changes in the regional climate that could increase their risks. Climate change may lead to industrial relocation, resulting either from sea-level rise in coastal-zone areas or from transitions in agro-ecological zones. Additionally, these regions are facing increasing environmental and socioeconomic pressures exacerbated by global climate change and climate variability. If sea-level rise occurs, the effects on the many harbors and ports around the continent will be quite devastating economically for many coastal-zone countries. Adaptation to climate change and variability is ultimately an issue of both post-disaster recovery and sustainable development.

At present there is a considerable degree of climate-related risk involved in infrastructure recovery projects, and future climate scenario situations suggest substantially higher risk as a result of increases in climate extremes and variability. Climate change, if adaptations are not made or countermeasures not taken, will compromise the functionality of the existing infrastructure. The adequacy of the infrastructure may be further challenged by its physical / mechanical aging. For upcoming infrastructure recovery projects, it is possible to avoid most of the damage costs attributable to climate change, and it is possible to do this in a cost-effective manner, if climate proofing is undertaken at the design stage of the project. Therefore, so-called recovery managers are urged to consider the likelihood that adverse weather will increase in frequency and intensity and that unfavorable climate conditions will persist, and thus to develop climate-proof recovery strategic plans to enhance the environment for adaptation.

The housing sector seems to have had the least successful post-disaster recovery interventions over the last decade in Bangladesh. Major infrastructure projects after the 1998 floods did not include individual housing rehabilitation and recovery, and instead focused mainly on public infrastructure. It appears that housing interventions supported by NGOs since the 1988 floods, including the 1991 cyclone, have faced a number of problems (ALNAP, 2002). Given the relatively large scale of the asset, appropriate coverage and targeting have been problematic, with some benefits going to the non-poor and some overlaps in geographical coverage occurring. Much of the housing provided through various interventions was better than that provided through a housing replacement scheme, which increased the cost and decreased the numbers of people that could be helped. There was little coordination among agencies in design. Problems with design ranged from buildings with too little floor space, to the use of reinforced concrete pillars in inappropriate soils, and a lack of participation of the affected population leading to inappropriate design. Also, there was a wide variation in costs.

Year after year, floods threaten the homes and livelihoods of thousands of people in vulnerable parts of Bangladesh. Yet a few simple, cost-effective improvements can help a house remain standing throughout the monsoon season. NGOs worked with communities to develop simple designs, like a two-foot high concrete plinth, which will prevent a house being washed away. A plinth raises a house up. It is made from soil, a little cement, and some pieces of stone and brick, and unlike traditional earthen floors that simply wash away, is strong and high enough to last through repeated floods. Bracings and fastenings bind the walls firmly to the house 'skeleton' through a network of holes and notches – locally called a 'clam system' – and the whole building can stay standing through the strongest of winds and rain. Animals are considered in the plans too. Crucial to the family's welfare, poultry and livestock have a separate area in the improved houses, to improve hygiene and to ensure that the henhouse can be picked up and carried to safety, out of the way of the floodwater. Water-thirsty plants are set around the house, such as bamboo, banana, hogla and kolmi – they 'drink up' flood water and hold onto the soil, helping the whole homestead remain intact. Most plants can be found growing wild locally, but a little people power is needed to get them in place (Practical Action, 2009).

- Houses are raised off the ground on a 1m high concrete base.
- Walls made from jute panels, strengthened with bamboo.
- Bamboo and banana trees are planted to soak up the water.

Case 15: Flood-resistant houses in rural settlements in Bangladesh

Wazuddin Fakirer Dangi, is a village located 3 km from the river Padma, in Faridpur District. This area is in the Char-lands (Bengali name for 'islands within rivers') and is highly susceptible to severe flooding during the monsoon season. Villagers' houses were provided by Practical Action, and designed to give them more protection from floods. Houses are built on a raised plinth made from sand, clay, and cement (meaning it is less likely to be washed away in floods), and made using concrete pillars and treated bamboo poles. Practical Action built the house using readily available and affordable materials, so that other families can copy the design and reap the benefits of the improved structure. It is important to work with local communities to choose the best ideas, using local knowledge and local materials, which are affordable.

Two solid floor plinths can be mixed and finished for only £31. Durable walls for 10 houses can be built from bamboo and jute for £62. As little as £120 is enough for all the nuts and bolts needed to hold 20 houses together, through the worst conditions, bringing the total cost of planning and building a flood-resistant house using all these techniques to £172.

Sources: Flooding in Bangladesh: Teacher's note
http://www.climatechoices.org.uk/docs/bangladesh_pps_notes.pdf

Lesson

- Recovery support for housing reconstruction should be based on indigenous designs and adaptable to flooding, such as movable housing or housing made from sturdier materials, and should use local materials and labor where feasible. This housing must be of the kind that can be rebuilt, repaired, or expanded by owners.

Case 16: Flood-resistant housing; Adapting to climate change in Dhemaji, Assam

The district of Dhemaji is located in the foothills of Arunachal Pradesh on the northeast stretches of the Brahmaputra River with Subhasiri on the one side and the Siang River on the other. Tribal communities like the Mishing, Deori, Koibatra, and Miya Assamese live on the banks of the river and are mostly below the poverty line (BPL). The monsoon season in this subdivision starts in April/May and continues until August/October. The floods in these areas are caused by excessive rains in Arunachal Pradesh and nearby states, siltation, and change of river course due to erosion.

The housing types in the rural Assam are stilted houses and so-called 'Chang Ghar' (hanging houses) that are designed for flood adaptation. These types of houses are typically used by members of the Mishing tribal community who are familiar with living near flood-prone rivers. Traditionally, these houses were used to save granaries from floods. Other communities have also started following the same method for housing. The stilting is done using timber. Split bamboo mats are placed over the bamboo framework to form the walls. Flooring is basically comprised of mats made out of split bamboo or wooden planks. One of the most peculiar characteristics of a *chang gha*r is the kitchen in the center of the living room. The pigs remain under the floor of the *chang ghar* eating the dropping from the house.

Due to siltation in the river, many villages remain submerged for more than four months in a year. Homestead rising is done in many places, but this is not the right solution. Local resources, both building materials and human resources, are available for repair and rebuilding.

The *chang ghar* types of buildings are generally suitable for habitation even after they have been affected by floods and sand casting. In extreme cases, people are used to dismantling their houses and keeping the wooden poles and trusses in a safe place until they can be reassembled after the flood waters recede. Bamboo and timber are plentifully available locally. Timber which has been washed away from the forested hills of Arunachal Pradesh during the floods is collected from the river and stored by local people for future use.

Lessons

- Recovery support in housing reconstruction must be based on indigenous designs and adaptable to flooding, such as movable housing or housing made from studier materials, and should be made using local materials and labor where feasible.
- Housing recovery programs are more sustainable when the housing can be rebuilt, repaired or expanded by owners with technical support from external agencies and technical experts.

Case 17: Infrastructure climate-proofing project in Kosrae, Micronesia

Climate change will most often appear in the form of changes in the frequency and consequences of extreme events and inter-annual and similar variations, rather than as long-term trends in average conditions. At a practical level, adaptation should thus focus on reducing both present and future risks related to climate variability and extremes. In many instances, current levels of climate risk are already high due to increases in risk over the past few decades. Moreover, adapting to current climate extremes and variability prevents precious financial and other resources from being squandered on disaster recovery and rehabilitation and is an essential step to being able to withstand the pending changes in climate. Adaptation has many dimensions and must also be viewed as a process.

The Cook Islands Ports Authority was in the process of developing the Western Basin of Avatiu Harbor in Rarotonga to accommodate an increasing number of fishing vessels, to provide sufficient wharf to minimize delays in offloading fresh fish, and to allow the fishing vessels to use the harbor in most maritime conditions other than those associated with cyclones. The first stage, involving an expenditure of NZ$1 million sourced through a government grant, overseas aid grant, cash reserves, and a loan, involved the construction of a wharf facility, but with no added protection against storms beyond what is provided by an existing breakwater.

The design brief for the Western Basin states that the breakwater and quay walls should have a nominal design life of 60 years. Fixtures should be robust enough to withstand a cyclone with a 10-year recurrence interval. The brief acknowledges that severe damage will be sustained by fixtures in a cyclone with a 50-year recurrence interval. It goes on to say that the main quay should be designed to withstand wave forces associated with a cyclone with a 50-year recurrence interval with only minimal damage. Cyclone wave heights should be based on a 50-year recurrence interval, and a calculated significant wave height of 10.75 m (10 percentile wave heights of 13.65 m). The relationship between maximum wind speed and significant wave height for a given recurrence interval was determined using past studies of tropical cyclone risks for the study area. It thus represents the “current” climate. However, both the historical record and some global climate models (GCMs) suggest that the frequency and intensity of cyclones in the vicinity of Rarotonga are increasing and may continue to increase, asymptotically. Consideration was given to the impacts of global warming on changes in cyclone intensity and, hence, significant wave heights. In light of these findings, a 2.5–10% increase in cyclone intensity per degree of warming was used. Under current climate conditions, the 50-year significant wave height is estimated to be about 10.8 m. Under the climate projected for the year 2060, the 50-year significant wave height increases to about 12.0 m. The sea-level projections incorporated both a regional component based on GCM results and a local component based on trends in mean sea level as estimated from tide gauge data. After accounting for the climate-related rise, the local trend appears to be about 1.7 mm/yr, most likely related to vertical land movement. By the year 2060, the mean sea level is projected to rise by 50 to 80 cm over current levels.

The final concise report for the development of the Western Basin indicates that the breakwater should have a nominal design life of 60 years. Given this specified design life, and the preceding projections regarding recurrence intervals for extreme winds and hence significant wave heights, and of sea-level rise, the breakwater design should be based on a significant wave height of at least 12 m and allow for a sea-level rise of at least 0.5 m.

Case 18: Integrated Climate Change and Flood Management Plan, Pune City, India

The city of Pune in Maharashtra State, India, has a population of nearly 5 million people and is located at the confluence of three rivers, the Mutha, Mula and Pavana. It has been affected by several severe floods over the last six decades, the most significant being the 1961 flood that involved a major dam failure. Anticipating an increased frequency of floods owing to climate change, and in order to reduce its carbon footprint, the city authorities have developed a comprehensive climate change adaptation and mitigation plan.

A systematic city-wide plan of practical action to reduce flooding was implemented. The first step was to assess the flood risks by analyzing hourly rainfall intensity and examining the likely changes in impacts in low-lying areas and places where natural drainage was blocked by the construction of houses or by roads without adequate bridges. A detailed city drainage map was developed. The plan introduced structural and planning measures for restoring natural drainage, widening streams, extending bridges, and applying natural soil infiltration methodologies. Watershed conservation techniques such as afforestation and building small earthen check dams were undertaken in the hilly areas. Property tax incentives were provided to encourage households to recycle wastewater or use rainwater harvesting by storing run off from their roofs for domestic use. These efforts were complemented by improvements in flood monitoring and warning systems and social protection for affected families. The initiative has been jointly driven by the elected municipal government, the municipal commissioner, and an active citizen group called Alert, and involves many different city departments. It demonstrates that local governments can prepare for climate change by reducing and managing the local factors that lead to disasters.

Source: UNISDR (2009).

A risk-based approach to adaptation is both desirable and applicable. It combines both the likelihood and consequence components of climate-related impacts and can assess risks for both current and anticipated conditions, with the option of examining either specific events or a combination of those events over time. A risk-based approach also facilitates an objective and more quantitative approach, including cost-benefit analyses, that results in an evaluation of the incremental costs and benefits of adaptation and assists in prioritizing adaptation options.

However, there are a few shortcomings of the risk-based approach. Most barriers to the successful application of a risk-based approach to adaptation relate to the existence of, and access to, information. Additional barriers include the need for formal specification of risk-based targets that define future levels of acceptable risk.

NOTE: Development practitioners and recovery managers are urged to note and act on the finding that the likelihoods of adverse weather and climate conditions are already high and are projected to increase in the future. Similarly, the consequences of these weather and climate events are also already very severe and are likely to increase markedly as a result of climate change. Most climate-related risks can be reduced in a cost-effective manner.

Governments should ensure that all regulations (e.g., building codes, public health regulations) are also climate-proofed as this will allow the enforcement of policies and plans that should, themselves, be climate-proofed. They should ensure that all proposed recovery programs, including new and upgraded development projects, are climate proofed in the design stage. This should be part of good professional practice, with the national and state Climate Risk Profiles being used as the basis for climate-proofing the infrastructure, community, and other development projects. Compliance with this requirement should be assessed as part of enhanced EIA procedures.

The design and funding implications associated with the climate-proofing of developing countries, their recovery infrastructure, and their community and other development projects are addressed early in the project cycle; and the incremental costs of this climate-proofing can be met from other sources including soft loans, special recovery grants, and other sources in the future.

The risk-based recovery approach can be linked to sustainable development by identifying those risks that may arise due to climate variability and change. Disasters often provide opportunities not just to recover to a pre-existing status but also to take additional steps toward further climate-resilient development.

For Further Information please see:

http://www.climatechoices.org.uk/docs/bangladesh_pps_notes.pdf

http://practicalaction.org/disaster-reduction/flood-resistant_housing

Approach 2: Balanced Sectoral recovery intervention: infrastructure and livelihoods

Imbalances in post-recovery sector development increases number of vulnerable families

Community infrastructure development in the recovery phase alone cannot provide protection against future disasters. It must be part of a greater strategy of combining livelihood recovery with disaster risk reduction.

Case 19: Imbalances in post-recovery Sector Development after 2008 Mozambique flood (Not Good Practice)

Many households in the southern provinces of Gaza and Maputo, and in northern Inhambane (Govuro), lost significant numbers of large livestock during the Mozambique floods. Livestock is an important part of a household's livelihood and acts as a hedge against crop loss. Poorer households lost chickens and ducks. Cattle are symbols of wealth and power within the community. The re-stocking of high value animals such as cattle was less common in all of the areas visited. When cattle were distributed, it was always through a formal association or group distribution system. Small livestock were distributed with varying degrees of success. A number of villages were decimated by Newcastle's disease in chickens shortly after the restocking had been completed.

In the recovery, the inability of the government and/or agencies (perhaps due to the large capital investment that would be needed) to address the question of asset depletion in the form of cattle loss has meant that the rural communities of Chokwe, Marracuene, and Govuro are significantly more vulnerable than they were before the floods. The agencies present in these areas during the recovery period were aware of the livelihood strategies of the populations with whom they were working. However, although the agencies and the government authorities were aware of the strategies, this did not always translate into interventions that would help to restore or improve individual livelihoods. On the contrary, the work resulted in extensive recovery of the social and economic infrastructures in the district. The organizations that collaborated during the recovery period also recognized the need to continue their partnership in the post-recovery period due to the high risk of subsequent disasters related to future climate variability and their initiation of changes that require long-term, sustained input to reduce vulnerability.

Case 20: Gaza Province, Chokwe District, Lhate Village

Villagers in Lhate were evacuated during the floods and returned to their homes after the flood waters retreated. The remote rural community relies on small-scale subsistence farming and the trading of agricultural products in good years. After the war, a number of families had invested in cattle. During the recovery period, after their return home, the people of Lhate benefited from housing materials, seeds and tools, and basic domestic utensils. Small livestock (chickens and ducks) were also distributed, although the chickens died of Newcastle's disease during the first year. Vukoxa (a local NGO for the elderly) helped the community set up a farmers' association that included the elderly of the village. While the association was provided with cattle for plowing and breeding, individual households were not provided with livestock to replace cattle lost during the floods. The village also benefited from a new school and health clinic.

In general, it is probably fair to say that the people of Lhate benefited from post-emergency interventions in terms of habitation security and infrastructure development that will bring long-term benefits for the population. However, this poor rural community is without doubt poorer, and households have reduced options in terms of their coping strategies.

Optimism rests with the ability of the villagers to work together in the newly formed associations and to take advantage of the social and economic infrastructure now available in the area.

Source: Wiles et al. (2005).

