

# REPORT



Climate & Development  
Knowledge Network

LOSS AND DAMAGE IN VULNERABLE COUNTRIES INITIATIVE

## EVIDENCE FROM THE FRONTLINES OF CLIMATE CHANGE: LOSS AND DAMAGE TO COMMUNITIES DESPITE COPING AND ADAPTATION

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Loss and Damage  
in Vulnerable Countries Initiative

## Evidence from the frontlines of climate change: loss and damage to communities despite coping and adaptation

This report was written by Koko Warner, Kees van der Geest and Sönke Kreft, United Nations University Institute for Environment and Human Security (UNU-EHS); with contributions from Saleemul Huq (International Center for Climate Change and Development – ICCCAD), Sven Harmeling (Germanwatch), Koen Kusters (Wereld in Woorden – Global Research and Reporting, Amsterdam), and Alex de Sherbinin (Center for International Earth Science Information Network – CIESIN, Columbia University).

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# Abbreviations and acronyms

CDKN	<i>Climate and Development Knowledge Network</i>
CIESIN	<i>Center for International Earth Science Information Network</i>
COP	<i>Conference of the Parties</i>
FAO	<i>Food and Agriculture Organization of the United Nations</i>
FGD	<i>Focus Group Discussion</i>
GDP	<i>Gross Domestic Product</i>
GHG	<i>Greenhouse gas</i>
HH	<i>Household</i>
IPCC	<i>Intergovernmental Panel on Climate Change</i>
LDCs	<i>Least Developed Countries</i>
MCII	<i>Munich Climate Insurance Initiative</i>
NGO	<i>Non-governmental organizations</i>
PRA	<i>Participatory Research Approach</i>
SBI	<i>Subsidiary Body for Implementation</i>
SIDS	<i>Small Island Developing States</i>
UNFCCC	<i>United Nations Framework Convention on Climate Change</i>
UNU-EHS	<i>United Nations University Institute for Environment and Human Security</i>

# Executive summary

## New thinking and the contribution of this report

New thinking and practical approaches are needed to address the threats to human security that climate change combined with social vulnerability pose for current and future patterns of loss and damage.

Loss and damage is already a significant – and in some places growing – consequence of inadequate ability to adapt to changes in climate patterns across the world. Yet neither the literature on climate change nor on loss and damage fully reflects the circumstances under which households (HHs) manage climatic stressors, resulting societal impacts, and the consequences of not being able to adjust sufficiently to negative impacts. Policymakers need better information, empirical data and analysis of both the challenges and the potential solutions.

In response to this need, the Loss and Damage in Vulnerable Countries Initiative carried out research to find out [how the impact of climate change on society leads to loss and damage among vulnerable HHs](#). This question is answered here with [findings from five countries across three major regions \(Bangladesh, Bhutan, Gambia, Kenya and Micronesia\)](#). This report is based on that research and serves as a resource for future research. It includes:

- **Research methods to assess loss and damage at local level:** The research approach developed for the Loss and Damage in Vulnerable Countries Initiative is a [model for community-based assessment of loss and damage](#). It employs a variety of methods, including a HH survey, focus group discussions (FGDs) and expert interviews. In addition, local meteorological and other relevant data was gathered and compared to local perceptions of changes in climatic stressors.
- **New empirical evidence:** A team of national and international researchers was deployed to five locations: Bangladesh, Bhutan, The Gambia, Kenya and Micronesia. The team gathered a large volume of quantitative and qualitative data (n= 1,769 HH surveys, and an additional 200 participants in FGDs and expert interviews) on climatic stressors, societal impacts, current adaptation and coping measures, and residual loss and damage affecting households in the communities studied.
- **Analysis of case study findings:** Case study evidence from the five diverse research sites generated answers to the question '[How does the impact of climatic variables on societal impacts lead to loss and damage among HHs in vulnerable countries like Least Developed Countries and Small Island Developing States](#)'. To bring insights into the significance of that evidence, an analysis section highlights [four current loss and damage pathways](#).
- **Policy reflections:** Drawing on the findings of the field research, global and national policy reflections are put forward for consideration by governments, multilateral and research institutions, and non-governmental organizations (NGOs) working directly with many of the world's most vulnerable populations.

## Summary of findings

- Satkhira is a coastal district in [Bangladesh](#). It faces the double threat of sea level rise and frequent cyclones. Both result in saltwater intrusion, which has a severe impact on rice cultivation, the mainstay of the local economy and the principal source of food for the majority of the population. Salinity in soils has increased sharply. Eighty-one per cent of the survey respondents reported high salinity levels in their soils, compared to just two per cent 20 years ago. To adapt to higher salinity in soils, farmers have planted new, saline tolerant-rice varieties. This strategy worked reasonably well until 2009, when cyclone Aila hit the area and caused a sudden and drastic increase of salt content in the soil. Almost all farmers in the area lost their complete harvest that year. In the two subsequent years, salinity levels were still too high and rice yields were extremely poor. The study estimates that between 2009 and 2011 the total loss of rice harvest amounted to US\$1.9 million for just the four villages surveyed. The findings from the Bangladesh study exemplify a case where seemingly successful measures to adapt to slow-onset processes are not strong enough to avoid loss and damage when the situation is aggravated by an extreme weather event.
- The loss and damage case study in [Bhutan](#) looked at the impact of changing monsoon patterns on rice cultivation. The monsoon rains are starting later and the total amount of rain has reduced sharply over the past two decades. This has implications for the availability of irrigation water. Rice farmers in the study area (Punakha district) have tried to adapt by modifying water-sharing arrangements between villages and by using water more efficiently. When this is not enough, they change from rice to crops that require less water. Eighty-seven per cent of the respondents indicated that these measures were not enough to avoid adverse effects of reduced availability of water. Moreover, the adaptation measures involve extra costs, both monetary and non-monetary.
- The North Bank Region in [The Gambia](#) is a drought-prone area. Meteorological data since 1886 show a strong decrease in average annual rainfall. In 2011, the region experienced a severe drought once again, resulting in very low crop yields for some and total crop failure for others. Ninety-seven per cent of the survey respondents experienced adverse effects of the drought on their HH economy. Most HHs tried to survive by finding alternative sources of money to buy food. This was difficult, however, because food prices rose and there was tough competition for scarce jobs. Other coping strategies, such as reliance on food relief and selling properties, were only partly successful or endangered future livelihood security. Despite these coping measures, sixty-three per cent indicated that they had to modify their food consumption because of the drought and low harvests. Some were forced to buy cheap, less nutritious food; others had to reduce portion sizes or the number of meals; and the worst-off had to do both.
- In December 2011, River Nzoia in Western [Kenya](#) broke its dykes and caused havoc in Budalangi Division. Crops were washed away, livestock drowned, houses were severely damaged and there was an outbreak of water-borne diseases. Flooding in this low-lying area on the shores of Lake Victoria is not a new phenomenon. However, floods have become more frequent and intense over the past decades. The case study in Kenya looked particularly at coping strategies in the aftermath of the December 2011 floods. Ninety-one per cent of the respondents received relief aid, often in camps. However, for many HHs the food that was distributed to them was not enough. The other coping strategies they adopted, such as the sale of draught animals to buy food or reconstruct their house, were found to have severe implications for future livelihood security.

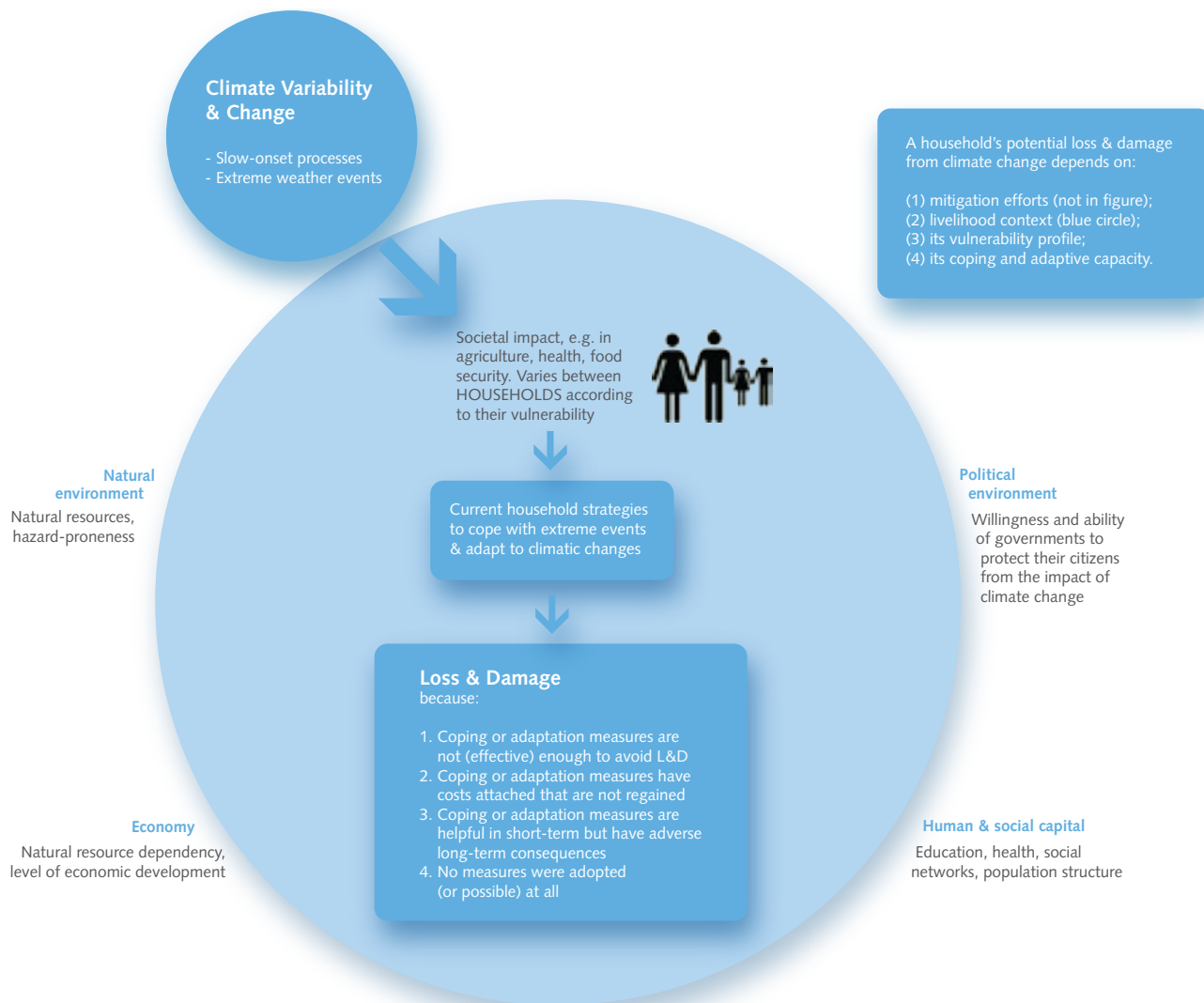


Figure 1: Household potential for loss and damage.  
Source: Kees van der Geest and Koko Warner (2012).

- The island of Kosrae in the Federated States of [Micronesia](#) has much higher levels of human and economic development than the other study sites. However, people in this Small Island Developing State (SIDS) are particularly vulnerable to climate change as the rising sea level is expected to exacerbate coastal erosion, inundation, storm surge and other coastal hazards. The case study shows that measures adopted in response to coastal erosion, such as building sea walls and planting trees along the shore, do reduce some of the adverse impacts. However, 92 per cent of the respondents who adopted adaptation measures reported that these are not sufficient and some have negative side effects. For example, big rocks from ancient ruins have been used to build seawalls, resulting in severe damage to the cultural heritage of the island. Compared to other case study sites, a relatively high proportion (40 per cent) of the respondents did not adopt any measures to counter coastal erosion or its adverse effects. Almost three-quarters said that they lacked the resources to do so, for example to build a sea wall to protect house and properties.
  
- The community-based research synthesized in this report for policymakers reveals [four different current pathways to loss and damage](#), in relation to how surveyed HHs use a variety of measures to adjust to climate stressors for specific aspects of their lives (such as food production, safety of assets, etc.). Residual impacts of climate stressors occur when:
  - existing coping/adaptation to biophysical impact are not enough to avoid loss and damage;
  - measures have costs (economic, social, cultural, health, etc.) that are not regained;
  - despite short-term merits, measures have negative effects in the longer term ('erosive coping');
  - no measures are adopted – or possible – at all.

Figure 1 helps illustrate the potential of HHs to incur loss and damage, showing how these four pathways to loss and damage can unfold.

### Summary of policy reflections

Vulnerable countries like those featured in this research are at the frontlines of both loss and damage realities today as well as policy discussions and the search for solutions. Loss and damage discussions under the United Nations Framework Convention on Climate Change (UNFCCC) have emerged as a distinct thematic area since the Cancun Agreements in 2010<sup>1</sup>, and today decision makers are grappling with both the current and future policy steps that will need to be taken in order to understand and address loss and damage. Most immediately, decision-makers will strive to reach a decision about how to deal with loss and damage in the climate negotiations at the 18th session of the Conference of the Parties (COP18 in Doha, December 2012). Decisions on loss and damage should consider:

- [Systematic support at community level to assess the risks of loss and damage](#). Communities are often left with no support to make choices about adaptation. Assessment tools are under discussion in the UNFCCC work programme and could be enhanced as part of the work under adaptation and loss and damage. These assessment tools must be accessible to communities and understandable to the lay person. In coping with extreme events, early warning information is essential.
  
- [Assess non-economic losses](#). The investigations also reveal that loss and damage today goes beyond quantifiable, formal sector economic impacts that can be measured in terms of physical assets or gross domestic product. Non-economic losses are documented in the case studies. Failing to measure these non-economic losses means that they could elude policy attention. Without explicit efforts

to assess these kinds of losses, policymakers may have a myopic view of both impacts and solutions.

- **Unknown victims, uncounted costs: call for international mitigation.** Adaptation, though positively framed, comes with costs and consequences for the communities that have to practise it. The UNFCCC needs to systematically take these facts and channel them to international decision makers to inspire the ambition urgently needed to reduce greenhouse gas (GHG) emissions.

### Addressing soft limits through resilience building efforts

The research showed that many HHs surveyed employ a variety of approaches to get by, although many of these have longer-term erosive implications for livelihoods and well-being. If social vulnerabilities to climatic and other stressors are the source of loss and damage problems, then improving social resilience provides some of the solutions.

- **Support for communities to increase resilience.** While there is often a mentioning of 'no-regrets' adaptation measures, the case studies reveal that in many cases the measures undertaken come with additional costs. Economic and other support to improve their resilience must be scaled up. This could include direct (international) financial support for the implementation of adaptation or mitigation measures, but also support for risk-sharing instruments like insurance or mechanisms to help lessen the distress caused by adverse impacts.
- **Improve sustainable development and welfare prospects for the communities.** Policies are needed that will promote investment in actions to enhance resilience – even if they are not immediately related to specific climatic stressors. For example, livelihood diversification, education and investments in gender equity may improve the ability of

communities to forestall reaching limits to adaptation.

