BMZ Federal Ministry for Economic Cooperation and Development

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Disaster risk management and adaptation to climate change

Experience from German development cooperation

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Contents

Preface

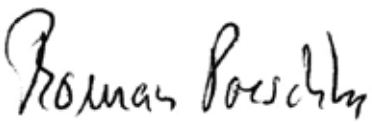
Time and again, extreme natural events trigger disasters that cause immense human suffering and lead to enormous economic losses and environmental damage. The populations of developing countries are particularly vulnerable. Climate change increases the risk of disasters. Investment in disaster risk management can save human lives, as well as minimise or even prevent economic, social and environmental damage and losses. Precautionary risk management is economically more efficient than post disaster response and recovery and safeguards the longterm success of development cooperation.

The increase in the number of extreme weather events is one of the problems that are brought about by climate change and that call for adaptation of vulnerable societies. Even without climate change, disaster risk management is in itself an important building block of sustainable development, and apart from climatic phenomena, also includes geological events, which are unaffected by climate change. There is significant overlap between these two themes, making good cooperation between the two essential.

This publication aims to pinpoint commonalities between disaster risk management and adaptation to climate change. It describes the experience gathered from German development cooperation's work in seven countries, which we see as a stimulus to aim for more effective and efficient interaction between the two fields and to work towards a significant reduction of risk in our partner countries by implementing risk management measures adapted to the respective conditions.

The Sector Project 'Disaster Risk Management in Development Cooperation' would like to thank the German Red Cross, the Kreditanstalt für Wiederaufbau, Welthungerhilfe and GIZ, which add value to the publication with their project work experience.

We would like to thank all our colleagues from the projects for their valuable contributions to the publication, and express our appreciation of the project work performed by them, their respective teams and all the participating experts at the partner institutions.



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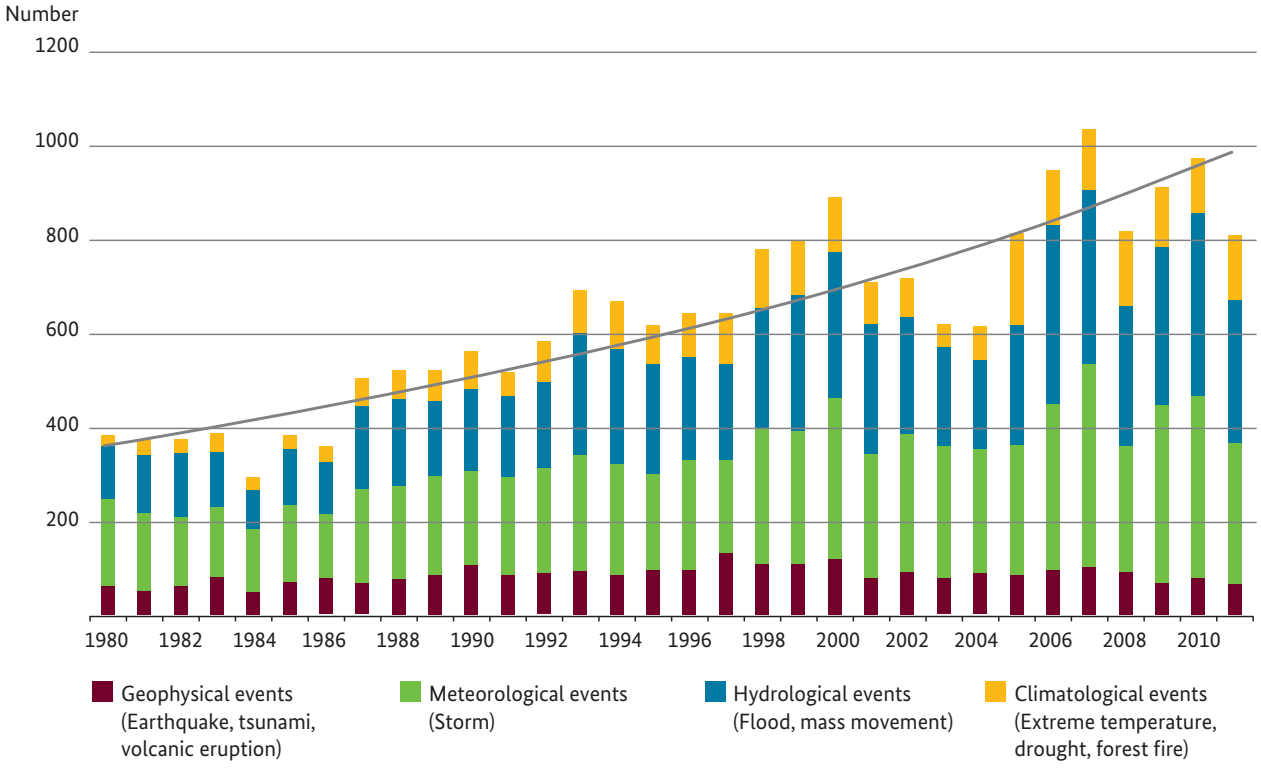
1. Context

As climate change progresses, atmospheric processes are liable to change to the extent that extreme weather events such as floods or droughts occur in regions that have not experienced them before, or at least not to the same degree. Developing and emerging countries suffer particularly seriously from such changes on account of their relatively low resilience. To counteract this, the International Panel on Climate Change (IPCC) recommends above all strengthening disaster risk management in areas under threat (*IPCC, 2012*). The number of weather-related disasters has almost tripled since 1980. The trend towards ever greater damage resulting from natural disasters is partly attributable to socioeconomic development: the population is growing, and more and more people are settling in risk areas. The value of the affected infrastructure is also rising. At the same time the increase in the number of weather-related disasters cannot be explained without reference to climate change. The fact that disaster risk management is worthwhile is illustrated by a calculation from the World Bank, according to which 1 USD spent on preventive measures saves 7 USD in post-disaster response (*World Bank, 2004*).