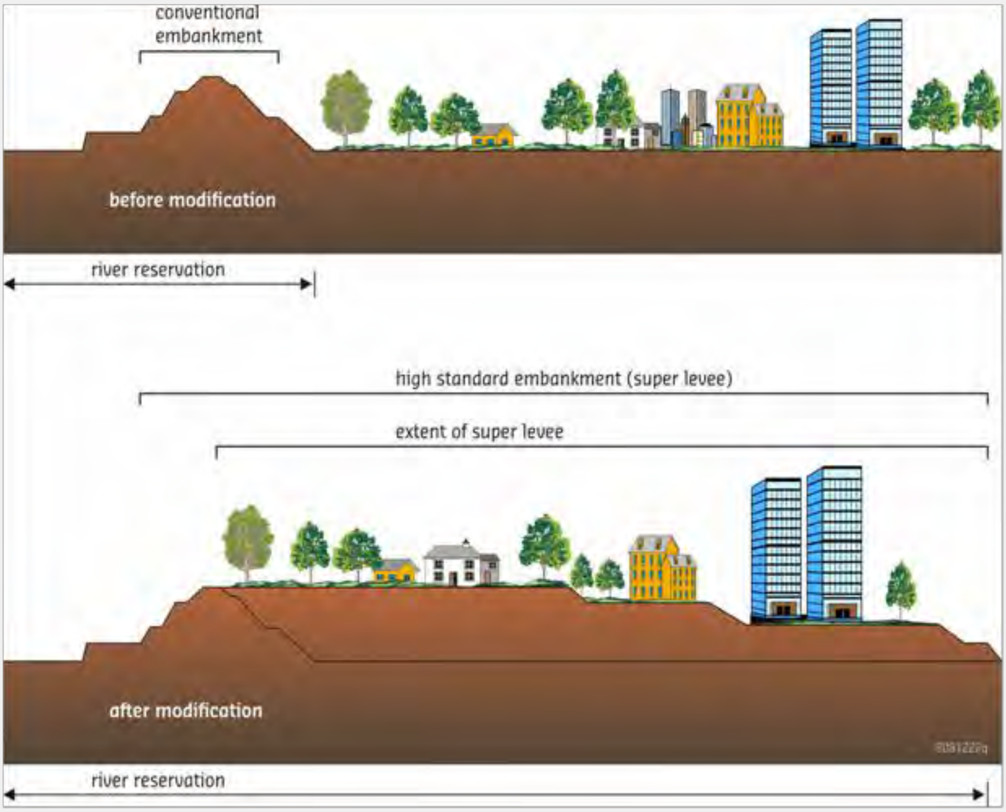
Approach 3: Localized approaches for climate-resilient urban flood management

Case 21: Super levee in Japan: Flood-resilient peri-urban land use adaptation

In 1977, the River Commission of the Ministry of Construction recommended Comprehensive Flood Control Measures in rapidly urbanizing basins. It suggested not only upstream retardation using dams and downstream river channel improvements, but also that the development of residential areas so that no new extra discharge would be generated. Earlier the basic strategy for flood control in Japan was to direct water to the sea as soon as possible. The means of control were a continuous levee system, divergent canals, and sediment control. During the period of rapid growth after World War II, floods became prevalent in rapidly urbanizing areas where paddy fields and hill slopes were converted to residential and industrial areas. As this sprawling urbanization continued, floods in relatively small urban rivers and sporadic landslides were the major causes of damage. In 1987, the River Commission recommended a high standard levee policy and thus began the construction of super levees, such as that found in the downstream portions of the Sumida River in Tokyo. A super levee consists of elevated land behind the original narrow laser-like levee. The base length of a levee is typically 100 to 150 m long. The super levee protects urban areas where there are extensive urban facilities and absolutely no levee breakage is allowed

To respond to increasing flood risks and their devastating consequences to society, Japan developed the concept of super levees. A super levee is a river embankment with a broad width which can withstand overflow. It prevents uncontrolled flooding due to a dike break. The slope of the embankment is made very gentle. In the unlikely event that the river rises above the embankment, the water would spill 'gently' down the slope. The embankment is protected from destruction and serious damage to assets along the river is minimized. The super levee differs from the conventional embankment, which is basically a wall separating inland areas from the river.

The adaptation of conventional dikes to super levees offers a number of benefits. A super levee is more resistant to overflow, seepage, and earthquakes. In addition it provides usable land and space for urban development and it restores access to the riverfront. The concept of super levees is also a good example of the multifunctional use of infrastructure.



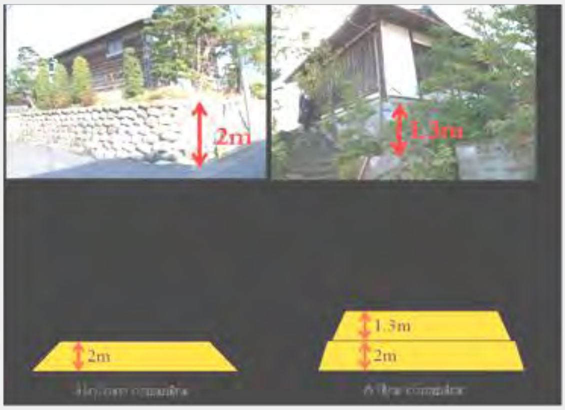
Source: The International Water Source: The International Water Association (IWA), IUCN and the World Water Council, 2009.

Climate change seems to increase the frequency of torrential rains with high intensity. AMeDAS (Automated Meteorological Data Acquisition System) observation records show that over the past 20 years, the number of heavy rainfall events producing more than 100 mm/hr have nearly doubled (River Bureau).

In the past, people had no control over the river, but they still protected lives and assets using small-scale technologies, local knowledge, wisdom, and traditions, and cooperation within their communities. Flooding from the river was accepted as a natural phenomenon, so that rather than trying to prevent flooding, people instead developed tools to reduce damage. The floods were also considered beneficial insofar as they brought a fresh coating of silt and mud, helping to regenerate the soil and improve crop yields. Given the present threat posed by climate change, mere technological options may not be sufficient to reduce disaster impacts.

Case 22: Damage reduction technology intervention at the community/household level in Japan

To reduce the impacts of floods, traditional ring dikes have been built in some areas to protect several houses and cultivated areas. These types of ring dikes are observed in several locations and are interconnected in main places. A key feature of a ring dike is that it is maintained by the local community. In each village and neighborhood, there are special committees to look after the ring dikes, which often become too expensive for local residents. Cooperative maintenance helps to strengthen local community ties and bonds and develops self-esteem in communities.



Flooded house in Japan. *mizuya*'s plinth height adjustment

To reduce the impacts of floods, some communities use elevated houses (known as *mizuya* in Japanese). These are mainly seen among relatively well-off families but can be used as potential shelters for the neighborhood. Well-off families possess larger amounts of land, bigger houses, and more assets than ordinary citizens. In addition to their main house, well-off families also possess a *mizuya,* which is an elevated house to be used in case of flooding. Initially, the *mizuya* was built as a storage area only for protecting household assets. At that time, the *mizuya*'s height was only 2 m. In 1896, this area experienced a severe flood disaster. The *mizuya* was destroyed due to flooding. During the flood, a lot of driftwood hit the main house and the *mizuya*, resulting in very serious damage. After the disaster, the homeowners' priority was to protect the main house from driftwood. In addition, the homeowners reconstructed the *mizuya* by raising the plinth level 1.3 m over the previous plinth level of 2 m (Figure 5). Furthermore, the modified version of the *mizuya* is one in which people can also stay for a longer period. It now consists of two rooms, two storage areas, and a toilet. It can also be observed that well-off families have emergency boats available for evacuation. Usually, one specific section of the main house is elevated and people can take shelter in this elevated area. This also helps in reducing the impacts from secondary sources of damage such as debris and theft.

Local and traditional knowledge has proven useful. Such knowledge may change from time to time but the principles remain unchanged. Since most of these traditional pieces of knowledge and technologies have been modified over time, they offer higher resilience and lower redundancy. Moreover, community involvement is the key to the success of localized knowledge. Too much dependency on modern technology makes people dependent on the system. This reduces a community's own capacities and erodes the concept of self-help. Thus, the ideal disaster reduction measures will incorporate a balanced combination of modern technology and traditional knowledge. Traditional, local and indigenous knowledge plays a crucial role in going "the last mile" and bridging the gap between theory and practice in the implementation of climate-resilient technologies, since they are closer to the people and communities.

All stakeholders must be involved in planning and implementing climate change strategies in urban areas. This can be done by ensuring that climate change information is included in formal municipal education programs, by creating public awareness, including within slums and other informal sectors, and by paying particular attention to the needs and potential roles that can be played by youth and women.

Strong Institutional Support for Climate-Resilient Recovery

Chapter 4

Approach 1: Integrated climate risk management in recovery through local institutions

The geographic location of Bangladesh in South Asia, at the confluence of the three mighty river systems of the Ganges, Brahmaputra and Meghna, renders her one of the most vulnerable places on earth to floods and cyclones. Human-induced climate change exacerbates the problem, with its already manifest effects, and the half-meter sea-level rise that is predicted to occur by 2050 is likely to permanently inundate about 11% of the territory of Bangladesh (IPCC, 2001). With her age-old experience of coping with natural disasters, Bangladesh has already established an institutional mechanism for management that recognizes the role of different stakeholders. The country has also formulated a changed corporate approach that emphasizes broad-based strategies for disaster management that involve the management of both risks and consequences of disasters, including prevention, emergency response, and post-disaster recovery. A major focus entrusted to community involvement for preparedness programs is to protect lives and properties. Involvement of local government bodies becomes an essential part of the strategy. Local institutions know their communities and should have the main responsibility for identifying the poor and vulnerable and supporting them in building safe rural and urban settlements. These institutions should ensure that climate information reaches the poorest and most vulnerable through appropriate services.

The combined experiences of Bangladesh are often cited to demonstrate progressive and comprehensive approaches to recovery interventions and a thorough understanding of the climate change context, as key decisions are based on risk assessments following disasters.

Case 23: Disaster risk management and recovery system in Bangladesh

Following a major cyclone in 1991, Bangladesh authorities were motivated by the frequency of disasters and a sharpened general awareness of disaster risks to reassess some of their disaster reduction strategies as a part of the recovery process. The cyclone shelters were redesigned, enlarged, and relocated in closer proximity to current population centers. Cultural traditions and behaviors also were taken into account, with later accommodations even being made for the safekeeping of the economically important family livestock. Important design modifications required the shelters to be constructed with two elevated stories to protect families displaced by floods. All other official buildings on the low-lying coastal lands and off-shore islands were required to be built of resistant engineered *pucca* construction. In all cases newly built official public buildings such as police stations and health facilities were to have two stories so they could serve as informal emergency shelters in times of flooding.

Crucially, all shelters were built so that they could be used routinely throughout the year as schools, health clinics, or other public facilities. These everyday functions ensured that the buildings were well maintained, and more importantly, that they assumed a familiar public association with civic needs and disaster preparedness. Over the years, these community cyclone and flood shelters have become an integral element in the overall local risk reduction strategy, while also offering development benefits. They offer public education and preparedness activities, and are a focus for emergency exercises and evacuation drills practiced by local preparedness committees. All of these activities together have come to be widely characterized as a strategy for "living with floods." The government agencies developed and implemented a number of recovery projects to address both future climate-change-induced threats and livelihood opportunities as part of the recovery program.

Lesson

- Bangladesh made a pronouncement, and implemented comprehensive and integrated risk reduction approach to post-disaster recovery management based on the government’s new strategy and program. Long-term recovery provides a physical opportunity as well as the basis for collective inspiration to introduce climate change options through structural and non-structural risk reduction elements. Integrating disaster risk reduction into any *prior* planning of recovery, including its explicit reference in anticipated climate change impacts, may be considered.

Approach 2: Building local institutions and local capacities for increased resilience to climate change

The adaptive capacity of people and communities is mediated through institutions. Disseminating information, building knowledge, articulating needs, ensuring accountability, exchanging goods and services, and transferring resources: all these are needed for adaptation and are guided by and happen through institutions. In an uncertain world, adaptation cannot be effective without effective and accountable organizations and institutions.

While the effects of climate change may be vast, their brunt will be borne locally by individuals, families, villages, and neighborhoods. Discussions of climate change must be turned upside down, switching from a global to a local focus. Priority must be given to strengthening existing capacities, particularly among local authorities and civil society organizations, and to laying the foundations for the robust management of climate risk and the rapid scaling up of adaptations through community-based risk reduction. Capacity building and capacity development are among the most urgent requirements for addressing climate risk, particularly at the local level. The capacity of the community to understand climate risk issues, effectively use available information, develop the necessary institutions and networks, plan and build appropriate CCA actions are among the key considerations. In addition, applying the Hyogo Framework for Action (HFA) on Disaster Risk Reduction at the community level can help create the necessary environment for achieving many of the goals of CCA.

Case 24: Role of Community Institutions and Participatory Water Resource Management in Drought Adaptation Participatory water resource management in drought adaptation in Amhednagar

Several landmark examples can be cited from Maharashtra of community-managed water resource management initiatives that have resulted in significant local benefits to communities, including improved natural resource management and livelihoods in low rainfall environments.

Located in Ahmednagar district, the village of Hiwre Bazaar is not covered by any major irrigation program. Years ago, it was similar to thousands of other villages in the same block that lacked access to any irrigation. However, effective watershed development and management efforts over the last 15 years have transformed the earlier conditions, had positive outcomes in terms of ecosystem restoration (such as improved soil moisture content), and assured incomes from agriculture even during drought years. This has also reduced outward migration. The village has developed its own water regulations linked to its crop plans, which promote a mix of vegetable and millet crops. Annual decisions on cropping intensity ensure efficient management of resources and their equitable distribution for crop growth.

In Korhate village in Nashik, a water user association (WUA) administers water resource sharing for irrigation in major projects. Water allocations are entirely based on cropping patterns and associated volumetric allocations. The WUAs have been found to function effectively and to distribute water equitably, ensuring allocations to small and marginal farmers. Drip irrigation for horticulture crops is promoted. The government of Maharashtra further strengthened local bodies during 2005, empowering WUAs with full legal authority to manage water distribution, maintain irrigation channels, and resolve conflicts.

Initiated in the 1970s, the Pani Panchayat initiative in Pune district prioritized water in the village and restricted the cultivation of water-intensive crops. There are currently 25 pani panchayat schemes in Maharashtra, based on either a groundwater or surface water communal source. Within a pani panchayat village, nearly a third of the village land is typically brought under the scheme, which is managed under the principles of delinking land and water rights and cultivation of only seasonal crops. Hydrological parameters, such as groundwater level or rainfall, are used to assess the amount of water that can be used during the year for crop irrigation. These schemes have survived several droughts successfully, but more recent evidence suggests that some of these initiatives may be endangered by gradual over abstraction in the surrounding areas.

Sources: TERI (2007), DFID (2005a).

Approach 3: Prioritized recovery interventions in line with pre-disaster development initiatives

Case 25: Social infrastructure development, Chokwe, Mozambique

The 2000 floods in Mozambique destroyed many existing buildings, many of which had been made from traditional materials. In Guevara and Late rural communities identified roads and bridges as major priorities in the post-flood recovery in 2000, but they also recognized that the areas affected by the floods had been poorly served by the social infrastructure, namely the health and education network, even before the floods. The floods were seen by communities as presenting an opportunity to integrate a recovery program with social infrastructure development, as these are important assets for future development

Education: During the recovery phase, 249 new classrooms were built. In total, 101 schools were rehabilitated and constructed, and equipment for those schools was provided. An additional 4,500 children are now attending school in the district.

Health: Two new health centers were built with prospects for building one more. All the damaged health centers were rehabilitated and a new maternity block was built. The rural hospital and hospice center were also rehabilitated with recovery funds.

Source: UNICEF (2000a). Lessons Learned from the Mozambique Floods.

Mozambique has one of the lowest literacy rates in the world, and has an extremely high infant mortality rate. Mozambique communities readily identified components of the social infrastructure as priorities for post-flood recovery, both in cases where social infrastructure was destroyed and also in areas where schools and health centers had not previously existed. The construction of roads and bridges was carried out in coordination with the local and provincial authorities in accordance with provincial and district plans. Additional facilities were usually provided as a result of the influence of the local district authorities (in the areas of education and health) in accordance with previously identified priority areas, and human and financial resources were also made available to staff the new facilities. It was clear that this was one of the main positive outcomes of the devastating floods.

Approach 4: Climate-resilient recovery through insurance services

Insurance in a changing climate

According to the United Nations International Strategy for Disaster Reduction (UNISDR), more than three-quarters of recent economic losses can be attributed to climate-related hazards. The Intergovernmental Panel on Climate Change (IPCC) has also predicted that increasing weather variability due to climate change will make matters even worse.

Financial planning prepares governments for catastrophic climate impacts and maintains essential government services in the immediate aftermath of disasters. Pre-arranged financing arrangements—such as catastrophe reserve funds, contingent lines of credit, and catastrophe bonds—allow governments to respond swiftly, scale up social protection programs, and avoid longer-term losses that accrue to households and communities while people are homeless, out of work, and experiencing basic deprivations (Linnerooth-Bayer et al., 2009). Having immediate funds available to jump-start the rehabilitation and recovery process reduces the derailing effect of disasters on development.

In Grenada in 2004, for example, the winds of Hurricane Ivan caused losses equivalent to more than 200 percent of GDP. Because outside aid is not always immediately available, 16 Caribbean countries have developed a well-structured financial risk-management scheme to streamline emergency funding and minimize service interruptions. In place since 2007, this scheme provides rapid liquidity to governments following destructive hurricanes and earthquakes, using innovative access to international reinsurance markets that can diversify and offset risk globally.