- The findings also underline the importance of **strong community involvement** in decision-making on adaptation and mitigation measures, combined with independent technical assessments of potential consequences of any planned coping measures.

### Hard limits and impacts for which no measures can be adopted

In other areas, there are already **limits to adaptation at all levels** due to issues such as the scope of the biophysical impact (e.g., changes in the monsoon pattern) or the degree to which a society can deal with the impact (e.g., widespread poverty and climate-exposed livelihoods of a majority of a population). Policy approaches are needed that clearly set out the consequences of approaching and surpassing hard limits (at all levels). Tools are needed for identifying decision points and defining options for decision pathways.

- **Comprehensive assistance to national governments** towards setting up supportive frameworks. While there are vulnerability assessments related to climate change in many countries, more substantive and systematic national approaches to assessing and addressing loss and damage faced by vulnerable communities are rare. National governments need to be able to monitor these threats in order to respond in time (e.g., in case of extreme weather events) and prepare measures to ensure food security, market interventions as appropriate, etc. These may be supported by the establishment of a permanent institutional mechanism to address loss and damage, regionally or internationally.
- **Increase profile of loss and damage in national policymaking.** Given the potential threats in many countries,

it is important to raise the political profile of loss and damage risks associated with climate change impacts.

→ [Advance threshold notification systems](#). The research has shown that current negative impacts are already translating into societal and/or individual loss and damage. More research investment is needed, in both natural and social science, to enable forecasting of these thresholds with the aim to operationalizing threshold notification systems to guide national and international policy.

### The scope of this report

This report does not provide global or national estimates of loss and damage related to any specific manifestation of climate change currently or in the future, nor does it perform exhaustive studies on loss and damage in all vulnerable countries or assess loss and damage at the national level. The research methods employed do not yield insights into attribution of climatic stressors to underlying causes of these stressors. The extent to which local climatic changes and extreme events can be attributed to climate change is an issue beyond the scope of this research.

Instead, the report lays out evidence of current relationships between climatic stressors, societal impacts, responses and residual loss and damage. The authors hope that this report will be useful in discussions of where loss and damage pressures exist today in climatic stressors and societal impacts, and where they may emerge in the future. The research presented here contributes to local scale, empirically based case studies within the practical time and resource limits implied (the case studies were designed to be relevant to decision-making processes in 2012 and to the drafting process of the 5th Assessment Report of the Intergovernmental Panel on Climate Change (IPCC)).

The research results presented here were generated from local case studies. The research faced limitations in assessing potential

future impacts and how to deal with them, and relied on HH responses (perceptions and expectations) and interpretations of the analysis about the present as an early indicator of the future. The case studies should be treated as points of departure for further research. The case studies focus on the impacts of climate threats on people in vulnerable areas and their responses to such threats.







# 1. Introduction

Science and policy are on a quest to better understand the consequences of climate change for society, and what those consequences might be if society and the ecosystems upon which it depends are unable to adjust completely or in the necessary time-frame. Geologic records indicate that profound shifts in earth systems and life forms have accompanied climatic changes in the past. In the anthropocene era, the interaction of humans with changing natural environments leads to patterns of loss and damage that affect society. This is the story of loss and damage which this Report begins to tell, using evidence drawn from empirical studies in Bangladesh, Bhutan, The Gambia, Kenya and Micronesia, commissioned as part of the Loss and Damage in Vulnerable Countries Initiative ([www.lossanddamage.net](http://www.lossanddamage.net))<sup>ii</sup>.

## 1.1 Emerging area for science

There is a growing realization in the field of science that new perspectives are needed to understand what the impacts of climate change will mean for society, especially in areas with a limited ability to adapt to some or all of those impacts.

Scientists are exploring the impacts of climate change driven by human action affecting the concentration of GHGs in the atmosphere, which in turn affects atmospheric and ocean temperatures. Recent reports from the IPCC (2007, 2012) affirm that human-induced factors are responsible for generating significant rises in temperatures around the world, with serious impacts on specific socio-ecological systems. The energy basis for the development of industrialized societies is the driving force behind global climate change.

Climate science has already established the range of impacts expected to accompany increases in atmospheric GHG concentrations and associated temperature rises: increases in the rate of sea level rise; increases in glacial, permafrost, Arctic and Antarctic ice melt; more rainfall in specific regions of the world and worldwide; more

severe droughts in tropical and subtropical zones; increasing heat waves; and more intense hurricane and cyclone activity. All of these changes are projected to affect natural systems globally, inducing alterations in hydrological, terrestrial, biological and aquatic sub-systems.

The potential impacts of unmitigated anthropogenic climate change have significant implications for the current organization of society. All of these changes have great potential for generating processes that affect large numbers of people, requiring a variety of adjustments to avoid and manage serious losses and damage. For example, sea level rise could redefine the borders of some countries, desertification and glacial melt could shape the habitability of large areas of the world where people rely on arable land and freshwater for survival, and temperature change could affect plant fertility and biodiversity. Failure to address loss and damage in a timely way could leave communities unprepared to manage and adjust to these changes.

## 1.2 Emerging area for policy discussions

The topic of climate change impacts has [major implications for policy discussions](#). One of the emerging and pressing policy questions concerns the way in which climate change might affect society, particularly when [communities face economic, political and social limitations in their ability to adjust to the biophysical as well as social implications of climate change impacts](#) (at community, national, regional and international levels).

Science and policy thinking need to be re-shaped around interactions between climate impacts and society. This Report contributes to that effort by [illustrating the relevance of the concepts of social vulnerability and social resilience to understanding how climate change impacts translate into loss and damage for society](#).

The United Nations Framework Convention on Climate Change (UNFCCC) was created to address the drivers of climate change, prevent dangerous anthropogenic interference with the Earth's climate system, and address the adverse effects of climate impacts in a way that would allow ecosystems (and human systems dependent upon them) to adjust in non-disruptive ways.

*"The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the*

*Convention, stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner."*

*United Nations Framework Convention on Climate Change, Article 2*

### Assessing and addressing loss and damage: the Subsidiary Body for Implementation Work Programme on Loss and Damage

At COP16 (held in Cancun, Mexico in December 2010), the Conference of Parties decided to establish the Work Programme on Loss and Damage under the Subsidiary Body for Implementation (SBI). The Cancun Adaptation Framework recognized *“the need to strengthen international cooperation and expertise to understand and reduce loss and damage associated with the adverse effects of climate change, including impacts related to extreme weather events and slow onset events”* (para 25).

The Cancun Adaptation Framework asked the SBI to make recommendations on loss and damage to the Conference of the Parties for its consideration at COP18 (para 29), as well as to strengthen international cooperation and expertise to understand and reduce loss and damage associated with the adverse effects of climate change. Decision 1/CP.16 also suggests that the SBI should strengthen international cooperation and expertise to understand and reduce loss and damage associated with the adverse effects of climate change, including impacts related to extreme weather events and slow onset events.

The idea that climate change could be accompanied by **loss and damage – the actual and/or potential manifestation of climate impacts that negatively affect human and natural systems** – has emerged over three broad phases of policy discussions since the early 1990s. These are described briefly below.

#### Mitigation and avoiding dangerous climate change

Historically, the underlying UNFCCC discourse on loss and damage – and, more broadly, on the impacts of climate change on society – has evolved along two parallel lines. From the early 1990s to the early 2000s, dialogue was characterized by an emphasis on mitigation: avoiding the causes of climate change first and cautioning polluters with the ‘polluter pays’ principle. The potential impacts of extreme weather events and longer-term impacts relating to sea level rise, glacial melt, desertification, etc. were considered politically unacceptable topics but built a strong case for ambitious mitigation. The early focus was on cautioning high-emitting countries about the consequences of not curbing their emissions (e.g., polluter pays principle).

#### Adaptation and adjusting to climate change impacts

A second strand of discussion focused on adaptation. It was taken up at least from the time of the adoption of the Kyoto Protocol in 1997 (a reason why the review process was built into the Protocol). The IPCC 2<sup>nd</sup> Assessment Report (IPCC, 1996) recommended stabilization of GHG emissions at the levels current at the time – and that an immediate reduction of 50–70 per cent was needed. However, by the middle of the decade 2000–10, and certainly with the publication of the IPCC 4<sup>th</sup> Assessment Report in 2007, discussions reflected a realization among scientists and policymakers that emission targets might be too low to prevent climate change and some of the negative impacts associated with it. Hence, it would also be necessary to discuss adaptation and negative impacts of climatic change on society. Scientists and policymakers agreed that some impacts of climate change might already be manifest and that adaptation was a necessary complement to mitigation in order to cushion the blow to communities from some of the expected impacts of climate change, including loss and damage.

Today, Parties and the international community have begun asking how to prepare for the possible consequences of climate change, in particular associated changes in ecosystems and society that may become increasingly difficult, or no longer possible, to adjust to sufficiently or in time – areas of concern highlighted in Article 2 of the UNFCCC. Questions arise about how to deal with those negative biophysical impacts of climate change for which no clear, practicable alternatives exist within the boundaries of our current values, culture and economic systems.

On a larger scale, some of these consequences might be seen as climate change affects the functionality of some low-lying island countries. Further questions arise about how to deal with potentially reduced habitability of coastal zones and dryland areas – many of which host dense human population concentrations, including megacities. The potential changes that science suggests may be felt as early as this century raises questions about the ability of environmental systems to adjust naturally. Further questions arise about whether food production, the associated livelihoods of an estimated 2.6 billion people (FAOSTAT 2010<sup>iii</sup> agricultural population according to the Food and Agriculture Organization of the United Nations (FAO) definition including farming, hunting, forests and fisheries) will be able to continue in a sustainable manner.

### 1.3 Working definition of loss and damage

'Loss and damage' is a new concept in climate change research, such that no commonly accepted definition is available yet. To inform the research questions and methods, the research team used a working definition of loss and damage as a baseline for common understanding of the concept *at local level*:

*Loss and damage refers to negative effects of climate variability and climate change that people have not been able to cope with or adapt to.*

This definition includes inability to respond to climate stresses (ie the costs of inaction) and the costs associated with existing coping and adaptive strategies (cf. erosive coping strategies and mal-adaptation). Such costs can be monetary or non-monetary. Loss and damage is also related to mitigation, as the potential costs of future climate change depend to a large extent on the intensity of climatic disruptions which depend on mitigation efforts globally.

The case study research looks at people's perspectives on loss and damage, while acknowledging that losses and damages are also incurred at higher levels of scale. Loss and damage associated with the negative effects of climate change varies between HHs and between countries or regions because of different levels of vulnerability (exposure and resilience). Levels of vulnerability can change over time, for example because of changes in livelihood contexts. Policies to address loss and damage can focus on combating the intensity of climate change (mitigation), reducing vulnerability and supporting coping and adaptive capacity.

This broad working definition includes some further caveats:

- A continuum: Loss and damage includes the full range of climate change-related impacts from (changes in) extreme events to slow-onset processes, and combinations thereof. For example, the 'process' of glacial melting can lead to the harmful 'event' of glacier lake outburst flood. To address loss and damage it is necessary to understand the kinds of events and processes that are associated with the adverse impacts of climate change.<sup>iv</sup> Loss and damage impacts fall along a continuum, ranging from 'events' associated with variability around current climatic norms (e.g., weather-related natural hazards) to 'processes' associated with future anticipated changes in climatic norms in different parts of the world. Loss and damage encompasses both incurred loss and damage and future loss and damage.
- Multiple temporal and spatial scales: Loss and damage encapsulates historic and present (occurring and observed) manifestations of climate change impacts as well as those that will occur in the future. Potential loss and damage by definition relies on assumptions regarding parameters such as emissions, vulnerability and exposure variables of the affected human (or natural) system. Today, loss and damage arising from climate change impacts is mostly a local problem with changes in extreme events and slow-onset impacts. Future loss and damage is potentially of inconceivable magnitude – especially considering non-economic values and the interconnectivity leading to cascading, transnational effects. The concept of tipping points in climate, natural and societal systems – a moment where profound and potentially irreversible system changes occur – is an important factor in weighing potential loss and damage.
- Human and natural systems: Loss and damage refers to impacts on human systems, which are often channelled through the negative impacts of climate change on natural systems. For example, sea level rise and glacial melt result from climate change stimuli, and these shifts in natural systems in turn result in loss and damage to human systems, such as loss of habitable land or fresh water. Additionally, characteristics of human systems (like development policy, poverty, etc.) affect the dependency of human systems on natural systems. Yet this connectedness does not change the fact that climate change impacts drive the loss and damage, which occurs through the 'path' of natural system shifts and their effects on human systems.
- Negative impacts: Loss and damage is an undesirable phenomenon of climate change impacts and does not include the impacts from managing climate change itself, which is discussed under the policy forum of response measures.



## 2. Methods

The research presented here generated original data, using a systematic research frame on loss and damage. The case studies collected primary data during fieldwork. This section summarizes the research frame for the case studies.

The CDKN case studies on loss and damage have three research goals:

1. To understand how the interaction of climatic variability and climate change with livelihoods (and other aspects of human well-being, like housing and health) and with social and physical assets creates [particular patterns of loss and damage today](#) in the context of broad ecosystem types in least developed countries.
2. To start understanding [how these factors might interact in coming decades](#), as the impacts of climatic variability and climate change manifest themselves more prominently.
3. In the context of climatic variability and climate change, to gain a better understanding of [what combinations of policies can reduce loss and damage, and improve resilience to the adverse impacts of climate change in vulnerable countries](#). The case studies will explore such policy alternatives in hotspot areas.

### 2.1 Research domains and questions to help address knowledge gaps on loss and damage

In order to better understand patterns of loss and damage in a Least Developed Country (LDC) context, in different ecosystems, the CDKN case studies gathered data in four research domains:

- **Climate stressor:** Manifestations of climate variability and climate change in specific ecosystems (for example, rainfall variability, droughts, floods, glacial melt, sea level rise, etc.). This could involve extreme weather-related events and more gradual changes.
- **Societal impact:** Societal impacts of the physical climatic drivers that are of importance in a particular ecosystem (for example, impact on food production, livelihood security, health, damage to physical assets, etc.).
- **Responses:** What is done to cope with and adapt to the societal impacts of extreme weather-related events and more gradual changes in the climate? The terms 'coping' and 'adaptation' are often used synonymously (Birkmann, 2011). This is problematic because they involve different types of responses to different types of stresses. In the loss and damage case studies, coping strategies were defined as short-term responses to the impacts of sudden events. Adaptation was defined as longer-term responses to more gradual changes.
- **(Residual) loss and damage:** What are the limits of coping with sudden events? What are the limits of adaptation to more gradual changes? What happens to a HH when it cannot cope or adapt further (e.g., limits of coping and adaptation are exceeded)? What are the effects of climate variability/change that people have not (yet) been able to avoid? This includes: (1) inability to cope or adapt; and (2) the consequences/costs associated with the inability of existing coping and adaptive strategies to fully avoid or reduce loss and damage. These costs often elude quantification but have high societal relevance and justify research.

Country	District/Region	Climate threat	Impact
Bhutan	Punakha	Changing monsoon	Rice production
Micronesia	Kosrae	Coastal erosion	Housing
Bangladesh	Satkhira	Salinity intrusion	Rice + drinking water
The Gambia	North Bank	Drought	Millet production
Kenya	Budalangi	Flooding	Crops, livestock + fish

Table 1: Climate stressors and societal impacts.