Countries, communities and households are described as **resilient** if they are able to withstand extreme events triggered by shocks or stresses without jeopardising their living standards or compromising their longterm development prospects. (*based on DFID, 2011*)

Rising trend of extreme weather events, 1980–2011



Source: Munich RE, 2012

The IPCC's Fourth Assessment Report (*IPCC, 2007*) indicates that global warming is most probably attributable to human influence. As climate change progresses, the intensity, duration, frequency and geographical extent of extreme weather events will increase, and the risk of disasters will rise as a consequence. The impacts of these changes can lead to freshwater resources being degraded, coastal zones and settlements being increasingly put in danger, drought phenomena intensifying, fertile soils being denuded, forest fires occurring more frequently, epidemics spreading and biodiversity being reduced. Natural geological events such as volcanic eruptions, earthquakes and seaquakes are not affected by climate change. They can, however, increase the vulnerability of the affected society and thus reduce their ability to adapt to the consequences of climate change. The causes of this vulnerability to extreme natural events are many and varied. The occurrence of disasters is made more likely by weak or non-existent early-warning systems, undesirable developments resulting from inadequate legal provisions or insufficient administrative capacity, and a lack of civil protection. The development of societies is set back to a greater or lesser extent when they are hit by disasters. For lack of technical, economic and financial resources, poor members of the population are least able to adapt to changing climatic conditions. Existing problems are exacerbated, above all in areas where people's everyday lives are already defined by the need to secure their livelihoods and by a lack of water, food, health care and education.

What is disaster risk management?

Disaster risk management comprises the entire systematic and conceptual framework of measures taken before the occurrence of a natural hazard with the aim of limiting the adverse impacts of a natural event on society. The objective of reducing disaster risk is made up of two elements: reducing the vulnerability of the population, and preventing the emergence of new hazards such as landslides caused by inappropriate use of land. In the bestcase scenario it is even possible to prevent a natural event from resulting in a disaster at all. *(BMZ, 2010)*

What is adaptation to climate change?

'Adjustment in natural or human systems to a new or changing environment. Adaptation to climate change refers to adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.' (*IPCC, 2001, Appendix B*)
Adaptation actions are taken to cope with a changing climate. (...) Adaptation can encompass national or regional strategies as well as practical steps taken at community level or by individuals. Adaptation measures can be anticipatory or reactive. Adaptation applies to natural as well as to human systems. *(European Commission, 2007)*

The aim of **disaster risk management** is to reduce a society's vulnerability to extreme natural events to the extent that a disaster does not arise or, if it does come to a disaster, that the damage and losses are reduced to a minimum. Disaster risk management consists of risk analysis, disaster prevention and mitigation, disaster preparedness and disaster-preventive reconstruction (*based on BMZ, 2010*).

2. The international debate

For many years the central focus of the international debate was directed at reducing the intensity of climate change and achieving significant reductions in global greenhouse gas emissions, but since the turn of the millennium attention has increasingly been paid to the necessity of adapting to the climatic changes that are already becoming noticeable. In the international debate the contribution that disaster risk management can make to climate change adaptation is undisputed: at the Conferences of the Parties in Bali (2007), Posen (2008), Copenhagen (2009) and Cancún (2010), disaster risk management was clearly highlighted as a key approach for adaptation to climate change. An IPCC Special Report, '*Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*', on the relationship between disaster risk management and climate change adaptation appeared for the first time in 2011, in the run-up to the conference in Durban (2011). The members of the G20 put disaster risk management on their agenda in 2012.

Disaster risk management has been an explicit area of activity for German and international development cooperation since the 1990s, especially in high-risk countries. Since 2005 the Hyogo Framework for Action, a plan of action adopted jointly by 168 governments, has represented the most important international framework in disaster risk management. The signatories agreed to bring about a significant reduction in the loss of human life caused by disasters as well as damage and losses of a social, economic and environmental nature. One central demand of the Hyogo Framework for Action is greater dovetailing of disaster risk management and climate change adaptation.

Hyogo Framework for Action 2005 – 2015: Building the Resilience of Nations and Communities to Disasters

Expected Outcome
The substantial reduction of disaster losses, in lives, and in the social economic and environmental assets of communities and countries

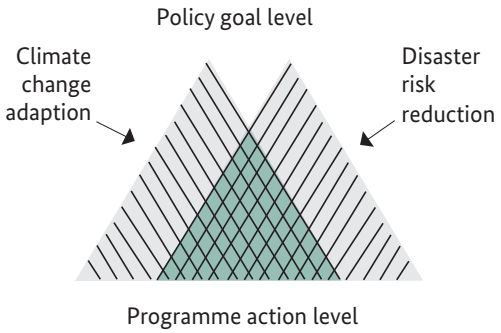
Priorities for Action

1. Make disaster risk reduction a priority: Ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation	**2. Know the risk and take action:** Identify, assess and monitor disaster risks and enhance early warning	**3. Build understanding and awareness:** Use knowledge, innovation and education to build a culture of safety and resilience at all levels	**4. Reduce risk:** Reduce the underlying risk factors	**5. Be prepared and ready to act:** Strengthen disaster preparedness for effective response at all levels

Source: UNISDR, 2005

3. Commonalities between the two fields

The illustration from the United Nations International Strategy for Disaster Reduction (UNISDR) shown here on the right (*UNISDR, 2009*) draws attention to the fact that the two fields have different policy goals but ultimately point in the same direction, even if they are not identical (policy goal level). The two fields overlap (green) because of the concrete action taken in both fields in relation to extreme weather events (programme action level). Within this overlapping area, the contribution made by disaster risk management (or disaster risk reduction) to climate change adaptation is at its greatest where disaster risk management addresses current risks that will be accentuated by climate change. Disaster risk management and climate change adaptation fully overlap where new risks arise in the course of climate change or known hazards change their geographical scope.