Innovations in managing and transferring climate risk in recovery programs are considered necessary in order to increase the resilience of agricultural livelihood systems. Climate-induced disasters cause direct as well as indirect losses. For example, a drought destroys a smallholder farmer's crops. Not only will he and his family go hungry, but if they own plough animals they will be forced to sell or consume them in order to survive. These impacts can last for years in the form of diminished productive capacity and weakened livelihoods. After the rains return or in the following good season, this family will be significantly worse off than before. Under the threat of a possible climate shock, people are under pressure to be excessively risk-averse. Creditors will not be prepared to lend if drought might result in widespread defaults, even if loans can be paid back easily in most years. This critically restricts access to agricultural inputs and technologies, such as improved seeds and fertilizers. Even though a drought (or flood, or hurricane) may occur only once in five years, the threat of the disaster is enough to block economic vitality, growth, and wealth generation during all years – good or bad.

The evidence indicates that extreme climate events are likely to increase in both frequency and magnitude over the coming decades. Climate change coupled with increased population pressure (the human population is expected to increase by more than 50% by mid-century) can result in a worsening of the regional food security situation in disaster-stricken areas.

Weather index insurance (WII) is a financial risk transfer product that has the potential to help protect people and livelihoods against disasters induced by climate change and variability. WII is linked to a weather index rather than actual crop losses, which are typically associated with traditional crop insurance. In the post-disaster phase, farmers do not pay much attention to the revival of crops left out in the field, as the insurance claim is linked with crop failure. But under WII, the insurance payout is not linked to crop failure, beyond an agreed upon threshold point, giving farmers the incentive to make the best decisions possible to revive crop survival during the post-disaster recovery phase.

Donor-supported catastrophe insurance is playing an increasingly visible role in developing countries. These climate linked insurance programs have the potential to ease economic losses and stabilize the incomes of poor people facing weather variability and climate extremes by transferring risks to the global capital markets. Weather insurance pilot programs are being tried out in India, Mongolia, Mexico, Ethiopia, Malawi, and Kenya, insuring small farmers and governments against crop failure due to drought. For example, in Malawi, smallholder farmers can now buy affordable, index-based drought insurance. Unlike traditional claims-based insurance, compensation is based on an index of local rainfall. By making farmers more creditworthy, this pilot loan/insurance scheme enables farmers to purchase hybrid seeds and thus greatly increases productivity (Hellmuth et. al., 2007). Past experience in Ethiopia where insurance payouts go directly to the government, which in turn supports the affected farmers, has shown that rainfall data can be reliable enough to trigger a payout and private insurance companies have shown an interest in such a scheme. Insurance also gives governments an incentive to put into place or update contingency plans or other risk reduction measures (WFP, 2006d).

To insure against insufficient funds for post-disaster relief and infrastructure repair, the Mexican government has insured its catastrophe reserve fund, including a catastrophe bond, which pays an above-market interest rate if rainfall exceeds a specified level, with part of the principal going to the Mexican government if rainfall is below this level.

The Caribbean island states have recently formed the world's first multi-country, index-based catastrophic insurance pool to provide governments with immediate liquidity in the aftermath of hurricanes or earthquakes.

Case 26: Catastrophe risk insurance facility: Caribbean community governments

Among the many challenges facing the governments of small island states in the aftermath of a natural disaster, the most urgent is obtaining access to cash to implement urgent recovery efforts and maintain essential government services. This challenge is particularly acute for Caribbean countries, whose economic resilience is limited by mounting vulnerability and high indebtedness.

The new Caribbean Catastrophe Risk Insurance Facility (CCRIF) provides Caribbean community governments with an insurance instrument akin to business interruption insurance. It furnishes short-term liquidity if they suffer catastrophic losses from a hurricane or earthquake.

A wide range of instruments exists to finance long-term recovery, but this facility fills a gap in financing short-term needs through parametric insurance. It disburses funds based on the occurrence of a predefined event of a particular intensity, without having to wait for onsite loss assessments and formal confirmations. This type of insurance is generally less expensive and settles claims quickly, because measuring the strength of an event is almost instantaneous. The facility allows participating countries to pool their individual risks into one better-diversified portfolio and facilitates access to the reinsurance market, further spreading risks outside the region. Such insurance mechanisms should be part of a comprehensive financial strategy using an array of instruments to cover different types of events and probabilities.

Sources: Ghesquiere, Jamin, and Mahul (2006), World Bank (2008e).

Many small countries are financially more vulnerable to catastrophic events because of the magnitude of disaster-related losses relative to the size of their economies).

Donor aid is an invaluable component of post-disaster recovery, but external aid may not be sustainable in climate change scenarios characterized by the escalation of extreme events. In turn, external investors are wary of the risk of disastrous infrastructure losses, while small firms and farmers cannot access the credit necessary for investing in higher-yield/higher-risk activities. This leads to slowed economic recovery and prolonged poverty. Insurance mechanisms, when applied as part of a broader climate change risk-management strategy, may be a powerful tool to help avoid or minimize human and economic losses following environmental catastrophes. However, insurance will not necessarily be appropriate for slow-onset climate impacts, such as sea-level rise and desertification.

A Climate Insurance Assistance Facility would enable mainly micro-scale risk pooling and transfer mechanisms that provide coverage for medium-loss events (e.g., a 1-in-50 year event). This would provide direct insurance to households, farmers, or governments, and would offer support to nascent micro-, meso-, and macro-scale disaster insurance systems, like those operating in Malawi and the Caribbean. If tested and found viable across the continents, in the long run, these approaches would drastically change the way development organizations provide post-disaster recovery assistance and support adaptation to climate change.

Case 27: Weather-indexed insurance for agriculture in Andhra Pradesh, India

The insurance company ICICI Lombard, in collaboration with the Hyderabad-based microfinance institution BASIX, piloted a rainfall-indexed insurance program to protect farmers from drought during the groundnut and castor growing season. This was the first weather insurance initiative in the developing world. Insurance was sold to 230 farmers, mostly small, in Mahabubnagar district, Andhra Pradesh, in 2003. In 2004, the program was significantly modified in terms of geography, product design, and scope, and was further improved in 2005 by adding new features recommended by farmers. Within three years, the small pilot program had expanded into a large-scale operation in which 7,685 policies were sold in 36 locations in six states. Similar products are also being offered by the Agricultural Insurance Company of India, and the scheme has achieved widespread acceptance among the farmers.

Weather-indexed insurance is less susceptible to the problems intrinsic to traditional multi-peril crop insurance. The publicly available weather indicators are easily measured and transparent and the automatic trigger and low-cost weather-monitoring stations reduce the insurer's administrative costs, which in turn makes products more affordable to farmers. Moreover, the exogenous nature of the weather indicators helps prevent both adverse selection and moral hazards.

A major challenge in designing weather-indexed insurance is minimizing basis risk: the potential mismatch between payouts and actual losses. Since indemnities are triggered by weather variables, policy holders may experience yield loss in specific locations and not receive payments. Some farmers may be paid without losses. The effectiveness depends on how well farm yield losses are captured by the index used. Weather insurance contracts essentially trade in the basis risks for transaction costs, and the insurance will not be attractive if the basis risk becomes too high. A low correlation between yield and rainfall projected by the EPIC agronomic model for the study districts suggests that the implementation o f rainfall index insurance may encounter future difficulties.

Sources: World Bank (2005b), Skees, Hazell, and Miranda (1999), Hess (2003).

Case 28: Index-based insurance in Bolivia, Fondo de Mitigación del Riesgo Agrícola Bolivia

Fundación PRO FIN has developed an innovative, index-based insurance scheme that is being piloted in four provinces in Bolivia. It combines incentives for risk reduction and a flexible, people-centered index mechanism. In this scheme, the trigger is based on the production levels of reference farming plots in areas that are geographically similar in terms of temperature, precipitation, humidity, and type of soil. Farmers identified as good practitioners, by their peers, farm the reference plots. The scheme is based on the fact that these farmers have established reputations within their communities for their skills and knowledge and that the yields on their plots can serve as reliable indicators of whether production levels have been adversely affected by environmental factors (thus triggering an insurance payout) or by other factors within a farmer's control. This reduces the moral hazard in the scheme, and the reference farmers also serve as technical assistance agents to promote ideas for increasing yields and reducing disaster risks and impacts.

The system encourages other farmers to match the reference farmers in implementing efforts to reduce the effects of drought, excess rains, hailstorms, and frost, lest those farmers run the risk of having their own plots affected significantly more than the reference farmers' plots.

Source: Fondo de Mitigación del Riesgo Agrícola, at www.fundacion-profin.org/fmra.html.

Case 29: Mangrove rehabilitation and livelihood program in Banda Aceh, Indonesia

On December 26, 2004 an earthquake in the Indian Ocean unleashed a tsunami that caused the deaths of approximately 280,000 people, leaving many survivors in absolute devastation. Tibang is a village in Banda Aceh, less than one kilometer away from the coast. Only 40% of its population survived the tsunami, leaving approximately 800 survivors (Farhan, personal communication, 2006). Many have returned to the village, but some survivors were carried away from Tibang by the waves and remain in barracks scattered throughout the city. Family structures collapsed, killing parents, children, and siblings,and livelihoods disappeared as the tsunami washed away Tibang's fish and shrimp ponds, the village's major source of revenue.

The Coastal Rehabilitation and Livelihood Program in Banda Aceh incorporates various components of sustainability through mangrove rehabilitation and the development of a microenterprise, Tibang Products. Mangroves promote biodiversity by acting as a nursery for juvenile fish and aquatic invertebrate species (Adeel and Pomeroy, 2001). This gives mangroves environmental value, as well as economic value. The livelihoods of the villagers, particularly the women, depend on the collection and sale of crab, shrimp, fish, and oysters (the latter attach and live on the roots of mangrove trees). Mangroves also are significant because they protect coastal communities from storm surges, coastal erosion, and flooding (Barbier, Acreman, and Knowler, 1997; Ellison, 2000). The microenterprise is an initiative designed to rebuild livelihoods for women by providing skills training and access to potential job opportunities, and to create a revenue stream to support the ongoing maintenance of the mangroves. Although the tsunami was not a result of climate change, it is expected that more intense precipitation events and tropical cyclones are likely to occur due to climate change and may result in the devastation of coastal areas similar to that caused by the tsunami (Schneider, Rosencranz, and Niles, 2002). Therefore, the results from the thesis on which this paper is based can contribute to discussions about the design of future natural or man-made disaster recovery programs.

The Coastal Rehabilitation and Livelihood Program is the only mangrove program in the area that incorporates economic development and long-term plans for beneficiaries. The program has helped empower the women involved by presenting them with career opportunities that were unknown or unavailable to them before the tsunami, enhancing their skills, and creating a social network among them. These results suggest that the continued commitment of women to the program may be connected to the empowerment they feel as a result of the program.

- Disasters provide an opportunity for change, and the concept of sustainable development should be incorporated into the rebuilding of stronger communities, so that they are better protected from future disasters.
- Recovery is complex and requires patience, but by balancing the social, economic, and environmental aspects of a system, it can be accomplished.

Suggested web resources:

http://portal.iri.columbia.edu/portal/server.pt?space=CommunityPage&control=SetCommunity&CommunityID=684&PageID=0, *http://environment.tufts.edu/downloads/NicoleGuanzon.pdf*

Approach 5: Post-recovery risk reduction strategies with respect to climate change

While the actual hazards are expected to increase in frequency and intensity due to climate change, many improvements have occurred in the risk management and risk reduction strategies adopted by national governments. It is hard to get ahead when recurring disasters set back infrastructure and livelihoods time and again. For example, infrastructure that cannot be adapted to withstand the impacts of climate change may expose more people to risk. Mainstreaming climate concerns into capital investment plans entails integrating climate issues and adaptation priorities into national strategies. Improvements are seen in recovery operations when environmental considerations are explicitly included in measures to protect riverbanks and coastal areas through local participation and when there is recognition that risk reduction in recovery is very much a part of the development continuum.

Case 30: Risk Reduction Measures in recovery in the Maldives

Although the Maldives had not been routinely subjected to major disaster threats in recent memory, the inundation of the entire country by the Indian Ocean Tsunami highlighted the country's vulnerability to natural hazards. Because the Maldives is a small country of 1,192 widely distributed islands and atolls with a maximum elevation of only 1.5 meter above sea level, post-tsunami recovery was an important opportunity for that country. It provided an unprecedented chance for the government to recognize its exposure to disaster risks and to raise disaster awareness among its people. This provided the impetus to address disaster risk reduction issues by introducing a coordinated tsunami risk reduction and recovery program with several related features. Several lessons were learned in this process.

Initial government plans aimed to relocate people to some of the larger islands in the belief that this could provide residents with more rapid access to safer places in times of emergency. However, while this was seen as a solution for particularly vulnerable settlements, communities here, as in other countries, were unwilling to move.

An institutional policy framework for disaster management was created, comprising a legal foundation, well defined organizational responsibilities, and a strengthened Disaster Management Center. The strategy studied the disaster risk profile of the country and then designed multi-hazard preparedness and response plans for implementation at all levels. An early warning system was established throughout the country, and both national and regional Emergency Operational Centers were created. Efforts to raise public awareness and engage in training and capacity building were pursued to help contribute to a sustained interest in disaster reduction.

In considering their defining island and marine environment, government authorities sought to adopt structural measures that could provide safer island habitats for residents. These included altering the physical features of some islands by reclaiming land, elevating some areas for added protection, and creating wider or more numerous environmental protection zones. Elsewhere easier access to emergency facilities was created. However, the government found that reclaiming land or creating elevated areas were very expensive solutions that also required a high level of technical support that could not be sustained.

Throughout the housing reconstruction and repair process, an approach to "build back better" was adopted, emphasizing stronger and safer construction methods. Although there was a need for housing that had to be met at the time, the massive reconstruction also caused an acute shortage of building materials, resulting in high prices of all materials.

Lesson

- In order for Maldives to progress with sustainable development, climate resilient adaptation towards disaster risk management and reduction simply cannot be left out of long-term planning. Thus, any opportunity created during recovery to build back safer, greener, and better should not be passed up.

Risk reduction through climate-resilient livelihood adaptation

Low-lying coastal areas and deltas are highly vulnerable to sea-level rise, extreme weather events, and storm surges. Each coastal area faces different circumstances with regard to such factors as climate, population density, natural resources, infrastructure, economy, and governance. In the aftermath of a disaster, new dimensions will be added to this list. So the recovery responses to disaster ‘x’ in the context of climate change issues may vary. Coastal adaptations must be tailored to the local context through an inclusive process that matches development goals with the climate change issues, local capabilities, and the capacity of the community's institutions and community stakeholders.

Recovery offers opportunities to improve the mainstreaming of risk reduction approaches in sustainable livelihood development in many disaster-prone areas, such as coastal Bangladesh, West Bengal, Orissa, and Andhra Pradesh.

Case 31: Saline Water Intrusion Compel Livelihood Shift from Agriculture to Fisheries in Sundarbans, Bangladesh

The residents of Subarnabad, Bangladesh are resourceful people, having adopted an array of measures to cope with saltwater intrusion. When shrimp farming was initially introduced to the area, this offered new livelihood opportunities. The large landowners saw it as a means to increase their profits. Better-off groups were still adversely affected by the changes, but they had more capacity to take advantage of those changes and more resources to protect themselves from stressful conditions. However, small landowners and other poor and disadvantaged groups could not benefit from the new conditions. The adaptive strategies employed to cope with saline water intrusion were mainly autonomous and often risky and short term, including borrowing money, selling land, migrating, forcing women and children to earn wages, decreasing food intake, working outside the village, using fertilizers, selling livestock, raising goats instead of cattle, theft, and prostitution. These adaptation initiatives addressed immediate needs, but did not generally improve people’s adaptive capacities. Poverty and little or no access to fertile agricultural land limited economic opportunities outside of the shrimp industry, often preventing the pursuit of alternative livelihoods.

The Institute of Development Education for the Advancement of the Landless (IDEAL) and CARE Canada/Bangladesh worked directly with poor rural villagers for the broad purposes of environmental conservation and the promotion of caste, class, and gender equity. They promoted new hazard/saline-resilient livelihood strategies for income and food generation, including goat, duck, and hen rearing, chicken and crab farming, tree planting, the introduction of saltwater-tolerant vegetable gardens, and handicraft production. Villagers were provided with access to loans, a savings bank, and training and technical support for new livelihood strategies. The success of the adaptation strategies also led other residents to be willing to take the risk of trying new activities which they had once deemed too risky.

Promoting initiatives that enhance and diversify livelihoods may be seen as ‘business-as-usual’ in the field of development, but these initiatives are less common in the climate change field. By addressing local vulnerabilities and concerns, and building capacities in a broad sense, these initiatives can provide practical, effective, and contextually-relevant ways to decrease vulnerability and facilitate adaptation to climate change within the context of ongoing development processes.

Source: www.preventionweb.net/files/9739_tiempo59low.pdf

Approach 6: Zonation and Land Use Planning as a risk reduction approach to deal with adverse effects of climate change

There is a strong link between land cover and climate; thus, changes in land use and land cover can be important contributors to climate change and variability, while a changing climate can in turn affect future land use and land cover. A key challenge for decision makers, policy makers, and development partners is to understand the strategies adopted by farmers and other stakeholders in their efforts to address climate change-induced land degradation. The poorest of the poor, marginal and small farm holders are more dependent on their land and ecological services. They are also the most vulnerable to climate change, and they have no alternative but to adapt their livelihood systems to changing climatic conditions.