Source: Authors (2012).

Across the case studies, an attempt was made to answer the same type of research questions, while focusing on different climatic stresses and societal impacts (in red). Societal impacts can involve loss of physical assets, negative effects on livelihood sources and other aspects of human well-being – for example, housing and health.

#### Central question

How does the impact of [climate variable] on [societal impact] lead to loss and damage among HHs in [location]?

The central research question was addressed through sub-questions 1 to 4. Sub-questions 5 and 6 addressed the second and third objectives of this research (future loss and damage, and policy options to address loss and damage).

#### Sub-questions

1. What trends in [climate variable] are discernible?
  - a. According to regional literature and secondary data, e.g., changing rainfall patterns, frequency and severity of droughts and floods
  - b. In people's perceptions
2. What is the impact of [climate variable] on [societal impact]?
  - a. According to secondary data, e.g., correlation between rainfall and crop yields
  - b. In people's perceptions
3. How does the impact of [climate variable] on [societal impact] vary across HHs in the area?
  - a. The impact varies according to HHs' vulnerability profile



4. How do HHs deal with the impact of [climate variable] on [societal impact]?
  - a. Short-term coping with extreme events
  - b. Long-term adapting to more gradual changes
5. What kinds of losses and damages (costs?) are incurred as a result of the impact of [climate variable] on [societal impact]?
  - a. Inability to deal with this impact
  - b. Losses and damages associated with current ways of dealing with this impact?
6. What kinds of losses and damages can be expected as a result of the impact of [climate variable] on [societal impact] in the next two to three decades?
7. What can be done to reduce loss and damage from [climate variable]?

## 2.2 A mixed-methods social science approach to assessing loss and damage at local level

In the nascent body of literature on loss and damage, the case studies conducted for the Loss and Damage in Vulnerable Countries Initiative represent a first generation of research that systematically assesses residual impacts of extreme weather events and slow-onset climatic changes at **HH level**. The methods developed for this project build on earlier research experiences at UN University, such as the 'Where the rain falls' project (Warner et al., 2012; Rademacher-Schulz et al., 2012), supplemented with insights from the rich tradition of fieldwork-based studies of livelihood vulnerability, coping and adapting, particularly in rural agricultural environments (see van der Geest and Dietz, 2004). This methodology is described below and the research instruments are available at [www.ehs.unu.edu](http://www.ehs.unu.edu) and [www.lossanddamage.net](http://www.lossanddamage.net).

The loss and damage case studies used a mixed-method approach, combining qualitative research tools (FGDs and in-depth interviews) with a questionnaire survey. In preparation for each case study, a desk-study was conducted to collect and analyse existing regional and thematic literature and secondary data that served as an input to final decisions about research design and selection of climate threats and impact sectors on which to focus. The in-depth interviews focused on collecting details of the experiences of loss and damage from a limited number of people in the research areas. The questionnaire aimed to generate reliable estimations of the numbers of people in the research areas experiencing different climate change impacts and their strategies to deal with climate pressures and shocks. The aim of the FGDs was to gather information that allowed for a better interpretation of patterns of loss and damage reported by HHs in the questionnaire data.

Below, the following methods will be described: desk study; HH survey; FGDs; key expert interviews; and in-depth interviews.

### Desk study

The desk study consisted of a literature review and an analysis of existing data about climate threats (e.g., drought, floods, cyclones, sea level rise) and impact sectors (e.g., crop yields, salinity intrusion and coastal erosion). The literature review focused on relevant existing knowledge about impacts of climate change, coping mechanisms and adaptation. In most cases, the climate threats focused on were not new. Farmers in the Sahel, for example, have had to cope with recurring droughts since time immemorial. Impacts of and responses to drought in the Sahel have been studied extensively, and our work built on that knowledge. We go a step further by exploring the limits of coping and adaptation or the impact of climate stressors beyond coping and adaptation.

The desk study also served to assess existing data on direct losses and damages after extreme weather events, for example the 1994 glacier lake outburst flood in Bhutan and cyclones Sidr (2007) and Aila (2009) in Bangladesh.

### Household survey

A questionnaire survey with a sample size of between 273 and 400 HHs was conducted for each case study. A template questionnaire was designed that was later adapted for each case study to suit its thematic focus and characteristics of local livelihood systems and environments. The questionnaires had approximately 10 pages and interviews usually took 45 minutes to an hour. The questionnaires had four sections. The first section focused on socio-economic and demographic characteristics of the HH and their sources of food and income. The information gathered in this section could be used to create vulnerability profiles, comparing HHs in one location or across case study areas. Sections 2 and 3 focused on impacts of extreme weather events and slow-onset processes. Here an attempt was made to go to the core of the project's research questions about impact, coping, adaptation and residual impacts. Open questions were combined with closed question to optimize the balance between listening to the voices of vulnerable people and being able to quantify how widespread different impacts and responses are.

### Focus group discussions

FGDs were organized to gather the detailed background information needed to correctly interpret questionnaire data and to address questions of a more qualitative nature that would provide more context than survey data alone. The focus was on the complex dynamics between the key concepts of this research, such as climate variability and changes, societal impacts, vulnerability, coping, adapting and residual impacts. The FGDs yielded

qualitative information about how climate variability and climate change can lead to losses and damages among local populations. Key-words here are process and pathways of loss and damage. Another advantage of conducting FGDs was that it allowed the researchers to identify different experiences of men and women, young and old, and of different occupational groups (e.g., crop cultivators, pastoralists, labourers, traders) and wealth groups. This was achieved by having separate sessions for men and women, and other specific groups.

### Key expert interviews

Key informants were interviewed to obtain information that would not easily be obtained from PRA sessions and the questionnaire survey, for example about the activities of government agencies and NGOs in the area, particularly those aiming to address the adverse effects of climate variability and climate change. In addition to the officials interviewed, some case study researchers identified key resource people in their research areas who had specific knowledge about interest areas, such as a man in Kenya who was able to predict when and where dykes would break.

### In-depth interviews

A selected number of questionnaire respondents were interviewed in more depth to hear personal stories of impacts, responses and residual loss and damage. Questionnaire enumerators were instructed to alert the principal investigator when they came across respondents who were able and willing to share relevant personal accounts. The in-depth interviews focused on respondents' experiences with weather-related extreme events and slow-onset changes. These stories are used in the case study reports and future publications in the form of boxes and quotes.

### 2.3 Fieldwork: team composition and division of labour

Each research team consisted of a principal investigator, a note taker and five to ten questionnaire enumerators. For all case studies, the researcher was a citizen of the country where the work was done. In the case of Bhutan and Micronesia, an international researcher supported the national team during preparation, fieldwork and reporting. The principle investigators conducted all qualitative research (PRA sessions, key informant interviews and in-depth interviews) with the assistance of a person who took notes during the day and entered the qualitative data onto the computer at the end of the day. The principle investigators also organized 2–3-day training sessions for the questionnaire enumerators before the fieldwork started.





### 3. Empirical findings: loss and damage today in vulnerable communities across the world

This section summarizes findings from the CDKN Loss and Damage in Vulnerable Countries Initiative case studies. The findings are based on field research in the five countries covered by the project: Bangladesh, Bhutan, The Gambia, Kenya and Micronesia (in 2013, research will be completed in Nepal with CDKN, as well as research in Burkina Faso, Ethiopia, and Mozambique with CDKN and the Africa Climate Policy Center).

#### 3.1 Household characteristics in districts sampled

Each research site manifested particular characteristics, but the median values provide a snapshot of the populations across the investigation areas. Table 2 summarizes the HHs surveyed in districts in five countries. The last column of the table shows the median values for the respective rows.

Each research site manifested particular characteristics, but the median values provide a snapshot of the populations across the investigation areas. Each study surveyed between 270 and 400 HHs, with 1,769 HHs surveyed in total; also included were more than 200 individuals who participated in FGDs and expert interviews.

Research area	Bangladesh Shyamnagar (sub-district of Satkhira)	Bhutan Punakha District	The Gambia North Bank Region	Kenya Budalangi (division of Bunyala District)	Micronesia Kosrae State	Median values
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#### Survey overview

Population in research area (inhabitants)	265.004	25.650	172.835	53.356	6.616	
Proportion of research area population (%)	0,7	6,2	3,0	5,3	36,6	5,3
Households in survey (total = 1769)	360	273	373	400	363	
Average household size	5,51	5,86	13,82	7,07	6,67	6,67
Dependency ratio (average)	0,504	1,268	1,659	1,09	0,861	1,090
Religion (%)	Muslim (59.7) Hindu (38.9)	Buddhist (96.7)	Muslim (98.6)	Christian (100)	Christian (99.7)	

#### Age, gender, and education characteristics

<i>Age (average)</i>				46,25		
Respondent	41,19	48,84	50,56	48,61	49,99	48,84
Household Head	46,26	50,7	52,46		53,04	50,70
				20,5		
Female HH-H (%)	3,7	60,7	2,6	46,5	16,2	16,2
Female respondents (%)	30,6	62,6	13,9		35,3	35,3
				7,1		
HH-size (avg)	5,51	5,8	16,59		6,67	6,67
<i>Education Household Head (%)</i>				13,8		
None	39,1	84,1	20,4	14,3	0,0	20,4
Literacy / Madrasa	N/A	1,9	59,5	44,4	0,0	8,1
Primary	23,9	7,4	10,7	26,0	5,0	10,7
Secondary/tertiary	36,7	5,6	9,3	98,5	95,0	26,0
Total education	99,7	99	99,9		100	99,7

Research area	Bangladesh Shyamnagar (sub-district of Satkhira)	Bhutan Punakha District	The Gambia North Bank Region	Kenya Budalangi (division of Bunyala District)	Micronesia Kosrae State	Median values
<i>Household economy characteristics</i>						
<i>Household economic activities (%)</i>						
Crop cultivation	98,3	93,2	98,9	98,3	70,5	98,3
Livestock keeping	94,2	80,2	100	83,0	67,5	83,0
Non-farm activity	64,7	60,7	66,9	68,8	68,4	66,9
<i>Own land (%)</i>						
Size cultivated land (acres)	1,2	2,1	N/A	1,4	0,4	1,3
Irrigated land (%)	73,6	96,2	13,2	14,0	17,6	17,6
<i>Main purpose crop production (%)</i>						
Household consumption	85,1	76,9	84,3	93,8	94,9	85,1
Sale	14,9	10,9	15,7	6,2	4,7	10,9
<i>Crop sales (US\$) per annum</i>						
Average household income (US\$)	846	1743	756	1001	7711	1001
Proportion income from crop sales	15	19	30	12	4	15
<i>Trend in crop production</i>						
Decrease	75,9	30,0	87,7	77,7	40,0	75,9
Increase	22,5	34,5	10,7	19,1	13,0	19,1

\* Definition of dependency ratio: Ratio of HH members typically not in the labour force (the dependent part: age range 0-14 and >64) and those typically in the labour force (the productive part: age range 15-64). It is used to measure the pressure on productive HH members.

Table 2: Summary of households surveyed in five districts.  
Source: Loss and damage case studies fieldwork (2012)

The median value for the proportion of research area population was 5.3 per cent, but in Kosrae 36.6 per cent of the research area population was surveyed. Median HH size across the cases was 6.7. The median age of heads of HHs was 50.7. Of the HHs surveyed, a median value of 16.2 per cent was headed by women (with 35 per cent of overall survey respondents being female). The median dependency ratio for the case studies was 1.09. The surveyed HH dependency ratio is the highest in the research site of The Gambia (1.66), followed by Bhutan (1.26). This means that in The Gambia, on average, every active HH member corresponds to 1.66 inactive (dependent) HH members. The end of the spectrum is the research site in Bangladesh where, on average, every active HH member corresponds to only 0.5 inactive (dependent) HH members.

Religious affiliation appeared relatively homogenous in the districts surveyed, with over 96 per cent of all HHs surveyed belonging to the same broad faith (with the exception of Bangladesh, where almost 60 per cent surveyed were Muslim and 38.9 per cent were Hindu). Education levels of HH heads were notably low in Bhutan, where 60 per cent of the surveyed HHs were led by women and where 84 per cent of those HHs had no formal education. Education of HH heads was highest in Kosrae, Micronesia, with 95 per cent having received secondary or tertiary education.

The HHs studied were highly sensitive to climatic disturbance because of livelihoods based on farming (98.3 per cent) and livestock keeping (median value of 83 per cent). HHs also engaged in non-farm activities – typical for most rural economies – with the median value of 67 per cent. Crop cultivation was lowest for Micronesia, at 70 per cent of HHs surveyed. All other districts surveyed engaged above 96 per cent in crop cultivation for HH economic activities.

Median land ownership was 90 per cent across all HHs surveyed, with the highest in The Gambia (97 per cent) and Micronesia (91.7 per cent). Despite these high levels of engagement in crop cultivation, access to land of sufficient quality to support HH food consumption and income needs was an important issue in the research areas. The average area of land under cultivation for HHs across all sites was 1.28 acres (excluding grazing land for livestock).

For most HHs surveyed the main purpose of cultivating crops was HH consumption – the median value was 85 per cent, with 94.9 per cent of HHs surveyed in Micronesia cultivating crops for their own consumption. A median value of 10.9 per cent of surveyed HHs primarily engaged in cultivating crops for the purpose of selling the produce. Trends in crop production show HHs reporting a median value of 75.9 per cent decreases, with The Gambia reporting 87.7 per cent decreases in crop production.









Figure 2: The research area in Bangladesh: Shyamnagar Sub-district. Map created by CIESIN. See technical annex for details.

### 3.2 The limits of adaptation in Shyamnagar, Bangladesh: loss and damage associated with salinity intrusion<sup>v</sup>

Of all areas in the world, the coastal zone of Bangladesh is among the most vulnerable to climate change. One particular problem is the occurrence of cyclones and storm surges, which cause low-lying coastal areas to overflow with salt water. This has resulted in a gradual increase in soil salinity over the last 20 years.

A study of 360 HHs in four villages in the coastal district of Satkhira explored how this affects rice production, how people are adapting to it, and whether adaptation measures are enough to avoid adverse impacts. The study found that the introduction of saline tolerant rice varieties is the most important adaptation measure. It has successfully limited the negative effects of saline intrusion. In 2009, however, a major cyclone led to a sudden and drastic increase in salt level in the soils – exceeding the

tolerance level of the cultivars that farmers have at their disposal. As a result, rice yields have decreased drastically in the years since the cyclone. This case thus highlights the limits of adaptation.

#### What is the climatic stressor?

The gradual increase in salinity levels has been exacerbated by the increased severity and frequency of cyclone and storm surges. Increased saline levels in the soil have severe adverse effects on crop yields, livelihoods and the health of the affected communities. Eighty-one per cent of the 360 HHs surveyed currently experience high salinity in their rice fields, compared to just two per cent a decade ago.