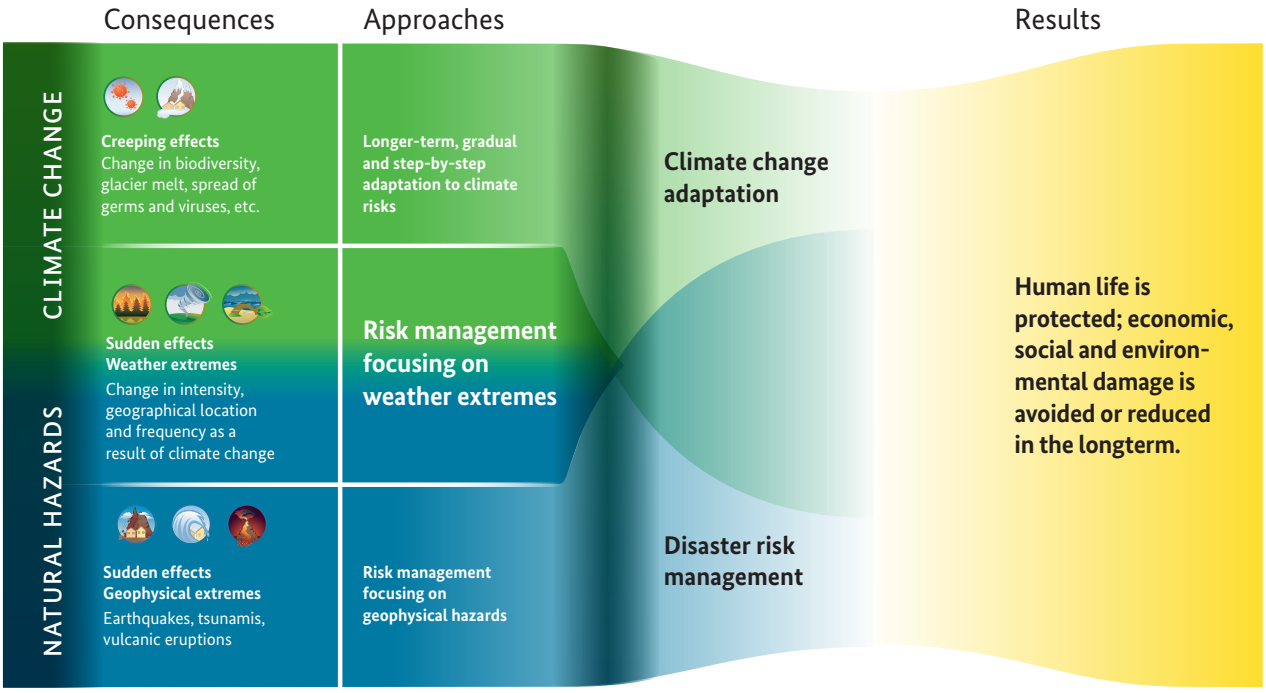


Source: UNISDR, 2009

Climate change adaptation takes account of all impacts caused by a changing climate. These impacts on society and the environment may be either positive or negative. Climate change can lead to limited incremental changes. On the other hand, scenarios with considerable, generally adverse repercussions are also expected. Climate change adaptation and disaster risk management always coincide where climatic and meteorological changes have an effect on extreme natural events and thus influence the risk of disaster. Disaster risk management has to draw upon these future scenarios in order to do justice to its mandate of efficiently and effectively minimising or preventing the adverse impacts of a natural event before a hazard occurs.

Extreme hydrological, meteorological and climatological events (floods, storms, droughts) are changing in their intensity, frequency and geographical extent as a conse-

Interface between disaster risk management and climate change adaptation



Source: GIZ (Sector Project 'Disaster Risk Management in Development Cooperation')

quence of climate change. This is where there is commonality between the two fields, and the resultant need for cooperation between them (see illustration above).

Vulnerability

Vulnerability is a central reference point for both disaster risk management and climate change adaptation.[1] The target groups of both fields are societies and population groups at risk from extreme natural events.

A natural hazard is always a threat to a society. The vulnerability of a society as a function of its general socio-economic conditions as well as its capacity to cope and adapt essentially determine whether damage and losses arise and an extreme event escalates to become a disaster.

Vulnerability denotes a state in which an individual or group is exposed to external shocks and stress factors and has difficulty coping with those shocks and stresses. (*Based on Robert Chambers, 1989*)

The development of societies is set back to a greater or lesser extent when they are hit by disasters. As the events in the USA (Hurricane, 2008) and Japan (the tsunami of 2011) have shown, even advanced, highly developed service economies are vulnerable despite their economic potential, in some circumstances precisely because of their level of technological development, but also on account of inadequate disaster risk management and coping capacities.