Vast sections of land are currently under threat due to increasing human population and agricultural expansion. Following a major disaster in these areas the recovery programme usually applies a protective strategy (such as building dikes & levees or sea-walls) and/or a retreat strategy (such as establishment of set-back zones or relocating threatened buildings) in the flood / cyclone prone areas and coastal areas. To adapt to the new situation arising from climate change, existing zoning regulations could be modified to consider the future impacts from a rising sea level. A successful adaptation strategy may include increasing society's ability to cope with the effects of disaster, e.g. emergency plans, insurance, modification of land use and agricultural practices.

Approach 7: Managing climate risk: Incorporating climate information into decision-making

When adaptation efforts focus more specifically on hazards and impacts, an important framework for action is provided by the concept of climate risk management (CRM). CRM refers to the process of incorporating climate information into decisions to reduce negative changes to resources and livelihoods. This framework accommodates the fact that often the effects of anthropogenic climate change are not easily distinguished from the effects of events and trends within the historic range of climate variability. The CRM approach encourages managing current climate-related risks as a basis for managing more complex, longer-term risks associated with climate change. Use of climate information distinguishes the CRM approach from typical development efforts, though the success of CRM may have strong development implications and vice-versa. Many disaster-response planning activities fall into the CRM category, as do many technological approaches (e.g., drought-resistant crops). Climate-proofing projects most often fall into this category, though many discrete adaptation projects also focus on CRM. In the dry lands of Kenya, a CRM approach is being used to prepare for future droughts, which are expected to intensify as the climate changes.

Case 32: Managing Climate Risk in Rural Kenya

Home to 10 million people, Kenya's arid and semi-arid lands have the lowest development indicators and highest incidence of poverty in the country. Over 60% of inhabitants currently live below the poverty line. Increasing population pressures, overgrazing, crop reduction in fallow fields, and recurring conflicts between pastoralists and farmers all pose serious development challenges. These will be exacerbated by climate change, which is expected to cause both floods and droughts to increase in frequency and severity. In response to the devastating effects of past droughts—and the prospect of more as climate change intensifies—the Center for Science and Technology Innovations has partnered with the Arid Lands Resource Management Project to work with communities in the Makueni District in introducing a suite of measures to reduce vulnerability to climate change. Climate and weather forecasts are being downscaled and communicated to farmers to help them select appropriate planting times. Local production systems are being diversified through the use of drought-tolerant crop varieties and better systems for collecting and storing seeds. Farmers have been trained in soil and water conservation, weather prediction and interpretation, the selection of seeds to fit climatic and land conditions, and early land preparation and planting. Technologies such as sand dams and drip irrigation have also been introduced to improve access to water.

Credit systems are being strengthened, allowing community members to pursue diversified or alternative livelihood activities. Taken together, these interventions represent a climate risk management approach to development. Historical, current, and future climate information has been used to understand vulnerability to drought and to devise strategies to decrease it. Specifically, information on the effects of past droughts has highlighted where livelihood systems fall short and where greater capacity is needed. Access to current and seasonal weather forecasts allows farmers to make more informed decisions that reduce their exposure to short-term climate risk. Knowledge of longer-term trends associated with climate change encourages them to think about how decisions and investments made today will stand up to even drier and more variable conditions tomorrow. Selecting seeds that are appropriate for the expected climatic conditions further safeguards against drought. Through better access to and understanding of climate information, these communities have improved their understanding of future conditions, are able to implement agronomic practices based upon this knowledge, and thus have increased their capacity to adapt to climate change.

Source: WRI.

The success of CRM depends heavily upon the availability of climate information, and is enhanced when climate change predictions can be made with relatively high certainty and precision. If adaptation initiatives are too concretely based on risk assessments turn out later to have been inaccurate, investments may be wasted, and mal-adaptation could result.

Approach 8: Responding to Climate Change

The adaptation actions discussed in this review focus almost exclusively on addressing impacts associated with climate change. Normally, these actions target climate risks that are clearly outside of historic climate variability, and have little bearing on risks that stem from anything other than anthropogenic climate change. For example, communities that relocate in response to sea-level rise mainly fall into this category. Other examples of adaptations to observed changes in climate include partial drainage of the Tsho Rolpa glacial lake (Nepal), as do many responses to glacial melting. Far-reaching technological approaches that address unprecedented levels of climate risk also belong in the highly targeted category.

Because measures that are highly targeted at climate change impacts do not address non-climate change challenges, they tend to require new approaches that fall outside of the relatively well-understood set of practices that might be considered part of the development "comfort zone" (Mcgray et. al, 2007). This level of innovation usually takes the form of a discrete effort, and is often both costly and fundamentally challenging to cultural and political norms. After all, even with the clearest, most certain climate predictions in hand, it isn't easy to decide to leave the island where your family has lived for generations, or to accept that the land your community has farmed for centuries is becoming too dry to sustain agriculture. Moreover, initiatives that relocate whole groups of people or that launch large, untested engineering endeavors come with large price tags that require a high level of political will.

As such, many measures in this continuum take on an extreme or "last-ditch" quality, and many people, quite rightly, wish to avoid them. This is one reason we see so few activities from this category in our set of examples. A more important reason, however, is that at least at the moment it is difficult to distinguish climate change effects from "normal" climate variability. Therefore, we see more adaptation approaches that address climate change and other sources of risk together using a CRM approach (see above). Given the current state of climate change, high-impacts-targeted activities also require long-term planning, since the most clearly distinguishable impacts of climate change are still years or decades from being felt in many places.

However, it is also clear that the need for high-impacts-targeted climate change action can in many cases be reduced by the success of other types of adaptation efforts, and by work to stabilize greenhouse gas concentrations in the atmosphere. We can think of the boundary on the continuum between "managing" climate risk and "confronting" climate change as a threshold that moves right if greenhouse gas mitigation and climate adaptation are successful, shrinking the scope of impacts-targeted action needed. To the extent that climate adaptation and greenhouse gas mitigation fail, the threshold moves left, expanding the scope of impacts-targeted activity, since the direct effects of climate change will be felt more directly by more people.

This is not to say that climate change-specific action can be avoided entirely. Science shows us with increasing precision that we are already "committed" to a certain amount of global warming, which has direct implications for many people in many places. Places such as Nepal (Case 34) are moving forward with proactive planning for some specific eventualities. That these instances remain relatively few indicates that society will need more than climate predictions to prompt proactive planning for those consequences of climate change that will be most unique and potentially most difficult to address.

Case 33: Adaptations to Observed Changes in Climate: Reducing Risks of Glacial Lake Outburst through Partial Drainage of the Tsho Rolpa Glacial Lake (Nepal)

As the earth warms, mountain glaciers are melting. The melted water pools behind unstable natural dams, which are formed of moraine, the sediment that glaciers carve out of the mountains as they move. Glacial lakes have existed as long as there have been glaciers, but with climate change, the volume of water stored in these lakes is growing. This heightens the risk of the moraine dams being breached, suddenly releasing huge volumes of water downstream. In August 1985, an avalanche dumped tons of ice into the Dig Tsho glacial lake in eastern Nepal. The resulting 5 m wave overtopped the moraine dam and released a flood that destroyed homes, bridges, farmland, and a nearly completed hydropower plant.

The glacial lake was drained within six hours. Four or five deaths resulted from this event—a figure that could have been much higher had the flood occurred during the height of the tourist season. The risk of another Dig Tsho-type outburst flood is growing, as temperature increases at high altitudes in the Himalayas correlate with increasing glacial lake volumes. A 2001 inventory carried out by the United Nations Environment Program and the International Center for Integrated Mountain Development identified 20 sites at risk in Nepal. Among the most dangerous sites is the Tsho Rolpa glacial lake, situated 4,580 m above sea level and fed by the rapidly retreating Tradkarding glacier. The glacial lake grew from an area of 0.23 km^2 in the late 1950s to 1.65 km^2 in 1997. At this size, the lake stored 90–100 million cubic meters (m^3) of water, at least a third of which would be released downstream if the 150-m-tall moraine dam were breached. Recognizing the risks posed by this high-altitude warming and lake expansion to rural communities and infrastructure, such as the Khimiti hydropower plant, the government of Nepal initiated a project in 1998 to drain down the Tsho Rolpa glacial lake. An expert group recommended cutting a channel into the moraine to reduce lake levels by 3 m, which was expected to reduce outburst flood risk by 20%. This measure was carried out in conjunction with the establishment of early-warning systems in 19 downstream villages. However, experts are warning that total outburst flood prevention will require a further draining of as much as 17 m—a costly endeavor. Nevertheless, the initial step toward reducing glacial lake outburst flood risk in Nepal provides an example of anticipatory development planning that targets a clear impact of climate change.

Source: WRI (2007).

Lessons

- The relocation of a population seldom represents a long-term viable option, and is generally contrary to people's wishes or commitment.
- The use of existing natural resources and environmental conditions can be a useful means of reducing disaster risks, but careful consideration is required before projects embark on a major alteration of natural forms.
- It is important to assess the adequacy of the supply of materials and the availability of labor and skills before embarking on large building programs to ensure that the program is sustainable.

Chapter 5

Community-based Approaches

Approach 1: Preparing communities for climate-resilient recovery

The Community-Based Adaptation (CBA) Program, a GEF funded initiative, provides capacity building for adaptation planning through community level consultations in a number of countries such as Bangladesh, Bolivia, Niger, Samoa, Guatemala, Jamaica, Kazakhstan, Morocco, Namibia, and Vietnam. In the future it is expected that these people will be affected by cyclones, floods, and droughts more frequently and intensely as a result of adverse climate changes. Past experience has shown clearly that villagers are willingly and voluntarily collaborating to develop and apply adaptation measures by contributing their time and resources (Francisco, 2008). This kind of risk-sharing practice constitutes a community-based adaptation activity, one example of which is an adaptation project implemented in the Thua Thien Hue Province of Vietnam. Similar types of recovery projects and practices that focus on climate change adaptation should be tried in other countries trying to implement post-flood recovery initiatives and to reduce the vulnerability of communities. For example, in Cox Bazar, Bangladesh, when women became fully involved in disaster preparedness for cyclones, as well as other post-disaster rehabilitation and recovery activities such as education, reproductive health, self-help groups, and small and medium-sized enterprises, the number of women killed or affected by cyclones fell dramatically (IFRC-RCS 2002 in Sperling, 2003).

Case 34: Community-Based Adaptation to Climate Change in Vietnam

This project was implemented in four communes and eight villages in Quang Dien and Phu Vang Districts, Thua Thien Hue Province, in the north–central coast of Vietnam in 2002. These villages experience about 30 days of flooding each year. In 1999, one of the worst floods resulted in the loss of hundreds of lives, along with property destruction and other economic losses. This severe incident attracted international support for the government of Vietnam. During the relief operations, an initiative was launched to promote "capacity building for adaptation to climate change." The main objective was to help build adaptive strategies to enable communities to deal with recurrent climatic catastrophes and to minimize the loss of lives and property. This process involves three major steps for each participating community:

1. Scenario building includes identifying and analyzing the hazards, vulnerability to climate change, and existing and required adaptive capacity of the respective village. Interviews, focus group discussions, field surveys, historical profiling, and mapping of vulnerable sites are some of the methods used to describe the current situation and future scenarios related to climate change. Adaptation mechanisms at the household and community levels, as well as social institutions that could contribute to hazard and disaster management strategies are identified at this stage.
2. Planning involves discussions among the leaders of social groups or organizations, such as those for farmers, fishers, women, youth, and other village political associations. Deliberations on threats and potential impacts arising from climate change and possible measures to address these issues are carried out at this stage. These measures can be livelihood improvements in agriculture and aquaculture, disaster management protocols, and other strategies. The participation of local government officials is critical during this process to ensure acceptance and implementation of the plan at the community and district levels, as well as to increase the likelihood that the government will co-fund some of the subprojects identified. The main output at this stage is a "safer village plan" that will increase the resilience of the community to the negative impacts of climate change.
3. Project implementation of some subprojects identified in the plan is made possible through in-kind and cash contributions to the community's adaptation funds. These subprojects involve measures to ensure the safety of the people, infrastructure, and livelihoods of the village. Construction of an inter-community road and multipurpose school (as an emergency shelter), as well as technical support for agriculture and fisheries are provided. Training on the use of early warning devices, and rescue and relief operations are extended to representatives of various social groups. Critical equipment in giving timely warnings of impending disasters, including boats, life jackets, and megaphones, are made available to representatives of the social groups.

Source: Francisco (2008).

From a country perspective, community-based approaches provide the most effective capacity building for practical adaptation actions through implementation and a 'learning by doing' process. Community-based adaptation is an important tool for developing adaptation options and it is important to share the knowledge gained from these experiences.

Case 35: Recovery support for communities through drought-resilient recovery in Andhra Pradesh

The government of Andhra Pradesh assigns a high priority and commitment to strengthening development outcomes, as indicated by its support for robust relief machinery and recent strategies to build long-term resilience to climate risks among rural communities. Under the oversight of the Department of Rural Development, the state is implementing an innovative drought adaptation pilot initiative in dryland areas of Mahabubnagar and Anantapur districts by the Society for the Elimination of Rural Poverty and the Watershed Support Services and Activities Network. A state government interdepartmental steering committee and a convergence committee comprised of the commissioner for rural development and representatives of the National Rural Employment Guarantee Scheme have been set up to oversee project implementation. The initiative, which will be implemented over a period of three years with technical assistance from the World Bank, seeks to:

a. Identify gaps and missing links in the ongoing drought-related programs and activities in Andhra Pradesh;

b. Facilitate institutional integration at the state, district, and community levels for delivering drought-related assistance;

c. Design and test innovative methods and instruments for helping selected communities adapt to drought, targeting different groups within these communities; and

d. Improve awareness of drought adaptation options and approaches, and disseminate the results of the pilot efforts to build support and demand for wider replication.

The pilot Drought Adaptation Initiative focuses its resources on four areas of intervention:

a. Management of common natural resources, dealing with pro-poor water resource (particular groundwater) and common land management;

b. Production systems, focusing on diversification and intensification in agriculture, livestock, and horticulture, with technological innovations;

c. Economic instruments and marketing, with a focus on improved access to markets, credit, and insurance for new and innovative activities specifically designed for drought adaptation; and

d. Institutional support and capacity building, with a focus on institutional strengthening of farmers and other villager organizations, including such community-based organizations as self-help groups, watershed committees, and credit committees.

Pending successful outcomes, the pilot is expected to build support and demand for wider replication in Andhra Pradesh and to provide lessons to other semiarid states.

Source: World Bank (2008).

Case 36: Managing drought through rainwater harvesting initiatives in Gujarat

An analysis of past rainfall data for the state of Gujarat indicates that in the last two decades, the intensity of the three-year periods of consecutive rainfall decreases is increasing, thus creating a severe drought situation. The intensity and return period of major drought events have increased substantially in last two to three decades, and these are often correlated to climate change impacts. However, climate model predictions indicate a general increase in rainfall over the western part of India with more intense rain events in future. While the increased rainfall is a welcome development to this drought-stricken part of the country, an increase in the intensity of rainfall might lead to high surface runoff and a loss of water from the region.

To promote sustainable methods of rainwater harvesting techniques, SEEDS (Sustainable Environment and Ecological Development Society, an NGO) decided to test and promote activities involving the collection of rooftop rainwater and the recharging of underground water. Based on this survey, as well as on existing village data and focus group discussions, two villages in Porbandar, Thoyona and Digvijaygadh, were selected. Thoyona especially suffers from irregular availability of irrigation water while Digvijaygadh has a drinking water problem. SEEDS promotes sustainable methods of rainwater harvesting techniques, which are designed, maintained, and managed by the local communities. Therefore, it was decided that the following activities would be promoted:

1. Rooftop rainwater harvesting at a school building in Digvijaygadh
2. Well recharging structure and farm ponds in Thoyona
3. Training of communities in water conservation and harvesting.

Rooftop Rainwater Harvesting at a School Building in Digvijaygadh

District: Porbandar ; Taluka (Block): Ranavav ; Village: Digvijaygadh Digvijaygadh is a working class village with around 70 households from the Sager and Rabari community. It is socially and economically under developed. Once a village with good farms, the community has been reduced to a working class community due to the degradation of natural resources. A local NGO, SEEDS, enabled the village community to formulate their own water model plan that was implemented for their village based on their needs. The villagers could not contribute financially, but they contributed by providing labor, transportation, water from wells, and water curing services. Most importantly, they were able to participate in the program right from the start, from the identification of need and resource mobilization to implementation. Some of the villagers have also shown an interest in how the water of the village might be collected collectively.

SEEDS began by organizing community meeting and holding focus group discussions, and these were followed by community mobilization. After community members were mobilized, training as well as small-scale workshops with participants were conducted during the implementation process.

Source: SEEDS (2004).