#### What is the impact?

Increased salinity in the soils negatively affects the production of rice – the most important agricultural crop in the coastal zone and the source of food for most Bangladeshis. Higher salinity levels in water sources also have severe negative impacts on people's health and well-being. Women have reported changes in menstruation when salinity levels were high, as well as more incidences of miscarriage. There have also been an increasing number of water-borne diseases such as diarrhea and dysentery, primarily affecting children. Several studies have shown that such health problems in Bangladesh can be attributed to a large extent to the consumption of salty water (e.g., Khan et al., 2011; Abedin et al., 2012).

#### How do affected populations adapt to saline intrusion?

The research found that over the last 20 years farmers have been adapting their practices to deal with increased soil salinity. Some farmers 'wash' their rice fields with water to reduce the soil's salinity content. For this, they may have to purchase fresh water from neighbouring canals and ditches, or build additional irrigation channels. Others raise their seedbeds with fresh soil

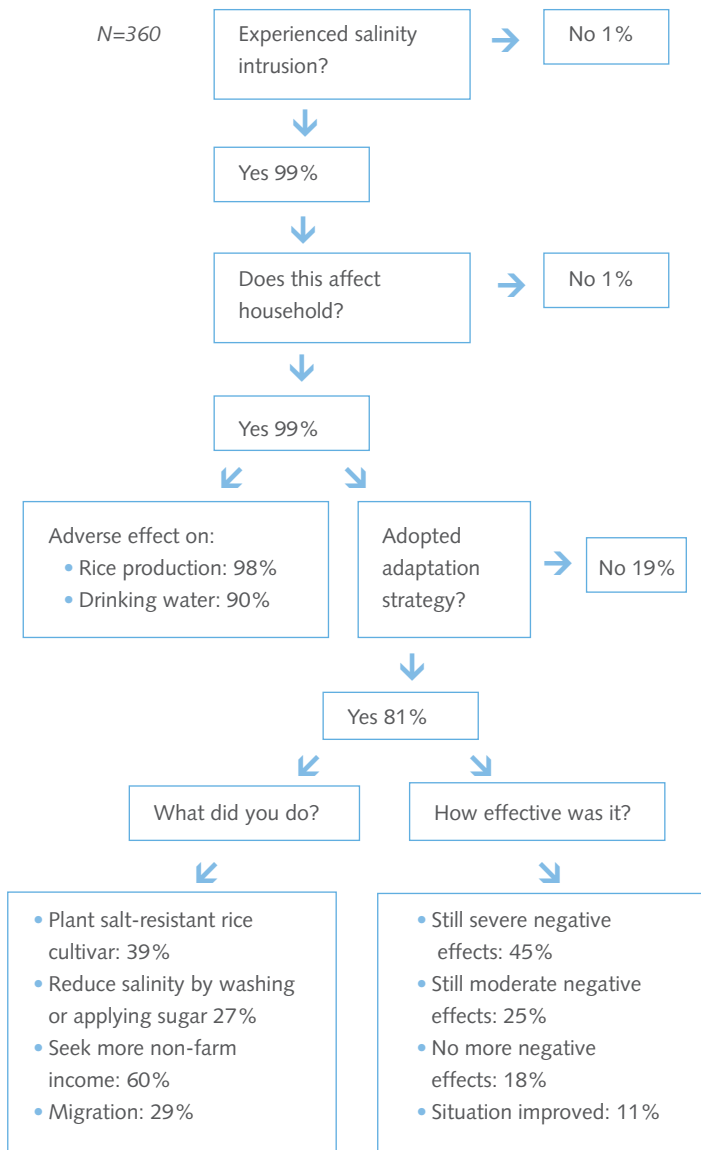


Figure 3: Summary of findings in Bangladesh.  
Source: Fieldwork; questionnaire survey (2012).

and some innovative farmers have even started applying sugar to the rice fields to reduce salinity. The most important adaptation, however, has been the adoption of new saline-tolerant rice cultivars, which have been developed by national research institutes.

#### What is the loss and damage?

The saline-tolerant varieties of rice have enabled farmers in Bangladesh to continue producing rice despite gradually increasing salinity levels – at least until 2009. After cyclone Aila hit the country in May 2009, the salinity content of the soil in the research area rose to a level that even the improved cultivators could not handle. The cyclone led not only to an immediate loss of harvest: the higher salinity level it left behind also significantly decreased rice harvests in the consecutive years. It is estimated that between 2009 and 2011 cyclone Aila resulted in a loss of US\$1.9 million for the four villages surveyed.

#### What is next?

The severity of cyclone Aila exposed how truly vulnerable coastal regions are to salinity intrusion. Based on the study findings it is evident that farmers can no longer keep pace with increasing salinity in their soils. As a result, government investment in large-scale infrastructure, such as embankments, and rain water harvesting systems, is necessary for reducing the loss and damage associated with salinity intrusion. Measures must also be taken to improve the economic resilience of affected HHs. Improving non-farm income earning capacity is crucial for HHs to recover after a disaster. Educating communities regarding the danger of consuming salinity intruded water is also crucial. Due to the poverty in the region, loss of productivity due to illnesses associated with drinking contaminated water is more likely to severely affect HHs.



Figure 4: Extent of Cyclone Aila (2009) over Southwest Bangladesh. Map created by CIESIN. See technical annex for details.

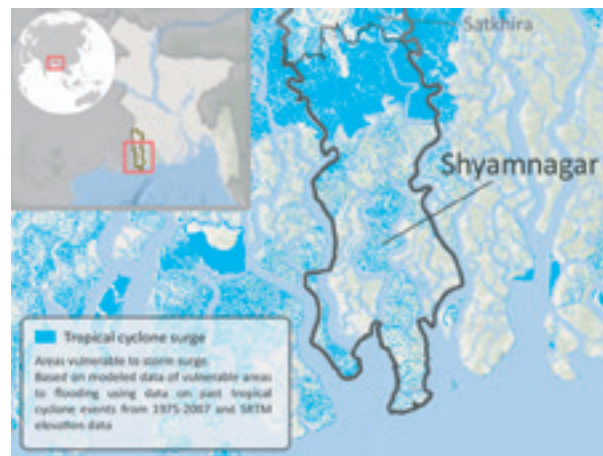


Figure 5: Vulnerability to storm surges caused by tropical cyclones in Shyamnagar Sub-district, Bangladesh. Map created by CIESIN. See technical annex for details.

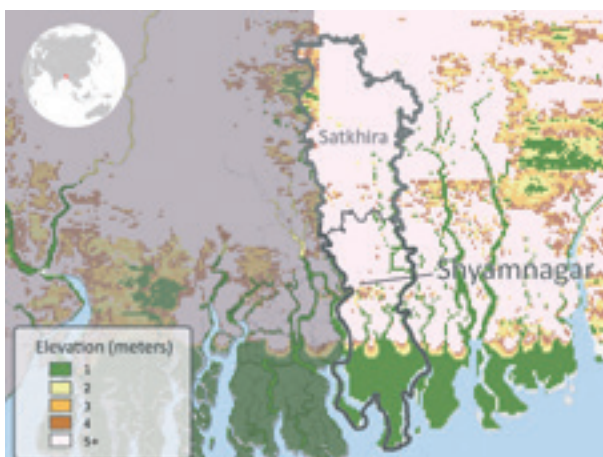


Figure 6: Elevation map for Satkhira District, Bangladesh. Map created by CIESIN. See technical annex for details.

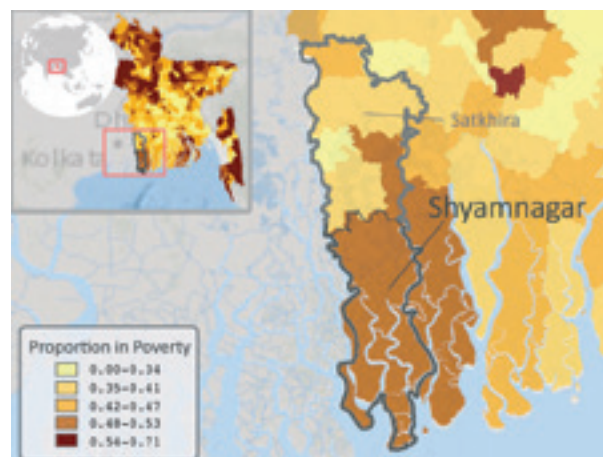


Figure 7: Proportion of population in poverty in Satkhira District and Bangladesh. Map created by CIESIN. See technical annex for details.

### An example of loss and damage: Trying to keep up with increasing salinity

Compared to other people in the village of Jelekhali, Noren-dranath Mondol (82 years old) is better off. He owns seven acres of land, which he uses for rice cultivation. In addition he owns a large fishpond. Until about 10 years ago, the traditional rice varieties that he cultivated yielded five to six tons of rice per acre every year. When he noticed that his rice yields were going down because of increasing salinity in his soil, he adopted a new salt-tolerant variety (BRRI dhan 47) developed by the Bangladesh Rice Research Institute. This helped. His yields were even higher than before. However, in 2009 when cyclone Aila hit the area and inundated most of the land, the salinity was far too high for the new variety. He says, *"I didn't get a single bag of rice from my seven acres in 2009 and in the past two years the harvest has also been extremely poor. This year we started cultivating a rice variety that has even higher salt tolerance. It's called BINA 8. We prefer the older varieties because they look thin and attractive and we are used to this kind of rice. But if we can get the best yields with BINA 8, then that's what we will produce."* Cyclone Aila caused havoc not only to Noren-dranath's rice farm: all his fish died when the pond was flooded with salty water. He estimates the total loss of fish at 85,000 taka (US\$1,040). Another problem for him is that healthcare expenses for his family increased sharply after Aila. He said: *"Nowadays I pay more than 5,000 taka (US\$61) per month for treatment of water-borne diseases. I have a filter at my home to clean pond water but it's just not enough."*











Figure 8: The research area in Bhutan: Punakha District. Map created by CIESIN. See technical annex for details.

### 3.3 The costs of adaptation in Punakha, Bhutan: loss and damage associated with changing monsoon patterns<sup>vi</sup>

Changing monsoon patterns are affecting the livelihoods of small-scale farmers in Bhutan, who depend on these rains to irrigate their rice fields. A study in Punakha District identified various ways in which respondents try to adapt to the changes in water availability, such as shifting crops, developing water-sharing mechanisms and intensifying the maintenance of their irrigation channels. These measures are mostly considered insufficient. Moreover, they come with extra costs – in terms of money as well as in terms of time, social cohesion and livelihood security.

#### What is the climatic stressor?

Several recent studies have noted changing rainfall patterns in the Himalayan region, but much is still unclear about the direction of these changes and their local manifestations. In Punakha District,

rainfall has reportedly become less reliable. Over 90 per cent of respondents in a survey of 273 HHs in the district indicated that the amount of rainfall has been decreasing in the last two decades. And that is not all. Farmers also emphasized changes in the timing of the summer monsoon rains. These local perceptions were confirmed by an analysis of rainfall data between 1990 and 2010 from six meteorological stations in the same area.

#### What is the impact?

Travelling through Punakha it becomes clear why the area is referred to as the rice bowl of Bhutan, with irrigated rice terraces stretched out on the mountain slopes throughout the district. The majority of people in the area are small-scale farmers with rice cultivation as their main source of livelihood. Although a large glacial-fed river meanders through the valley bottom, farmers have never been able to use it to irrigate their fields due to the sharply inclined slopes on both sides of the river. Farmers thus depend on the small rain-fed streams coming down from the mountains. For this, the summer monsoon period is crucial. Only during these four months is there plenty of water. As a result of changing rainfall patterns, however, it is becoming increasingly difficult for farmers to access enough irrigation water from these streams, and 81 per cent of all respondents claim this is negatively affecting their rice production.

#### How do affected populations adapt to changing rainfall patterns?

Most farmers take measures to adapt to the changing availability of water. The study found that communities are developing new, or modifying existing, water-sharing arrangements and that farmers spend more time on the maintenance of irrigation channels to make sure water is used efficiently. There are innovations as well. A few rich farmers have been able to purchase gasoline pumps and are pumping water from the main river in the valley bottom all the way up to their fields using long plastic hoses – a completely new phenomenon in the area. For about one-third of the respondents, a main adaptation measure was to shift from irrigated rice to rain-fed crops on part of their fields. Some farmers said they had shifted from two to one harvests of rice a year (see Box on page 45).

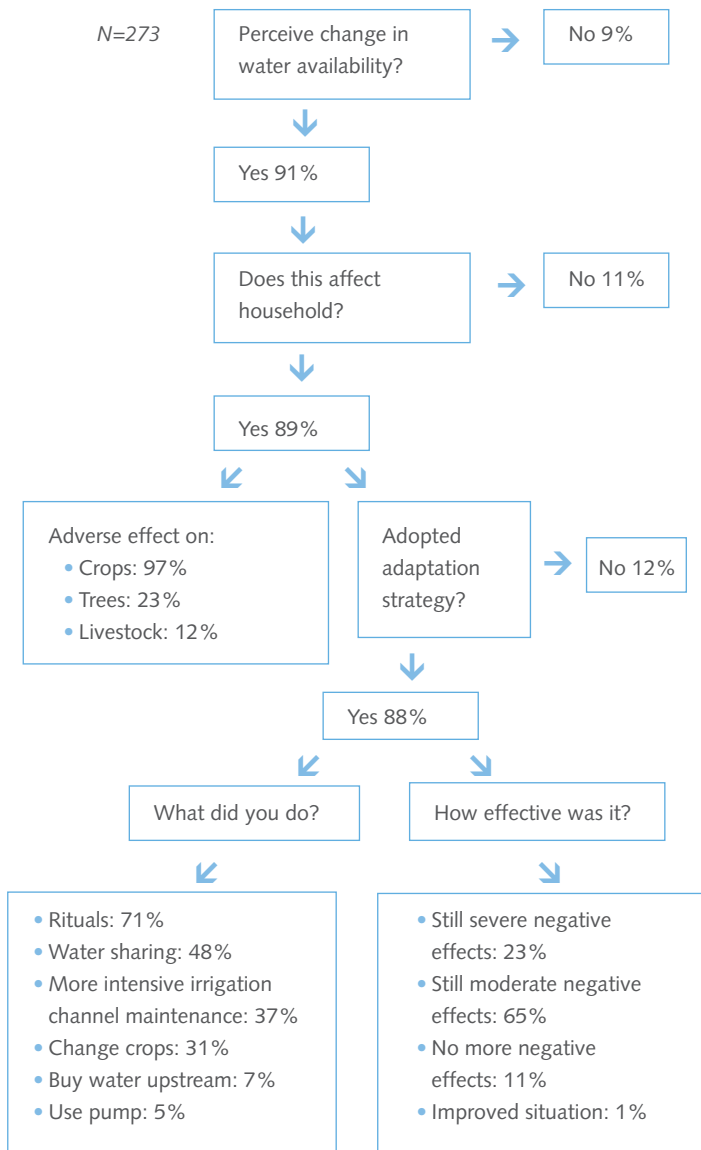


Figure 9: Summary of findings in Bhutan.  
Source: Fieldwork; questionnaire survey (2012).