Vulnerability is not solely dependent on material resources. The greater the equality of participation in the general well-being of a society, because support is provided and adequate integration into social networks is assured, the better equipped a society will be to deal with natural events. Poverty and social disadvantage therefore have a key role to play. Wherever social security systems are limited, financial reserves are low and governance is poor, the level of risk rises.

Disaster risk management and climate change adaptation aim to strengthen the prevention, mitigation, adaptation and self-help capacities of all population groups, thereby contributing to poverty reduction and to socially equitable development.

Actor landscape

As a rule, both fields work with the same partners: environment ministries and disaster risk management authorities, municipal and local government administrations, the affected population and their associations, meteorological institutes, and representatives from various sector ministries. Disaster risk management and climate change adaptation cover an extremely wide range of operational but also scientific fields that must be networked on an interdisciplinary basis and processed consensually. Politicians, authorities, scientists and academics, the private sector and civil society organisations all have to cooperate in order to arrive at lasting solutions to problems. The nature and intensity of the cooperation depends on the specific risk profile and must be adapted accordingly. Particular demands are therefore placed on the planning and implementation capacities of the countries under threat. A coordinated approach for support services from international cooperation is required so as not to overstrain the planning and implementation capacities in the partner countries, which are often already tightly stretched.

Both fields require a multi-level approach in order to gear policy guidelines and cross-sectoral strategies to the needs and conditions in-country, such as the microclimate, the local risk profile or the capability of the population under threat. Neither climate change nor extreme natural events stop at national borders, so in both fields it is essential to think and act internationally.

Responsibility of each individual

Whereas adaptation to climate change and its impacts now command appropriate public attention, disaster risk management continues to attract only limited notice on the wider stage as long as disaster events and their consequences are not of topical interest. Despite receiving increasing attention at international level, in many

[1] In disaster risk management, vulnerability is defined as: '*The characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard*' (*UNISDR, 2009*). In climate change adaptation, the definition of the term is similar: '*The degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity.*' (*IPCC, 2001, Appendix B*)

countries disaster risk management is only gradually taking root in society to an extent commensurate with the threat. Often, for example, less attention is paid to the improvement of a protective sea wall or the conservation of a protected area than to the construction of a new housing development or a tourism complex. Consequently, both fields still face the challenge of establishing risk management more firmly in the social and political mainstream, as a central element.

Increasingly persuading the public, authorities, associations, decision-makers and citizens of the importance of preventive action is a concern for both fields. Risk management and adaptation actions should become a visible political issue for all citizens. Individuals, groups and enterprises are called upon to play a decisive part in minimising risk for themselves by taking preventive action of their own.

Investment in risk management and adaptation must be made a mandatory part of national budgets, innovative financing mechanisms must be introduced and greater use must be made of knowledge and innovation from the private sector.

Myanmar: Children's painting competition as part of the International Day for Disaster Reduction 2011.

4. Experience from German development cooperation in networking the two fields

A common thread through the various experiences from the work of German development cooperation described in the following sections is the linking of disaster risk management and adaptation to climate change.

The examples from Mozambique and Nicaragua illustrate how the risks arising from climate change can be taken into account in the 'classic' disaster risk management instrument: the early-warning system. Whereas the example of **Mozambique** describes in detail how the first urban Mozambican early-warning system was set up for the city of Beira and explains how it works, the example of **Nicaragua** graphically illustrates how an early-warning system is also able to contribute to minimising crop losses and thus to securing the incomes of farmers, in addition to its original purpose of warning of impending disasters.

Risk analysis adapted to local conditions, taking account of climate change, enables smallholders growing rice in **Sri Lanka** to adjust to the impacts of climate change in good time. The measures implemented by the project make an important contribution to maintaining the livelihoods of the farming population.

The example from the Mekong Delta in **Viet Nam** describes how disaster risk management, climate change adaptation and the management of natural resources go hand in hand and thus how an integrated solution can be achieved to improve people's livelihoods under changing conditions.

Incorporating disaster risk management into the planning phase of large-scale urban infrastructure measures against the background of climate change leads to a noticeable reduction of risk – as the example of six cities in **Ethiopia** demonstrates.

The examples from **Peru** and the **Caribbean** examine the financial side of reducing disaster risks: disaster risk financing. An innovative approach to integrating disaster risk management into a country's national investment planning is explained in detail using the example of Peru. A study conducted in four countries of the Caribbean established the demand for the introduction of insurance policies for low-income households and the prerequisites that need to be in place.

4.1 Establishing the first urban early-warning system in Mozambique

Mozambique's National Institute for Disaster Management (*Instituto Nacional de Gestão de Calamidades, INGC*) forecasts that annual average rainfall will rise by as much as 15 percent. Furthermore, sea level is expected to rise by at least 30 cm by 2100 (*INGC, 2009*). Extreme weather events will occur more frequently and will intensify. The towns and cities along the Indian Ocean are particularly vulnerable, with high population densities and a concentration of economic activity. The second-largest port city in Mozambique, Beira, has been projected to lose 5-9 percent of GDP by 2030 if appropriate action is not taken to adapt to climate change. The anticipated costs of climate change could be reduced by 43 percent by action to strengthen the resilience of socio-economic systems (*INGC, 2009*).

Since 2009, climate change adaptation has been an integral part of German-Mozambican development cooperation. Experience shows that institutional mainstreaming and strengthening of disaster risk management in Mozambique makes an important contribution to climate change adaptation. In 2010 and 2011, work was begun on transferring tried and tested disaster risk management measures from rural areas to certain districts of the coastal city of Beira for the first time on a pilot basis, including adaption to urban conditions. Mozambique's first urban flood early-warning system was also installed for the districts involved.