Case 37: Community-based drought-proof livelihood initiatives: Kutch, Gujarat

The district of Kutch, which comprises 24% of the total area of the State of Gujarat, falls in the arid tracts of the country and has a unique arid coastal climate. While Kutch has always been a drought-prone region, the incidence of drought has become more regular, with any five-year cycle including two to three years of drought.

The Kutch Nav Nirman Abhiyan, Nehru Foundation for Development introduced two initiatives to play a role in drought recovery. The first initiative is called the Drought-Proofing Program which creates local dams to decentralize rural drinking water and sanitation, and to secure water for periods of drought. The second initiative focuses on livelihood options. Since Kutch has traditionally been well-known for its handcrafts, Abhiyan supports local people engaged in handicraft work, especially women, to create expanded livelihood options.

One of the first steps in the Kutch livelihood program is identifying the local resource base, that is, the skills, raw materials, traditional knowledge, aptitudes, and interests of local people. Since Kutch is one of the most craft-rich areas in the country, the handicraft industry has become the most visibly identified area of livelihood generation. The various crafts practiced include weaving, *ajrakh* block printing, tie-dye, pottery, leather working, bell making, knife making, silver and gold jewelry, and *rogan* art . However, to initiate craft programs, without a comprehensive understanding of the complexity of a craft in an artisan's lives, the very niche markets of the handicraft industry, craft designs, and the craft market, means that the initiating organization immediately runs into its first and primary problem – that of having heightened the expectations of artisans before developing the marketing chain. More problems ensue related to quality, markets, unsold stocks of product generated in the initial enthusiasm to help, and blockages to the flow of funds. Crafts activities force NGOs to undertake the difficult and complex task of walking the line between the socio-economic developmental needs of the community, the arena of arts and crafts, and the world of business.

Lesson

- Innovative approaches at the local level, when planned properly and linked to local government programs and policies, can lead to successful mitigation measures that can be effective in the long run. As a result of these initiatives, though they differed in their specific focus as mentioned above, all these targeted communities were able see the advantages of implementing measures that support their livelihood. The significance of these initiatives lies not only in their physical results, but also in their promotion of participation by local people and their utilization of local knowledge (Shaw et al., 2005).

Relevance of contemporary rainwater harvesting to climate change

History tells us that cultures who have occupied an area for a long period do not give up until they have exhausted all their options for survival in that area. Rather than migration, people may resort to modifying their residential environments by adapting strategies to optimize the utility of available water by harvesting rain (Pandey et al., 2003). A comprehensive knowledge of climate fluctuations and corresponding adaptation by human society is crucial for our progress towards sustainability. Where the seasonal cycle of rainfall is large, adaptation through rainwater collection may be particularly effective in tropical monsoon regions.

As the climate changes, people may resort to harvesting rainwater. As a sound adaptation, why does rainwater harvesting matter more today than any other time in the Holocene? There are several reasons:

1. More than one billion people currently lack access to clean drinking water and almost 3 billion people lack basic sanitation services;
2. The human population will grow faster than increases in the amount of accessible fresh water, causing the per capita availability of freshwater to decrease in the coming century;
3. Climate change will cause a general intensification of the earth's hydrological cycle in the next 100 years, with generally increased precipitation, evapo-transpiration, occurrence of storms, and significant changes in biogeochemical processes influencing water quality.

As summers get hotter and hotter, and anthropogenic climate changes exert further strain on economic, social, and natural systems water scarcity is likely to grow in India and elsewhere. Addressing water problems holds the promise of the future for a world impacted by the compound effects of climate change, population growth, and a decrease in the water-impounding area of traditional tanks due to urbanization. Rural and urban water use, the restoration of streams for recreation, freshwater fisheries, and protection of natural ecosystems are all competing for water resources formerly dedicated to food production (Pandey et al., 2003). Under such circumstances, decentralized rainwater harvesting adaptations have proven efficient. For example, in the Negev Desert, the decentralized harvesting of water in micro-catchments from rain falling over a one hectare watershed yielded 95,000 liters of water per hectare per year, whereas collection efforts from a single large unit of a 345 ha watershed yielded only 24,000 liters per hectare per year. Thus, 75% of the collectible water was lost as a result of the longer distance of runoff. For instance, the indigenous teras water-harvesting system in Sudan offers agricultural production security and also raises the nutrient limited yield from 150–250 to 650 kg/ha through its nutrient-harvesting effects.

Widespread arsenic poisoning is another case in point where rainwater harvesting has great potential as a possible solution. In West Bengal and Bangladesh, alluvial Ganges aquifers used for public water supply are polluted with naturally-occurring arsenic, which adversely affects the health of millions of people by causing arsenicosis and increasing the risk of cancer. Millions of people are at risk in Bangladesh alone. Arsenic mobilization is associated with the advent of massive irrigation pumping that draws relatively young water directly into the aquifer. Deep wells are being advocated as a remedy, as these may provide a source of clean water, but such a solution is only temporary. Rainwater harvesting is a better option to provide arsenic-free, safe water in a cost-effective and accessible manner, particularly for drinking and food preparation. We must, however, address several challenges effectively to make rainwater harvesting efficient, particularly the treatment of harvested rainwater in areas where pollution is rampant. For instance, it is now possible to use nano-filtration for the removal of hardness, natural organic material, micropollutants such as pesticides, viruses and bacteria, salinity, nitrates, and arsenic. With an insightful policy, rainwater harvesting can be promoted as a core adaptation strategy for achieving the global security and sustainability of water resources in an era of anthropogenic climate change.

Rainwater harvesting in response to climate extremes enhances the resilience of human society. An integrated perspective of traditional knowledge on adaptation strategies, such as the rainwater harvesting system, is particularly useful to comprehend vulnerability and adaptation to environmental stresses at the local level.

Local studies on risk management and decision-making can complement global climate modeling exercises in order to fully capture the complexities of real life. Although rainwater harvesting continues to be practiced globally, and there is renewed interest in its revival, the system nonetheless has fallen to disrepair.

Approach 2: Participatory community learning: Climate Field Schools

Behavioral change in response to long-term climate change adaptation can be best achieved through participatory community learning.

Case 38: Indonesia's experience with Climate Field Schools (CFS)

The current Climate Field Schools (CFS) being undertaken by LACC, which is working on integrating climate change concepts, reflect a good practice that should be maintained and sustained. As a time-tested non-formal education method among farmers, Farmer Field Schools (FFS) provide value-added features to the otherwise unilinear, top-down methods based on the diffusion model or technology transfer approach.

The Climate Field School (CFS) concept is a group-based learning process introduced with the aim of increasing farmers' knowledge of climate and their use of climate forecast information. The basic concept of CFS is to disseminate climate information to end users by translating the information from scientific language into field language and then translating field language into farmers' language through field schools (Motha et al., 2004).

Indonesia's national meteorological service, the Meteorological and Geophysical Agency (BMG), incorporated El Niño information into its dry season forecast, which was released in March 1997, six months before the onset of the event.

But despite the availability of such information, the 1997‑98 El Niño resulted in widespread social and economic damage in Indonesia because adequate mitigation measures were not taken. Large‑scale forest fires generated a regional smoke and haze emergency and El Niño‑induced drought resulted in a production shortfall of three million metric tons of paddy. While the information was released by BMG six months before the onset of the El Niño event, there was no institutional mechanism to translate the global El Niño index into local impacts. This demonstrates that issuing climate information alone is not sufficient for recovery planning and rather that it must be translated into terms of impacts on the variables that are of interest to decision makers. For example, reservoir managers need to know how an El Niño event might affect stream flow and evaporation. On the other hand, farmers need to know how El Niño could potentially impact the spatial and temporal distribution of rainfall.

ADPC efforts to stimulate local capacities to implement climate risk management strategies resulted in innovative approaches that are initiated by program stakeholders themselves. One such initiative is the Climate Field School (CFS).

In Indramayu district, which has a very heterogeneous rainfall pattern, BMG responded to stakeholder needs by downscaling the seasonal forecast in spatial terms, i.e. dividing the district into different rainfall regions and producing forecasts for each region. Information regarding the varying dates of onset and termination of rain in different parts of the district is instrumental in setting up a cropping strategy (e.g. dry seeding vs. wet seeding) as well as in determining the timing of planting activities. In Kupang, the program has institutionalized a sustained dialogue between forecast providers and users. The CFS employs practical and field‑based learning for agricultural extension workers and farmers to enhance their expertise in using climate forecasts to make appropriate farming‑related decisions. While dialogues between farmers and extension workers formally extended over only two seasons, the CFS has become a permanent institutional mechanism that connects producers of climate information, agricultural extension workers, and end users, including small‑scale farmers. Institutional mechanisms at the district level involving BMG and district officials have also been established to interpret and make use of climate information to manage climate risks in water resource management and the agricultural sector.

Source: ADPC, "Twenty Years of Reducing Disaster Risks in Asia & the Pacific."

At the heart of C/FFS is the experiential learning process or "learning by doing" approach. Here, a group of farmers undergo a cyclical process of being exposed to an "experience" (actual or simulated) which they observe and reflect upon (analysis), derive lessons from (principles learned), and use as the basis for planning actual applications of such lessons and principles to immediate or future problems.

Transforming short-term adaptation behaviors into long-term behaviors

CFSs are designed to enable farmers to acquire knowledge on climatology and build their capacity to read and understand climate information and data so that they can better plan their farming activities based on this information. Eventually, the series of C/FFS sessions on weather, climate variability, climate risks and impacts, mitigation, adaptation, early warning, and other climate-related topics can help transform their short-term adaptation behaviors into longer-term behaviors. This is based on the assumption that as they learn more about the science of climate change through C/FFS, they will acquire a more well-rounded knowledge that enables them to come up with broader and more long-term decisions.

Climate Change and Human Health in Recovery

Chapter 6

The health of human populations is affected by climate variability and change through both direct mechanisms, for example, heat waves in conjunction with episodes of poor air quality, especially in urban areas, and indirect pathways, such as changes in the prevalence of vector-borne and non-vector-borne infectious diseases. Populations with different levels of technical, social, and economic resources would differ in their sensitivity to climate-induced health impacts. Sensitivity to climate variability and change would be expected to be higher for those populations with poor basic living conditions such as overcrowding, malnutrition, and inadequate access to health services. Thus, the sensitivity of the health of the human populations to climate conditions can be expected to be highest in developing countries and among the poor in transitional and developed countries.

Global climate change would affect human health via pathways of varying complexity, scale, and directness, and with different timing. The more direct impacts on health include those due to changes in exposure to weather extremes (heat waves, winter cold); increases in other extreme weather events (floods, cyclones, storm-surges, droughts); and increased production of certain air pollutants and aeroallergens (spores and moulds). Decreases in winter mortality due to milder winters may compensate for increases in summer mortality due to the increased frequency of heat waves.

Climate change, acting on health via less direct mechanisms, would affect the transmission of many infectious diseases. For example, vector-borne infections, the distribution and abundance of vector organisms and intermediate hosts, are affected by various physical factors, such as temperature, precipitation, humidity, surface water, and wind; and biotic factors, such as vegetation, host species, predators, competitors, parasites, and human interventions.

Many developing countries are particularly vulnerable to the impacts of climate change because of factors such as widespread poverty, recurrent droughts, inequitable land distribution, and overdependence on rain-fed agriculture. In recent years it has become clear that climate change will have direct and indirect impacts on diseases that are endemic here. Following the 1997–1998 El Niño event in east Africa, a Rift Valley Fever (RVF) outbreak in Somalia and northern Kenya killed as much as 80% of the livestock and affected their owners (WHO, 1998b).

The meningitis belt in the drier parts of western and central Africa is expanding to the eastern region of the continent. There is increasing evidence that climate change plays a significant role in vector-borne diseases (WHO, 1998). For example, malaria incidence in a highland area of Rwanda increased by 337% in 1987, and 80% of this variation could be explained by rainfall and temperature (Loevinsohn, 1994). Even small changes in mean temperature and precipitation can increase the potential of malaria epidemics. Flooding can facilitate breeding of malaria vectors and consequently malaria transmission in arid areas. The Sahel region, which has suffered from drought in the past 30 years, has experienced a reduction in malaria transmission due to the disappearance of suitable breeding habitats. Yet, there are risks of epidemics if flooding occurs (Faye et al., 1995). In addition, some of the traditional drought areas likely to receive increased rainfall, and therefore subject to flooding that could facilitate mosquito breeding, may become more vulnerable to the spread of malaria.

Cholera is a water and food-borne disease, and has a complex mode of transmission. Flood causes contamination of public water supplies, and unhygienic social water sharing practices. During El Niño years, cholera incidences increase substantially in cholera epidemics observed in Djibouti, Somalia, Kenya, Tanzania, and Mozambique (all lying along the Indian Ocean) due to two conducive factors: increased sea surface temperature and excessive flooding (WHO, 1998a).

Climate change is likely to expand the geographical distribution of several vector-borne diseases to higher altitudes and to extend the transmission seasons in some locations. Perhaps these diseases will expand into higher latitudes, or perhaps decreases in transmission may occur through reductions in rainfall or increases in temperature above a threshold for vector survival. As the process of climate change is gradual and detectable only over decades, the impact on health will also be slow to emerge. Over long periods, changes also occur in non-climatic risk factors. For most vector-borne illnesses (malaria, Leishmaniasis, tick-borne encephalitis, Lyme disease), current monitoring data can provide only very broad quantification of the relationship between climate and human disease. Assessment of the climate contribution to long-term trends requires data on factors such as land use, host abundance, and intervention measures.

Many of the adaptive measures are very effective, but may not be unique to climate change. Adaptive actions to reduce health impacts can be considered in terms of the conventional public health category of prevention, and constitute the basis of a no-regrets adaptation strategy. Understanding how climate affects the transmission of these diseases will lead to enhanced recovery planning, and effective interventions could lead to sustainable health security.

For example, bed nets can be supplied to populations at risk of exposure to malaria. In fact, early warning systems, such as extreme heat health warnings and famine early warnings, have been established to provide information on hazards and recommended actions to take for avoiding or reducing risks. Primary prevention largely corresponds to anticipatory adaptation. Several studies in Africa have demonstrated that insecticide-treated bed-nets and curtains can significantly reduce the risk of malaria infections (Lengeler,1998). The socioeconomic status of communities may determine whether safe drinking water (piped water, rain-harvested water, and protected wells) is available (Sabwa and Githeko, 1985). The quality of housing is important because simple measures such as screening windows and doors will prevent the entry of disease vectors into human dwellings.

Box 1: Diarrheal Illness

The relative importance of different pathogens and modes of transmission (via water, food, insects or human-human contact) varies between areas, and is influenced by sanitation levels. As pathogens are known to vary in their response to climate, this is likely to cause geographical variation in temperature relationships, depending on the level of development. The quantitative relationship between climate and overall diarrhea incidence (diarrhea due to all pathogens) has rarely been explicitly quantified.

A study in Peru provides evidence of the meteorological dependence of diarrheal illness and a possible analogue for longer-term climate change impacts. The time series data reported the relationship between temperature and relative humidity and daily hospital admissions at a single pediatric diarrhea disease clinic in Lima, Peru. Analyses based on 57,331 admissions over a period of just under six years revealed a 4% increase in admissions for each 1 °C increase in temperature during the hotter months, and a 12% increase per 1 °C increase in the cooler months. During the 1997–98 El Niño event, there was an additional increase in admissions expected on the basis of pre-El Niño temperature relationships. The time series methods used in this study independently controlled for seasonal variations, other climatic factors and long-term trends, so that the variation in diarrhea rates can be attributed confidently to variations in temperature.

The positive correlation is also biologically plausible, as a high proportion of diarrhea cases in Peru, as in many tropical developing countries, are caused by bacteria and protozoa (e.g., enatmoeba) which favor by high temperatures. Very long-term data gathering is necessary to provide clear evidence of changes in disease burdens in relation to longer-term changes in climate. Ideally this would cover not just one but multiple El Niño/La Niña-Southern Oscillation (ENSO) cycles.

Source: McMichael et al. (2003), WHO (2003).

Lesson

- Diarrheal illness is already of major importance for tropical developing countries because of its large contribution to the burden of ill health. Although that burden is much more a consequence of poor sanitation and nutrition than of climatic conditions, the demonstration of climate sensitivity suggests that climate change is likely to contribute to an increase in morbidity unless counteracted by increasing standards of living and improved public health.

Approach 1: Climate-smart urban and health care design fostering synergy between mitigation and adaptation

The concentration of population and consumption tends to increase rapidly during the early stages of urbanization and development. Denser urban areas have higher energy efficiency and shorter travel distances, but increasing the density of people, economic activity, and infrastructure tends to amplify the effects of climate on cities. For instance, green space can reduce the urban heat-island effects, but it can also fall victim to building developments. Similarly, increased density combined with the paving of infiltration areas hampers urban drainage that mitigates flooding.

In the recovery stage, unless disaster impacts are systematically reduced, past development gains will be at risk. Development initiatives do not necessarily reduce vulnerability to natural hazards, and they can unwittingly create new vulnerabilities or heighten existing ones. So the focus in recovery should shift from reactive to preventive measures. Thus climate-change predictions have to be taken into account in current recovery decision-making and longer-term planning (GFDRR, 2005).