### What is the loss and damage?

Eighty-seven per cent of the farmers who adapted claimed that their measures were not enough to neutralize the negative effects of changing water availability. What is more, the adaptation measures are associated with extra monetary and non-monetary costs. The growing reliance on water-sharing arrangements, for example, has led to increased tensions between HHs and villages, and a rising number of conflicts – sometimes ending in violence (see Box). Another cost is the time invested in the maintenance of the irrigation channels. For a HH with one acre of paddy fields, maintenance work would normally absorb one or two days in the summer season, while this can increase to more than 15 days of work when water is scarce. Last, but not least, the cultivation of non-irrigated crops instead of irrigated rice is seldom the preferred option for farmers. Not only because rice is the staple food, but also because the yields of non-irrigated crops are less secure and the income per acre can be up to eight times lower compared to paddy rice.

### What is next?

In contrast to extreme events such as floods, gradual changes in water availability are an easily overlooked area for interventions. This underlines the importance of small-scale farmers being able to secure access to water, in addition to agricultural extension services that focus on the use of fertilisers and better seeds. This can, for example, be done by investing in research on, and development of, collective and private water services (such as water storage, water pumps and irrigation systems), crop diversification and conflict resolution. More generally, there is a need for a broad discussion on loss and damage due to climate-induced changes, in which the costs of adaptation are conceived not just in monetary terms, but also in terms of time, social cohesion and food security.

Adaptation measure	Costs
Changing from irrigated rice cultivation to the cultivation of rain-fed crops	Rice is the preferred food crop. Moreover, the harvest of rain-fed crops is less reliable, and the income per acre can be up to eight times lower compared to paddy rice
Using gasoline pump to extract water from the main river	For an average HH with two acres of paddy fields, hiring a water pump costs around US\$300 per cultivation season. Purchasing a pump costs around US\$1,000
Buying the right to access part of the irrigation water from an upstream village	For an average HH with two acres of paddy field this costs up to US\$140 per season
Water-sharing arrangements between HHs and villages	Violation of arrangements leads to (violent) conflicts, negatively affecting social cohesion within and between villages
Intensifying maintenance of irrigation channels	In water-scarce years, the amount of time a farmer has to spend on the maintenance of irrigation channels can be up to 15 times higher compared to wet years

*Table 3: The costs of adaptation in Bhutan.  
Loss and damage case study fieldwork in Bhutan (2012)*



### Examples of loss and damage: from two to one paddy harvests and inter-village conflicts

Spread over the terraced landscape of Tshekha village, clusters of men and women are working in the paddy fields – working long days. The monsoon started late again this year, so everyone is working extra hard to get things done before the monsoon period ends. One of the farmers, Ap Gala, explains that he decided in 2009 to switch from two to one paddy harvests a year, in response to the increasingly unreliable rains. Since then, it has become more important for him to find temporary unskilled work during the winter months, for example in house construction, which pays US\$3.50 a day. Ap Gala needs the money to buy rice and other food items for his young family. *“Food used to be more secure,” he says. “Now we sometimes do not have enough to eat.”*

Phub Lham is a farmer in Gumkamo village. She used to act as the community's Yu-pen, the person who manages matters related to irrigation. Asked about the changes in water availability, she says: *“I guess we are used to conflicts about water, but the conflicts are on the rise. And they are getting more severe. Our village is located at the very end of the irrigation channel and we depend on water-sharing agreements that have been developed by our forefathers with the village upstream. In dry years farmers from the neighbouring village may secretly divert extra water into their fields. More than they are entitled to. And when we find out, it is too late. The last time this happened all the men from my village gathered and went to the neighbouring village in the middle of the night to destroy the bunds bordering their rice terraces. Out of pure frustration.”*

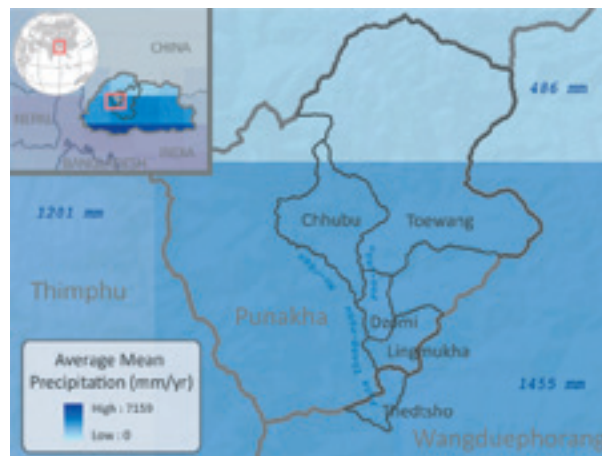


Figure 10: Mean precipitation in Punakha District and Bhutan. Map created by CIESIN. See technical annex for details.





Figure 11: The research area in The Gambia: North Bank Region.  
Map created by CIESIN. See technical annex for details.

### 3.4 Limited coping capacity in the North Bank Region, The Gambia: loss and damage associated with drought<sup>vii</sup>

The Gambia, located in West Africa, has a history of recurrent droughts. The country is especially vulnerable to climate change as its economy is based primarily on agriculture. A study of 373 HHs in 31 villages investigated how HHs in the North Bank Region of The Gambia coped with a severe drought that occurred in 2011. Next to receiving food aid, people coped with the drought by looking for additional income to buy extra food, for example by selling HH property. Despite this, the study found that 63

per cent had to modify their food consumption, for example by changing from three to two meals a day. This suggests that food aid and people's own coping measures were not enough to prevent serious negative effects on people's food intake.

#### What is the climatic stressor?

In the North Bank Region of The Gambia, droughts have been occurring with increasing frequency. Rainfall data have been recorded in nearby Banjul since 1886. A recent study (Dia

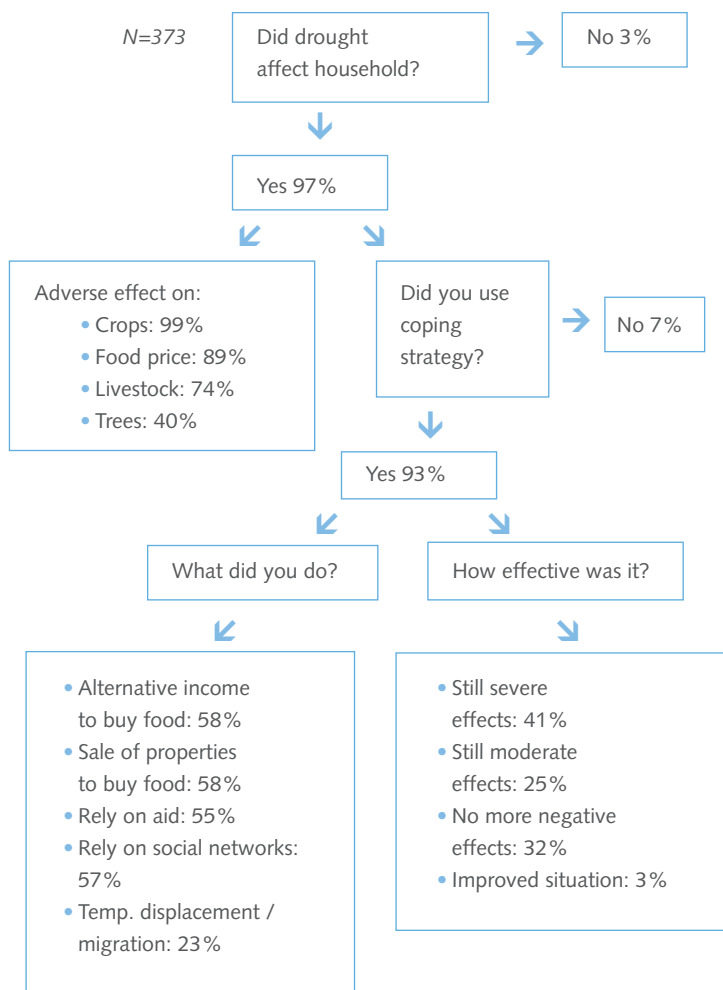


Figure 12: Summary of findings in The Gambia.  
Source: Fieldwork; questionnaire survey (2012).

Ibrahima, 2012) shows a long-term trend of decreasing rainfall. The last 30 years have been by far the driest (796.3 mm per year on average) since records began. Comparing 30-year averages since 1886, rainfall levels in the last three decades are over 35 per cent lower than in the first 30 years, when average annual rainfall was over 1,200 mm per year (Dia Ibrahima, 2012). The erratic rainfall pattern is similar to that of the Sahel region. In 2011, The Gambia was hit by a very severe drought once again.

### What is the impact?

Seventy-five per cent of the population of The Gambia depends on agriculture. Droughts result in poor or failed harvests, which threaten the food security and livelihoods of large sections of the population. A study of 373 HHs found that the 2011 drought affected ninety-seven per cent of the respondents, many of whom lost their entire harvests. Seventy-four per cent of the respondents indicated they had lost livestock, which are an essential component of their asset base. Also, low crop yields resulted in higher food prices and reduced calorie intake, which affected people's health and well-being. This was reflected in increased incidences of illness and child malnourishment during and after the drought.

### How do affected populations cope with drought?

When the harvests failed because of the 2011 drought, most HHs tried to cope by finding alternative sources of money to buy food. This was difficult, however, because food prices rose. Moreover, there was tough competition for scarce jobs. About a fifth of respondents in a survey of 373 HHs indicated that one or more members migrated temporarily to urban centres to look for work, in response to the failed harvest. Many HHs reported they sold personal assets, e.g., livestock and property, and sought support from relatives and friends. Reliance on food aid from relief agencies was important, but the amount of food people received was insufficient, partly because of distribution gaps.





Figure 13: Land use and location of study villages in The Gambia. Map created by CIESIN. See technical annex for details.

### What is the loss and damage?

HHs practised a variety of coping strategies to offset these negative impacts. Some of these measures, such as the sale of HH assets to offset the negative impacts of drought, can have long-term negative implications. After selling livestock, for example, a HH can lose traction power needed to cultivate the land. This kind of coping can be erosive in that it threatens the future sustainability of the HH. The study also found that 63 per cent of respondents indicated that the combination of all coping measures was still not enough to avoid reduced food intake. They had to modify their food consumption, for example by buying cheap, less nutritious food, by reducing portion sizes or number of meals or by a combination of these measures. This indicates insufficient coping. Food – the most basic human need – was still compromised, even after all avenues for coping were exhausted.

### What is next?

Increasing farmers' awareness and knowledge is crucial for mitigating loss and damage incurred by drought. At national level, efforts need to be made to educate farmers about soil conservation to retain enough moisture in the soil and decrease the negative impact of drought on crop production. In addition, farmers can improve their resilience prior to a drought by maintaining adequate food stocks (to last six to seven months) in anticipation of food shortages.

#### Example of loss and damage: impacts of the 2011 drought

Karamo Krubally from Malick Nana Village (Upper Niuni District) is a rice and groundnut farmer. He cultivates a total of five acres. The 2011 drought and subsequent crop failure caused severe havoc to his HH. He says, *"Hunger started creeping into my family like an eagle scavenging for a carcass. I was most of the time agitated, especially when my wife asked me for food to cook each day. I felt like a destitute person in the street. Because of the drought, we had to cut down our daily food intake from three times a day to two times a day and we had to eat smaller portions. My health deteriorated and I was most of the time feeling dizzy when standing. I went to the doctor who said that it was a result of low food intake. Our situation became even worse when my two work cows and a donkey became very weak due to lack of forage. The poor rainfall of that year had also affected the natural vegetation around the village where we graze our livestock. Almost all the grass was dry, and finding drinking water for the livestock was a challenge, as all the ponds around our farms that served as drinking points for the livestock dried out. Because of the weak physical condition of my work animals, I could not use them for long hours on the farm when the 2012 rains started setting in and when we had to prepare our fields."*





Figure 14: The research area in Kenya: Budalangi Division in Bunyala District. Map created by CIESIN. See technical annex for details.

### 3.5 Erosive coping in Budalangi Division, Kenya: loss and damage associated with the 2011 floods<sup>viii</sup>

In Kenya, floods are expected to increase in severity and frequency, with potentially devastating effects for the people living near riverbanks. The flooding of River Nzoia in December 2011 resulted in widespread damage to crops and the loss of livestock in Budalangi Division of Western Kenya. Research among 400 HHs in the area found that people's coping strategies included temporary relocation and migration, engagement in extra income-earning activities and reduction in non-essential expenditures. Many respondents also said they had sold property, such as land and cattle, in order to cope with the effects of the flood. This type of coping behaviour has a long-term negative effect on the sustainability of HH livelihoods.

#### What is the climatic stressor?

Budalangi Division is a low-lying area on the shore of Lake Victoria and is prone to periodic floods that result from rainfall in the catchment of River Nzoia. The latest flood occurred in December 2011 and was particularly devastating. This seems to be part of a trend. Over 96 per cent of the respondents indicated that floods have become more frequent and intense over the past 20 years.

#### What is the impact?

The severe impact of the 2011 flood is related to high poverty levels in communities along the shore of Lake Victoria. The flood led to loss of life, damage to infrastructure and disruption to the main sources of livelihood, such as crop production, fishing and livestock keeping. This had serious implications for people's food security and livelihood sustainability. The flood also had negative effects on people's health, as it increased the incidence of water-borne diseases such as malaria, diarrhoea and typhoid, and disrupted access to and provision of healthcare services.

#### How do affected populations cope with floods?

To deal with the immediate impact of the flood, many HHs temporarily relocated to camps, where government agencies and non-governmental organizations distributed relief material to sustain families. They provided tents, blankets, food items, medicines and water. Some organizations also provided seeds for early maturing crops to help HHs recovering from flood losses. A total of 91 per cent of the respondents indicated they had received aid after the flood. In addition to the aid, HHs adopted their own coping strategies. Several HHs, for example, decided to migrate for a longer period of time to upland areas. Also, an often-heard response was the reduction of expenditure on HH needs. Many people resorted to low-paying non-agricultural work, such as petty trade. Twenty-two per cent of the respondents said they had sold some HH assets in order to buy food.

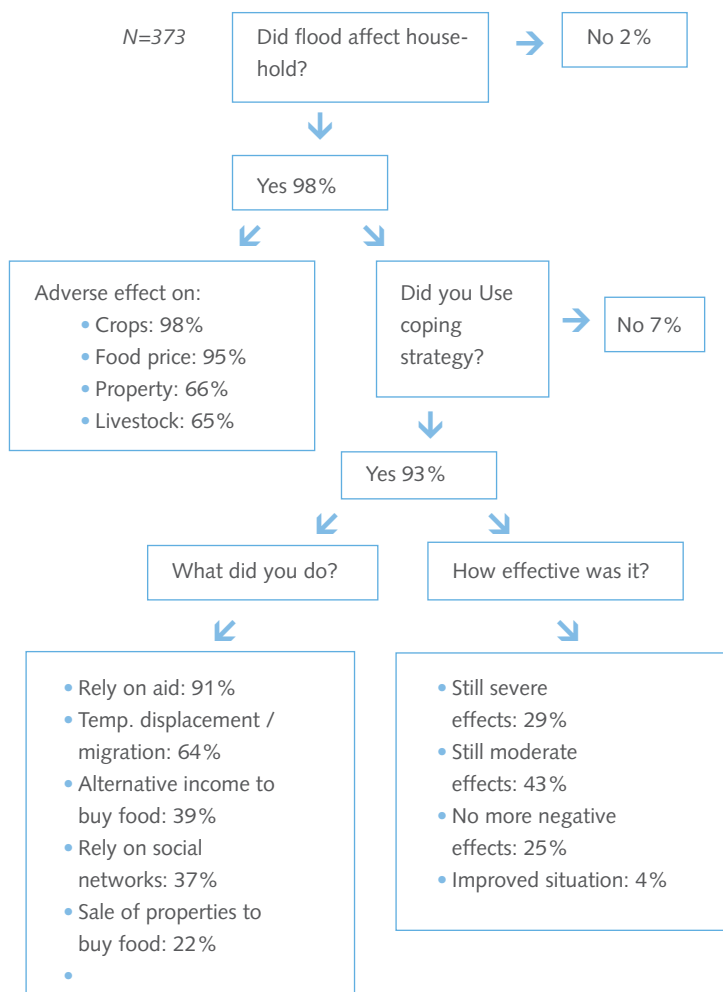


Figure 15: Summary of findings in Kenya.  
Source: Fieldwork; questionnaire survey (2012).