The early-warning system in Beira was backed up by a communication system that will enable the most urgent action to protect the local population to be initiated within an appropriate timescale. The sequences of action in the early-warning system are geared to the local needs of the population, based on problem analyses drawn up by the affected residents themselves as part of participatory risk analyses. The population rated emergency situations triggered by flooding as being especially serious. Such flooding is most likely to be the result of water backing up in lower-lying districts. The four pillars of the urban early-warning system were defined as part of a South-South exchange with advisors

Mozambique: The Chipangara disaster risk management committee explains to the Director of the Meteorological Institute how the simple flood sensors work.

from Latin American countries[2] more advanced in the field of early warning, and are explained below.

i. Institutional embedding of the early-warning system

The municipal authority and INGC jointly laid down overarching planning and action sequences for the eventuality of a disaster. The issues of disaster risk management and climate change were institutionally mainstreamed within the Beira municipal authority through the establishment of a joint working unit on coastal protection, disaster risk management and climate change (*Serviço de Protecçao Costeira, Gestao de Risco de Calamidades e Mudanças Climáticas*). New legislation introduced in 2012 on climate change adaptation in cities provides a binding basis for integrating local disaster risk management activities into municipal authorities' development and financial plans.

ii. Processing, transmitting and storing information

INGC collected information about climate change adaptation and systematically entered it into a database to be used as a reference source on early warning. This makes it easier for the actors involved, such as INGC, the Environment Ministry and the municipal authority, to access information quickly when needed. Another particularly important factor in how the early-warning system works is the flow of information between the local population, the municipal authority and INGC, although there is still scope for constant improvement and expansion in this respect.

iii. Installing and testing flood sensors

Low-cost flood sensors, made of easily obtained materials and simple to in-stall, were developed and installed in conjunction with the local disaster risk management committees, which were set up in 2010. The Faculty of Mechatronics at the local university (*Universidade Zambeze*) participated in manufacturing and maintaining the sensors. When the water reaches a critical level, an alarm is automatically triggered in the home of a volunteer, who alerts the local disaster risk management committee. The committee then warns the population under threat.

iv. Organisation and training

Risk analyses are performed at various institutional levels: national, municipal and local. This establishes a jointly coordinated basis for disaster risk management

[2] Guatemala, Honduras and Costa Rica

appropriate to the local circumstances. Training and back-up for the urban disaster risk management committee is a crucial prerequisite for proper functioning of the warning system. The committee's role is to raise awareness among the residents, to take precautionary action in good time, such as cleaning drainage channels, and to know what to do in an emergency.

Summary

In Beira, capacity for adaptation was verifiably increased by making the local population better prepared and more aware of the issues, as well as by embedding the early-warning system in the institutions. Disaster control exercises have shown that the local population's responsiveness in the districts concerned has been improved and consequently the level of disaster risk has been significantly reduced. Experience shows that disaster risk management and climate change adaptation are closely linked both thematically and institutionally at municipal level.

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4.2 Early warning and its many benefits, taking Nicaragua as an example

On the basis of the IPCC's Fourth Assessment Report (*IPCC, 2007*), the UN Economic Commission for Latin America and the Caribbean (ECLAC) calculated that as a consequence of climate change temperatures in Central America will rise by 1.8 degrees by 2100, amounts of precipitation will decline by at least 11 percent and extreme weather events will increase by up to 10 percent. The resultant economic damage is estimated to amount to 32 percent of the GDP of 2008 (*ECLAC, 2010*).

Since 2001, Welthungerhilfe has supported disaster risk management measures in the drainage basins of two rivers, Río Coco and Río Estelí. The strategy aims to establish lasting local self-help structures and locally active institutions in order to prepare for and cope with disasters, especially floods.

Telemetric rain gauges and level gauges installed in the middle reaches of Río Estelí transmit validated hydrological data from the region by radio link to the district disaster risk management committee and then on to state institutions. Computer models use the data to determine warning levels, which are communicated as appropriate. The bought-in radio equipment, powered by solar electricity, is operated all day, usually by local women, and is integrated into the civil protection communication network.

National government agencies interpret climate phenomena and weather events from satellite images, and, if necessary, forward the information with recommendations for warning levels. The warnings are passed on to the district committees via the civil protection service. Emergency plans have been drawn up to enable action to be taken in good time to cope with an impending disaster. Local rescue teams have been trained and equipped to provide first aid and rescue the injured.

The rainfall data that is collected is forwarded to the Ministry of Agriculture, where it is also used for drought forecasting. The Ministry can then give farmers targeted

recommendations on the choice of appropriate plant varieties and on tillage and irrigation. This reduces the risk of crop losses and makes an important contribution to securing farmers' incomes and to food security.

Hazard and vulnerability maps were produced for the communities to be used as the basis for land use planning and emergency plans. Recorded data is edited to create a computer-based information system to help prevent and cope with emergencies, showing among other things the location of existing infrastructure facilities (e. g. emergency shelters, drinking water supplies and evacuation routes) and the organisational structures and mechanisms that are activated in response to an extreme natural event.

Training measures for experts at the district authority and the members of the municipal committees have put them in a position to recognise potential hazards and when confronted by extreme weather events to take action so that in the best case the event does not lead to a disaster. The system has proved its worth in recent years in the face of floods.

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Nicaragua: A member of the district committee checks a rain gauge.