Climate-smart urban design can foster synergies between mitigation and adaptation. Promoting renewable energy resources tends to favor the decentralization of energy supplies. Green spaces provide shading and cooling, reducing the need to air-condition buildings or to leave the city during heat waves. Green-roofing can save energy, attenuate storm water, and provide cooling. Synergies between adaptation and mitigation are often related to building height, layout, spacing, materials, shading, ventilation, and air-conditioning. Many climate-smart designs, combining ecological principles, social sensibilities, and energy efficiency, are planned for urban areas in China, such as Dongtan, close to Shanghai, but so far the plans have largely remained blueprints (Girardet, 2008; Laukkonen et al., 2009; Wang and Yaping 2004; World Bank, 2010; Yip, 2008).

Case 39: Heat wave preparations in Spain: Strengthening the Existing Health Care System as Part of the **Heat Wave Recovery Program**

Anomalous hot and dry conditions between June and August 2003 affected several European countries including France, Spain, Italy and the UK. Europe experienced a consistent increase in mean temperature, with extreme temperature events to 6-7^{O}C above long-term average temperatures, and temperature variability (up to five standard deviations) accompanied by an annual deficit in rainfall by 300 mm (Parry et al., 2007). The Intergovernmental Panel on Climate Change (IPCC) model predicts that similar warm summers may occur at least every second year by 2080.

The recent heat waves, such as the one that killed about 70,000 people in Europe in 2003, showed that even high-income countries can be vulnerable. Heat waves are likely to increase in frequency and intensity with urban heat islands producing temperatures up to 3.5–4.5°C higher than in surrounding rural areas. For better preparedness, several countries and metropolitan areas now have heat-health warning systems.

After the 2003 heat wave, the Spanish Ministry of Health and CatSalut (the regional Catalan health service) implemented a comprehensive inter-ministerial and inter-agency action plan to blunt the effects of future heat waves on health (CatSalut 2008).The plan incorporates health responses and communications (at all levels of health care) triggered by a heat-health warning system. The plan has three levels of action during the summer season:

- Level 0 starts on June 1 and focuses on preparedness.
- Level 1 is triggered during July and August and focuses on meteorological assessments (including daily recordings of temperature and humidity), disease surveillance, assessment of preventive actions, and protection of at-risk populations.
- Level 2 is activated only if the temperature rises above the warning threshold (35°C in coastal areas and 40°C in inland areas), at which point health and social care and emergency service responses are initiated.

The action plan and its health system response depends on using primary health care centers (including social services) in the region. The centers identify and localize vulnerable populations, and strengthen outreach and disseminate public health information to them during the summer. They also collect health data to monitor and evaluate the health impacts of heat waves and the effectiveness of interventions. Similar actions are underway elsewhere. Wales has a framework for heat-wave preparedness and response. It establishes guidelines for preventing and treating heat-related illnesses, operates an early warning system during the summer months, and has communication mechanisms with the meteorological office. Metropolitan Shanghai has a heat-health warning system as part of its multi-hazard management plan.

Sources: Shanghai Multi-Hazard Early Warning System Demonstration Project, http://smb.gov.cn/SBQXWebInEnglish/TemplateA/Default/index.aspx (Accessed March 13, 2010)

Approach 2: Children's health care and climate change

Climate change is already affecting the spread and intensity of disease, especially those diseases that affect children. Because of their age and dependency on others, children make up the most vulnerable group. Climate induced change through increasing numbers of natural disasters will multiply the threats against children especially from poorer families who habitually live in marginalized and unsafe settlements. In Bangladesh, India, Sahel, Nepal and Pakistan, a 2^{o}C increase in the temperature profile of drought-affected areas will increase the diseases that most commonly affect children, such as malaria and diarrhea.

The increased frequency and intensity of shocks from climate change and natural disasters means poor households have less time to recover and bounce back, and thus adopt more risky survival strategies, such as cutting down on meals or selling any assets they may have in the short-term recovery, but in the long term it means they have fewer defenses against future crises. The only option available to parents may be to withdraw their children from school or send them out to work. Sometimes parents have to choose between children if they can only afford to send one child to school, and this often results in discrimination against girls. As climate change increases and many traditional livelihoods become unviable in the long term, education and training are very important tools to help children adapt to, cope with, and even avert climate change in the future.

Implementable options: Governments in countries particularly vulnerable to natural disasters and those predicted to be most affected by climate change need to make investments in national adaptation and preparedness planning and action. National Adaptation Programs of Action (NAPAs), for example, offer one possibility. NAPAs enable less developed countries to identify climate change adaptation needs and response plans. To be effective for vulnerable groups, especially children, this analysis needs to build in an explicit focus on the needs of children, as they have specific requirements and make up the largest group affected by climate change and natural disasters (McDiarmid, 2008).

Chapter 7

Implementation Guide

Implementing adaptation

Implementing adaptation plans and strategies is a vital next step. Adaptation options need to be matched to priority needs both in the context of community-based action, as well as disaster risk reduction. Adaptation plans may be integrated into national and sectoral planning to enable sustainable development and the efficient use of resources.

National governments have the responsibility to scale up lessons learned and products from adaptation projects.. To do this, it can be useful to start by creating awareness of climate change adaptation among planners and political decision makers beyond the environmental sectors, and training stakeholders within these areas. Operational guidelines could be prepared to help integrate adaptation into various sectors from the national to the local level, and from the local to the national level, and to encourage countries in the regions affected to implement more pilot projects and facilitate funding for such projects.

Capacity must be built at all stages of the adaptation process in developing countries. Focal points for climate change in those countries could be trained. Inventories of successful experiences and the expertise available could be developed. Links with the disaster risk reduction community, especially with regard to disaster preparedness rather than relief, could be reinforced. Enhancing synergies between the Rio Conventions would promote the sharing of information and knowledge on assessment processes. Capacity building and the training of stakeholders would help the necessary integration of adaptation into sectoral policies and environmental impact assessments. International climate change committees could be created to help feed relevant information to regional committees. Collaboration among institutions active in climate change in all developing countries and in the global North would help promote knowledge exchange and build capacity. National forums could promote the exchange of information on vulnerability assessments, and adaptation planning and implementation at the regional level.

The following implementation tasks are offered as recommendations. They draw on the lessons of cases from various countries.

Decision-making under uncertain conditions

An understanding of climate change and the impacts it will have at the micro-level are still hard to pin down. This is primarily due to the uncertainties built into systems i.e., the science of climate modeling, through scenario, model, and parameter uncertainties. It is micro-level information that communities, local and national governments want to inform their adaptation planning (Pettengelle, 2010). For example, how will the yield of maize change in individual districts or countries by the end of the century? Decision makers often have to make do with limited climate information and restricted technical capacity to apply such information for robust decision-making in recovery. This is a key concern frequently raised by practitioners in designing sound climate-resilient recovery programs related to future climate change adaptation. Thus, insufficient availability of and access to climate change information at the local level becomes a major barrier to its use in adaptation for recovery planning and implementation. This guidance note is intended to help in the use of existing climate observation (say, baseline years) and future projections to integrate climate change adaptation in development planning at various levels through recovery efforts.

Approach 1: Take stock of the available information on hazard exposure, vulnerabilities, and risk assessment before making intervention decisions

In any given location, the precise impacts of climate change are unknown. Experience shows that investments in pre-disaster policy development and planning pays dividends in terms of the quality integration of disaster risk reduction in recovery. An understanding of emerging trends, likely changes, and levels of vulnerability to specific changes can be built up from a variety of sources including local observations and meteorological data. Assessing what is known about the climate change impacts, what is uncertain (the 'known unknowns'), and the factors that limit adaptive capacity, and addressing all these areas make up the full continuum of adaptation (Pettengelle, 2010).

Historical weather and climate data and analyses of extreme conditions are usually available from meteorological agencies, and experts can be consulted on the availability of climate change projections that are downscaled for national use. Information on the exposure and vulnerability of communities is often harder to locate, but may be obtainable from standard national statistics or from surrogate data such as land cover, population, and income levels. Risk studies and assessments may be available for specific situations (UNISDR, 2009). For example, the flood-prone municipality of Pune, India undertook a city-wide assessment of flood risks, using detailed city drainage maps. Similarly, in the United Kingdom, London used a flood management study conducted by a national government agency as the basis for analyses and planned actions as a proactive adaptation initiative. South Africa, meanwhile, made projections of future water needs based on historical data and current trends.

Box 2: Good Recovery Planning

Recovery plans should have a clear and coherent approach to disaster risk reduction, be integrated into development initiatives, be multi-hazard in nature, and where appropriate, consider climate change scenarios. They should address anticipated future climate risks. The effective reduction of risk can only proceed from a prior identification and assessment of prevailing or foreseen risks, including climate risks, whereas much of the immediate recovery processes are determined by a post-facto assessment of physical losses. The prior planning of recovery or the development of recovery frameworks and strategies based on evidence and lessons from previous disasters will accelerate this process. For example, Pune City in Maharashtra has been affected by several severe floods over the last six decades, the most significant being the 1961 flood that involved a major dam failure. Anticipating an increased frequency of floods owing to climate change, the city authorities have developed a comprehensive climate change adaptation and mitigation plan. A systematic city-wide plan of practical action to reduce flooding has been implemented.

Source: GFDRR (2009), Provention (2009).

For details:

www.gfdrr.org/docs/ISDR_Applying_DRR_For_CCA.pdf,

www.proventionconsortium.org

Approach 2: Consider both climate change and non-climate factors when implementing climate change adaptation decisions

The task of recovery policy-makers, planners, and decision-makers is to recognize those activities and decisions at risk from a changing climate. Mainly in developing countries, decision makers at all levels often have to make decisions with limited technical capacity and inadequate access to climate information. The uncertainties commonly associated with climate change are often a key concern raised by practitioners in designing sound adaptation programs in recovery. Climate change is an important source of risk to the achievement of long-term recovery objectives. However, uncertainties associated with other future social, economic, and environmental changes may be equally important for the consideration of options during post-recovery interventions. Decisions must be made despite uncertainty. We recognize the reality that uncertainty will be significant for many aspects of climate change adaptation at the local level. Thus, following proactive decision-making during recovery, systematic and regular monitoring and appraisal is essential to help protect against uncertainty.

There are three types of climate-sensitive decisions, namely:

Climate adaptation decisions

Decisions must be made to manage the expected consequences of climate variability (e.g., cold years, flood events, seasonal droughts, storm surges, extreme wind speeds, freezing conditions, heat waves). These are decision areas where climatic factors have long been acknowledged as being a primary consideration in the choice of risk management options. With climate variability and change being the key drivers, these decisions are referred to as climate adaptation decisions (Willows and Connell, 2003).

Climate-influenced decisions

There are also many decisions where the outcomes could be affected by climate change, but where climate change is only one of a number of factors involved. For example, in the post-flood recovery program in Bangladesh, some of the constraints faced by BRAC were a lack of local varieties of rice, mustard seed, and organic fertilizer. The price of seeds went up in the post-flood period. Seedlings were not available in the local markets, and had to be purchased from government and local agencies that import seeds. BRAC provided recovery aid in kind, not cash.

Case 40: Sea-Level-Influenced Salinity: Bangladesh

Bangladesh is a densely populated, and economically unsound third world country exposed to multi-hazards. Future climate change may increase cyclone intensity and storm surge, increase flooding due to intense monsoon rainfall and slower river runoff, and cause sea level rise.

Sea level rise (SLR) is a major problem for southwest Bangladesh. The climate change scenario for 2050 suggests that an increase in the sea level of approximately one foot will have major negative impacts that will cause the permanent displacement of nearly 6 million people (Mohal & Hossain, 2007). It will also have an impact on drinking water, agriculture, and fisheries production due to the upward inland movement of the saline front northward, and the inundation of fresh water bodies in southwest Bangladesh.

Changes in livelihoods from farming to salt water fisheries as part of the adaptation measures adopted may cause other complex recovery issues, such as:

1. Increased unemployment due to the lower manpower requirements of salt water shrimp cultivation as compared to rice farming,
2. Increased salinity level of surrounding shrimp farm areas will hamper livestock grazing and milk yield, and the
3. Clearing of large mangrove areas and the collection of wild fry could affect non-target fish species.

With help from BRAC, the recipients could immediately sow the grains, rather than losing time trying to obtain these inputs in the market. (BRAC, 2000; Russell, 2000). Access to seeds is not a climate related factor but needs to be taken into account when making decisions about a recovery program. Such decisions may be called climate-influenced decisions (Willows and Connell, 2003).

Source: BRAC (2000).

Climate-independent decisions

Climate-independent decisions lead to actions that limit or constrain the ability of other decision-makers to manage, reduce, or otherwise adapt to the consequences of climate change. Climate-adaptation-independent decisions include the consequences of decisions taken today that restrict the freedom of future decision-makers to manage future climate risks. Climate-adaptation-independent decisions can be characterized as examples of unsustainable development.

Examples of adaptation-independent decisions include the construction of long-lived assets, such as housing developments, in areas vulnerable to increased risk of coastal flooding (IPCC, 2001b). Such developments can reduce the options available to flood risk managers to implement flood protection measures within a flood risk area both now and in the future, perhaps when the climatic hazard has become greater and more certain. They may also require specific present and future flood protection measures as a consequence of their location, thereby reducing resources available for existing developments in need of flood mitigation measures. (Willows and Connell, 2003).

Approach 3: Vulnerability reduction and risk reduction: Adaptations along the hazard-vulnerability-risk continuum

Two roughly distinct perspectives inform how people approach the challenge of climate adaptation: one focuses on creating response mechanisms to specific impacts associated with climate change, and the other on reducing vulnerability to climate change by building capacities that can help deal with a range of impacts. The first approach uses understood impacts as a starting point for distinguishing between adaptation and “normal” development.

Adaptation is often seen as a choice between reducing general vulnerability (for example, by improving people’s incomes or by diversifying their livelihood strategies), and preparing for specific hazards, such as floods. This choice between addressing the underlying causes of vulnerability to climate change impacts (start-point vulnerability), and a ‘predict and adapt’ model for specific climate-hazards (end-point vulnerability) is an artificial choice on the ground, where a combined approach is needed (McGray et. al., 2007).

It has often been observed that climate change information alone does not help in making reasonably good decisions. The approaches to adaptation also have some bearing on the decision-making in the long-term recovery process. To frame adaptation within the context of development efforts, McGray et al. (2007) positions adaptation activities along a continuum of approaches, from actions undertaken to address the underlying contributors to climate change vulnerability, to measures explicitly directed to address the impacts of climate change. The vulnerability-based approach, with its emphasis on underlying vulnerability factors (often non-climate factors), is less dependent on climate projections for adaptation planning. On the other hand, approaches starting with climate change impacts generally require more information on likely changes in key climate parameters to assess potential impacts.

In practice, of course, many instances of adaptation fall between the extremes of focusing on vulnerability versus focusing on impacts. Actions are taken with a specific type of impact in mind, but nevertheless involve activities with more general benefits in reducing vulnerability. One way of framing this diversity is as a continuum between wholesale development activities on one hand and very explicit climate change measures on the other.

Box 3: A continuum of adaptation activities: From development to climate change

Addressing Drivers of Vulnerability	**Building Response Capacity**	**Managing Climate Risk**	**Confronting Climate Change**
UGANDA: Providing women with crossbred goats and instructions in graze-free feeding (Karamoja Agro Pastoral Development Program)	BRAZIL: Participatory reforestation in Rio de Janeiro's hillside favelas to combat flood-induced landslides (City of Rio de Janeiro)	TANZANIA: Monitoring salinization of drinking water and drilling new wells to replace those that are no longer usable (South South North)	INDONESIA: Managing coral reefs in response to widespread coral bleaching (WWF)
BANGLADESH: Diversification of livelihood strategies in areas vulnerable to flooding (South South North)	MONGOLIA: Reinstating pastoral networks to foster appropriate rangeland management practices in arid regions. (National University of Mongolia)	MALI: Teaching farmers to collect climate data and integrate it into their planting decisions. (Government of Mali /Swiss Agency for Development and Cooperation	NEPAL: Reducing the risk of glacial lake outburst floods from Tsho Rolpa Lake (Government of Nepal)

Addressing Drivers of Vulnerability	Building Response Capacity	Managing Climate Risk	Confronting Climate Change
CUBA: Vaccination program to eradicate diseases in low income areas (Cuban Ministry of Health)	TANZANIA: Reviving traditional enclosures to encourage vegetation regeneration and reduce land degradation (Ministry of Natural Resources and Tourism, Tanzania)	BANGLADESH: Using nationally standardized risk assessment procedures to develop a community adaptation plan of action (local government)	
Vulnerability focus			**Impact focus**
The continuum can be roughly divided into four types of adaptation efforts (from left to right)			
Source: Modified from McGray et al. (2007).			