### What is the loss and damage?

Several of the coping measures taken by HHs in the aftermath of a flood have long-term costs, as they eat into HH assets and resources. For instance, temporary relocation takes children out of schools for months at a time, which results in a loss in human capital. Similarly, when HHs are forced to sell their traction animals to buy food, it becomes difficult for them to prepare a sizeable farm in subsequent years. This kind of coping is erosive because it threatens future livelihood sustainability. As a result, HHs fall into a vicious cycle of poverty.

The research found that 72 per cent of the respondents are still experiencing negative effects of the flood, despite their coping measures.

### What is next?

Most HHs lack the capacity to address flood impacts beyond their control. This calls for policy intervention by the government to invest in large-scale flood control infrastructure. For instance, dikes which were constructed over 24 years ago are in desperate need of repair and replacement. Many were poorly designed and result in underground seepage and backflows of water. This has the potential to destroy the foundations of houses and further complicate response and recovery efforts. There also exists a crucial need for developing community based early warning systems that combine both meteorological information and indigenous knowledge. Many villages have traditional weather forecasters who predict the likelihood of floods by observing changes in nature. These traditional sources need to be combined with official sources to educate communities on flood prevention and preparation and to improve access to early warning information.

### Examples of loss and damage in Kenya

Benson Maina Okoth from the village of Manyala is a traditional weather expert. This is his account of the December 2011 flood: *"The flood waters reached the village in the morning at around 10 a.m. By evening, the whole area was like a lake and people were forced to move to safer ground. Water entered people's homesteads and destroyed farms. Nine people lost their lives when the boat they used to escape from the floods capsized. There have always been floods here, but they were not as destructive as nowadays. Usually, these floods would stay for no more than three days. But last year, our village was flooded for more than three weeks. I personally lost 61 bags of rice from my 4-acre farm. My crops were just washed away and I could not harvest anything. A bag of rice was worth about 3,700 shillings at the time of the flood so I lost 225,700 shillings (US\$2,640). Compared to others in my village, I am not a poor man. But the floods also affect wealthier people. We lose more. The poor can run away and save their lives. People like me, we suffer to save our properties."*

Oonge Ochoa is a small farmer. He cultivates half an acre of maize, sorghum, millet and beans. He emphasizes that floods do not only bring havoc, they also make the soil fertile. But the 2011 floods were particularly destructive. He recounts: *"I lost my crops and four goats. My house collapsed and I have still not been able to rebuild it properly because I don't have money. When the floods came I moved my family to the camp at Runyofu Primary School and stayed there for two months. I depended on relief from the government and NGOs. They provided tents and food but this was not sufficient. The camp was overcrowded and our stay there was very stressful. Depending on relief aid all the time does not feel good. If I had the resources, I would move to a place where I can farm without worrying about floods. The government should give us land in a place where we can live safely and be productive."*



Figure 16: Flooded area (light blue) along the Nzoia river in Western Kenya, December 2011. Map created by CIESIN. See technical annex for details.





Figure 17: The research area in Micronesia, Kosrae State. Map created by CIESIN. See technical annex for details.

### 3.6 The limits of adaptation in Kosrae, Micronesia: loss and damage associated with coastal erosion<sup>x</sup>

Small-Island Developing States (SIDS) are particularly vulnerable to climate change; rising sea levels are expected to exacerbate coastal erosion, inundation, storm surge and other coastal hazards. Research in Kosrae, Micronesia shows that measures in response to coastal erosion have the potential to reduce some of the adverse impacts, but they may be insufficient or even have unintended negative effects. More drastic adaptation measures are needed, such as relocation and seawalls, but these will also have their limitations and come with associated costs to society. The study highlights the practical limitations for Kosrae and other SIDS to deal with coastal erosion. They are facing loss and damage, while hardly contributing to global GHG emissions.

#### What is the climatic stressor?

Eighty-seven per cent of the respondents in a survey of 363 HHs on Kosrae, Micronesia reported experiencing coastal erosion. The causes of coastal erosion include sea level rise and an increase in the frequency and severity of extreme weather events, such as storm surges. Sea level rise in the Federated States of Micronesia is 10 mm a year, compared to the global average of 3.2 mm.

#### What is the impact?

Eighty per cent of the respondents who experienced coastal erosion reported impacts to their HH economy. The majority of the HHs depend on farming activities for their HH consumption and the loss of farmland due to coastal erosion directly threatens their food security. Additionally, coastal erosion causes damage to property and other assets. Aside from the obvious economic costs, the study found that coastal erosion is also associated with loss of culture. As material resources on the island are limited, stones from ancient structures are used to build sea walls (see Box on page 58). Also, the deceased are traditionally buried next to the houses along the coast, but the graves are now being destroyed by coastal erosion and will most likely have to be removed and cultural practices discontinued.

#### How do affected populations adapt to coastal erosion?

HHs have mainly adapted to coastal erosion at an individual level by building sea walls, filling in land, planting trees, migrating to higher ground and improving their housing in order to withstand the water. While the government has built three extensive sea walls, individual HHs on Kosrae are largely left to their own devices to deal with coastal erosion. Yet, they believe the magnitude of the problems go beyond the individual level and their measures are insufficient for now and the future to adequately deal with coastal erosion.

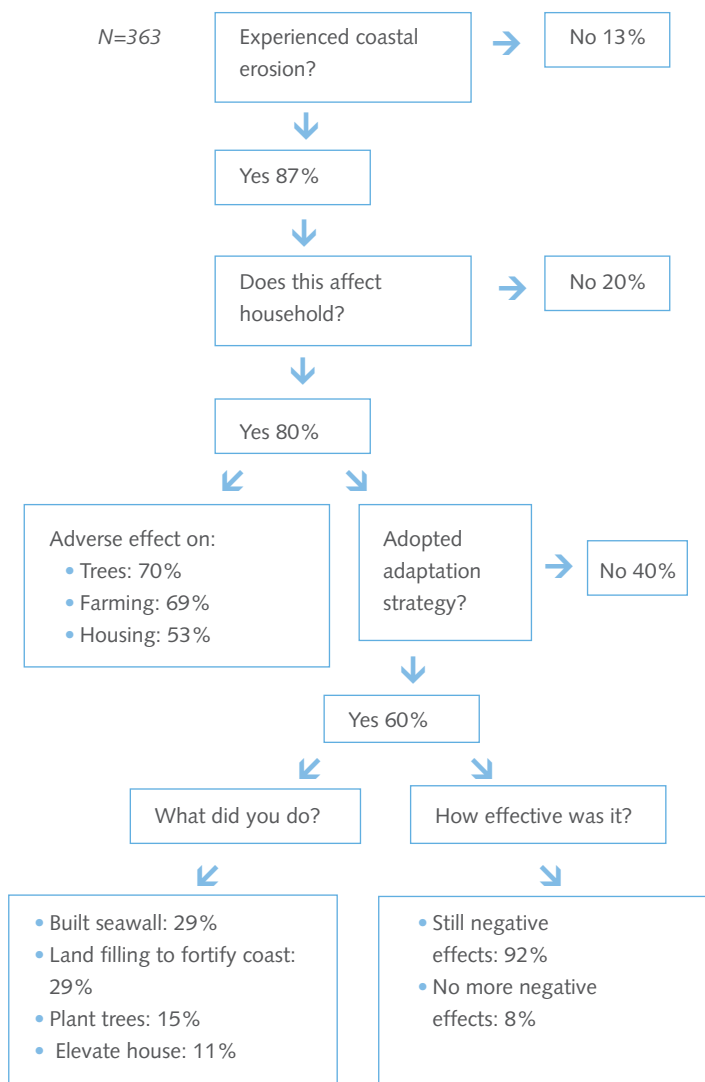


Figure 18: Summary of findings in Micronesia.  
Source: Fieldwork; questionnaire survey (2012).

### What is the loss and damage?

Although 60 per cent of respondents have undertaken adaptation measures, such as individual seawall building and tree planting, in 92 per cent of the cases respondents indicated that these adaptation measures are insufficient. The building of sea walls by individual HHs to combat coastal erosion is only partly effective. The large planned seawalls have even caused changing ocean currents and destroyed beaches right in front of the sea wall as well as in some instances exacerbating coastal erosion at the edges of the seawall. The immediate relief of these walls is negated by its negative impact over time.

### What is next?

The study found that most adaptation to coastal erosion on Kosrae has been undertaken at the individual HH level, however this has limited effectiveness for such a pervasive problem. Large-scale planned interventions by the government are necessary, such as building extensive coastal defences and relocation of people to higher located areas. Such planned interventions also have their limitations, including the dangers of maladaptation and the high social and economic costs of relocation upland. Moreover, typically for SIDS, Kosrae has limited capacity to adapt, due to its low GDP, remote location and a general lack of financial and material resources and technical expertise, while being particularly vulnerable to coastal erosion. This inhibits both the government's and local population's ability to adequately deal with the impacts of rising sea level in general and coastal erosion in particular. Without external assistance, an island like Kosrae will most likely not be able to adequately deal with the challenge that ongoing coastal erosion poses.





Figure 19: Elevation map for Kosrae, Micronesia.  
Map created by CIESIN. See technical annex for details.



Figure 20: Mangrove vegetation along the coast of Kosrae, Micronesia.  
Map created by CIESIN.  
See technical annex for details.



Figure 21: Impacts of extreme weather events experienced by households in Kosrae, Micronesia.  
Map created by CIESIN.  
See technical annex for details

### Examples of loss and damage: dyke construction and cultural loss

Kilafasru Kilafasru, from Malem District in Kosrae says, *"In 1971 we built the first seawall. We made it from coral reef rocks and rocks from the hill. It took six weeks to complete. Fifteen years later we had to build a new seawall, because the water just kept on rising. At that time we only used the rocks from the hill because it was illegal to use the coral reef rocks. In 2004 the last seawall was built – this time the government paid for it and we didn't have to do anything. The building of the latest seawall, however, had an unforeseen negative effect. It changed the current and as a result we lost all of our beaches. Today, the sea comes right up to the houses and we have a flood every year. I have made the seawall higher behind my house using bags of cement. Up to now I have bought 150 bags, costing me US\$500. It makes us feel safe again – at least for a while."*

Masayuki Skilling lives on the small island of Lelu, which is currently connected to Kosrae by a causeway. He used to be a weatherman. Asked about the measures people take to deal with coastal erosion, he said: *"The sea keeps on rising and people need to protect themselves. They have even started using the stones from the ancient ruins on Lelu Island, in order to build walls and fill the lands. Lelu is a unique historical site. Around 1100 AD, the chiefs of Kosrae lived on this small island, while the commoners lived on the main island. They built a complete city for the chiefs. Huge rocks, weighing tonnes, had to be shipped from Kosrae to Lelu by wooden canoes. Now, when I go to the ruins most of the walls that used to be there when I was young have disappeared."*







## 4. Analysis of current loss and damage patterns related to climatic stressors

This section analyses the findings from the five loss and damage case studies to show current relationships between climatic stressors, societal impacts and attempts to deal with these climatic stressors, generating four loss and damage pathways. This analysis adds to our understanding of how the interactions of climatic variability and climate change with livelihoods (and other aspects of human well-being, such as health) and physical assets create particular patterns of loss and damage in countries and communities vulnerable to climatic stressors and their societal impacts.

### 4.1 Adaptation and loss and damage occur simultaneously

The research reveals that adaptation and loss and damage occur as simultaneous processes, and that loss and damage is a real phenomena with tangible consequences today. Some of the most notable current impacts are on HH food production and livelihoods, raising questions about the ability of adaptation measures both formal and informal to stem the interacting negative impacts of climate change and vulnerable societies. The survey results (see also Section 3.1) indicate that some HHs have a greater diversity of assets and access to a variety of adaptation, livelihood diversification or risk management options – through social networks, community or government support programmes and education – which enables them to adapt to stressors in ways that enhance resilience. Of concern, however, are the greater number of vulnerable HHs which have the least access to such options – few or no viable livelihood diversification opportunities, not enough land, little education – using a variety of erosive coping measures as a survival strategy in an overall setting of increasing loss and damage which can trap them in a downward slope of decreasing human well-being and security.

Table 4 shows the percentage of HHs in each research site experiencing particular climate threats (slow-onset and sudden-onset), impacts, responses (coping or adapting) and residual loss and damage.

Climatic stressors are widely experienced in the research sites surveyed. For example, in Bhutan, 91 per cent of the HHs surveyed reported experiencing changes in monsoon patterns. In Kosrae, Micronesia, 87 per cent of HHs surveyed have experienced coastal erosion and a further 62 per cent have experienced extreme weather events. In Bangladesh, 99 per cent of surveyed HHs experienced salinity intrusion. The proportion of respondents for whom the climate stressor had a negative impact on the HH economy was also high: over 80 per cent in all the study sites. The most affected livelihood source was crop cultivation. As the large majority of respondents practise subsistence agriculture, one can expect direct impacts on food security. The vast majority of the survey respondents indicated that they adopted coping or adaptation measures to counter adverse effects of extreme weather events and slow-onset changes. Among the people who adopted such measures, most were not fully successful in avoiding residual impacts. For example, in the Bhutan study area, 87 per cent of HHs reported that they were still experiencing adverse effects of changing monsoon patterns despite adaptation measures. Similar results were found, albeit with a variety of different coping and adaptation measures, for all the other case studies. Of the HHs that adopted such measures, in Micronesia 92 per cent reported they were still experiencing adverse effects of the climatic stressor and resulting societal impacts, in Bangladesh the figure was 70 per cent, in Kenya 72 per cent and in The Gambia 66 per cent .