4.3
Risk analysis as the starting point for disaster risk management and food security in the context of climate change in Sri Lanka

A temperature increase of between 0.9° and 4° Celsius is forecast for Sri Lanka by 2100 (*Eriyagama, 2010*). Sri Lanka's national meteorological institute takes its figures from the IPCC, and expects that greater variability in precipitation will lead to an increase in extreme weather events (floods and droughts) (*Department of Meteorology, 2011*). Agricultural production, especially tea and rice, will be particularly hard hit.

Sri Lanka: A member of a disaster risk management committee in Ampara district with adapted seed. This led to an increase in yield of almost 20 percent.

Since 2008, the German Red Cross together with the Sri Lanka Red Cross Society have focused on disaster risk management and climate change adaptation measures in the eastern district of Ampara, which is one of the most disasterprone regions in the country. The population is regularly affected by flooding during the rainy season, and suffers from drought during the dry season. On top of that, there is a risk of tropical cyclones. Rice cultivation is often the only source of income. Climate change and the projected increase in extreme weather events have an adverse impact on living conditions and on agricultural production. People's livelihoods are increasingly under threat.

The changes to the climate observed by the local population and the resultant climate risks were included in the risk analysis performed at the start of the programme. Farmers and the agricultural authority submitted. Concurring reports on changes to the rainy season. A particularly significant point was the uncertainty surrounding the duration and continuity of the rainy season, which is becoming shorter. However, as the same amount of rain is falling within this shorter time, the risk of floods is rising. It was also possible to verify that the rainy season is interrupted by unexpected dry spells. Consequently, the rice harvest and seeds are increasingly destroyed by floods or drought.

Local disaster risk management committees and task forces have been trained. These groups are closely networked with state disaster management, which guarantees future support for the groups. At schools, programmes were run for teachers and schoolchildren to raise their awareness of future climate risks, and emergency plans were drawn up for the schools.

Farmer Field Schools have been set up where selected rice farmers learn how to adapt better to changes in the rainy season, on the basis of climate risk analysis, and pass this knowledge on to their neighbours. The farmers are testing how more moisture can be kept in the soil with the aid of compost. They are cultivating native varieties of rice that grow faster and continue to produce high yields despite floods or drought. Since the start of the programme crop yields have risen by an average of 20 percent compared with the previous three years. Thanks to the creation of local seed banks the farmers are earning additional income by selling adapted seed.

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Viet Nam: Mangrove forests protect the dyke and the intensively farmed land lying behind.

4.4
Protection of coastal zones in Viet Nam

Since 1993, sea level has been rising at an average of 3.1 mm per year (*Commenwealth Scientific and Industrial Research Organisation, CSIRO, 2012*). One cause is global warming. The most likely predicted outcome, based on series of measurements in geodetic oceanography, is an average rise of 40 cm by 2100 (*National Oceanography Centre (UK), NOC, 2012*). The rise in sea level is a particular threat to island states and countries with a wide coastal plain. The cost of coastal protection is considerably lower – in most cases less than 0.1 percent of GDP – than the cost of repairing the damage resulting from inactivity (*Nicholls et al., 2006*). The increase in extreme weather events raises the risk of climate change-induced disaster in the coastal zone of Viet Nam.

The provincial government of Soc Trang has been implementing coastal protection measures in the Mekong Delta since 2007, supported by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and with funding from the German Federal Ministry for Economic Cooperation and Development (BMZ). The measures comprise (i) the afforestation, rehabilitation, conservation and management of mangrove forests using co-management methods; (ii) the stabilisation of banks and rehabilitation of beaches or mudflats by building protective structures or breakwaters; and (iii) the sustainable use of mussel beds and restricting fishing to the use of certain methods.

The success of the work in Soc Trang is based on awareness-raising, the development and consolidation of expertise among employees in authorities, municipalities and cooperatives, and the introduction of new management methods in the form of co-management. Ownership rights were granted to local cooperatives, protection zones were designated and closed seasons introduced in fishing. Today, mangrove forests are sustainably managed and protect the dykes behind them. The local per capita daily income has more than doubled. Demand for firewood has fallen by half thanks to the introduction of wood-saving stoves.

The provincial government of Soc Trang is now implementing the model in more communities, and other provincial governments are adopting the model. Since 2011, the Australian Agency for International Development (AusAID) and BMZ have been supporting expansion of the successful model beyond Soc Trang. The central elements of the programme comprise the elaboration and implementation of national policy guidelines on the sustainable management of coastal ecosystems for adaptation to climate change and poverty reduction.

To sum up:

1) The impacts of climate change demand that change be made to the methods of using the mangrove forest. The changes always incorporate rehabilitation of the mangrove forest as an ecosystem in order to preserve or strengthen its environmental services.
2) Adaptation of the management methods to the changing conditions can improve the population's income situation. Coastal protection measures as a precaution against disasters help to safeguard people's livelihoods.
3) The development of expertise at all levels is geared to practical action and manifests itself in a replicable model, thus leading to the model being disseminated to other areas.

In 2011, members of the village co-management group in Soc Trang told the BBC:

'In 2007 we got VND 15,000 per day. Today we get VND 50 – 60,000 daily because of co-management and partly due to an increase in market prices. Now we have to go less far to catch or collect resources and there are fewer outsiders entering our area.'