The most vulnerability-oriented adaptation efforts shown on the left side of the table overlap almost completely with traditional development practices, where activities take little or no account of specific impacts associated with climate change, and have many benefits in the absence of climate change. On the far right, highly specialized activities exclusively target distinct climate change impacts, and fall outside the realm of development as we know it. Benefits of these activities will be reaped only in the event of climate change. The large-scale, qualitative descriptions of current and future trends in primary climate variables may well be sufficient to climate-proof long-term national or regional development strategies, e.g., to restructure the key climatically sensitive economic sectors. But the design of major coastal security infrastructure at a particular location requires information about changing surge and wave heights at the local level, in additional to broad sea-level rise projections, to aid the design of a defense system. McGray et al. noted that 65% of the adaptation projects reviewed that can be characterized as ‘addressing the drivers of vulnerability’ (the ‘development’ end of the continuum) also included activities that focused on the impacts of climate change (the ‘confronting climate change’ end of the continuum). This is the reality of adaptation on the ground, where all these elements must be addressed. For example, if likely impacts such as increased drought conditions are not considered when diversifying agricultural livelihoods, maladaptation is likely. Equally, if the insecurity of women’s land ownership is not addressed alongside adaptations in agricultural practices, then their future in a changing climate is not secure (Oxfam, 2009b).

Approach 4: Dealing with climate change adaptation mapping: Identifying the institutions, policies and mechanisms already in place for reducing disaster risk

A mapping exercise is an essential starting point in identifying which organizations need to be involved, and what synergies, overlaps, and gaps may exist. Ideally, this should be conducted jointly by colleagues from both the climate and disaster fields. It should also consider other relevant sectors, different levels of government, and the role of non-governmental organizations.

In Vietnam, a detailed study of existing institutional mechanisms and capacities for both disaster risk reduction and adaptation was conducted in preparation for the national policy forum. In the Maldives, efforts were made to take stock of existing programs and to engage in multi-sectoral consultations with local governments to assess the gaps and challenges to be addressed, prior to the formulation of a strategic national action plan. The strategy adopted in London (UK) is built on existing frameworks and programs on risk.

Approach 5: Plan an integrated program to tackle both climate change adaptation and risk reduction

Joint initiatives to address immediate practical problems are a good way to make progress and learn how to integrate the concerns of climate change and post-disaster recovery to achieve risk reduction. These may be new projects or revised and strengthened versions of existing programs. Adaptation programs can be quickly developed on the basis of existing disaster risk reduction efforts, while disaster risk reduction can be expanded through the increased capacity and resources made available for climate change adaptation.

Typically a multi-stakeholder engagement process is used, and in some cases this has been taken to the community level. Actions are partly funded by multilateral climate change funds.

Since there are no internationally agreed-upon guidelines for how to integrate climate change adaptation into recovery programs, various countries have made their own attempts to prepare frameworks, though these are diverse and largely untested. Some progress is being made in a number of countries to integrate climate change adaptation and recovery, both at the national policy level and through on-the-ground action. A few common themes and lessons are emerging. Local governments as well as national governments are taking the lead on this, and both are investing in incorporating climate-resilient adaptations into recovery strategies.

Approach 6: Community-based climate change adaptation model: Institutionalize through local government

In the rural areas of India, there is often a lack of communication between NGOs, local communities, and governmental organizations, such that important information from one sector is not shared with the others. Like most rural villages in India, the village community is the basic social system in Kutch. Each village community has a decision-making body, usually called a *panchayat*, which makes various decisions for the village economy and self-governance. Traditionally, this body has been dominated by people with power, and this sometimes causes inequality and corruption. However, after any major disaster like the Kutch cyclone of 1998 and the Bhuj earthquake of 2001, local level coordination and networking proved to be a very effective way for the implementation of a rehabilitation program.

There are hundreds of other villages that suffer from a recurrence of droughts, that would like to have water-saving and income-generating schemes included in the long-term drought-proofing mechanisms adopted by their local community. Climate change induced recovery programs from slow disasters (e.g. drought) can easily be implemented through such an institutional mechanism.

Case 41: Setu/NGO networks, Gujarat: Link between government and community

A network was established in Kutch after the Gujarat Earthquake to implement such effective initiatives widely and effectively. Abhiyan instituted a cluster level “sub-center” for every fifteen to twenty villages all across the district. This center became a *setu*.

After the Kutch cyclone of 1998, 26 local NGOs in the region came together and established Abhiyan as a central coordinating organization. Since its establishment, Abhiyan has played an important role in the local NGO network as each member NGO continues working in its specialized field. Soon after the earthquake, the members of Abhiyan realized the need for some coordination of their efforts. Although a considerable amount of aid and assistance came into Kutch, it was not distributed properly. Therefore, Abhiyan instituted a cluster level “sub-center” for every 15 to 20 villages all across the district. These centers became known as the *setu*. With their unique institutional structure, the *setu* focused on coordination between villages and government or aid agencies, and on information management to ensure that support would be provided to the most needy communities during the relief and rehabilitation process.

Originally 20 *setu* were established after the Bhuj earthquake, with each consisting of five to seven staff members with specialized roles. Most staff members were from surrounding cluster villages, such as local NGO members, and at least one staff member came from the villages in hopes that the *setu* or similar bodies would eventually be run by villagers. Since these staff members live near the villages and communicate with local residents on a daily basis, they have gained the trust of the villagers and have an accurate understanding of their situation and needs. This trust and understanding is essential to providing the support needed by the local people and the community. Since they work with villages closely and independently, the *setu* have been able to work with a multi-sectoral grievance mechanism. This helps create more equality and transparency in the village community's governance and decision-making processes.

Although an attempt has been made to link climate change impacts to drought, and to propose adaptation actions at the community and local government policy levels, it should be noted that the study presents only preliminary observations based on limited data (Annon, 2005).

Lesson

- The *setu* were initially established for earthquake response. They had played an important role in the rehabilitation process and now are working well in the development process. Because of their unique characteristics, the establishment of local network organizations like the *setu* following drought years has also worked well. These organizations, of course, work closely with local communities as well as local governments and NGOs so that necessary information for both short-term and long-term drought-proofing can be disseminated in local communities more effectively and efficiently.

Approach 7: Post-disaster surge capacity management: Strengthening everyday 'lifestyle issues' of key persons to leverage surge capacity during disasters

In the aftermath of any disaster, recovery programs are generally implemented quickly. It is important to note that some ad hoc systems and structures are adopted as part of a recovery program. Also, many reconstruction and rehabilitation programs in the past have led to the launch of major disaster risk reduction initiatives. However, with the passage of time, it is important to establish formal systems, procedures, and structures for the long-term sustainability of disaster risk reduction. Reducing risk in recovery and leaving a legacy and capacity to reduce risk in development requires a surge of institutional and technical capacity. In addition, normal development processes need to be streamlined to meet the expectations and demands for speed in recovery.

As the organizations responsible for the long-term development and viability of their areas, local governments must consider and institutionalize disaster risk reduction activities in their day-to-day operations, including development planning, land use control, and the provision of public facilities and services.

Surge capacity can be managed by increasing the capacity of an existing department, rather than creating a new department or agency, and this is a more viable option than those observed in many recovery programs in the past. Agreements for human resource sharing with the neighbourhoods and the prior planning and agreement of streamlined processes can facilitate and accelerate risk reduction mechanisms in recovery.

Case 42: Twinning for shared resources, China 2010

China has a twinning assistance program. This program has a role in providing badly needed financial and technical inputs to disaster-affected areas from a pre-established twin province or municipality. This mechanism pairs one better-off province with another in need. The agreement includes diverting 1% of the annual income, and technical capacity, from the richer province to fund recovery projects for three years. This partnership is mutually beneficial, providing the donor province with experience in providing financial and technical assistance to the disaster-affected province.

After the 2010 earthquake in China, through the twinning assistance program, Shandong Province and Shanghai Municipality provided funds not only to build schools and hospitals to higher than pre-disaster standards, but also to implement a program to upgrade the management and professional capacity in schools and hospitals in Beichuan County and Dujiangyan City. They did this by deploying existing staff to the newly built institutions to provide on-the-job training or by receiving teachers, doctors, and managers from recipient provinces to receive training. Thus, when the buildings become operational again, both the structure and the services provided will be of a higher standard.

Shifang is the recipient city paired with Beijing Municipality. Thirty-five primary and middle schools from Shifang signed a twinning agreement with 25 primary and middle schools in Beijing. This led to a Beijing – Shifang Distance Education Training Network that offers Shifang teachers access to about 20 courses over an e-learning system established by the Beijing Educational Science Institutes. On this network, more than a hundred education specialists provide on-line coaching. In addition, Shifang students can attend classes with students at their twin schools in Beijing using this system. Outstanding teachers from Beijing will go to Shifang to provide training to over 3,000 teachers and administrative staff. In addition, 180 key teachers from Shifang will go to Beijing for training in 2010.

Source: http://www.sc.gov.cn/zt_sczt/zhcjmhxjy/cjjy/kjcj/200912/t20091217_871603.shtml
http://www.sc.gov.cn/zt_sczt/zhcjmhxjy/dkzy/sf/200912/t20091201_859811.shtml

Lessons

- Twinning offers benefits to both recipients and donors, building capacities and government networks within the region and country. It provides a stable source of resources and critical capacity sharing for a number of years, which is agreed upon before a disaster strikes, encouraging longer-term partnerships and risk sharing. Twinning can help an area cope with the increased demand for skills after a disaster, and can help build its capacities. It can be agreed upon before a disaster, allowing for fast and predictable deployment during recovery.

- Sustained support and resources at the local level ensure that policies become reality.

Annexes

Annex 1: Tools

The uncertainty of the local climate is what leaves communities vulnerable. Thus, the only effective way to prepare for the effects of climate change is to increase the capacity to cope with and adapt to change, i.e. to increase resilience. If local communities have systematically assessed their situation and know clearly what they need to best adapt to climate change impacts, they can then effectively contribute to district level plans. These in turn can inform regional and national adaptation plans and programs.

Many tools have been designed to help communities and planners understand the likely local risks of climate change, and look at the vulnerability of their environment and livelihoods. Planning teams at the district or village development committee (VDC) level can use these tools to make assessments and gain an overview of the situation. Community-based organizations (such as forest user groups, water management groups, or soil conservation groups) can also use these tools to prepare themselves and to develop community-level adaptation plans (Regmi et al., 2010). These tools can help users analyze existing methods of coping and adaptation and then develop plans to increase resilience.

There are various tools available for working toward adaptation. Kathleen Dietrich of Penn State University summarized the many different tools used by practitioners in their adaptation work in tabular form (Box 4).

Example of the participatory tools to promote adaptation:

Community-based Risk Screening Tool – Adaptation and Livelihoods (CRiSTAL)

CRiSTAL is intended to promote the integration of risk reduction and climate change adaptation into community-level projects. By focusing on community-level projects, CRiSTAL promotes the development of adaptation strategies based on local conditions, strengths, and needs. CRiSTAL can be used by local communities, project planners, and project managers. This tool was developed by IUCN, IISD, SEI-US and Intercooperation.

For further information, visit:

http://www.iisd.org/security/es/resilience/climate_phase2.asp.

Participatory Toolkit for Impacts and Adaptation

DFID/UKAID's Livelihoods and Forestry Program in Nepal published a step-by-step guide to assessing the impact of climate change on forest-dependent communities. This tool kit is designed to help communities and planners understand the likely local hazards and risks of climate change and to look at the vulnerability of their environment and livelihoods. It helps them analyze existing methods of coping and adaptation, and then to develop plans to increase resilience. The kit consists of a range of tools that can be used in various situations. District or VDC (Village Development Committee) level planning teams can use them to make assessments and gain an overview of the situation. Community-based organizations (such as forest user groups, water management groups or soil conservation groups) can use them to prepare themselves and develop community-level adaptation plans.

Box 4: Participatory Tools to Support Adaptation

Adaptation Tool	Sponsor	Purpose	Scale/ Location	Methods	Final Outcome
Climate Vulnerability and Capacity Assessment (CVCA)	CARE International	Vulnerability and adaptation assessment	Community -focus, multi-scalar assessment	Secondary research, policy analysis, key informant interviews, participatory methods at the community/ household level	Inform and strengthen adaptation planning processes by providing context-specific information
Community-based Risk Screening Tool – Adaptation and Livelihoods (CRiSTAL)	Inter-cooperation	Project assessment and decision support tool	Community	Possible methods include stakeholder consultations, participatory workshops, site visits, document review, Internet research, and interviews	Devises adjustments to improve how projects impact the livelihood resources important to adaptation or suggest projects that better reduce climate risks
Climate Change and Environmental Degradation Risk and Adaptation Assessment (CEDRA)	TearFund	Project assessment and decision support tool, aids in access to information	Southern NGOs	Scientific information assessment, points of contact for information, tools from PADR, matrix assessment, process completed through report	Modified and newly agreed adaptation activities, improved understanding of climate change context and its relationship to environmental degradation
Adaptive Capacity Benchmarkng		Assess organizational capacities & change strategies in the context of climate change	Organizatio ns	Document review and interviews, variations on interviews such as card sorting	Recommendations for organizational improvement and climate change action plans
Systemic Approach to Rural Development (SARD)	Swiss Agency for Development and Cooperation	Livelihood assessment, planning, project assessment	Community /Local Governmen t	Mapping, household typology, access to services, power/conflict analysis, outcome mapping, vision development, planning	Vision statement, assistance in the design and re-orientation of development interventions
Participatory	ActionAid	Vulnerability	Multi-level	Tools vary by level:	Reveals causes of

Vulnerability Assessment (PVA)		assessment tool	(community, district, national)	PRA tools in the community, interview emphasis at other levels, recordings & video, are not detailed since it is based on another tool (REFLECT)	vulnerability, increases effectiveness of emergency and development activities
Participatory Capacities & Vulnerabilities Assessment (PCVA)	Oxfam	Vulnerability and coping assessment	Community	Participatory rural appraisal tools (mapping, matrices, ranking, Venn diagrams, etc.)	Information presented to government and other stakeholders, strategic planning (proposals), advocacy tool
Community-Based Disaster Risk Management (CBDRM)	Asian Disaster Preparedness Center (ADPC)	Risk assessment and management development	Community	Participatory rural appraisal tools (mapping, matrices, ranking, etc.), secondary sources, visioning/planning, social network analysis	Creation of Community Disaster Risk Management Organization (CDMO) and implementation of management plans
Participatory Assessment of Disaster Risk (PADR)	Tearfund	Vulnerability and capacity assessment, action planning	Community	Participatory rural appraisal tools (mapping, matrices, ranking, Venn diagrams, etc.), modified sustainable livelihoods approach (assets)	Action planning and advocacy
Livelihood Assessment Toolkit (LAT)	ILO, FAO	Livelihood assessment, coping/response strategies, impact	Community-focus, multi-scalar assessment	Secondary sources, qualitative/statistical information, participatory rural appraisal tools	Each step informs the next leading to various plans and actions within the pre- or post-disaster context

Source: Modified from Kathleen Dietrich, 2010, Regmi et. al. (2010). For details, visit http://wikiadapt.org/index.php?title=Participatory_tools_to_aid_adaptation (Accessed June 15, 2010).

Capacity building and training

Capacity building at the local, national, and regional levels is vital to enable developing countries to adapt to climate change. It is important for stakeholders and donors to recognize the role of universities, tertiary centers, and centers of excellence. Enhanced support is needed for institutional capacity building, including the establishment and strengthening of centers of excellence and the development of hydro-meteorological networks. Training for stakeholders in all sectors would help in the development of specialized tools for planning and implementing adaptation activities, thus promoting action by local and national governments.

Governments and national and international agencies should provide support for capacity building for adaptation. For example, the UNEP-funded Caribbean

Environment Program, represented at the SIDS meeting, promotes regional cooperation for the protection and development of the marine environment of the Wider Caribbean Region.

The World Conservation Union (IUCN) detailed their work on capacity building for adaptation, including their Community-based Risk Screening Tool – Adaptation and Livelihoods (CRISTAL). This tool can reduce the impacts of climate change on community livelihoods. It was tested in Africa by IUCN and has the potential for more widespread use after further tests.

Non-governmental agencies and organizations involved in capacity building for adaptation include the Red Cross/Red Crescent Center of Climate Change and Disaster Preparedness, and SouthSouthNorth, a network of organizations, research institutions, and consultants operating in Brazil, South Africa, Tanzania, Mozambique, Bangladesh and Indonesia aimed at driving the sustainable development agenda and building capacity for adaptation to climate change at the local level.

Examples of related programs include the Caribbean Planning for Adaptation to Climate Change project, which developed climate change scenarios for the Caribbean and calculated potential losses. Based on this project, a comprehensive adaptation program is now underway in the Caribbean. It includes the Mainstreaming Adaptation to Climate Change project, which brings together the climatbe change and disaster management communities, and the Special Program on Adaptation to Climate Change.

Human resources

Human and civil society resources are another critical component of coping and adaptive capacity. This category includes literacy, level of education, access to retraining programs, and other factors that determine how flexible individuals may be in adapting to new employment opportunities or shifts in living patterns brought about by climate variability or change. We chose to use the dependency ratio and literacy rate as indicators. The dependency ratio measures the proportion of economically active and inactive individuals in a population. A higher dependency ratio would indicate that economically active individuals had many others to support, and resources for adapting to changes in climate would be more limited. We calculated India's state-specific dependency ratios from state-specific percentages of male and female urban and rural populations in the workforce, and then averaged the results. The literacy rate was included as a measure of the skills that individuals would need in order to adapt.