Stressor type	Slow-onset with extreme event	Slow-onset
Country	Bangladesh	Bhutan
Research area	"Shyamnagar sub-district (Satkhira District)"	Punakha District
Households interviewed	360	273
Climate stressor	"Experienced medium or high salinity in soil: Yes: 99% No: 1% "	"Experienced changes in monsoon patterns: Yes: 91% No: 9% "
Impact on household economy?	"Yes: 99% No: 1% "	"Yes: 89% No: 11% "
Impact per sector	"Rice production: 98% Drinking water: 90% "	"Crops: 97% Livestock: 12% Tree crops: 23% "
Adopted adaptation or coping measure?	"Yes: 81% No: 19% "	"Yes: 88% No: 12% "
<b>Response type</b>		
Coping/Adaptation measure to deal with climate stressor	Adaptation "Salt tolerant cultivars: 39% 'Wash' rice field to reduce salinity: 27% Seek more non-farm income 60% Migration 29% "	Adaptation "Perform rituals: 71% Adjust water sharing arrangement: 48% Better maintenance of irrigation channels: 37% Changes in crop mix: 30% "
Adverse effects despite coping/adapting?	"Yes: 70% "	"Yes: 87% "
If no measures adopted, why not?	"Lack knowledge/skills: 68% Lack means/resources: 30% "	"Lack knowledge/skills: 68% Lack means/resources: 16% Not my task: 4% No priority: 12% "

Table 4: Percentage of households in each research site experiencing particular climate threats. Fieldwork (2012).

Extreme event	Extreme event	Slow-onset with extreme event
Gambia North Bank Region	Kenya Budalangi Division (Bunyala District)	Micronesia Kosrae State
373	400	363
"Drought (2011)"	"Flood (2011)"	"Experienced coastal erosion: Yes: 87% No: 13% "
"Yes: 97% No: 3% "	"Yes: 98% No: 2% "	"Yes: 80% No: 20% "
"Crops: 98.6% Livestock: 73.6% Food prices: 88.5% "	"Crops: 98% Food prices: 95% House/properties: 66% "	"Crops: 69% Tree crops: 70% Housing: 53% "
"Yes: 93% No: 7% "	"Yes: 93% No: 7% "	"Yes: 60% No: 40% "
Coping "Alternative income to buy food: 58% Sell assets (eg livestock) to buy food: 58% Ask relatives for food or money to buy food: 57% Reliance on aid: 55% Displacement /migration: 23% "	Coping "Reliance on aid: 91% Migration and move to camps: 64% Alternative income to buy food: 39% Ask relatives for food or money to buy food: 37% Sell assets (eg livestock) to buy food: 22% "	Adaptation "Build sea walls: 29% 'Landfill' to fortify coast: 29% Plant trees along coastline: 15% Elevate house: 11% "
"Yes: 66% "	"Yes: 72% "	"Yes: 92% "
"Lack knowledge/skills: 58% Lack means/resources: 28% "	"Lack knowledge/skills: 40% Lack means/resources: 31% Not my task: 10% No priority: 4% "	"Lack knowledge/skills: 47% Lack means/resources: 74% Not my task: 3% No priority: 0% "

The five case studies help build our understanding of how HHs in affected communities attempt to manage both climatic stressors and societal impacts associated with extreme events and incremental climatic processes. Moreover, the case studies illustrate that often the measures adopted by HHs are only partly successful in avoiding adverse effects of climate threats. The community-based research synthesized in this report reveals four different ways in which people in vulnerable countries incur loss and damage from climate stressors today. We call these 'loss and damage pathways'. Residual impacts of climate stressors occur when:

- existing coping/adaptation to biophysical impact is not enough to avoid loss and damage;
- measures have costs (economic, social, cultural, health, etc.) that are not regained;
- despite short-term merits, measures have negative effects in the longer term ('erosive coping');
- no measures are adopted – or possible – at all.

Each pathway is described in more detail below and illustrated with examples from the case studies. Across the five research sites, HHs were struggling with climatic stressors. Despite their efforts to cope with the impacts of extreme weather events and adapt to slow-onset climatic changes, many incurred residual impacts along the lines of one or several of the pathways listed above. The case studies also showed that the prevalence of the four loss and damage pathways varied between research sites. Each country manifested a different loss and damage pattern. These profiles of loss and damage pathways serve as a point of departure for further research to understand how climate change affects society today, and the possible consequences of adaptation shortfalls in the future.

#### 4.2 Existing coping/adaptation to biophysical impact is not enough to avoid loss and damage

The research in all countries indicated that existing efforts to cope with impacts of extreme events and adapt to climatic changes are often not enough to avoid tangible loss and damage to HH economies, livelihoods, health and cultural assets. For example, in Bangladesh adaptation measures to deal with rapidly rising soil and water salinity were not sufficient to deal with the sharp salinity increase from cyclone Aila. In Micronesia, people living along the coast have been building provisional seawalls to protect their houses and properties for many decades. However, these efforts are often not enough to avoid damage from sea level rises and storm surges. In Bhutan, rice farmers modified existing water-sharing arrangements and irrigation practices to deal with reduced water availability due to changing monsoon patterns. Still, many are forced to shift from two rice crops a year to one, or to cultivate part of their land with lower-yielding crops like maize. In The Gambia and Kenya, farm HHs lost all or part of their harvest because of drought and floods respectively. They adopted a variety of coping measures, including reliance on relief and looking for extra income to buy food, but many could not avoid inadequate food intake, which is a clear indication that coping strategies were not sufficient.

#### 4.3 Measures have costs (economic, social, cultural, health, etc.) that are not regained

More than two-thirds of the HHs that experienced extreme weather events or slow-onset climatic changes adopted coping or adaptation measures to prevent or deal with adverse effects. Some of these adjustment measures were forward looking and aimed at avoiding impacts from extreme events or gradual changes. Other measures were adopted to deal with a particular impact after it occurred (but not anticipating change). Participatory research sessions and HH survey results indicate that the measures undertaken have costs themselves which can be both monetary and non-monetary nature. In Bhutan, for example, when farmers are unable to adapt



to changing monsoon patterns and resulting reductions in water for irrigation by modifying water-sharing arrangements and irrigation measures, they start cultivating rain-fed crops like maize instead of rice on at least part of their farm. This has substantial costs. Crop yields and income from maize are much lower than for rice. Furthermore, rice is the preferred staple food in the research area. An example of non-monetary costs of adaptation measures comes from the island of Kosrae, Micronesia. People reported dismantling a 12th century fortress that was part of the national cultural heritage in order to have building material to create seawalls against coastal erosion.

Many HHs reported making choices that allowed them to adjust to some degree to a climatic stressor and resulting social impacts – such as changing food consumption patterns, reducing the number of meals per day, taking children out of school or taking on the costs of migration with an uncertain outcome. HHs in every research area reported relying on social networks for help when they faced climatic stressors and resulting social impacts. However, the geographical proximity of these social networks often will mean that there are limits to such kinds of coping and adaptation. FGDs indicated that most HHs in the study villages face similar exposure to climatic risks so when the village is hit, few will be in a position to help others who are in need (co-variation of risks). Many HHs reported deteriorating social relations as these climatic and related social pressures increased. These costs are often not restored to the HH, even though the HH can adapt some degree. These are the hidden costs of coping and adapting to climatic stressors and the often unreported social impacts that ensue. Local tensions arising over limited access to rainfall and irrigation water – such as in Bhutan, can contribute to lessening social capital and overall resilience of the community fabric to climatic and associated stressors.

#### 4.4 Despite short-term merits, measures have negative effects in the longer term (erosive coping)

Across the five case studies it was seen that many communities and HHs employ erosive coping strategies (see Box) that allow them to cope on a short-term basis to climatic stressors and related social shocks but which weaken HH resilience in the longer term. Actions like selling productive assets such as livestock, eating seed stock and taking children out of school so they can seek alternative work compromise longer-term livelihood sustainability. In Kenya, participants in FGDs talked about selling cattle needed to do farm work in order to buy food. The following season, the family has no way to plough their fields. Another example comes from the North Bank Region in The Gambia, where rain-fed farms have just one harvest a year, at the end of the rainy season. After a drought year, when crop yields are low, there is not enough food in store to last until the next harvest. Typically, the hunger season is in the months prior to the next harvest, when essential farm work needs to be done. If able-bodied HH members have to migrate to urban centres to look for work in order to buy food in the short term, they cannot put their time and energy in the farm work, and their next harvest will also be poor. Measures undertaken to deal with and adapt to climate stressors can make HHs more vulnerable to these and other stressors, and can make it more difficult to escape poverty.

Many HHs in the loss and damage case study areas in Bhutan, Bangladesh, Kenya and The Gambia do not have enough land, and therefore have limited options to diversify livelihoods away from crop and livestock production. These HHs tell stories of 'just getting by', and do not have access to or are unable to capture many, or any, sustainable adaptation or livelihood diversification options. For these HHs, repeated environmental shocks and stressors erode their livelihoods, food security and asset base enough to make other adaptation options inaccessible. This pattern can be seen in all the case studies, particularly in HHs that face more significant challenges with poverty and food insecurity and low livelihood diversification options for their climate-sensitive economic activities.

#### 4.5 No measures are adopted – or possible – at all

HHs across all case study areas – but particularly in Micronesia – indicated that they were sometimes unable to undertake measures to manage climatic and social impacts at all. This is often because of 'soft limits' to adaptation and includes reasons such as lack of education or understanding of what to do (median value 68 per cent for all HHs surveyed). When faced with such limits, HHs and communities reported having to make difficult choices about the location and quality of their future lives, or accept loss and damage. These choices included HH attempts to migrate to other locations, accepting deteriorating standards of living and loss of cultural values, and witnessing the disintegration of commonly held values and practices in the community. Some impacts such as changes in monsoon patterns and salinity intrusion (in Bhutan and Bangladesh respectively) elicited the highest rates of responses where HHs did not know what more they could do to manage the ensuing challenges – already in Bhutan and Bangladesh a variety of adjustments were being undertaken to adapt. Interestingly, 16 and 30 per cent of HHs surveyed in Bhutan and Bangladesh respectively noted that limited resources was the reason for not taking measures against the climatic and related social impacts. Participatory discussions further elaborated that no amount of resources would be enough to deal with some of the impacts HHs are already facing. The result is loss and damage for these communities and – at least at community level – 'hard limits' to adaptation.

#### Erosive coping

People who live in risk-prone areas and who are confronted with certain climate hazards (e.g., droughts) will usually try to avoid adverse effects through preventive or proactive measures (e.g., risk spreading in agriculture and livelihood diversification). When these measures are not enough to avoid adverse effects when a hazard actually hits the area, people will have to cope with the resultant food and livelihood stresses. If the impact is not very severe, most people will be able to cope by drawing on the buffers they have created, by finding additional sources of food or money to buy food, or drawing on social support networks without jeopardizing future livelihood security. These coping strategies can be labelled 'non-erosive'. If the crisis is more severe, for example when an area is hit by drought in several subsequent years, or when several hazards strike simultaneously, the set of non-erosive coping strategies will soon be exhausted and people will have to take more drastic actions to combat the crisis. These actions can seriously affect people's future livelihood security and these 'coping strategies' can be labelled 'erosive' (De Waal, 1989). The label 'erosive coping strategy' contains a contradiction in terms, however. 'To cope' literally means to deal successfully with something difficult: e.g., to manage. When a HH's coping or adaptation strategies jeopardize the HH's future food and livelihood security, this HH is not 'coping'.

*Source: adapted from Van der Geest and Dietz (2004).*







## 5. Policy reflections: a challenge for policymakers today and in the future

The research findings described in Sections 3 and 4 raise key questions about the implications for leadership and policy on mitigation, adaptation and anticipating and addressing the consequences for society if adjustments cannot be made in sufficient scale and time to avoid loss and damage. The research findings presented here turn around a common assumption that policymakers will face difficult questions at some future point about managing the unmanageable. Instead, research shows that loss and damage is already happening.

Vulnerable countries like those featured in this research – LDCs and SIDS – are at the frontlines of both loss and damage realities today and also policy discussions and the search for solutions. Furthermore, evidence from the case studies suggests that current loss and damage patterns strike at the very purpose of much of climate policy and especially the purpose of the UNFCCC: to avoid dangerous climate change and ensure the possibility of natural systems being able to adapt in sufficient time so as not to impede food production and sustainable development.

### 5.1 Facing the future implications of loss and damage today

Loss and damage discussions under the UNFCCC have emerged as a distinct thematic within the adaptation area since the Cancun Agreements in 2010<sup>x</sup>, and decision makers are grappling

with both current and future policy steps that will be needed to understand and address loss and damage. This research confirms the needs and interests of vulnerable developing countries, especially SIDS and LDCs, which are represented in calls from these Party groups for international support and coordinated strategy<sup>xi</sup>. The research helps inform what such a strategy could achieve, such as identifying gaps in knowledge and practice, facilitating effective assessment and identifying ways to address loss and damage now and in the future. Messages from IPCC suggest that the observed insights are only a harbinger of things to come (IPCC, 2007; IPCC SREX, 2012).

Most immediately, decision makers will strive to reach a decision about how to deal with loss and damage in the climate negotiations at COP18 in Doha. COP18 is an interim but important milestone in a journey towards 2015 and a post-2020 climate regime. COP18 provides a window of opportunity for discussions on loss and damage, as the SBI Work Programme on Loss and Damage is mandated to make a recommendation to the COP about the role of the Convention in assessing and addressing the issue<sup>xii</sup>.

Questions for policymakers at that forum include how the Conference of the Parties can provide overall leadership and guidance in the coordination of efforts to assess and address loss and damage, efforts which will then be carried out in harmony with the climate resilient, sustainable development policy and action. Decision makers will continue to grapple with how to ramp up mitigation and adaptation. The emerging realization (e.g., consequences of shortfalls in mitigation and adaptation) will also drive efforts to assess actual and potential consequences arising from adverse climate change. Emerging science findings such as those presented here will increasingly inform such policy discussions about the temporal, spatial, institutional and operational limits to adaptation as well as specific actions related to addressing loss and damage.

## 5.2 Losing ground (costs of adaptation and erosive coping)

A lesson to be learned from the case studies is that communities anticipate and undertake actions to buffer themselves from the negative impact of climatic stressors. Communities proactively attempt to manage challenges – they are not passive victims that do nothing until assistance arrives. But in spite of this, community action is often not at the appropriate scale to counter the full impact of the extreme event or slow-onset stressor. Communities and HHs might engage in adjustment and adaptation strategies that allow them to weather the storm but in ways that undermine their economic, social and cultural assets. Such erosive strategies come with costs and negative side effects. Even in instances where government interventions are ongoing, the case studies indicated that observed adaptation practice was autonomous and individual.

→ Targeted adaptation support not hitting the ground: loss and damage lens needed to evaluate effectiveness of adaptation interventions and to advance a pro-poor, gender-sensitive adaptation agenda. More needs to be done to advance adaptation practice and support to impact people on the ground. This research shows how climatic stressors affected people's livelihoods. Women, poor people and landless people are commonly rendered as particularly vulnerable, and also experience the highest loss and damage in the examined hotspots of this study. Applying a loss and damage lens at the community level shows that adaptation intervention needs to be scaled up and targeted at vulnerable groups. In some instances, loss and damage is a result of poorly executed or poorly designed adaptation interventions, which also come to light when taking a loss and damage view.