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4.5 Adaptation of urban infrastructure for disaster risk management in the context of a decentralisation project in Ethiopia

Various forecasts predict a sharp rise in annual rainfall in Ethiopia. An average rise of between 10 percent and 70 percent is expected across the country, and the number of heavy rainfall events may rise by up to 18 percent (*McSweeney, 2009; World Bank, 2011*). As well as catastrophic droughts, in recent years heavy rains have occurred with increasing frequency in Ethiopia, causing major damage. The unusually intense rainy season in 2006 caused the greatest losses and damage to date: according to official estimates, 1,000 people died and about 280,000 people were made homeless. In most Ethiopian cities, the infrastructure is not prepared for such extreme weather events. If any drainage systems are in place at all they are often deficient due to a lack of maintenance, which meanwhile leads to entire districts being flooded every year.[3]

The importance of disaster risk management in urban areas has now logically also been reflected in national policies. In preparation for the National Adaptation Plan of Action (NAPA), for example, the Ethiopian Government drew up national strategies for dealing with water, covering not only traditional supply issues but also the prevention of flooding caused by heavy rainfall.

The urban development project described below, which KfW Entwicklungsbank has been supporting since 2007 with funds from BMZ, illustrates how urban disaster risk management can be put into practice with simple means. The objective of the project is to enable the cities to plan and monitor infrastructure measures independently and to maintain the infrastructure with due consideration for climate change. Before the infrastructure schemes were built, GIZ made crucial preparations in the cities involved in the programme by introducing administrative and planning procedures to ensure that the schemes meet the needs of the population and that operation of the infrastructure can be mainstreamed in municipal budget planning processes. In turn, the granting of funds to finance

[3] URAdapt, an ongoing project conducted by the International Water Management Institute (IWMI), is currently analysing the hydrological and socio-economic influence of climate change on the development of Ethiopian cities (*World Bank, 2011*).

Ethiopia: Before and after building a simple drainage system in Hawassa.

infrastructure schemes was linked to an obligation to draw up viable operating and maintenance strategies that are organised by the cities themselves and are intended to ensure sustainable operation of the installations.

Six of the eleven programme cities decided to construct drainage systems[4] – a choice that very clearly illustrates the importance of climate change adaptation measures from the standpoint of urban development. Conversations with residents confirm that an effective contribution to disaster risk management has been made. They report that the annual floods have not reappeared since the simple pipe systems have been built. The residents also say that there has been a noticeable decline in the number of cases of malaria, because, thanks to the drainage pipes, there is much less stagnant water where the mosquitoes could breed.

Currently the second phase of the programme is in progress in eight new cities where it is also becoming apparent that disaster risk management is a matter of great priority and will continue to be in future.

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4.6 Integration into public budgetary planning in Peru

According to a study by the Tyndall Centre for Climate Change Research, Peru is the third most vulnerable country to climate-related changes (*Rosenberger, 2006*). The number of disasters multiplied six-fold between 1990 and 2000. The National Environmental Council (*Consejo Nacional del Ambiente*) states that seven out of ten of these disasters were climate-related. ECLAC expects Peru to experience an increase in extreme weather events such as floods and droughts, and that the rise in sea level will cause massive coastal erosion. Climate change is also likely to be a factor in the possible degradation of over 60 percent of the land area by 2100 (*ECLAC, 2010a*).

Public strategies can be crucial for a country when it comes to avoiding new risks and minimising existing ones. In partnership with GIZ, commissioned by BMZ, and in association with UNISDR, the Peruvian Ministry of Economy and Finance has begun to take systematic account of both disaster risk management criteria and climate change adaptation considerations in government investment decisions.

A public investment project is evaluated in three stages: risk analysis, identification of disaster risk management measures and assessment of the benefit of the measures.

[4] As well as the building of drainage systems, the programme also financed landfill sites, roads, bus stations and markets. The World Bank is financing infrastructure schemes in other Ethiopian cities at the same time.

Stages in the assessment of the reduction of disaster risks

Analysis of project costs without measures of risk reduction:
Investment, operation and maintenance (see formula above)

Additional social costs in case of disasters:
a) Health-care in emergencies, rehabilitation and refurbishment
b) Reduction of project benefits for users during the period of emergency, rehabilitation and refurbishment

Analysis of project costs with measures of risk reduction:
Inclusion of 'avoided costs' (= costs which are not generated in case of disasters, thanks to risk reduction measures)

based on Alberto Aquino, Verena Bruer and Julio García (2010)

Risk analysis is indispensable for determining what damage and losses might be caused by disasters, and to what degree. The relevant stakeholders are also identified and their vulnerability established, as well as the vulnerability factors for the investment scheme as a whole. This information can be used as the basis for estimating the probability of the investment project suffering damage and losses of various degrees of severity as a consequence of disasters. Once the risk analysis is completed, appropriate risk reduction measures have to be found. Possible measures include changing the project location, the infrastructure features, the timetable for project implementation and the technology envisaged for operation. The last stage is to assess the usefulness of the planned risk reduction measures, which involves a comparison of the costs and benefits of the measures. Each option is evaluated on the basis of a cost-benefit or cost-effectiveness analysis to establish which measures provide the greatest benefits or are associated with the lowest costs.

When private-sector investments are assessed, the principal criterion for the cost-benefit analysis is the capital value. No attention has yet been paid to the probability of the occurrence of a disaster. A social assessment, on the other hand, also takes account of considerations relating to disaster risk management.

The Peruvian Ministry of Economy and Finance has been able to gather experience with taking account of disaster risk management criteria in the country's public investment system (*Sistema Nacional de Inversión Pública, SNIP*) since 2004. Risk analysis is a prescribed part of the planning phase of every public investment project. In November 2011, with recourse to the experience gathered in disaster risk management, a similar procedure was launched in order to ensure that considerations relating to climate change adaptation will also be included in public investment decisions.