Expertise is lost between projects, and often it is difficult to retain experts once they reach a high level of expertise. Working groups created under these projects, which show significant potential for providing technical and scientific support, need to realize their potential by becoming better at disseminating information and compiling a database of best practices. For example, the Linking Climate Adaptation (LCA) Network was set up to help communities, policymakers, practitioners, and academics share experiences and knowledge about adaptation to climate change. Training is also needed for models to be effectively applied and used for assessments at the national or regional level. For example, the PRECIS initiative helps build capacity by providing training on how to use the climate model to generate high resolution climate change scenarios for developing count

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Annex 3: Glossary of climate-resilient recovery terminology

The following concepts and terms have been identified from reports and documents of the IPCC, the UNFCCC, other UN agencies (e.g., UNDP, UNEP, ISDR), and national reports. For each term/concept, the paper presents various definitions that are found in literature, with the source of a specific definition stated at the end of the definition. The GN does not analyze these terms here.

Adaptation: Changes in practices, both short- and long-term, that take into account the impacts of climate change. (IFPRI 2009)

Adaptation: A process by which strategies to moderate, cope with, and take advantage of the consequences of climatic events are enhanced, developed, and implemented. (UNDP, 2005)

Adaptation: The process or outcome of a process that leads to a reduction in harm or risk of harm, or realization of benefits associated with climate variability and climate change. (UK Climate Impact Program (UK CIP, 2003)

Anticipatory Adaptation: Adaptation that takes place before impacts of climate change are observed. Also referred to as proactive adaptation. (IPCC 2007a)

Autonomous Adaptation: Adaptation that does not constitute a conscious response to climatic stimuli but is triggered by ecological changes in natural systems and by market or welfare changes in human systems. Also referred to as spontaneous adaptation. (IPCC 2007a)

Planned Adaptation: Adaptation that is the result of a deliberate policy decision, based on an awareness that conditions have changed or are about to change and that action is required to return to, maintain, or achieve a desired state. (IPCC 2007a)

Adaptation: An adjustment made in response to a perceived change in a human or natural system in order to reduce vulnerability, build resilience, or both. Adaptation can be proactive (anticipatory) or reactive, and planned (involving public intervention) or autonomous (representing spontaneous action by private actors). (ADB & IFPRI, 2009)

Adaptation: Adjustment in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts. This term refers to changes in processes, practices, or structures to moderate or offset potential damages or to take advantage of opportunities associated with changes in climate. It involves adjustments to reduce the vulnerability of communities, regions, or activities to climatic change and variability.

Adaptation Assessment: The practice of identifying options to adapt to climate change and evaluating them in terms of criteria such as availability, benefits, costs, effectiveness, efficiency, and feasibility. (IPCC TAR, 2001a)

Adaptive capacity (in relation to climate change impacts): The ability of a system to adjust to climate change, mitigate potential damages, take advantage of opportunities, or cope with consequences. (IPCC 2007a)

Adaptive capacity: The ability of institutions and individuals to avoid potential damage, take advantage of opportunities, or cope with consequences of change. (ADB & IFPRI, 2009)

Adaptation Costs: Costs of planning, preparing for, facilitating, and implementing adaptation measures, including transition costs. (IPCC TAR, 2001a)

Agroecological zone: Defines zones based on combinations of soil, landform, and climatic characteristics. The particular parameters focus on the climatic and edaphic requirements of crops and on the management systems under which the crops are grown. (FAO 1996)

Anthropogenic: Resulting from human activities. (IPCC 2007)

Baseline/Reference: The baseline (or reference) is any datum against which change is measured. It might be a "current baseline," in which case it represents observable, present-day conditions. It might also be a "future baseline," which is a projected future set of conditions excluding the driving factor of interest. Alternative interpretations of the reference conditions can give rise to multiple baselines. (IPCC TAR, 2001a)

Baseline/reference: The state against which change is measured. It is either a “current baseline,” representing observable, present-day conditions, or a “future baseline,” a projected future set of conditions excluding the driving factor of interest. (IPCC 2007a)

Capacity building: In the context of *climate change*, capacity building is developing the technical skills and institutional capabilities in developing countries and economies in transition to enable their participation in all aspects of adaptation to, mitigation of, and research on *climate change*, and in the implementation of the Kyoto Mechanisms, etc. (IPCC 2007a)

Carbon fertilization: The effect of additional concentrations of CO_2 in the atmosphere on plant growth. (IFPRI 2009)

Carbon pool: Above-ground biomass, belowground biomass, litter, dead wood, and soil organic carbon. (IPCC 2007b)

Carbon sequestration: The process by which carbon sinks remove CO_2 from the atmosphere. This can be done naturally by plants, or artificially, for instance, by removing CO_2 from coal-fired power plant emissions. (IFPRI 2009)

Clean Development Mechanism (CDM): An arrangement under the Kyoto Protocol allowing industrialized countries with a GHG reduction commitment to invest in projects that reduce emissions in developing countries, as an alternative to more expensive emission reductions in their own countries. (IFPRI 2009)

Climate change: Refers to a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. (IPCC 2007)

Climate change: A change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods. See also climate variability. (UNFCCC)

Climate Change: The climate of a place or region is changed if over an extended period (typically decades or longer) there is a statistically significant change in measurements of either the mean state or 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. Note that the definition of climate change used in the United Nations Framework Convention on Climate Change is more restricted, as it includes only those changes which are attributable directly or indirectly to human activity.) (UN/ISDR, 2004)

Climate prediction: The result of an attempt to produce an estimate of the actual evolution of the climate in the future, for example, at seasonal, inter-annual, or long-term time scales. Such predictions are usually probabilistic in nature. Also called a *climate forecast.* (IPCC 2007c)

Climate projection: A projection of the response of the climate system to emission or concentration scenarios of GHG and aerosols, or radiative forcing scenarios, often based upon simulations by climate models. Climate projections are distinguished from climate predictions to emphasize that climate projections depend upon the emission/concentration/radiative forcing scenario used, as these are subject to substantial uncertainty. (IPCC 2007c)

Climate proofing: Actions to protect infrastructure, systems, and processes against climate impacts. (Parry, Hammill, and Drexhage 2005)

Climate scenario: A plausible and often simplified representation of the future climate, based on an internally consistent set of climatological relationships that has been constructed for explicit use in investigating the potential consequences of anthropogenic climate change, often serving as an input to impact models. Climate projections often serve as the raw material for constructing climate scenarios, but climate scenarios usually require additional information such as on the observed current climate. (IPCC 2007c)

Climate threshold: The point at which the atmospheric concentration of GHG triggers a significant climatic or environmental event that is considered irreversible, such as widespread bleaching of corals or a collapse of oceanic circulation systems. (IPCC 2007b)

Climate Variability: Climate variability refers to variations in the mean state and other statistics (such as standard deviations, or the occurrence of extremes) of the climate on all temporal and spatial scales beyond that of individual weather events. Variability may be due to natural internal processes within the climate system (internal variability), or to variations in natural or anthropogenic external forcing (external variability). See also *climate change*. (IPCC TAR, 2001)

Community-Based Disaster Risk Management (CBDRM): A process of disaster risk management in which 'at risk' communities are actively engaged in the identification, analysis, treatment, monitoring, and evaluation of disaster risks in order to reduce their vulnerabilities and enhance their capacities. (ADPC,2006)

Coastal regulation zone (CRZ):

Conference of the Parties (COP): The supreme body of the UNFCCC, comprising countries with right to vote that have ratified or acceded to the convention.

Coping Capacity: The means by which people or organizations use available resources and abilities to face adverse consequences that could lead to a disaster. (In general, this involves managing resources, both in normal times as well as during crises or adverse conditions. The strengthening of coping capacities usually builds resilience to withstand the effects of natural and human-induced hazards.) (UN/ISDR, 2004)

Coping: The "use of existing resources to achieve various desired goals during and immediately after unusual, abnormal, and adverse conditions of a hazardous event or process. The strengthening of coping capacities, together with preventive measures, is an important aspect of adaptation and usually builds resilience to withstand the effects of natural and other hazards" (Agrawal, 2008). From http://sitemaker.umich.edu/aid_climate_change/glossary_of_terms (accessed on 13 August 2009).

Coping range: The range of climate where the outcomes are beneficial or negative but tolerable. Beyond the coping range, the damages or loss are no longer tolerable and a society (or a system) is said to be vulnerable. (UNDP, 2005)

Downscaling: A method that derives local- to regional-scale (10 to 100 km) information from larger-scale models or data analyses. Two main methods are dynamical downscaling and empirical/statistical downscaling. (IPCC 2007c).

Drought: A deficiency that results in a water shortage for some activity or for some group. (Heim 2002)

El Niño-Southern Oscillation (ENSO): The term El Niño was initially used to describe a warm water current that periodically flows along the coast of Ecuador and Peru, disrupting the local fishery. It has since become identified with a basin-wide warming of the tropical Pacific Ocean east of the dateline. This oceanic event is associated with a fluctuation of a global-scale tropical and subtropical surface pressure pattern called the Southern Oscillation. This coupled atmosphere-ocean phenomenon, with preferred time scales of 2 to about 7 years, is collectively known as the El Niño-Southern Oscillation (ENSO). The cold phase of ENSO is called *La Niña.* (IPCC 2007c)

Ecosystem: A dynamic complex of plant, animal, and microorganism communities and the nonliving environment interacting as a functional unit. (IFPRI 2009)

Ecosystem resilience: A measure of how much disturbance an ecosystem can handle without shifting into a qualitatively different state. (SRI 2009)

Extreme weather event: An event that is rare at a particular place and time of year, normally as rare as or rarer than the 10th or 90th percentile of the observed probability density function. (IPCC 2007c)

Global warming: Refers to the gradual increase—observed or projected—in global surface temperature, as one of the consequences of radiative forcing caused by anthropogenic emissions. (IPCC 2007b)

Governance: An inclusive concept recognizing the contributions of various levels of government and the roles of the private sector, nongovernment actors, and civil society. (IPCC 2007b)

Kyoto Protocol: A protocol to the international Framework Convention on Climate Change that aims to reduce greenhouse gases in an effort to prevent human-induced climate change. The treaty entered into force in February 2005, and had been ratified by 182 countries as of October 2008. (IFPRI 2009)

La Niña: See El Niño-Southern Oscillation (ENSO).

Local: Refers generally to the sub-national geographic scale, but can mean something as specific as a particular area or place. It is the scale of administration and analysis closest to people and their everyday activities. Local here refers to the interface between households and grassroots organizations,

Maladaptation: An action or process that increases vulnerability to climate change-related hazards. Maladaptation often includes planned development policies and measures that deliver short-term gains or economic benefits but lead to exacerbated vulnerability in the medium to long-term. (UNDP 2006)

Mitigation: Actions to reduce GHG emissions and increase carbon sequestration. (IFPRI 2009)

Monsoon: A tropical and sub-tropical seasonal reversal in both surface winds and associated precipitation. (IPCC 2007a)

National Adaptation Programs of Action (NAPA): A process for least developed countries (LDCs) to identify priority activities that respond to their urgent and immediate needs to adapt to climate change. (UNFCCC 2002)

Potential: In the context of climate change, potential is the amount of mitigation or adaptation that could be—but is not yet— realized over time. Potential levels are identified as market, economic, technical, and physical. (IPCC 2007b)

Reinsurance: The transfer of a portion of primary insurance risks to a secondary tier of insurers (reinsurers); essentially "insurance for insurers." (IPCC, TAR, 2001)

Resilience: The ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organization, and the capacity to adapt to stress and change. (IPCC 2007a)

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. (UN/ISDR, 2004)

Risk: The result of the interaction of physically defined hazards with the properties of the exposed systems, i.e., their sensitivity or social vulnerability. (APF 2005)

Risk (climate-related): The result of the interaction of physically defined hazards with the properties of the exposed systems, i.e., their sensitivity or (social) vulnerability. Risk can also be considered as the combination of an event, its likelihood, and its consequences, i.e., risk equals the probability of climate hazard multiplied by a given system's vulnerability. (UNDP, 2005)

Social resilience: "...[T]he ability of human communities to withstand and recover from stresses, such as environmental change or social, economic, or political upheaval" (SRI 2009). This idea is similar to adaptive capacity.

Scenario: A forward-looking description of events and series of possible actions that can be used in policy-oriented research. (IFPRI 2009)

Sea-level change: Sea level can change, both globally and locally, due to (i) changes in the shape of the ocean basins, (ii) changes in the total mass of water and (iii) changes in water density (steric). (IPCC 2007c)

Sea-level rise: An increase in the mean level of the ocean. (IPCC 2007a)

Sea wall: A human-made wall or embankment along a shore to prevent wave erosion. (IPCC 2007a)

Sustainable development: Creating and maintaining prosperous social, economic, and ecological systems by fostering adaptive capabilities and creating opportunities. (Holling, 2001 as quoted in RA 2009)

Spontaneous adaptation: See *autonomous adaptation.*

Strategy: Refers to a broad plan of action that is implemented through policies and measures. A **climate change adaptation strategy** for a country refers to a general plan of action for addressing the impacts of climate change, including climate variability and extremes. It may include a mix of policies and measures, selected to meet the overarching objective of reducing the country's vulnerability. (UNDP, 2005)

Threshold: A property of a system or a response function, where the relationship between the input variable and an output or other variable changes suddenly. It can be important to identify thresholds, and other non-linear relationships, as these may indicate rapid changes in risk. (UKCIP Technical Report. 2003. Climate Adaptation: Risk, Uncertainty and Decision-Making.)

Vulnerability: The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. (IPCC 2007a) Vulnerability is often denoted as the antonym of resilience. (SRI 2009)

Vulnerability assessment: The process of identifying who and what is exposed and sensitive to change. Vulnerability assessment starts with a consideration of the factors that make people or the environment susceptible to harm, e.g., access to natural and financial resources, the ability to self-protect, and the availability of support networks so on. (E. Tompkins et al., 2005)

Annex 4: Acknowledgements

IRP and UNDP India would like to acknowledge the input and expertise of the following individuals who participated in consultative workshops, served as resource person and technical experts, contributed case studies and/or peer reviewed the Guidance Note on Recovery: Climate Change.

Akilesh Surjan, lecturer/Research Associate, UNU; Ashok Malhotra, UNDP; Atsushi Koresawa, ADRC; Bagmi Mishra, SMRC; Chris Summerville, Kiko Network (NPO); Dr. Jyotsna Bapat, Sr.IND.Consult; Dr. R.K.Mall, NIDM, MHA-Delhi; Dr.P.K. Dash, MCD, Delhi; George Haddow, Bullock & Haddow LLC; Gyaneshwar Singh, AMRITH, UP (NGO);Hari. Srinivas, UNEP; Hideki Yamamoto, Graduate School of Environmental Sciences, Okayama University; Rajib Shaw, Graduate School of Global Environmental Studies, KYOTO UNIVERSITY; Tetsuro Fujitsuka, APN; Kenro Taura, Secretary General, Kiko Network (NPO); Masahiko Isobe, Vice president, Department of Socio-Cultural environmental Studies, Graduate School of Frontier Sciences, The University of Tokyo; Matteo Marchisio, UNDP; Mikio Ishiwatari, JICA; Nupur Gupta, UNDP; Prashant Hedao, Auzoville; Rajeev Issar, BCER-UNDP; Ramesh K. Jalan , Sol,E, UNDP; Reena Mohanty, SMRC; SVRK Prabhakar, Policy Researcher (Adaptation), IGES; Saiful Mohammad, UNDP; Satoru TET Oishi, Dr. Eng. Professor, Research Center for Urban Safety and Security KOBE University; Sindhuja Khajuria, UNDP; Tanvi Patel, CFID; Yoshihiro Imai, Deputy Director, Industry & Employment Department, Hyogo Prefectural Government.

International Recovery Platform Secretariat

DRI East Tower 5F
1-5-2 Wakinohamakaigan-dori
Chuo-ku, Kobe 651-0073
Japan

TEL: +81-78-262-6041
FAX: +81-78-262-6046
E-mail: info@ recoveryplatform.org
URL: www.recoveryplatform.org

Special thanks to the partners who support IRP: Asian Disaster Reduction Center(ADRC); Hyogo Prefectural Government, Japan; International Federation of Red Cross and Red Cresent Societies(IRFC); International Labour Organization (ILO); Ministry of Foreign Affairs Government of Italy; Cabinet Office Government of Japan; Swiss Agency for Development and Cooperation (SDC); Government of Switzerland; United Nations Development Programme (UNDP); United Nation Environment Programmes (UNEP); United Nations Human Settlements Programme (UN Habitat); United Nations International Strategy for Disaster Reduction (UNISDR), United Nations Office for the Coordination of Humanitarian Affairs (UN-OCHA), and The World Bank