→ **Systematic support at community level to assess the risks of loss and damage.** Communities are often left with no support to make choices about adaptation. Assessment tools are under discussion in the UNFCCC work programme and could be enhanced as part of the work under adaptation and loss and damage. These assessment tools must be accessible to communities and understandable to the lay person. In coping with extreme events, early warning information is essential. While anchored in their indigenous knowledge and values, affected communities need to be empowered with forward-looking techniques in order to embark on longer-lasting adaptation and coping strategies and avoid maladaptive or erosive behaviours. The case studies show that many people who undertake measures do this because of their knowledge of approaches that have been used in the past. Whether these are adequate to address the climate of the future has rarely been considered systematically. Taking account of information generated through assessments should be the basis for judging the suitability of current approaches against the background of future climate change, including whether traditional responses continue to be adequate or would aggravate the situation. The ability to identify suitable approaches needs to be improved where technical support and building of local and domestic capacity is crucial.

→ **Not all about money: non-economic losses.** The investigations also reveal that loss and damage today goes beyond quantifiable, formal economic impacts that can be measured in terms of physical assets or GDP. While there is a bias in databases and collection of information about quantifiable losses, it is important that policies call for the assessment of non-economic values as well. Non-economic losses are documented in the case studies – for example, damage to the HH incomes of sustenance farmers whose losses are less apparent because they do not engage fully in formal market activities. Other examples of non-economic

losses include loss of livelihoods in, and shifts in population away from, climatically stressed areas – such as eroding coastline areas, saline-infused agricultural areas, and remote and fragile water stressed mountain areas. Insights from Bhutan and Micronesia showed cultural values and heritage being lost. Social capital was seen to be eroding over water disagreements at local level; however, that social cohesion would be an asset in community resilience. Failing to measure these non-economic losses means that they could elude policy attention. Without explicit efforts to assess these kinds of losses, policymakers may have a myopic view of both impacts and solutions because policy tends to address values that are assessed.

→ **Unknown victims, uncounted costs: call for mitigation.** Adaptation, though positively framed, often comes with costs and consequences for the communities that have to practise it. Coping strategies can become erosive and undermine people's productive assets. Assessing loss and damage sheds light on these otherwise hidden costs of GHG emissions. The UNFCCC, as the world body addressing the problem of climate change, needs to systematically take these facts and channel them to international decision-makers to inspire the ambition urgently needed to reduce GHG emissions.

### 5.3 Soft and hard limits, and loss and damage

The case studies show that limits to adaptation are already manifesting themselves – and where those limits are approached or surpassed, patterns of loss and damage become evident. Communities and countries face dynamic biophysical as well as social limits. Some of these limits can be ameliorated to some degree through appropriate policies, while other limits may represent 'hard' limits for which few if any practicable options exist to avoid loss and damage. This section discusses that range of limits,

and the policy implications of trying to navigate those limits in ways that lessen negative consequences for society.

**Addressing soft limits through resilience building efforts.** The research showed that many HHs surveyed employ a variety of approaches to get by, although many of these have longer-term erosive implications for livelihoods and well-being. Some of these limits relate to the difficulty or inability of affected groups of people to adjust at particular scales, for example at local level. In theory, it may be possible for a national government to enable adjustments to be made – through investments in communities, alternative livelihoods, etc. – but without such assistance communities may not be able to make the necessary adjustments and will incur loss and damage. If social vulnerabilities to climatic and other stressors are the source of loss and damage problems, then improving social resilience provides some of the solutions.

→ **Support for communities to increase resilience.** While there is often mention of ‘no-regrets’ adaptation measures, the case studies reveal that in many cases the measures undertaken come with additional costs. This has implications for sustainable development, in particular with regard to poor communities since people have to divert some of their scarce resources to adapt to loss and damage – resources that could be used to improve food security, strengthen livelihoods including through economic diversification, etc. Healthy, functioning communities can act as formal and informal safety nets and can be strengthened through national programmes. Economic and other support to improve their resilience must be scaled up. This could include direct financial support for the implementation of adaptation or mitigation measures, but also support for risk-sharing instruments like insurance or mechanisms to help lessen the distress caused by adverse impacts.

- **Improve sustainable development and welfare prospects for the communities.** It is important to apply measure to reduce the general vulnerability in areas such as poverty, food insecurity or health deficits. These can improve the sustainable development and welfare prospects of vulnerable communities and bring them into a better position to withstand climate change risks by further undertaking measures to address loss and damage on their own. Policies are needed which invest in actions that enhance resilience – even if they are not immediately related to specific climatic stressors. Livelihood diversification, education and investments in gender equity may improve the ability of communities to forestall reaching limits of adaptation.
- The findings also underline the importance of strong **community involvement** in decision-making on adaptation and mitigation measures, combined with independent technical assessments of potential consequences of any planned coping measures. Therefore, policymakers at different levels – national, sub-national – need to pursue measures to scale up systematic support for assessing and addressing loss and damage.

#### **Hard limits and impacts for which no measures can be adopted**

In other areas, there are already **limits to adaptation at any level** due to issues such as the scope of the biophysical impact (such as changes in the monsoon pattern) or the degree to which a society can deal with the impact (such as widespread poverty and climate-exposed livelihoods of a majority of a population). Such limits challenge the ability of even national governments to adjust to the negative consequences of climatic stressors and the resulting social impacts. For hard limits, assistance may be needed from regional or international communities. In such cases there will be a need for policy and operational coordination, timeliness in planning and action. Policy approaches are needed



which make transparent what the consequences of approaching and surpassing hard limits (at all levels). Tools are required for identifying decision points and defining options for decision pathways.

→ **Comprehensive assistance to national governments in setting up supportive frameworks.** While there are vulnerability assessments related to climate change in many countries, more substantive and systematic national approaches to assessing and addressing loss and damage faced by vulnerable communities are rare. However, it is obvious that countries at severe risk need to have a better understanding of what they are facing, how it may affect their development pathways and what they can do about it. This will require the development of adequate capacities (human capacity, institutional capacity) and provision of financial and technical support to allow governments to create adequate frameworks that can help vulnerable communities cope with the challenges. The required capacity should also include dealing with the potentially severe 'secondary impacts' related to world food production systems (e.g., impacts on food availability and trade due to heat waves or other climatic stressors that reduce crop yields and drive staple food prices worldwide). National governments need to be able to monitor these threats in order to respond in time (eg in case of extreme weather events) and prepare with measures to ensure food security, market interventions as appropriate, etc.

→ **Increase profile of loss and damage in national policymaking.** Given the potential threats in many countries, it is important to raise the political profile of loss and damage risks associated with climate change impacts. This is also necessary in order to avoid as much as possible, or prepare for, potential longer-term social disruptions and security problems. Taking care of vulnerable people will become more difficult, as well as high-level policy goals such as reducing poverty, improving food security and pursuing sustainable development. If more extreme

forms of coping with loss and damage, like migration, are increasingly pursued by people from vulnerable communities – and probably people with 'more capacity' may be the first ones to migrate – that could disrupt the social and economic functioning of the remaining inhabitants.

→ **Advance threshold notification systems.** The research has shown that current negative impacts are already translating into societal and/or individual loss and damage. The fundamental parameters of a system might change suddenly. This could happen as a function of either the biophysical stressor itself (combined impacts of slow-onset processes and an extreme shock, or a tipping point of the stressor), or the response of the dependent socio-economic system. More research investment is needed, in both natural and social science, to enable forecasting of these thresholds with the aim of operationalizing threshold notification systems to guide national and international policy.

#### 5.4 Loss and damage as an equity and climate justice issue

The magnitude of 'residual loss and damage' depends on the effectiveness of mitigation and adaptation efforts. However, as a result of both historical and current GHG emissions, some degree of climate change impacts is already locked in. Thus, even after the best possible mitigation and adaptation action has been taken, societies worldwide will still face some residual loss and damage.

The frontiers of future loss and damage can be limited through the mitigation and adaptation choices that are made today. Climate change impacts are driven by the level of greenhouse gases in the atmosphere. Negative climate change impacts that lead to loss and damage also influence the ability of human systems to adapt to changes in climate. Present choices about mitigation and adaptation determine not only current, but especially future, loss and damage potential – although there is significant uncertainty in the decision-making context.

Mitigation ambition most greatly influences the degree to which loss and damage will be avoided, particularly from around 2030 onwards. Until 2030, decisions that impact on the level, scale and efficacy of adaptation will affect the ability of societies to adjust to manifestations of climate change – for example, alterations in climatic variability such as shifts in seasonality of rainfall, heat waves, magnitude and frequency of extreme weather events. The most effective approach to addressing loss and damage in the long term – in the sense of avoiding future loss and damage and minimising impacts in the short and medium terms – is enhancing both mitigation and adaptation.

Addressing loss and damage is of common concern for humankind, as well as an issue of climate justice. The element of (in) justice has a spatial and temporal dimension. The potential spatial distribution of the negative consequences of loss and damage, particularly unquantifiable elements such as social, cultural and psychological loss and damage – will burden those countries that have contributed least to global GHG emissions and which have the most limited capacities to deal with the consequences of loss and damage. Without adequate action, communities in these countries will increasingly experience loss and damage, with significant consequences both nationally and globally.

## 6. Outlook: decision pathways and consequences for loss and damage

The research presented here tells a story of community efforts to adjust and adapt to the negative impacts of climate stressors, and the consequences when limits to those adaptation efforts are reached. Addressing loss and damage is important because it will affect how society manages the negative impacts of climate change while pursuing other goals, such as resilient and low-carbon development. The research has shown that possibilities and constraints for society today will play out against our collective ability to stem the pathways that lead to loss and damage.

The research illustrates that loss and damage has tangible consequences today, and that adaptation as well as loss and damage occur simultaneously. Some of the most notable current impacts in the research were on food production and livelihoods. As climate change intensifies, this raises questions about the ability of both formal and informal adaptation measures to tackle the interacting negative impacts of climate change and vulnerable societies.

Success in addressing loss and damage depends on ambitious mitigation and adaptation today. This would mean that the impacts of climate change could be somewhat contained or reduced while shifting gradually to new forms of organization that would enable humans to live in balance with new climate conditions in the future. The consequences of a failure to address loss and damage sufficiently would compromise sustainable development, call into question food production in many parts of the world, and jeopardize the resource base of many communities more broadly.

# End notes

i UNFCCC. 2010. 1/CP.16. Cancun Adaptation Framework.

ii An additional CDKN-supported case study will be completed early in 2013 (Nepal), as well as three additional case studies in Burkina Faso, Mozambique, and Ethiopia in collaboration with the Africa Climate Policy Center.

iii <http://faostat.fao.org> and <http://faostat.fao.org/site/550/default.aspx#ancor>.

iv Although throughout this document the terms 'weather extremes' (usually discrete temporal events) and 'slow onset climatic processes' (non-discrete continuous processes) are used, the literature review also acknowledges that for practitioners these distinctions are not as clear cut. The climate stimuli above interact in complex ways, and also interact with human systems in ways that drive loss and damage.

v Information in this section is based on the CDKN-supported case study carried out by UNU-EHS in Bangladesh, conducted by Golam Rabbani, Bangladesh Center for Advanced Studies (BCAS).

vi Information in this section is based on the CDKN-supported case study carried out by UNU-EHS in Bhutan, conducted by Norbu Wangdi (Ugyen Wangchuck Institute for Conservation and Environment, Bumthang, Bhutan) and Koen Kusters (Wereld in Woorden – Global Research and Reporting, Amsterdam).

vii Information in this section is based on the CDKN-supported case study carried out by UNU-EHS in The Gambia, conducted by Sidat Yaffa, University of The Gambia.

viii Information in this section is based on the CDKN-supported case study carried out by UNU-EHS, conducted by Denis Opondo Opiyo, Maseno University, Kisumu, Kenya.

ix Information in this section is based on the CDKN-supported case study carried out by UNU-EHS in Kosrae, Micronesia, conducted by Iris Monnereau, University of the West Indies, Barbados and Simpson Abraham, Kosrae Island Resource Management Authority.

x UNFCCC. 2010. 1/CP.16. Cancun Adaptation Framework.

xi Views on the Role of the Convention expressed by Parties and Observer organisations as part of the mandated work for 2012 of the SBI Work Program on Loss and Damage can be found at [https://unfccc.int/parties\\_observers/ngo/submissions/items/3689.php](https://unfccc.int/parties_observers/ngo/submissions/items/3689.php).

xii UNFCCC. 2010. 1/CP.16. Cancun Adaptation Framework. Paragraphs 25-29.

# Mapping Technical Annex and References

The maps produced for this report were developed using data sets from multiple sources. Here we provide the citations for the data sets that were employed for the thematic maps by country. Basemap data for all reference maps and thematic maps comes from Ocean Basemap from ArcGIS online. Country borders and subnational administrative unit boundary layers are from a combination of SEDAC's Gridded Population of the World v.3 and GADM database of Global Administrative Areas.

The production of these maps was completed by Tricia Chai-Onn, Malanding Jaiteh and Dara Mendeloff (GIS staff) and Alfonso Pinto (Map Designer) under the overall supervision of Alex de Sherbinin at the Center for International Earth Science Information Network (CIESIN), a unit of the Earth Institute at Columbia University. All mapping work was completed in ArcGIS v10.1 and converted to images for final production in Adobe Illustrator.

## Bangladesh

### Cyclone Aila map

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### Storm surge map

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### Elevation map

U.S. Geological Survey, EROS Data Center Distributed Active Archive Center (EDC DAAC). 1996. Global Digital Elevation Model (GTOPO30).

### Poverty map

Center for International Earth Science Information Network (CIESIN)/Columbia University. 2005. Poverty Mapping Project: Small Area Estimates of Poverty and Inequality. Palisades, NY: NASA Socioeconomic Data and Applications Center (SEDAC). <http://sedac.ciesin.columbia.edu/data/set/povmap-small-area-estimates-poverty-inequality>

## Bhutan

### Precipitation map

The Mean Annual Precipitation Map is based on the Legates Surface and Ship Observation of Precipitation dataset constructed by Dr. David Legates, University of Oklahoma, and Dr. Cort Willmott, University of Delaware, and available from the NASA Global Change Master Directory.

Village location data: Loss and damage case study fieldwork in Bhutan (2012).

## Gambia

### Land cover map

GOTG (Government of The Gambia). 2003. Gambia 50,000 database. Ministry of Local Government and Lands. Banjul. Government of The Gambia

## Kenya

MODIS Flood Map December 2011

MODIS data on flood extent courtesy of Dartmouth Flood Observatory.

## Micronesia

Elevation map

The elevation map data were provided courtesy of Blair P. Charley.

Mangrove map

Giri, C. 2013 (forthcoming). Mangroves of the World. Palisades, NY: NASA Socioeconomic Data and Applications Center.

Impact of extreme weather events map

Data provided by case study authors Iris Monnereau and Simpson Abraham.









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## LOSS AND DAMAGE

*The Loss and Damage in Vulnerable Countries Initiative* was initiated by the Government of Bangladesh (GoB) and motivated by the need to understand more about this emerging issue. In order to move forward the debate on loss and damage for the benefit of the least developed countries (LDCs) and other vulnerable countries, the GoB requested assistance from the Climate and Development Knowledge Network (CDKN) to help build a common understanding around loss and damage and provide insight into what it entails for vulnerable countries.

*CDKN has appointed a consortium of organizations, which includes Germanwatch, United Nations University Institute for Environment and Human Security (UNU-EHS), International Centre for Climate Change and Development (ICCCAD) and Munich Climate Insurance Initiative (MCII) to carry out this work.*