Precondition: Existence of a SNIP

Raising awareness of stakeholders
Ministries: Economy and Finance, Environment, Agricultre; regional goverments; international cooperation

Building a national consensus

Preparing conceptual and methodological tools
Initially, their consideration in the Formulation and evaluation of new public investment projects is on a voluntary basis

Dissemination and capacity building
Capacity building courses with technical staff at national and regional level

Formalizing regulations and methodologies
Improved versions are formalized and made obligatory

Monitoring, evaluation and feedback
Regular monitoring and adjustments to changed circumstances

based on Alberto Aquino, Verena Bruer and Julio García (2010)

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4.7 Study on micro-insurance for weather-related hazards in the Caribbean[5]

The countries of the Caribbean are affected by a series of in-creasingly frequent weather-related hazards such as droughts, floods and hurricanes. For Belize, Grenada, Jamaica and St. Lucia, data from the World Health Organization's Centre for Research on the Epidemiology of Disasters (CRED) shows that over the last 30 years 1.5 million people were directly affected by damage caused by floods and tropical storms, the total cost of which amounted to over 5 billion USD. The cost of climate change for the Caribbean is estimated to be almost 6 billion USD per year through to 2050 (*Bueno et al., 2008*). Rasmussen (2004) estimates that damage from hurricanes, which occur roughly every 2.5 years, accounts for about 2 percent of the affected country's GDP.

The study into people with low incomes working in the agriculture and tourism sectors in Belize, Grenada, Jamaica and St. Lucia investigated a sample of 275 people in each country (total sample size 1,100). The average household earned an income only 13 percent above the poverty line, and is therefore classed as vulnerable. A total of 49 percent of those surveyed stated that they are heavily or very heavily dependent on agriculture, 41 percent stated that they are heavily or very heavily dependent on tourism in their country and 14 percent indicated that they are greatly dependent on both sectors. Almost 70 percent of those surveyed were engaged in some form of self-employment, although as an indication of the level of informality, 61 percent of the enterprises were not registered.

People on low incomes are confronted with considerable weather risks: 42 percent of those questioned in the study have suffered losses due to extreme weather events since 2000, some of them more than once. In addition, the homes of 26 percent of those surveyed have been damaged by floods or strong winds, and 38 percent have lost customers or employment for the same reason.

The main coping mechanism after a disaster is to use savings (36 percent), followed by loans (12 percent) and taking government support (9 percent). Among these results, the most problematical responses are these: 'no repair or replacement', not knowing what to do or 'wait and see'. The number of responses of this nature (about 25 percent) demonstrates an implicit demand for insurance services.

The long-term effect of today's coping strategies is that financial reserves are used up, the level of indebtedness rises and family life is adversely affected. Government support reinforces a culture of dependency among those affected. The survey participants were also asked to estimate the risk of their being affected by certain scenarios. The most striking risk was the loss of custom-ers or employment, which 33 percent of those surveyed rated as high and 30 percent as very high. Another problem was that 28 percent estimated the risk of their homes being damaged by strong winds as moderate to very high. These results show that there is an implicit demand for micro-insurance covering weather-related risks in the region.

The study shows that there is a high level of implicit demand for micro-insurance to cover weather-related risks, and moderate explicit demand. All in all, 23 percent of those surveyed stated that there is high or very high demand for the product, with 33 percent indicating moderate demand.

Demand for micro-insurance covering weather-related risks in the Caribbean (percent)

Demand	Grenada	St. Lucia	Jamaica	Belize	Average
None	16,2	16,3	27,3	18,5	19,6
Very low	11,0	8,8	12,9	12,4	11,3
Low	15,8	15,0	8,3	11,2	12,6
Moderate	38,6	31,3	22,3	40,6	33,2
High	14,3	24,6	16,3	14,9	17,4
Very high	4,0	4,2	12,9	2,4	6,0

Source: Munich Climate Insurance Initiative (MCII) and GIZ, 2011

[5] The study was commissioned by the German Federal Ministry for the Environment (BMU), and executed by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) through the United Nations University, Bonn and the Munich Climate Insurance Initiative (MCII). One of the main features in product design is the involvement of the MCII, the Caribbean Catastrophe Risk Insurance Facility (CCRIF), MicroEnsure and Munich Re, organisations with experience in the areas of climate change adaptation, risk management, micro-insurance and reinsurance.

The results of the study are now being used as the basis for introducing two insurance policies for people on low incomes, issued by a partnership between the Munich Climate Insurance Initiative (MCII), the Carribean Catastrophe Risk Insurance Facility (CCRIF), MicroEnsure and Munich Re in cooperation with the governments of Jamaica, Belize, St. Lucia and Grenada. Certain considerations have to be taken into account when designing the product: simplicity for customers, fast and smooth handling of insurance claims, products matching the needs of a broad group of people on low incomes, and early-warning systems and information in order to provide an incentive to keep losses and damage to a minimum.

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List of abbreviations

BMZ	German Federal Ministry for Economic Cooperation and Development
CCRIF	Caribbean Catastrophe Risk Insurance Facility
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DFID	Department for International Development (UK)
ECLAC	UN Economic Commission for Latin America and the Caribbean
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
INGC	Instituto de Gestão de Calamidades (National Disasters Management Institute, Mozambique)
IPCC	International Panel on Climate Change
MCII	Munich Climate Insurance Initiative
UNISDR	United Nations International Strategy for Disaster Reduction

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